



SAN DIEGO 2001



BOSTON 2005



LONDON 2008



CHICAGO 2009



SALT LAKE CITY 2015



SAN FRANCISCO 2017



MONTREAL 2019

# INSAR 2021 VIRTUAL



2001



2021

# INSAR

International Society for Autism Research

**ANNUAL MEETING**

## MAY 3-7, 2021

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## Invited, Keynote Speakers, Awards

### KEYNOTE ADDRESS

#### **Event 101 - Keynote - Petrus J. de Vries MBChB, FRCPsych, PhD**

#### **What Kind of Research Should We Do and Where Should We Do It?**

*P. J. de Vries, Centre for Autism Research in Africa, Division of Child & Adolescent Psychiatry, University of Cape Town, Cape Town, South Africa*

In 2001 the International Society for Autism Research (INSAR) was founded and held its first international conference. The 20<sup>th</sup> anniversary of INSAR is a good time to reflect on the kind of research we should be doing in the autism and neurodevelopmental community, and to consider where we should be focusing our research efforts over the next 20 years. In this keynote, we will discuss two related research journeys. The first is the story of Tuberous Sclerosis Complex (TSC)-Associated Neuropsychiatric Disorders (TAND) to illustrate how close partnership with the TSC community shaped our research questions and research strategies. The second is the story of autism in Africa to illustrate how the realization that 95% of people with autism live in low- and middle-income countries (LMIC) led to a paradigm shift in our research.

### KEYNOTE ADDRESS – LIFETIME AWARDEE

#### **Event 102 - Keynote – Helen Tager-Flusberg, PhD**

#### **INSAR Lifetime Awardee Keynote**

**Helen Tager-Flusberg**, *Department of Psychological and Brain Sciences, Boston University, Boston, MA*

### KEYNOTE ADDRESS

#### **Event 103 - Keynote - Tony Charman, PhD**

#### **Two Steps Forward, One Step Back: Lessons from Developmental Studies of Early Autism**

*T. Charman, Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

The past few decades has seen great progress in early autism research. Thirty years ago the notion that autism could be prospectively identified in infancy, that early intervention could begin at the age of two or even before, and that we would be uncovering evidence on internal and external influences on outcomes from such an early age was restricted to a handful of optimists (and visionaries). I will review our work, and that of other groups, on population screening, early diagnosis and outcomes, studies of infants with a family history of autism, and early intervention trials. Whilst progress has been made, there are also salutary lessons to be learnt about whether we have been using the right methods or even asking the right questions.

KEYNOTE ADDRESS

**Event 104 - Keynote - Lucina Q. Uddin, PhD**

**Network Neuroscience of Autism**

*L. Uddin, University of Miami, Coral Gables, FL*

Recent advances in network neuroscience have paved the way for discoveries into the neurobiology of autism. Network neuroscience has introduced tools and conceptual frameworks that permit exploration of dynamic aspects of brain function *in vivo*. Over the past decade, “under-connectivity” theories of autism have given way to more nuanced characterizations of the neural basis of the disorder. I will review our recent functional neuroimaging studies investigating functional brain connectivity in autism through a developmental lens. I will further illustrate how analysis of brain dynamics can contribute to understanding flexible behaviors in autism. The talk will conclude with a discussion of some of our recent work parsing heterogeneity and comorbidity in neurodevelopmental disorders using individual connectome mapping.

KEYNOTE ADDRESS

**Event 105 - Keynote - Stormy Chamberlain, PhD**

**Mechanisms of Repression and Therapeutic Approaches for Angelman Syndrome**

*S. J. Chamberlain, Dept. of Genetics and Genome Sciences, University of Connecticut Health Center, Farmington, CT*

Angelman syndrome is a neurodevelopmental disorder caused by the loss of function from the maternal allele of *UBE3A*, a gene encoding an E3 ubiquitin ligase. The paternal allele of *UBE3A* is silenced by *UBE3A-ATS*, a long non-coding RNA expressed exclusively in neurons. Activation of the silent paternal allele offers a promising therapeutic approach for Angelman syndrome. Using human induced pluripotent stem cell models of Angelman syndrome, we have carefully studied the cellular phenotypes in AS neurons, and uncovered details of the mechanisms regulating the expression of *UBE3A-ATS* and repression of paternal *UBE3A*. This detailed understanding has aided the development of antisense oligonucleotide (ASO) therapeutics to activate paternal *UBE3A* in human AS neurons and revealed the mechanisms underlying this therapeutic approach. Based on our understanding of these mechanisms, we are beginning to explore the next generation of therapeutic strategies to activate paternal *UBE3A* by delivering shRNAs using viral vectors. This improved therapeutic approach combines the targeted activation of paternal *UBE3A* with the one-and-done benefits of gene therapy. As multiple therapeutics for Angelman syndrome are currently in or nearing clinical trials, Angelman syndrome is poised to be an important proof-of-principle for other neurodevelopmental disorders.

# Adult Outcome: Medical, Cognitive, Behavioral, Social, Adaptive, Vocational

## PANEL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

### Panel 201 - Barriers and Facilitators of Child, Teacher and System-Level Intervention Outcomes

**Panel Chair:** Rebecca Landa, *Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD*

**Discussant:** Brian Boyd, *Juniper Gardens Children's Project, University of Kansas, Kansas City, KS*

Community-based providers are the primary early intervention source for children with autism spectrum disorder (ASD). However, multi-level barriers threaten effective intervention delivery and children's outcomes. This panel's goal is to examine such barriers and multi-level risk and protective factors related to high fidelity EBP implementation and child treatment response. Results of four studies involving community providers' implementation of evidence-based intervention practices will be presented. Panelist 1 will focus at the child level, examining impact of phenotypic features on treatment response of preschoolers with ASD in a school-based randomized controlled trial. Panelist 2 will focus at the teacher level, examining factors that support and constrain resiliency in teachers of preschoolers with ASD, and how these factors relate to fidelity of Naturalistic Developmental Behavioral Intervention (NDBI) implementation. Panelist 3 will focus at the consultant level, examining how the qualities of consultants who support parent-teacher dyads in use of best practices affect children's IEP goal attainment. Panelist 4 will focus at the system level, examining relationships between climate, training, and fidelity outcomes. The Discussant will consider the implication of results for the design of intervention ingredients, professional development approaches, and organizational systems to promote resiliency at all levels to optimize child outcomes.

**201.001 (Panel)** Risk and Protective Factors Related to Teachers' High Fidelity Intervention Implementation

**R. Landa<sup>1</sup>** and **A. M. Englestad<sup>2</sup>**, (1)*Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD*, (2)*School of Education, Harvard University, Cambridge, MA*

#### Background:

Teachers of preschoolers with ASD are immersed in a complex, dynamic system. Within that system, barriers impact the relative success with which they attain high fidelity implementation of naturalistic developmental behavioral intervention (NDBI) strategies. These barriers may serve as cumulative risk factors, ultimately impacting teachers' well-being and retention in the workforce. Yet there is heterogeneity amongst teachers in the degree to which their fidelity of implementation is affected by barriers. Little is known about this heterogeneity. To address this knowledge gap, research is needed to define teacher characteristics associated with resiliency to previously reported barriers to high-fidelity implementation of evidence-based intervention strategies.

#### Objectives:

To define factors that constrain (risk factors) and support (protective factors) teacher resiliency to fidelity attainment barriers that have been previously defined in the literature.

#### Methods:

22 teachers of preschoolers with ASD, randomized to the NDBI training condition in a larger RCT, participated in this mixed-methods sub-study. Quantitative data included: (1) coach-completed survey documenting presence of barriers to fidelity attainment (defined in extant literature) after teachers completed 20 weekly job-embedded coaching sessions; (2) Behavior Rating Inventory for Executive Functions for Adults (BRIEF-A); (3) Maslach Burnout Inventory (MBI); (4) Autism Self-Efficacy Scale for Teachers (ASSET); and (5) monthly teacher fidelity of NDBI implementation coded blinded to group membership and date of collection. Teachers scoring at critical levels on the quantitative measures, defined by the measure (BRIEF-A), measure developers (MBI), or +1.25 standard deviations from the mean (ASSET, coach-report), were considered "high-risk" for vulnerability to fidelity attainment barriers. Association between baseline MBI, BRIEF-A, ASSET scores and Post-PD fidelity attainment was examined. Qualitative data were obtained from a focus group consisting of coaches. The field

guide was designed to define factors constraining or supporting teacher fidelity attainment. Transcripts were coded using a content analysis approach.

#### Results:

Coach-reported barriers and perceived impact on teacher fidelity attainment are presented in Table 1. Based on the teacher-reported and coach-reported measures, 50% of teachers in the sample met criteria for “high-risk.” Despite these barriers and risks, all but one teacher attained >80% fidelity of NDBI implementation after completing the PD program, and there was no evidence of a linear relation between baseline levels of teacher burnout, self-efficacy, or executive functioning and post-PD fidelity score. Qualitative data revealed 14 protective factors and six risk factors of teacher resiliency to barriers. Results inform a PD framework with embedded protective supports for teachers who are likely to face barriers to high-fidelity NDBI implementation.

#### Conclusions:

Results indicate that teachers of preschoolers with ASD face many barriers to high-fidelity NDBI implementation. NDBI coaches can address risk factors to support teachers’ resiliency to these barriers. Consistent, individualized, supportive job-embedded coaching to implement NDBI strategies in existing classroom instructional routines likely contribute to resiliency via offering teachers new perspectives and skills, boosting confidence in their ability to provide effective instruction, and providing increased social supports. Future research should examine causal effects of coaching strategies and bringing to scale personalized coaching approaches that support teacher resiliency and high-fidelity intervention implementation.

**201.002 (Panel) Which Children Are Responding and Why? a Novel Method to Understand Subtypes of Treatment Responders and Non-Responders**

*A. Wallisch<sup>1</sup> and B. A. Boyd<sup>2</sup>, (1)University of Kansas, Kansas City, KS, (2)Juniper Gardens Children's Project, University of Kansas, Kansas City, KS*

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**Background:** While advancements in autism research have led to the development of evidence-based practices for children with autism spectrum disorder (ASD), we know there are children who continue to demonstrate minimal benefits from these interventions (Vivanti et al., 2014). A potential reason for non-responders to evidence-based interventions is the vast heterogeneity in symptoms and behaviors across the autism spectrum. To account for this heterogeneity, the idea of precision medicine, or personalized treatment, is pushing the field forward to understand how different treatments impact subgroups of populations in distinct ways (Hamburg & Collins, 2010). However, we still know little about how individual child differences impact treatment response in ASD. We examined how individual child differences impacted the efficacy of the Advancing Social Communication and Play (ASAP) intervention (Boyd et al., 2018). ASAP is a manualized, classroom-based intervention focused on coaching educational teams to improve the social communication and play skills of preschool-aged children with ASD.

**Objectives:** We examined how 1) children group by subtype based on child-level variables, and 2) subtype membership changed over time.

**Methods:** We performed a secondary analysis with data drawn from the cluster randomized controlled trial of ASAP to examine the heterogeneity of children in our sample and understand how that impacted treatment response. The data included 3-5 year old children with ASD (n=160) who were randomly assigned to ASAP or business as usual (BAU). We used latent class analysis to examine pre-treatment and post-treatment subtypes of children based on play skills, social communication skills, classroom engagement, challenging behavior, and autism severity. Next, we used a latent transition analysis (LTA) to determine which children transitioned subtypes, and if those children were in the ASAP or BAU group.

**Results:** After comparing fit statistics of a 2 to 6 class solution, results suggested a 3 class solution fit best for the pre-treatment and post-treatment models. All latent classes were differentiated by child characteristics. For example, the three latent classes divided into a higher (n= 22), middle (n= 95), and lower (n= 43) performing class based on social communication, play, and engagement skills, as well as challenging behavior and autism severity. Post-treatment latent classes followed a similar pattern of characteristics. The LTA indicated that 13 children in the ASAP group transitioned to a higher performing latent class, whereas 4 children in the BAU group transitioned to a higher latent class.

**Conclusions:** Using a data-driven approach to examine children’s pre-treatment characteristics may aid in understanding their response to intervention. Specific to the ASAP intervention, results suggest that 13 children in the ASAP group changed to a higher performing class, and these children were either transitioning from the lower-performing subtype to the mid-performing

subtype, or the mid-performing subtype to the higher performing subtype. ASAP may be less effective for children in the higher performing subtype, and more effective for children in the lower and mid-performing subtypes.

**201.003 (Panel)** School-Based Consultant Predictors of IEP Outcomes and Implementation Fidelity with Compass  
**L. A. Ruble<sup>1</sup>, L. N. Ogle<sup>1</sup> and J. H. McGrew<sup>2</sup>,** (1)Special Education, Ball State University, Muncie, IN, (2)Psychology, Indiana University - Purdue University Indianapolis, Indianapolis, IN

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#### Background:

Schools are the primary source of intervention for children with ASD; yet, there is a notable research-to-practice gap. School-based interventions often fail to target key areas of social communication and learning skills associated with positive developmental outcomes. Further, workforce shortages of special educators, who have the highest attrition rates and often lack adequate knowledge on the use of evidence based practices, often result in children with ASD failing to receive the maximum benefit possible from their individual educational program (IEP). Thus, implementation strategies that help improve special education are paramount. One way to address the demand for more and better trained teachers is through consultation. Consultation possesses a unique multiplier effect by impacting many children efficiently. Trained consultants provide a direct avenue for incorporating EBPs that can be personalized to the student and their settings. COMPASS is an intervention specifically for children with ASD validated in three RCTs. Essentially doubling IEP outcomes, COMPASS brings together the parent and teacher for identifying personalized goals and intervention plans with facilitation from a consultant.

#### Objectives:

The purpose of this presentation is to describe school-based consultant predictors of child goal attainment outcomes and increased fidelity of implementation of COMPASS.

#### Methods:

Twelve school-based consultants (age 24-60) were recruited to help validate a COMPASS training package. The training package consisted of two in-person days and online materials on (a) conducting the initial goal setting and intervention planning consultation with parent-teacher dyads and (b) providing follow-up teacher coaching sessions. A total of 31 teachers and parents of children between ages of 4 and 13 years participated. Each dyad received a 3-hour consultation with the trained consultant, followed by data-driven supervision via video conferencing and written performance feedback following each consultation.

End of year researcher ratings of child goal attainment outcomes were correlated with consultant ratings of (a) consultation experience/skills, knowledge and attitude toward EBPs, and administrator support; researcher ratings of consultants' (b) quality of process skills and teaching plans, as well as fidelity to the consultation and first coaching session; and students' (c) ASD severity (SCQ and Vineland ratings).

#### Results:

Because of the small sample size, correlations at  $p \leq .10$  are reported (see Table). Variables that predicted end of year child IEP goal attainment outcomes included consultants' experience, teaching plan quality and EBP knowledge, and consultants' consultation fidelity and consultation skills. Variables that predicted implementation fidelity of the consultation included consultants' process skills, EBP knowledge, and teaching plan quality.

#### Conclusions:

Consultation is a complex skill that requires the ability to establish effective partnerships with teachers and parents as well as the ability to assess and integrate parent and teacher concerns into critical learning goals for children with ASD that are often neglected in IEPs yet are essential for positive developmental outcomes. Consultant factors of knowledge and application predicted child outcomes. High fidelity to the initial consultation was associated with child outcomes, process skills, teaching plan quality, and knowledge of EBPs. Overall, the results suggest that interpersonal and training factors are associated with increased fidelity and child outcomes.

**201.004 (Panel)** A Mixed Methods Evaluation of Implementation Climate and Leadership within Education Programs for Students with ASD

## **Background:**

Although EBP for ASD have been identified, leaders and educators report difficulty using these practices in their schools. The California Autism Professional Training and Information Network (CAPTAIN) is a multi-agency collaborative focused on increasing dissemination and implementation of EBP for ASD. Toward this aim, CAPTAIN emphasizes member use of high-quality training and coaching practices to improve outcomes.

**Objectives:** The purpose of this project was to explore relationships between implementation climate, implementation leadership and training outcomes within special education services for students with ASD.

## **Methods:**

### Qualitative methods

CAPTAIN members (n=30) participated in focus groups to discuss their experiences with practice implementation, interactions with administration, and the process of conducting trainings. Transcripts were coded to identify the most common themes regarding implementation climate and leadership.

### Quantitative methods

Education system leaders (n=264) completed quantitative measures characterizing their personal implementation leadership behavior and the implementation climate of their organization. Measures included the Implementation Leadership Scale (ILS; Aarons et al., 2014) and the Implementation Climate Scale (ICS; Ehrhart et al., 2014).

CAPTAIN members (n=200) reported on quantity and quality of training and coaching they provided throughout the 2018-2019 academic year. To quantify these CAPTAIN member outcomes, a performance score was calculated for each cadre member.

Associations between Leader ratings, aggregated by special education region, and CAPTAIN member performance scores were evaluated using ANOVA and bivariate correlations depending on the measures.

## **Results:**

Focus groups themes highlighted the importance of leadership, provision of educational supports and prioritizing EBP implementation. CAPTAIN members reported using a variety of strategies to gain leader buy-in including frequent communication and data-based presentations.

Overall, leaders had high ratings of their own implementation leadership (Mean = 3.09, SD = 0.52). In regards to implementation climate, selection for openness to EBPs was rated the highest (Mean = 3.00, SD = 0.79), while Rewards was rated the lowest (Mean = 1.14, SD = 0.77).

Overall, CAPTAIN members trained 88.21 (SD = 96.32) and coached 30.32 (SD = 58.54) providers (including special educators, paraeducators, general educators, and direct service providers). Performance scores were calculated (Mean = 44.3, SD = 20.3).

Higher self-rated ILS scores were associated with higher CAPTAIN member performance scores ( $p$ -values  $<.05$ ) indicating that leaders' self-perception of their own implementation behavior has an impact on CAPTAIN member performance. Similarly, higher scores on the ICS recognition scale (recognition use of EBP) was associated with coaching quality ( $p = .04$ ).

## **Conclusions:**

These findings contribute to the understanding of how system level factors impact dissemination and implementation of EBP for ASD in school programs. Across methodologies, leadership was identified as a key supportive factor. In contrast, the Rewards

domain of implementation climate was highlighted as a challenge.

**PANEL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL**

**Panel 215 - Towards Cross- and Multimodal Biomarker Discovery in Autism – Updates from the AIMS2TRIALS Project**

**Panel Chair: Jan Buitelaar**, *Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands*

**Discussant: Jan Buitelaar**, *Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands*

Autism spectrum disorder (ASD) is among the most common neurodevelopmental conditions. Nonetheless, effective medical treatments for the core symptoms are still lacking. This is largely due to the great clinical and biological heterogeneity across the autism spectrum, which hinders our ability to detect significant efficacy signals. Consequently, over recent years, research efforts have increasingly focused on the identification and validation of biomarkers that allow the stratification of patient populations according to biological subtypes. As the largest multicenter, multidisciplinary autism project worldwide, the AIMS2TRIALS consortium provides an unprecedented opportunity to answer questions related to biomarkers. Specifically, the AIMS2TRIALS Longitudinal European Autism Project (LEAP) aims to improve our understanding of disease mechanisms to identify and validate stratification markers and targets for surrogate endpoints, and to guide the development of personalized precision medicine approaches in ASD. Here, we present an update on our most recent research efforts within LEAP across different imaging and neurocognitive modalities (EEG, eye-tracking, structural, task and resting-state fMRI), and introduce novel, innovative imaging methods (connectome-wide mega-analysis, normative modeling, task potency, linked independent component analysis, canonical correlation analysis). Combined, our findings highlight neurodevelopmental differences at different levels linked to outcome and represent potentially suited treatment targets.

**215.001 (Panel)** The N170 Face-Sensitive Brain Response: Toward a Stratification Biomarker for ASD

**E. J. Jones<sup>1</sup>**, L. Mason<sup>1</sup>, C. Moessnang<sup>2</sup>, C. H. Chatham<sup>3</sup>, L. Ham<sup>4</sup>, J. Tillmann<sup>5</sup>, G. Dumas<sup>6</sup>, C. L. Ellis<sup>7</sup>, C. Leblond<sup>8</sup>, F. Cliquet<sup>9</sup>, T. Bourgeron<sup>10</sup>, T. Charman<sup>11</sup>, J. K. Buitelaar<sup>12</sup>, E. Loth<sup>13</sup>, M. Johnson<sup>14</sup>, D. Murphy<sup>15</sup> and L. G. EU-AIMS<sup>15</sup>, (1)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom, (2)Department of Psychiatry and Psychotherapy, Central Institute of Mental Health, University of Heidelberg, Mannheim, Germany, (3)Neuroscience and Rare Diseases (NRD), Roche Pharma Research and Early Development, Roche Innovation Center, New York, CA, (4)Roche, Basel, Swaziland, (5)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (6)Human Genetics and Cognitive Functions Unit, Institut Pasteur, Paris, France, (7)Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (8)Institut PASTEUR, Paris, France, (9)Institut Pasteur, Paris, France, (10)Human Genetics and Cognitive Functions, Institut Pasteur, Paris, France, (11)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (12)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, (13)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (14)Department of Psychology, University of Cambridge, Cambridge, United Kingdom, (15)EU-AIMS Organization, London, United Kingdom

Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterised by difficulties in social communication, but also great heterogeneity. To offer individualised medicine approaches, we need to better target interventions by stratification of people with ASD into subgroups with different biological profiles and/or prognoses. Since interpreting information from the human face is critical to successful social interaction, studying neural responses to faces may provide a neurobiological index of socially-acquired expertise. One well-characterised neural signal that has been previously reported to be atypical in ASD is the face-sensitive N170 event-related potential.

Objectives: We sought to test whether the N170 response to faces could have potential as a stratification biomarker in ASD by measuring neural (EEG) responses to faces in a large group of N=436 children and adults with and without ASD.

Methods:

Participants were enrolled in the European multisite LEAP study. EEG was recorded while participants watched pictures of upright and inverted faces, and standard techniques were used to extract the amplitude and latency of the N170 component. In addition, taking advantage of the multimodal nature of the LEAP study, we examined how N170 responses associated with i) the Vineland Socialisation scale and its subdomains as a measure of everyday social functioning at both baseline and at 12-24 month follow-up; ii) fMRI measures of social brain functioning (activation in the fusiform gyrus in response to faces); and iii) polygenic scores derived from common variants previously associated with ASD. We also used Gaussian mixed-model clustering to identify substructure within the ASD group.

#### Results:

The speed of early-stage face processing (N170 latency) was on average slower in ASD than age-matched controls ( $F(1,430)=9.43, p=0.002, \eta_p^2=0.021$ ; Figure 1). In addition, N170 latency was associated with responses to faces in the fusiform gyrus area (FG3 at MNI [30 -64 -10]) ( $t=3.93, P_{SVC}=0.032; R^2=.131, N170\ b=0.285, p < 0.001$ ) and polygenic scores (PGS) for ASD (Spearman's  $r^2=0.026; p=0.0031$ ; ASD  $r^2=0.022; p=0.039$ ; controls  $r^2=0.024; p=0.074$ ), triangulating links to social biology. Critically, within the ASD group N170 latency predicted change in adaptive socialisation skills over an 18-month follow-up period ( $r(141)=-0.235, p=0.005$ ; Bonferroni-corrected  $\alpha=0.02$ ). Data-driven clustering of the EEG waveform identified three subgroups (BIC=33483, AIC=33294; Cluster 1,  $n=118, 48\%$ ; Cluster 2,  $n=27, 11\%$ ; Cluster 3,  $n=101, 41\%$ ); Cluster 2 had slower N170 ( $F(2,245)=64.32, p < 0.001, \eta_p^2=0.975$ ; Figure 2) and poor social prognosis ( $F(2,144)=4.41, p=0.014, \eta_p^2=0.209$ ; Figure 2). Within Cluster 2, the association between N170 latency to upright faces at P7 and P8 explained over 25% of the variance in the change in the same subdomain Vineland Socialisation (Play and Leisure Time) scores between baseline and 18 month follow-up visit ( $r(19)=-0.517, p=0.023$ ).

Conclusions: Taken together, this provides converging evidence for the utility of the N170 as a potential stratification biomarker to identify biologically and prognostically defined subgroups in ASD, and may provide a blueprint for similar endeavours in other psychiatric conditions.

#### **215.002 (Panel) Social Attention in Complex Dynamic Scenes Relates to Symptom Severity in Children, Adolescents and Adults with ASD**

**L. Mason<sup>1</sup>, E. J. Jones<sup>1</sup>, J. Tillmann<sup>2</sup>, H. L. Hayward<sup>3</sup>, T. Charman<sup>4</sup>, E. Loth<sup>5</sup>, J. K. Buitelaar<sup>6</sup>, D. Murphy<sup>7</sup> and L. G. EEU-AIMS<sup>1</sup>,** (1)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom, (2)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (4)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (5)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (6)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, (7)EU-AIMS Organization, London, United Kingdom

#### Background:

Autism is a neurodevelopmental disorder that affects social communication and flexible behavior. Theories including a role for compromised social attention are common, and metrics of social attention have been raised as putative biomarkers for variation in symptomatology within autism; however, we lack demonstrations that case-control effects reported in small diverse studies are robust and generalisable. Here, we examined social attention during viewing of complex social scenes in a large and heterogeneous sample of individuals with and without autism.

#### Objectives:

To assess differences between individuals with and without autism in attention to social content during naturalistic social scenes, and to determine the relationship of looking patterns to core and association concurrent and future symptomatology.

#### Methods:

Eye tracking data was collected during viewing of 3 complex dynamic video excerpts with music soundtrack (a clip from the 50 Faces series featuring one or two people in a set of street interviews; the cafeteria scene from the film "The Dollhouse"; and an excerpt of two characters in a music booth from the film Before Sunrise) by  $n=453$  autistic people and  $n=311$  neurotypical controls across 7 sites in Europe. Duration of looking to a-priori defined areas of interest (face, eyes, mouth) was computed and examined in relation to diagnostic group, age, IQ, and measures of core and associated symptoms.

## Results:

Autistic people looked less at faces versus bodies (Figure 1; 50 Faces:  $F(1,562)=19.042$ ,  $p<.001$ ; Dollhouse/Music Booth;  $F(1,722.184)=30.492$ ,  $p<.001$ ) but not eyes versus mouths (50 Faces:  $F(2,1124)=2.396$ ,  $p=.083$ ; Dollhouse/Music Booth;  $F(2,822.649)=1.799$ ,  $p=.166$ ) relative to neurotypical controls. Group differences were largely consistent across age and IQ within the typical range. We observed small but significant bivariate correlations in the ASD group between a factor representing less face vs body looking and higher scores on the ADI Social subscale,  $r(333)=-.19$ ,  $p=.002$ , and the ADOS Social Affect subscale,  $r(304)=-.21$ ,  $p<.001$ , weakly with the SRS t score, other:  $r(293)=-0.10$ ,  $p=0.089$ , self:  $r(142)=-0.18$ ,  $p=0.028$  and not with the Vineland Socialisation scale,  $r(299)=.093$ ,  $p=.113$ . These correlations became slightly stronger when controlling for age, ADI Social,  $r(330)=-.20$ ,  $p<.001$ ; ADOS Social Affect,  $r(301)=-.20$ ,  $p<.001$ ; SRS other,  $r(290)=-.14$ ,  $p=0.015$ ; SRS self,  $r(139)=-.17$ ,  $p=0.043$ . The strength of these associations did not vary with IQ (mild ID or no ID) or sex (male/female). Looking patterns were not associated with associated conditions like anxiety, ADHD or depression or with change in core symptoms over time ( $r's<.1$ ,  $p's>.1$ ). No significant phenotypic associations were observed with eyes vs mouth looking ( $r's<.1$ ,  $p's>.1$ ).

## Conclusions:

Reduced social attention during naturalistic scenes in autistic people does not vary with age or IQ but does relate to core symptoms, raising the possibility that it reflects a component or consequence of the experience of autistic symptomatology. Refined and optimised measures should be pursued to develop their potential as quantitative scalable assessments of autistic traits.

**215.003 (Panel) Neuroanatomical and Genetic Substrates of Change in Adaptive Behaviour in Autism Spectrum Disorder**  
**C. M. Pretzsch<sup>1</sup>, T. Schäfer<sup>2</sup>, M. V. Lombardo<sup>3</sup>, V. Warrier<sup>4</sup>, C. Mann<sup>2</sup>, A. Bletsch<sup>2</sup>, C. H. Chatham<sup>5</sup>, D. Floris<sup>6</sup>, J. Tillmann<sup>7</sup>, A. Yousaf<sup>8</sup>, E. J. Jones<sup>9</sup>, T. Charman<sup>10</sup>, S. Ambrosino<sup>11</sup>, T. Bourgeron<sup>12</sup>, G. Dumas<sup>13</sup>, E. Loth<sup>14</sup>, J. K. Buitelaar<sup>15</sup>, F. Cliquet<sup>16</sup>, C. Leblond<sup>17</sup>, S. Baron-Cohen<sup>18</sup>, C. Beckmann<sup>19</sup>, T. Banaschewski<sup>20</sup>, S. Durston<sup>21</sup>, C. M. Freitag<sup>22</sup>, D. Murphy<sup>14</sup>, C. Ecker<sup>23</sup> and L. G. EEU-AIMS<sup>24</sup>, (1)IoPPN King's College London, London, United Kingdom, (2)Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Goethe-University Frankfurt am Main, Frankfurt, Germany, (3)Center for Neuroscience and Cognitive Systems, Laboratory for Autism and Neurodevelopmental Disorders, Istituto Italiano di Tecnologia, Rovereto, Italy, (4)University of Cambridge, Cambridge, United Kingdom, (5)Neuroscience and Rare Diseases (NRD), Roche Pharma Research and Early Development, Roche Innovation Center, New York, CA, (6)Donders Centre for Cognitive Neuroimaging, Nijmegen, Netherlands, (7)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (8)Goethe University Frankfurt, Frankfurt, Germany, (9)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom, (10)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (11)University Medical Center, Utrecht, Netherlands, (12)Human Genetics and Cognitive Functions, Institut Pasteur, Paris, France, (13)Human Genetics and Cognitive Functions Unit, Institut Pasteur, Paris, France, (14)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (15)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, (16)Institut Pasteur, Paris, France, (17)Institut PASTEUR, Paris, France, (18)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (19)Centre for Functional MRI of the Brain (FMRIB), University of Oxford, Oxford, United Kingdom, (20)Department of Child and Adolescent Psychiatry, Central Institute of Mental Health, University of Heidelberg, Mannheim, Germany, (21)Department of Psychiatry, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands, (22)Autism Research and Intervention Center of Excellence Frankfurt, Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital Frankfurt, Goethe University, Frankfurt, Germany, (23)Department of Child and Adolescent Psychiatry, University Hospital, Goethe University, Frankfurt am Main, Frankfurt, Germany, (24)EU-AIMS Organization, London, United Kingdom**

Background: Autism spectrum disorder (ASD) is a neurodevelopmental condition associated with difficulties in the domains of social communication, restricted and repetitive patterns of behaviours and interests, and sensory anomalies. This typically results in impaired adaptive behaviour, i.e. the ability to perform everyday tasks. However, the neurobiological mechanisms that underpin adaptive behaviour in ASD across the lifespan on a group and individual level remain poorly understood; and this hampers the development of effective pharmacological treatments.

Objectives: Hence, the aim of the present study was to examine, for the first time, the neuroanatomical and associated genetic substrates of change in adaptive behaviour in ASD from childhood to early adulthood.

Methods: In 204 autistic individuals (age range 6-30 years) we acquired magnetic resonance imaging (MRI) data at entry (T1); and adaptive behaviour scores using the Vineland Adaptive Behaviour Scale-II (VABS-II) at T1 and T2 (~12-24 months later).

Based on the VABS-II change between T1 and T2, and recently published Minimal Clinically Important Difference (MCID) scores, we grouped autistic individuals into three groups: (i) those whose scores increased ( $\Delta V \geq 4$ ), (ii) did not change ( $4 < \Delta V < 4$ ), and (iii) declined ( $-4 \geq \Delta V$ ). First, we compared baseline neuroanatomy between outcome groups. Next, using data from 279 age-matched neurotypicals, we examined if neuroanatomy, i.e. deviations from the neurotypical neurodevelopmental profile, predicts clinical outcome on an individual level. Then we examined the association between neuroanatomy (differences between clinical outcome groups and deviations from the typical profile) and genetic variation. Finally, we estimated the utility of these neuroanatomical findings as enrichment markers in simulated clinical trials.

**Results:** We identified spatially distributed patterns of neuroanatomical variability (including in frontal, temporal, parietal, and occipital regions) that are associated at the group level with change in adaptive behaviour over time. We also found that deviations from the typical neurodevelopmental profile are predictive of an individual's subsequent change in adaptive behaviour. Our gene enrichment analyses revealed that neuroanatomical group differences, especially between those individuals whose adaptive behaviour skills increased vs declined, were sensitive to underlying ASD-associated genomic mechanisms. Moreover, neuroanatomical deviation from the neurotypical profile correlated with autism polygenic scores restricted to genes expressed in these regions. Finally, we found that enriching simulated clinical trials for subjects with greater neuroanatomical abnormality improved our ability to detect fixed treatment effects.

**Conclusions:** In ASD, developmental differences in neuroanatomy and associated genetic factors may underpin and help predict variation in subsequent adaptive behaviour change. If validated, our findings may aid the future development and evaluation of better targeted ('personalised medicine') interventions in ASD.

#### **215.004** (Panel) Cross-Modal Analyses Define Atypical Connectivity Biomarkers in Autism

**D. Floris<sup>1</sup>, I. Ilioska<sup>2</sup>, T. Mei<sup>3</sup>, G. Bussu<sup>4</sup>, T. Looden<sup>1</sup>, T. Banaschewski<sup>5</sup>, C. Moessnang<sup>6</sup>, T. Charman<sup>7</sup>, J. Tillmann<sup>8</sup>, S. Baron-Cohen<sup>9</sup>, S. Durston<sup>10</sup>, F. dell'Acqua<sup>11</sup>, E. Loth<sup>11</sup>, D. Murphy<sup>11</sup>, J. K. Buitelaar<sup>3</sup>, C. Beckmann<sup>12</sup> and L. G. EU-AIMS<sup>13</sup>,** (1)Donders Centre for Cognitive Neuroimaging, Nijmegen, Netherlands, (2)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands, (3)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands, (4)Donders Institute for Brain, Cognition and Behaviour, Radboudumc, Nijmegen, Netherlands, (5)Department of Child and Adolescent Psychiatry, Central Institute of Mental Health, University of Heidelberg, Mannheim, Germany, (6)Department of Psychiatry and Psychotherapy, Central Institute of Mental Health, University of Heidelberg, Mannheim, Germany, (7)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (8)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (9)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (10)Department of Psychiatry, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands, (11)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (12)Centre for Functional MRI of the Brain (FMRIB), University of Oxford, Oxford, United Kingdom, (13)EU-AIMS Organization, London, United Kingdom

**Background:** Autism Spectrum Disorder (ASD) is a highly heterogeneous condition and underlying biological mechanisms remain unknown. The most recent consensus is that ASD is a disorder of atypical neural connectivity across multifaceted neurobiology. While resting-state fMRI is ideally suited to investigate the disconnection nature of autism, multi-modal analyses are becoming increasingly important to tap into the system-level alterations involving several neurobiological features.

**Objectives:** To identify robust markers of quantitative biological 'connectivity' phenotypes across both resting-state fMRI and multi-modal features using novel imaging-methods.

#### **Methods:**

All analyses were based on different subsamples from the AIMS2TRIALS multisite Longitudinal European Autism Project (N between 340-1824 subjects; age 6-30 years). We applied a range of innovative methods ideally suited to derive biomarkers in large heterogeneous samples by conducting both **a**) uni-modal analyses using resting-state fMRI and **b**) multi-modal analyses integrating resting-state, task-, structural and diffusion MRI data. **a**) In Study 1, we conducted a connectome-wide mega-analysis aggregating data from both LEAP and ABIDE to map functional dysconnectivity across the entire brain in autism and related these to clinical symptomatology. In Study 2, we defined amygdala parcels based on its functional connectivity within three large-scale networks subserving distinct aspects of social functioning before testing the associations between polygenic scores/adaptive social functioning and parcel volumes. **b**) For multi-modal analyses, in Study 3 we used Linked Independent Component Analysis to integrate grey (VBM) and white (DTI) matter features. Canonical Correlation Analysis (CCA) was performed to explore the aggregated effects between all components of GM-WM covariations and symptom severity. In Study 4,

we used task potency to integrate resting-state fMRI with task-fMRI data across a range of different cognitive tasks. Multi-modal, individual-level task potency deviations were identified using normative modeling and followed up with CCA.

Results:

**Study 1)** Individuals with ASD showed widely distributed alterations of functional connectivity. While hypoconnectivity affected sensory and higher-order attentional networks and was associated with social impairments and repetitive behaviours, hyperconnectivity affected cortico-subcortical systems and the default mode network which was associated with social impairments. **Study 2)** We found a significant association between amygdala with ventromedial prefrontal cortex ( $p < 0.001$ ) and with anterior cingulate cortex (AAC) ( $p = 0.013$ ) and levels of adaptive social functioning. There was a significant interaction effect between polygenic scores and levels of ADHD traits ( $p = 0.02$ ) on AAC parcel volume. **Study 3)** We found a significant component associated with decreased density of bilateral insula, postcentral, angular and inferior temporal gyrus, and increased density of caudate and supra-/intra-calcarine cortex in autism while co-occurring altered WM diffusion features in superior longitudinal fasciculus ( $p = 0.040$ ). **Study 4)** We found greater levels of global task-potency atypicality for autism in each task ( $p < 0.001$ ). Furthermore, there were significant brain-behaviour modes of covariation between task potency atypicality spatial patterns and autism-related behavioural features.

Conclusions: Autism is associated with a complex pattern of both hypo- and hyperconnectivity. In order to achieve advances in our understanding of system-level atypicalities in ASD, integrating different structural and functional brain measures is the most promising method providing the basis for elucidating mechanisms through which interventions may improve functioning.

## PANEL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

### Panel 222 - Substance Use Among Adolescents and Adults on the Spectrum

**Panel Chair: Laura Graham Holmes**, *Boston University School of Public Health, Boston, MA, Hunter College, City University of New York, New York City, NY, Boston University School of Public Health, Boston, MA, Hunter College, City University of New York, New York City, NY*

Substance use disorder prevention is an important component of adolescent and adult health. Considering that an estimated 707,000-1,116,000 autistic youth will turn 18 years old by the year 2030, there is a tremendous deficit of information about substance use by autistic people. This panel presents the findings of four separate studies addressing questions about autistic adolescent and adult substance use. Collectively, these studies analyzed data from hundreds of autistic youth and adults using interview, survey, and secondary data analysis methods. Presentation 1 ( $n = 390$ ) presents a novel analysis of nationally representative data on U.S. school-based substance use disorder prevention education for U.S. students with autism, showing they are less likely to receive this service than youth without disabilities. Presentation 2 uses a large-scale cross-sectional study ( $n = 733$ ) to identify psychiatric conditions associated with substance use disorders in autistic individuals compared to clinical controls. Presentation 3 explores the thoughts and opinions of autistic young people ( $n = 40$ ) about their experiences with alcohol. Finally, Presentation 4 presents an analysis of U.S. states in which autism is a qualifying condition, and the results of a qualitative interview study of  $n = 40$  autistic youth about their cannabis use.

**222.001 (Panel)** School-Based Substance Use Education: Inclusion of Youth on the Autism Spectrum in a Representative U.S. Sample

**J. Rast<sup>1</sup>**, *L. Graham Holmes<sup>2,3</sup>, A. Roux<sup>4</sup> and E. F. Rothman<sup>4</sup>*, (1)*A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*, (2)*Boston University School of Public Health, Boston, MA*, (3)*Hunter College, City University of New York, New York City, NY*, (4)*Community Health Sciences, Boston University School of Public Health, Boston, MA*

Background:

This study provides an update on rates and predictors of substance abuse education (SAE) participation for autistic youth compared to other youth with and without individualized education plans (IEP) and 504 plans. Almost 800,000 youth classified as autistic are served by the U.S. special education system, with 92% enrolled in regular schools and most spending at least half of their time in general education classrooms. These students require health education providing the information and skills to make informed decisions about substance use. In 2000, data from the National Longitudinal Transition Study-2 showed autistic youth were the least likely across IEP classifications to receive SAE.

Objectives:

- 1) Estimate the percentage of students with an IEP classification of autism who have received SAE as compared to the percentage of students with no IEP and no 504 plan who have received SAE.
- 2) Identify factors associated with the receipt of SAE within and across IEP classifications.

#### Methods:

The National Longitudinal Transition Study-2012 was designed to yield nationally representative estimates of the experiences of U.S. youth served by the special education system. We compared rates of SAE across groups of youth who were 14 or older and able to self-report via survey who had: (a) an IEP classification of autism ( $n=390$ ) (b) other IEP classifications ( $n=4420$ ), (c) a 504 plan ( $n=350$ ), or (d) no IEP or 504 plan ( $n=980$ ). For each group, we conducted bivariate and multivariate regression analyses to identify characteristics of youth and educational experiences that were associated with receipt of SAE. Analysis was performed using Stata 15 and accounted for the complex survey design.

#### Results:

- 1) Students classified as autistic were significantly less likely to report SAE (49.6%) than students with no IEP/504 (57.4%).
- 2) For autistic youth, there were no bivariate or multivariate associations with receipt of SAE. In contrast, For youth in any other IEP category, youth attendance at an IEP meeting (OR 1.49, 95% CI 1.18-1.87), no trouble with conversation ability (OR 1.99, 95% CI 1.32-3.01), and no trouble getting to places outside the home (OR 1.59, 95% CI 1.21-2.09) were associated with higher odds of SAE receipt.

#### Conclusions:

Even as rates of drug abuse, dependence, and overdose deaths climb in the U.S., autistic students continue to be underserved when it comes to SAE. The lack of prevention services for autistic youth may result in poorer health trajectories across the lifespan. Research and policy advocacy are urgently needed to ensure that autistic youth have more access to SAE.

**222.002** (Panel) Substance Use Disorder in Autistic Adults: A Cross-Sectional Study of a National Mental Health Database  
**K. L. Unwin<sup>1</sup>, J. Underwood<sup>2</sup> and J. Hall<sup>1</sup>**; (1)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, VIC, Australia, (2)Neurosciences & Mental Health Research Institute, Cardiff University, Cardiff, United Kingdom

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#### Background:

Substance Use Disorders (SUDs) are diagnosed when the use of drugs, including alcohol, continues despite negative consequences. SUDs have a devastating effect on individuals lives and these effects are amplified when SUD co-occurs with autism. Studies have shown that concurrent SUD with autism not only negatively affects health and functioning, but also heightens risk of mortality. Evidence suggests that concurrent SUDs may stem from autistic individuals attempting to self-medicate, using substances to alleviate anxiety, social inhibition and sensory symptoms. Despite this, SUDs are reportedly underdiagnosed in autistic people, creating a barrier to services and support. There is also limited research in this area, particularly with regard to associations of SUDs within autism that could serve as red flags to support clinicians in the prevention or diagnosis of SUDs.

#### Objectives:

To investigate the psychiatric and neurodevelopmental conditions associated with SUDs in autistic individuals as compared to a clinical control group.

#### Methods:

Diagnostic and demographic data from 741 autistic adults (Male,  $n=397$ , 19-88 years) and 733 age- and gender-matched clinical controls were extracted from the National Centre for Mental Health database (Wales, UK). Data for this database were collected through standardized interview and clinical records. Binomial logistic regressions were used to assess associations with psychiatric and neurodevelopmental disorders across both groups.

## Results:

Ninety-eight of the autistic adults and 129 of the clinical controls had a co-occurring diagnosis of a SUD. In the autistic sample, SUDs were associated with Generalised Anxiety Disorder (Odds Ratio;  $OR=2.47$ , 95% C.I. 1.31-4.66), Bipolar Disorder ( $OR=2.58$ , 95% C.I. 1.37-4.85) and Emotionally Unstable Personality Disorder ( $OR=2.15$ , 95% C.I. 1.12-4.14). A concurrent ID or ADHD diagnosis was not statistically associated with SUD in either group. In the clinical control group, SUDs were associated with Generalised Anxiety Disorder ( $OR=2.31$ , 95% C.I. 1.33-4.00), Bipolar Disorder ( $OR=2.03$ , 95% C.I. 1.18-3.50), Depression ( $OR=4.38$ , 95% C.I. 2.08-9.25), Schizophrenia ( $OR=3.36$ , 95% C.I. 1.67-6.78) and Psychosis ( $OR=2.02$ , 95% C.I. 1.10-3.71), but not Emotionally Unstable Personality Disorder.

## Conclusions:

In this large-scale, cross-sectional study, we identified factors associated with SUDs in autistic individuals which could serve as potential indicators for either undiagnosed SUD, or the need for preventive strategies against SUD to be put in place. In particular, these potential risk factors include Generalised Anxiety Disorder, Bipolar Disorder and Emotionally Unstable Personality Disorder. These findings align with the self-medication explanation of SUDs in autism as those with autism and a concurrent mood disorder were more likely to have a SUD. Future work should further investigate risk factors for SUDs in autism, specifically exploring if there is a causal relationship between them.

### 222.003 (Panel) Underage Alcohol Use in Youth on the Autism Spectrum

**E. F. Rothman<sup>1</sup>** and **L. Graham Holmes<sup>2,3</sup>**, (1)Community Health Sciences, Boston University School of Public Health, Boston, MA, (2)Boston University School of Public Health, Boston, MA, (3)Hunter College, City University of New York, New York City, NY

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## Background:

Although autistic youth have previously been seen as protected from substance use disorders due to rule-following or lack of exposure to peer pressure, recent studies show that they do use alcohol. For example, between 23%-44% of autistic college students report using alcohol,<sup>1</sup> and a large survey of autistic adults ( $n=507$ ) indicated half of all drinkers reported binge drinking, and most perceived that alcohol had positive benefits including improved communication.<sup>2</sup> Further research about alcohol use among autistic people is needed in order to support substance use interventions for this population.

## Objectives:

The purpose of this study was to explore the thoughts and opinions of a sample of U.S. autistic youth about motivations to use or abstain from alcohol, alcohol expectancies, refusal self-efficacy, family communication, peer use norms, rule-following, and risk perception; and in those with recent alcohol use, types of alcohol consumed, how procured, with whom and in what context, perceived effects, and consequences.

## Methods:

Forty youth were recruited for a qualitative interview study via social media advertising and databases of prior research participants. Eligible youth were: (1) 16-20 years; (2) U.S. residents; (3) English-speakers; (4) Had a diagnosis of autism, verified by reviewing documentation; (5) Demonstrated ability to complete an interview; and (6) had a drink of alcohol in the past year ( $N=20$ ) or had not ( $N=20$ ). Participants or their parent completed the SRS-2. Interviews took place over Zoom, with the option of speaking aloud or using the chat feature to text (interview questions in Table 1). Interviews were recorded and transcribed, and Dedoose software was used to organize text into excerpts. Two independent raters coded excerpts using an inductive approach to identify themes, presented with illustrative quotes (Table 2).

Of 98 individuals interested in participation, 41 were eligible and 40 completed the interview (mean age=18 years). They were White non-Hispanic (81%), Asian (7%), Black (3%), Hispanic/Latino (2%), and multiracial (7%). Sixty-one percent were male, 29% female, and 10% non-binary gender. SRS-2 T-scores (mean=94.2,  $SD=10.3$ ) were consistent with autism symptoms in the severe (96.3%) or moderate (3.7%) range.

## Results:

Drinkers described the effects of alcohol as enjoyable, relaxing, and disinhibiting. In general, youth stated that their parents hadn't communicated explicit rules about alcohol use. However, they described being affected by the alcohol culture in their homes, for example: envisioned themselves using alcohol in adulthood in a similar manner to their parents. Drinkers and non-drinkers both imagined that alcohol use decreases anxiety for autistic people, although some worried disinhibition would make them less socially effective. Several college youth described episodes of binge drinking or drinking to alleviate stress rather than for fun. One youth described a "special interest" in cocktail ingredients which facilitated college social relationships.

Conclusions:

Underage alcohol use is a normative aspect of the transition to adulthood. Youth on the spectrum are aware of and interested in alcohol, and some associated negative health effects or potential positives. Family communication about alcohol use may be minimal and could be strengthened for youth on the spectrum as they enter adulthood.

**222.004 (Panel) Where Is Cannabis Legally Available to Autistic Youth and Adults in the U.S., and Why Do Autistic Youth Report Using Cannabis?**

**L. Graham Holmes<sup>1,2</sup> and E. F. Rothman<sup>3</sup>,** (1)Boston University School of Public Health, Boston, MA, (2)Hunter College, City University of New York, New York City, NY, (3)Community Health Sciences, Boston University School of Public Health, Boston, MA

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Background:

Autistic adults, and parents of autistic children, are targeted by the cannabis industry to use cannabis to address autism symptoms and co-occurring conditions that include problems with sleep, anxiety, irritability, seizure, self-harm, sensory processing, and alexithymia. Three experimental studies have found promising effects of cannabis on autism symptoms. However, cannabis may have negative effects that exacerbate autism symptoms, and one study has found that cannabis use may be more likely to lead to cannabis use disorder (CUD) among autistic people than neurotypical people. This study sought to address the information gap about the availability of legal cannabis to autistic people in the U.S., and why autistic youth report using cannabis.

Objectives:

The objectives of this two-part study were to: (1) Analyze U.S. state policies regarding recreational and medicinal use of cannabis for autistic people; and (2) Investigate experiences of cannabis use among autistic youth aged 16-20 years.

Methods:

To address our first objective, we reviewed U.S. state health websites and statutes to determine whether recreational and medicinal cannabis were legal and if legal, under what circumstances autistic adults or parents of autistic youth could obtain cannabis. To address our second objective, we interviewed n=40 autistic youth recruited via social media advertising and databases of prior research participants. Eligible youth were: (1) 16-20 years; (2) U.S. residents; (3) English-speakers; (4) Had a formal autism diagnosis, verified by reviewing documentation; and (5) Demonstrated ability to complete an interview. Participants or their parent completed the SRS-2. Zoom interviews were recorded and transcribed, and Dedoose software was used to organize text into excerpts. Two independent raters coded excerpts using an inductive approach to identify themes, presented with illustrative quotes (Table 1).

Of 98 potential participants, 41 were eligible and 40 completed the interview process (mean age=18 years). They were White non-Hispanic (81%), Asian (7%), Black (3%), Hispanic/Latino (2%), and multiracial (7%). Sixty-one percent were male, 29% female, and 10% non-binary gender. SRS-2 T-scores (mean=94.2, SD=10.3) were consistent with autism symptoms in the severe (96.3%) or moderate (3.7%) range.

Results:

1) There are 28 U.S. states in which autistic adults could obtain cannabis legally, and 19 states in which parents can obtain medicinal cannabis for autistic children (Figure 1).

2) Youth who used cannabis reported that they used it to improve sleep and gastrointestinal issues, to relieve stress and social anxiety, and have fun. Some said that they used it along with or enjoyed it more than alcohol. Users were open with parents or

had even received cannabis from parents. Youth perceived some potential harms, but generally thought it was less harmful than alcohol.

Conclusions:

Cannabis is widely available for autistic people in the U.S. Autistic young people use cannabis for medicinal and recreational purposes and may be unaware of potential harms. Given the ferocity of cannabis industry marketing techniques, we must begin to characterize how autistic adults and parents of autistic youth think about the state of the science about risks and benefits of cannabis, and how they choose whether to use it.

## PANEL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

### Panel 229 - Digitally Augmented Phenotyping of Autism Spectrum Disorders

**Panel Chair: Christine Falter-Wagner**, *Department of Psychiatry and Psychotherapy, LMU Hospital Munich, Munich, Germany*

**Discussant: Kai Vogeley**, *Department of Psychiatry and Psychotherapy, University Hospital Cologne, Cologne, Germany*

Differential diagnostics of autism spectrum disorders (ASD) currently relies mainly on (semi-standardised) behavioural observation. The diagnostic reliability of clinical impression formation depends heavily on in-depth clinical experience and represents a particular challenge for adult diagnostics. Methods of digital recording and analysis of behaviour promise high potential for more objective and economic ASD diagnostics based on the assessment of biological and behavioural markers. The approaches presented in this panel investigate the potential of digital assessment methods and machine learning for digitally augmented phenotyping of ASD. The contributions to the panel will discuss high resolution parameters of temporal coordination between gaze, gesture, verbal output and facial expression. Assessment methods comprise coupled eye-tracking and computerised movement detection, video analysis, computer vision approaches, machine learning amongst others. A balance of controlled laboratory settings and ecologically valid interpersonal interactions will be discussed. Such digital assessment methods could shape ASD diagnostics in the future by providing an objective, automatized phenotyping aid augmenting clinical decision making, providing more efficient diagnostic procedures and adding to cross-institutional reliability of clinical decisions.

**229.001 (Panel)** Temporal Patterns of Automatically Measured Nonverbal Communication in ASD  
**C. Bloch**, *Department of Psychiatry and Psychotherapy, LMU Hospital Munich, Munich, Germany*

Background: Interpersonal synchrony as a correlate of functional communication leads to prosocial effects such as sympathy, empathy and rapport. But what mechanisms underly interpersonal synchrony?

The timing of signals within persons in interaction could play an important role for the coordination of signals between subjects. The multimodal temporal coupling of different nonverbal channels describes the level of intrapersonal synchrony. Empirical evidence for motor and sensory timing peculiarities in autism-spectrum-disorder (ASD) imply that the intrapersonal temporal coupling of nonverbal channels in individuals with ASD may underly temporal mechanisms that could be discriminable from controls.

Objectives: Aim of this study is to investigate the temporal coupling of gaze with a pointing gesture as effect size of intrapersonal synchrony. Including adults with ASD and controls should reveal typical coupling mechanisms and potential deviations in the diagnosis group.

Methods: A preliminary sample of participants with F84.5 diagnosis ( $N = 15$ ) according to ICD-10 and an age, gender and IQ-matched control group ( $N = 15$ ) was raised. Patients have been recruited from an outpatient clinic for autism in adulthood where diagnosis was confirmed by consensus diagnostic of two independent clinicians.

During the study which was performed in a standardized interpersonal setup the experimental conductor took the role as the interaction partner of the participant. Conductor and participant sat opposite each other and a display was placed between them facing the participant. In 4 blocks with 30 trials each the task of participant was to let the interaction partner know on which side

a target appears by means of gaze and pointing gesture. Each trial started with mutual eye contact as initial shared attention after which the target was presented. An Eyelink 1000 plus (SR Research) controlled with a connection via Pylink (Psychopy) allowed for the detection of saccade onsets and pointing onsets by key release in a temporal resolution of 1000 fps. Objective of investigation was the temporal interval between the onsets of gaze and gesture.

Results: A linear mixed effects model including group as fixed factor and subjects as random factor for the temporal interval between gaze and gesture onset explains significantly more variance than the model without the group factor ( $\chi^2(1) = 4.89, p = .027$ ) indicating a significantly bigger temporal gap between the nonverbal signal onsets in the ASD group ( $M = 271.03$  ms,  $SD = 81.45$  ms) compared to controls ( $M = 211.58$  ms,  $SD = 62.67$  ms).

Conclusions: These preliminary results support the hypothesis of peculiar intrapersonal temporal coupling of nonverbal channels in ASD. The sample need to be filled and additional covariates need to be assessed in order to draw clear conclusions from this study.

**229.002** (Panel) A Computer Vision Approach for Classifying Autistic Behaviour during Dyadic Interactions  
*A. L. Georgescu, King's College London, London, United Kingdom*

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Background: Successful social encounters depend unarguably to a large degree on the smooth exchange of nonverbal cues between two or more interaction partners. Impairments in exchanging nonverbal cues are characteristic of developmental disorders such as Autism Spectrum Conditions (ASC). Thus, modelling nonverbal behaviours is a well-fitting means for developing automatic diagnostic tools.

Objectives: The main goal of this work is to introduce a proof-of-concept method of automatic analysis of autistic behaviour in dyadic interactions between two human adults, which is minimally invasive and easily scalable.

Methods: In this paper we focus on the computational analysis of nonverbal behaviours in dyadic social interactions between two adults. There are three dyad types, composed of either two typical individuals (10 dyads), two autistic individuals (10 dyads) or one typical and one autistic individual (9 dyads). Each dyad interacts in five different scenarios. We extracted two 60 second clips from each scenario of each dyad. In this way, we obtained 11 short clips for each dyad group resulting in 317 clips in total. We then used computer vision tools like OpenPose and the Looking-At-Each-Other network to extract both individual features (i.e. head, hand and leg movement) and interpersonal features (i.e. mutual gaze and head, hand and leg synchrony) from videos, which were then used to train two classical machine learning methods (i.e. support vector machines and random forests).

Results: Our results show that the proposed approach can detect ASC (random forest) at a performance of 70% and recognise dyad type at a performance of 72%, which has implications for minimally invasive autism screening. For both classifiers, interpersonal features provided better results as compared to individual features and combining all the features clearly improved the performance. For example, when random forest was used for the classification of autism, combining all the features outperformed using the individual features by a margin of 12% and using the interpersonal features by a margin of 2%.

Conclusions: In a proof-of-concept study, we demonstrate that it is possible to classify adults with ASC from TD based on nonverbal behaviours using a computer vision approach. We also show that including dyadic nonverbal behaviours improves predictive performance.

**229.003** (Panel) Social Synchrony in Interpersonal Settings for Automatic Classification of Autism Spectrum Disorder  
*J. Köhler, LMU Munich, Munich, Germany*

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Background: Fundamental deficits in social interaction and communication are characteristic for people on the autism spectrum. These deficits are visible, amongst others, in reduced temporal coordination with other individuals, frequently termed interpersonal synchrony. Rising prevalence rates as well as time-consuming diagnostic processes call for advancements in the diagnosis of ASD. Though often classified as a disorder of social interaction, integrating this interpersonal aspect into an objective diagnostic process for ASD remains a challenge. The increasing overlap between psychiatric research and machine learning techniques offers promising approaches to classify ASD from phenomenological, behavioral or biological data.

Objectives: A thorough investigation of these coordination deficits in naturalistic social settings and their potential use for (differential) diagnosis is currently lacking. The following studies aim at objectively capturing interpersonal synchrony in autistics adults across multiple modalities and ultimately combining machine learning techniques for classification to aid the diagnostic process.

**Methods:** Patients seeking diagnosis in two specialized autism outpatient clinics were filmed during their initial diagnostic interviews. Interpersonal movement synchrony between patient and diagnostician was measured using Motion Energy Analysis (MEA; Ramseyer & Tschacher, 2011). Importantly, the diagnosticians were naïve to diagnosis at the time of recording. Only after patients went through the full diagnostic process according to German S3- guidelines, they were allocated to the respective groups ASD+ (patients receiving an autism diagnosis) and ASD- (patients for whom any autism diagnosis was ruled out). Additionally, screening measures of autism symptom severity (autism quotient, empathy quotient, adult dyspraxia checklist) were collected. In a second study (Georgescu et al., 2019), a support vector machine classification algorithm was trained on INTRApersonal (between head and body movement) synchrony data of interaction dyads consisting of either one or two ASD patients as well as typically-developing control dyads. Further, this experimental setup is currently expanded to include additional behavioral and biological measures such as analysis of facial expression or speech as well as physiological and endocrinological parameters.

**Results:** Results for the first study showed significantly reduced movement synchrony between patient and diagnostician in the group of patients later diagnosed with ASD while there were no differences for the standard diagnostic screening tools, movement difficulties or the total amount of movement. In the second study, our classification algorithm was able to classify autistic and typically-developing adults with a balanced accuracy of 75.9%. The contribution of additional objective behavioral and biological parameters of social interactions to diagnostic classification remain to be investigated.

**Conclusions:** Combined with further (objective) behavioral and clinical parameters, social interaction settings provide opportunities to refine the diagnostic process for ASD. Furthermore, integrating social interaction data with machine learning techniques may aid in capturing the heterogeneous phenotype of ASD in the future.

**229.004 (Panel) Automated Analysis of Social Interaction Behavior in Autism Spectrum Conditions (ASC)**  
**H. Drimalla, University of Bielefeld, Bielefeld, Germany**

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**Background:** Difficulties in social communication and interaction are a core diagnostic criterion of autism spectrum conditions (ASC). Objective measurement and quantification of social interaction abilities could improve diagnostic processes and support therapeutic interventions.

**Objectives:** Using two newly developed standardized tasks and automated video analysis we aimed to quantify the nonverbal communication abilities of people with ASC and neurotypical participants.

**Methods:** In two studies, we measured different aspects of social interaction behavior of people with ASC and neurotypical participants.

The first study used a newly developed naturalistic interactive task, that consists of a standardized 7-minute simulated dialogue via video and automated analysis of facial expression, gaze behavior and voice characteristics. We compared nonverbal social interaction behavior of 37 individuals with ASC and 43 healthy controls using automated analysis of this task and evaluated the task's diagnostic value.

The second study compared instructed facial imitation between 39 individuals with ASC and 41 healthy controls. Using computer-based face analysis and a newly developed emotion imitation and recognition test, we related individuals' voluntary facial imitation to their recognition abilities.

**Results:** The two new paradigms combined with automated video analysis allowed us to detect and quantify differences in social interaction behavior between individuals with ASC and neurotypical controls.

Using the naturalistic interactive task, we were able to identify individuals with ASC with an accuracy comparable to expert ratings, based on facial expressions and voice characteristics alone. Individuals with ASC were characterized by a reduced social smile and facial imitation, as well as a higher vocal base frequency and a higher harmonic noise ratio.

The imitation and recognition tasks showed that individuals with ASC recognized fewer emotions from facial expressions correctly and were slower and less precise in imitating the facial expressions than neurotypical individuals. In both groups, a stronger as well as a more precise imitation scaled positively with an participants' accuracy of emotion recognition.

**Conclusions:** The use of digital paradigms in combination with automatic video analysis and machine learning methods seems promising to measure social-interactive impairments more precisely and to understand them better. In a next step, we plan to

compare interaction behavior across different psychopathologies and assess the diagnostic specificity of digital interaction analysis.

## ORAL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

### Oral 301 - Social, Sexual and Neuropsychiatric Health in Autistic Adults

**301.001** (*Oral*) Healthy Relationships for Autistic People: Intervention Development

**E. F. Rothman<sup>1</sup>** and **L. Graham Holmes<sup>2,3</sup>**, (1)Community Health Sciences, Boston University School of Public Health, Boston, MA, (2)Boston University School of Public Health, Boston, MA, (3)Hunter College, City University of New York, New York City, NY

#### Background:

Research has established that for many autistic youth, loneliness, social isolation, peer harassment, and dating and sexual aggression victimization are significant problems.<sup>1-5</sup> One in four experiences bullying by peers.<sup>2</sup> Neurotypical people also experience challenges in their relationships, so these problems are not unique to autistic individuals, but autistic youth may have fewer opportunities to engage in informal learning from peers about how to establish and maintain healthy relationships. Moreover, school-based healthy relationships promotion programs are rare, and autistic youth likely have even less access to these types of programs than neurotypical peers. Importantly, “healthy relationships” programs (i.e., how to avoid toxic relationships) are very different from social skills interventions that teach the mechanics of meeting people and holding polite conversations. There is a critically important gap in the field: healthy relationships programs for autistic youth are urgently needed.

#### Objectives:

The purpose of this study was to gather formative data to inform a new healthy relationships intervention for autistic youth.

#### Methods:

Twenty-five youth 16-22 years old were recruited for a qualitative interview study via social media advertising and databases of prior research participants. Youth were eligible if they were: (1) 16-22 years old; (2) living in the U.S.; (3) English-speakers; (4) Had a diagnosis of autism from a professional, verified by reviewing documentation; (5) Had  $\geq 1$  close friend; and (6) Demonstrated ability to complete an interview. Eligible participants or their parent completed the SRS-2. Interviews took place over Zoom. Participants were given the option of speaking aloud with the camera on or off, or using the chat feature to text. Interview questions are available in Table 1. Spoken interviews were audio-recorded and transcribed. We used Dedoose software to organize text into excerpts. Two independent raters coded each excerpt using an inductive approach to identify themes. Illustrative quotations that exemplified each theme were selected for presentation (see Table 2).

Of 61 individuals interested in study participation, 35 were eligible. Ten did not complete the interview scheduling process. Of the 25 interviewed, 72% were white, 12% were multiracial, 8% were Black and 8% were Asian. Forty-four percent were male, 44% female, and 12% non-binary gender. The mean age was 18 years old. Participant SRS-2 T-scores (mean=92.3, SD=11.2) were consistent with autism symptoms in the severe (96%) or moderate (4%) range.

#### Results:

Participants reported that healthy relationships were ones in which they could be their authentic selves without “conforming,” where there was reciprocity, they listened to one another’s problems, and they could “vent.” Some expressed a desire for advice about dating as an asexual person, expressed that they lacked training on consent and sexual boundary setting, navigating breakups, and coping with hurt. Participants expressed a preference for a class co-taught by a neurotypical and autistic adult and favored mixed gender students.

#### Conclusions:

The content of the intervention in development should emphasize the importance of feeling like one's natural self in healthy relationships, how to set boundaries and negotiate consent, feature autistic and neurotypical team teaching, and be offered to mixed gender groups.

### **301.002** (Oral) The Sexual Preferences and Sexual Health of Autistic Adults

**E. Weir**, C. Allison and S. Baron-Cohen, Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom

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**Background:** Autistic individuals, and particularly autistic females, may identify with a wider diversity of sexual orientations than others.<sup>1,2</sup> Although the majority of autistic individuals are interested in sexual or romantic relationships, there is some evidence that autistic individuals may have reduced sexual libido or be more likely to identify as asexual.<sup>2,3</sup> Studies also suggest that autistic individuals may have reduced likelihood of contracting sexually transmitted infections (STIs) than non-autistic individuals;<sup>4,5</sup> however, no existing studies consider whether asexuality or lack of sexual activity may explain this reduced risk.

**Objectives:** To explicate the sexual preferences, activity, and health of autistic adults, as well as to identify the sex differences in these patterns. In addition, we hoped to clarify the relative risk of STIs among sexually active autistic individuals.

**Methods:** We disseminated an anonymized, online survey to n=2,386 adults (n=1,183 autistic) aged 16-90 years of age. We employed unadjusted (Fisher's exact tests) and adjusted (Binomial Logistic Regression) models to describe the sexual activity, risk of contracting STIs, and sexual orientation of autistic and non-autistic adults. We used z-scores to estimate relative differences between females and males to identify sex differences in these areas.

**Results:** For every ten non-autistic people who report ever being sexually active, only four autistic people report the same (OR: 0.383; 95% CI: 0.283–0.517; FDR:  $2.18 \times 10^{-9}$ ). In addition, autistic adults are three to nine times more likely to be asexual, homosexual, or 'other' sexuality; similarly, they were less likely to be heterosexual. There were no differences in age of sexual activity onset or self-reported contraction of STIs; full results are provided in Table 1. When evaluating sex differences, autistic males are uniquely likely to be bisexual (OR: 3.382; 95% CI: 1.716 – 6.666; p-value:  $4.478 \times 10^{-4}$ ), whereas there are no significant differences in rates of bisexuality between autistic and non-autistic females (OR: 1.263; 95% CI: 0.942 – 1.695; p-value: 0.119). Conversely, autistic females are uniquely likely to be homosexual (OR: 3.275; 95% CI: 1.922 – 5.579; p-value:  $1.341 \times 10^{-5}$ ), with no difference in rates of homosexuality between autistic and non-autistic males (OR: 0.708; 95% CI: 0.408 – 1.228; p-value: 0.219). Full results of sex differences are provided in Table 2.

**Conclusions:** Autistic males or females are more likely to identify as asexual, bisexual, and homosexual, as well as less likely to identify as heterosexual; these patterns vary based on sex. Further, though a majority reported being sexually active, both autistic males and females were less likely than others to have been sexually active. Crucially, there were no differences in age of sexual activity onset or likelihood of contracting STIs among sexually active individuals. This is the largest study of sexual health and preferences of autistic adults, and of autistic females without intellectual disability. Sexual education and sexual health screenings of autistic adults must remain priorities; healthcare professionals should focus on using language that affirms a diversity of sexual preferences and orientations and supporting autistic patients who may be experiencing minority stress due to this intersectionality.

### **301.003** (Oral) Functional Impacts of Co-Occurring ADHD Symptoms in Autism across Adulthood

**S. C. Duane**<sup>1</sup>, B. E. Yerys<sup>2</sup>, G. McQuaid<sup>3</sup>, N. R. Lee<sup>4</sup> and G. L. Wallace<sup>1</sup>, (1)The George Washington University, Washington, DC, (2)Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA, (3)G, Washington, DC, (4)Drexel University, Philadelphia, PA

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**Background:**

Adults with autism spectrum disorder (ASD) self-report attention-deficit/hyperactivity disorder symptoms (ADHD) more frequently than the general population. Nevertheless, very little research has examined the presence of ADHD symptoms in ASD and their potential impact on quality of life and adaptive skills during adulthood. In childhood and adolescence, co-occurring ADHD in the context of ASD has been linked with poorer quality of life and more limited adaptive functioning compared to those without ADHD.

**Objectives:**

Examine the association between co-occurring ADHD and measures of subjective quality of life and adaptive skills in autistic adults.

Methods:

Participants (n=731) were recruited via Simons Powering Autism Research and Knowledge (SPARK) and included adults with a professional diagnosis of ASD (58% female) ranging in age from 18-83 (M=40) years. Participants completed questionnaires online, including measures of ADHD symptoms, subjective quality of life, and adaptive skills. ADHD was treated as both a categorical variable (self-report yes [ASD+ADHD] or no [ASD-ADHD] for an accompanying ADHD diagnosis based on a previously given or current diagnosis) and dimensional variable (ADHD symptom screen). For categorical analyses, three analyses of covariance (ANCOVAs), accounting for the effects of age, sex assigned at birth, socioeconomic status, autistic traits, anxiety symptoms, and depression symptoms, were used to examine ASD+ADHD vs. ASD-ADHD differences in subjective quality of life and adaptive skills. For dimensional analyses, five linear regressions examined associations between continuous ADHD symptoms and subjective quality of life and adaptive skills using the same covariates. Bonferroni corrections were applied to the ANCOVAs (adjusted threshold:  $p < .0167$ ) and regression analyses (adjusted threshold:  $p < .01$ ) to adjust for multiple comparisons.

Results:

Utilizing a lifetime ADHD diagnosis to delineate groups (39% yes in this sample) revealed lower physical health quality of life among ASD+ADHD as compared to ASD-ADHD, after accounting for the entered covariates ( $F=4.25, p=.04, h_p^2=.007$ ); however, this did not survive correction for multiple comparisons. Examining continuous ADHD symptoms and their contribution to variance in quality of life and adaptive skills showed considerably more effects. Increasing ADHD symptoms (even after accounting for the effects of all covariates and an adjusted  $p$  value) were significantly associated with decreased physical health ( $t=3.50, p<.001, \Delta R^2=.01$ ) and environmental (home, resources, etc.) health ( $t=3.96, p<.001, \Delta R^2=.02$ ) quality of life and with poorer daily living skills ( $t=5.88, p<.001, \Delta R^2=.04$ ).

Conclusions:

Although a large number of adults with ASD in the current study reported having a current or prior diagnosis of ADHD, this categorical delineation was not predictive of adult outcomes. In contrast, a dimensional examination revealed that higher current ADHD symptoms were associated with poorer subjective quality of life and adaptive daily living skills among ASD adults. Therefore, rather than qualitative distinctions among ASD adults based on the presence/absence of an ADHD diagnosis, a dimensional perspective might better inform our understanding of adult outcomes and ways to improve them. Targeting ADHD may have important implications for improving both independent living and quality of life for ASD adults. Future studies also should evaluate outcomes for 'well-treated' versus treatment-resistant ADHD in ASD adults.

**301.004** (Oral) Are Parkinsonism Features in Autism during Middle and Older Adulthood Linked with Poor Outcomes?  
**G. L. Wallace<sup>a</sup>** and **G. McQuaid<sup>d</sup>**, (1)The George Washington University, Washington, DC, (2)G, Washington, DC

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Background:

Emerging evidence links Parkinsonism (i.e., motoric features associated with Parkinson's Disease [PD], such as limb stiffness and bradykinesia) with autism spectrum disorder (ASD), above and beyond usage of antipsychotics. For example, several studies have found increased rates of PD diagnoses in both younger and older ASD adults and one study has found elevated Parkinsonism features in two samples of older ASD adults. However, research to date has yet to examine whether adults with both ASD and elevated Parkinsonism features experience worse outcomes than those without these motor symptoms.

Objectives:

Examine associations between parkinsonism features and middle and older adult outcomes in ASD.

Methods:

406 adults with ASD (57% female) ranging in age from 40-83 (M=52) years were recruited via Simons Powering Autism Research and Knowledge (SPARK). They each completed a battery of questionnaires online. The presence of parkinsonism features was evaluated using the weighted cut-off score from the Parkinsonism Screening Questionnaire (PSQ) resulting in

ASD+Park and ASD-Park groups. Subjective quality of life was measured using the four dimensions (physical health, psychological health, social relationships, and environmental health) of the World Health Organization Quality of Life-BREF questionnaire and the complementary Autism Quality of Life scale. Adaptive functioning was measured using the Waisman Activities of Daily Living scale. Memory abilities were assessed using the Prospective/Retrospective Memory Questionnaire. A series of analyses of covariance (ANCOVAs) accounting for the effects of age, sex assigned at birth, autistic traits, and current antipsychotics usage were used to examine ASD+Park vs. ASD-Park differences in subjective quality of life, adaptive skills, and memory functioning. In complementary analyses, multiple linear regressions examined links between (unweighted) continuous PSQ ratings and subjective quality of life, adaptive skills, and memory functioning, separately, using the same covariates.

Results:

135 (33%) of these ASD adults met screening criteria for parkinsonism on the PSQ. The ASD+Park group reported significantly poorer subjective quality of life across all dimensions ( $F_s > 5.18$ ,  $p_s < .05$ ,  $\eta^2_s > .015$ ), including the autism-specific scale ( $F = 10.00$ ,  $p = .002$ ,  $\eta^2 = .03$ ), more limited adaptive skills ( $F = 14.33$ ,  $p < .001$ ,  $\eta^2 = .04$ ), and poorer memory ( $F_s > 11.97$ ,  $p_s < .001$ ,  $\eta^2_s > .035$ ) compared to the ASD-Park group. Similarly, linear regression analyses revealed that increasing parkinsonism features in the entire ASD sample were significantly predictive of decreased subjective quality of life, adaptive skills, and memory ( $t_s > 5.20$ ,  $p_s < .001$ ,  $\Delta R^2_s \geq .06$ ) after accounting for covariates.

Conclusions:

Converging with prior studies, we find elevated rates of parkinsonism features among middle and older adults with ASD. Extending this work, the current study provides the first evidence that elevated parkinsonism features are linked with poor outcomes across domains important for everyday functioning during middle and older adulthood in ASD. This study therefore highlights the importance of further investigating parkinsonism risk and etiology in ASD, particularly given the rising numbers of adults with ASD, whether newly diagnosed or those aging with a pre-existing diagnosis.

## ORAL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

### Oral 315 - Contributing Factors and Pathways to Autistic Adult Mental, Behavioral and Social Outcomes

**315.001** (Oral) Predicting Uncertain Multi-Dimensional Adulthood Outcomes from Childhood and Adolescent Data in People Referred to Autism Services

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#### Background:

Due to the heterogeneous nature of autism spectrum disorder (ASD) it is difficult to provide a long term prognosis for a child. Nonetheless, the question of what the future may hold is important - to support planning, identify areas for intervention, and to provide insight into a diagnosis. A well rounded description of a child's adult outcome requires a diverse set of measures, including cognitive function, mental health and well being, behavioral domains, the extent of autism symptoms, and a persons work and living situation. We consider the challenge of making individual predictions of the multi-faceted adult outcome for a child referred to autism services, based on assessments made throughout childhood and adolescence. This allows us to better identify aspects of the outcome that are likely determined by early childhood, predictable only by measures taken in late adolescence, or aspects less amenable to prediction.

A comprehensive personalized prediction of potential adult outcomes for an individual may present challenges in interpretation due to the number of outcomes measures that can be considered. We also explore predicting a single personalized outcome created from the priorities across adult outcomes measures for a particular individual.

#### Objectives:

To assess which aspects of the adult outcome are predictable and from which ages good predictions can be made. Secondly to consider whether priorities for a particular individual can be incorporated into predictions of adult outcomes by forming a personalized outcome.

## Methods:

We used data from 123 adults participating in the Autism Early Diagnosis Cohort. Participants were recruited from autism programs in North Carolina, Chicago, and Michigan, from age 2 and followed up repeatedly through childhood and adolescence to adulthood. We predicted 14 adult outcome measures including cognitive, behavioral and well being measures. Continuous outcomes were modeled using lasso regression and ordinal outcomes were modeled using proportional odds regression. Optimism corrected predictive performance was calculated using cross-validation or bootstrap. We also illustrated the prediction of an overall composite formed by weighting outcome measures by priorities elicited from parents.

## Results:

We found good predictive performance from age 9 for verbal and non-verbal IQ, and daily living skills. Predictions for symptom severity, hyperactivity and irritability improved with inclusion of behavioral data collected in adolescence but remained modest. For other outcomes covering well being, depression, and positive and negative affect we found no ability to predict adult outcomes at any age. Predictive performance is shown in figures 1. Predictions of composites based on parental priorities differed in magnitude and precision depending on which parts of the adult outcome were given more weight.

## Conclusions:

Verbal and non-verbal IQ, and daily living skills can be predicted well from assessments made in childhood. For other adult outcomes, it is challenging to make meaningful predictions from assessments made in childhood and adolescence using the measures employed in this study. Future work should replicate and validate the present findings in different samples, investigate whether the availability of different measures in childhood and adolescence can improve predictions, and consider systematic differences in priorities.

### 315.002 (Oral) Sources of Sexuality and Relationship Education for Adults in the United States

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## Background:

Sexuality and relationship education (SRE) is designed to provide positive physical, mental, and social outcomes. Understanding where adults look for and find SRE knowledge is key to continued development and dissemination of accessible and tailored SRE programming. Especially for autistic adults who are less likely to have comprehensive SRE experiences, characterizing the utilization rates of sources of information across various SRE content areas is necessary to inform educational models moving forward.

## Objectives:

To identify sources of SRE for adults with and without autism.

## Methods:

A total of 132 US-based adults were included in the final sample, of which 44 participants were previously diagnosed with ASD and 88 were neurotypical (NT), based on self-report. Participants had a mean age of 25.96 years (SD = 5.88) and represented 23 states. Genders reported included: 49% women, 31.2% men, 3% non-binary, 16.6% chose not to identify. 63% of respondents were White, 5% Hispanic/Latino, 7.5% Black, 4.5% Asian, 4.5% as Multiracial, and 14.3% chose not to identify. The average Autism Quotient-10 score was 4.77 (SD 2.29).

Participants were recruited through social media to complete an anonymous online survey. Autistic and NT adults were compared on sources of SRE information by topic. Sources of information included internet website of verifiable quality, internet website of non-verifiable quality, romantic partner, similar-age peer (e.g., within two years of own age), friend more than two years younger, friend more than two years older, parents, siblings, mentors, care providers, other). Topics included gender identity, sexual orientation, partnered sexual acts, non-partnered sexual acts, kissing, flirting, dating, consent, assertiveness.

## Results:

Autistic adults were significantly less likely to learn information about Flirting (41.5% ASD vs. 65.9% NT;  $\chi^2(1, N = 132) = 8.14, p < .01$ ), Dating (41.5% ASD vs 65.9% NT;  $\chi^2(1, N = 132) = 8.14, p < .01$ ), and Consent (32.1% ASD vs. 54.9% NT;  $\chi^2(1, N = 132) = 7.04, p < .01$ ) from similar age peers than their neurotypical counterparts. For partnered sexual behaviors, romantic partners were endorsed as a source of information by a significantly lower percentage of the autistic respondents (37.7 %) than of the NT participants (60.4%) ( $\chi^2(1, N = 132) = 6.92, p < .01$ ). Across the remaining five content areas, no diagnostic group differences emerged across the surveyed sources of information. Figure 1 shows break down of sources of information combined across diagnostic groups. For these content areas, the internet emerged as the significantly most consulted source, followed by peers, followed by parents, providers, and mentors.

## Conclusions:

Diagnostic group differences reflect that autistic adults have less access to the peer-based, informal learning that promotes SRE knowledge. Autistic people would benefit from SRE that augments learning in these content areas since traditional peer sources of information may be underutilized. Of note, the internet was the most used source of information across topics and diagnostic groups. This highlights the need for including internet literacy as part of SRE programs and for increasing comfort and resources for parents, providers, and mentors on SRE topics so that they can serve as alternative sources of information.

**315.003** (Oral) Is Camouflaging Autistic Traits Associated with Defeat, Entrapment and Suicidal Thoughts? Expanding the Integrated Motivational Volitional Model of Suicide.

**S. A. Cassidy<sup>1,2,3</sup>, E. McLaughlin<sup>1</sup>, R. McGranaghan<sup>1</sup>, M. K. Pelton<sup>1</sup>, S. Baron-Cohen<sup>2</sup>, R. O'Connor<sup>4</sup> and J. Rodgers<sup>3</sup>,** (1)School of Psychology, University of Nottingham, Nottingham, United Kingdom, (2)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (3)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, (4)Coventry University, Coventry, United Kingdom, (5)University of Glasgow, Glasgow, United Kingdom

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## Background:

Camouflaging autistic traits to 'fit in' in social situations is associated with suicidal thoughts and behaviours, but it is unclear why. One potential reason could be that camouflaging autistic traits contributes to feelings of defeat and entrapment – known risk markers for suicidal thoughts in the general population, as outlined in the Integrated Motivational Volitional Model of Suicide. For example, if one continues to experience social difficulties and exclusion despite one's best efforts to camouflage, leading to feelings of a failed social struggle (defeat), and that this situation will never change (entrapment).

## Objectives:

1) To test whether camouflaging autistic traits is associated with feelings of defeat and entrapment; 2) To test whether camouflaging and feelings of defeat and entrapment together are associated with suicidal thoughts; 3) To test whether camouflaging autistic traits is associated with suicidality through defeat and entrapment.

## Methods:

180 UK undergraduate students (76.7% female, 18-67 years) completed a cross-sectional online survey from 5<sup>th</sup> February – 23<sup>rd</sup> March 2020 including self-report measures of defeat and entrapment, autistic traits, current depression and anxiety symptoms, camouflaging autistic traits, and lifetime suicidal thoughts and behaviours. Multiple hierarchical regression explored whether autistic traits and camouflaging predicted defeat and entrapment. Logistic regression explored whether defeat and entrapment, and camouflaging, predicted lifetime suicidal thoughts. Serial mediation analysis explored whether the association between autistic traits and lifetime suicidality was significantly mediated by camouflaging, defeat and entrapment.

## Results:

After controlling for age, gender, current depressive and anxiety symptoms, autistic traits accounted for significantly more of the variance in defeat and entrapment (1.1%), and camouflaging accounted for a further 3.2% of the variance. After controlling for age, gender, current depression and anxiety symptoms, defeat and entrapment (but not camouflaging) accounted for significantly more variance in lifetime suicidal thoughts. However, the interaction between defeat and entrapment and camouflaging accounted for significantly more variance in lifetime suicidal thoughts than either variable alone. The association between autistic traits and lifetime suicidality was significantly mediated by camouflaging, defeat and entrapment.

Conclusions:

This is the first study to show that camouflaging autistic traits in order to fit in social situations, is associated with feelings of defeat and entrapment, and lifetime suicidal thoughts, as predicted by the IMV. Results are consistent with the interpretation that camouflaging autistic traits together with feelings of a failed social struggle (defeat) and that this situation will never change (entrapment), are particularly associated with increased risk of suicidal thoughts. This suggests that it is perhaps when social difficulties continue despite one's best efforts with a perception that this situation will never change, that particularly increases vulnerability to suicidal thoughts.

**315.004 (Oral)** The Role of Social Competence and Quality Interactions on Autism Stigma

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**Background:** One of the predominant factors contributing to autism stigma is the breakdown in social communication between that of an autistic individual and a typically-developing individual. As such, autistic individuals often have trouble navigating social environments. This often leads to the formation of both negative perceptions of, and discriminatory behaviours towards, autistic individuals by typically-developing individuals. Fortunately, research has demonstrated that quantity and quality of contact with autistic individuals may decrease autism stigma. However, the extent to which autism stigma is reduced is unclear. Further, it is unclear whether additional factors may also reduce autism stigma.

**Objectives:** The objective of this study is to assess whether a relationship exists between autism stigma and the following three variables: social competence, the level of contact with autistic individuals, and the quality of contact with autistic individuals.

**Methods:** Participants (N=242, Mage=18.48, SDage=2.60) were recruited from university and high school in British Columbia. Participants were asked to participate in the autism stigma task, designed by Sasson and colleagues (2017) where they rated ten second clips of autistic and non-autistic individuals auditioning for a game show. Participants were asked to rate the individuals in the video clips on various traits such as attractiveness and intelligence, as well as rate their (participants) own behavioural intentions and attitudes towards the individuals in the video clips such as their willingness to spend time with them. Following this task, participants were asked to fill out a series of questionnaires assessing their own social competence and their quality and level of contact with autistic individuals.

**Results:** Autistic individuals were rated more negatively overall on both traits ( $t(241)=-21.12, p<.001$ ) and behavioural intentions ( $t(241)=-16.3, p<.001$ ). Correlational analyses also indicated a significant relationship between autism trait stigma and social competence ( $r(240)=.2, p=.002$ ) but not autism trait stigma and quality of contact ( $r(240)=-.107, p=.100$ ). Additionally, a correlation was found between autism behavioural intention stigma and social competence ( $r(240)=.194, p=.003$ ), as well as autism behavioural intentions stigma and quality of contact ( $r(240)=-.182, p=.005$ ). There was no significant relationship between autism stigma overall and level of contact.

**Conclusions:** The positive relationship between social competence and both autism trait and behavioural intention stigma indicates that individuals who are more socially competent tend to have stronger biases against autistic individuals. This is likely due to the fact that individuals who are more socially competent are better at identifying social faux pas in other individuals. However, those who are higher in social competence tend to demonstrate higher levels of social motivation. Creating opportunities for these individuals to engage with autistic individuals may represent an effective way to reduce autism stigma. Additionally, given the significant relationship between quality of contact and autism behavioural intentions, interventions designed to decrease autism stigma should focus on creating environments wherein quality interactions between autistic and typically developing individuals can occur.

**POSTER SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL**

**Poster 401 - Adult Outcome: Medical, Cognitive, Behavioral, Social, Adaptive, Vocational Posters**

**401.001 (Poster)** "Realizing the Problem Wasn't Necessarily Me": An Exploration of the Meaning of Childhood Adversity and Resilience in the Lives of Autistic Adults

**Background:** Little is known about the influence of childhood adversity and resilience on children on the autism spectrum, despite evidence that they experience more adversity than their peers. The high incidence of adversity in the lives of children on the autism spectrum arguably influences their lifelong mental health and emotional well-being. Furthermore, the development and characterization of resilience in children on the spectrum is not understood. Therefore, to improve lifelong mental health outcomes among individuals on the autism spectrum, it is vital to understand how they experience adversity and resilience, and the role of these phenomena on their well-being.

**Objectives:** Interpretative phenomenological analysis (IPA) was used to understand the influence of childhood adversity on the well-being of adults on the autism spectrum, and the meaning of resilience in their lives. Specifically, we asked autistic adults to describe their experiences of childhood adversity, the impact of those experiences, and the characteristics and quality of resilience in their lives.

**Methods:** This study involved two phases. First, to align the study with the desires and perspectives of the autistic community, five advisors from the autistic and autism communities were consulted to ensure a rigorous research design. Their advice informed recruitment and data collection methods, and provided cultural understanding through which to conduct data analysis. Subsequently, four adult women, aged 19-27, diagnosed with autism prior to age 18, participated in semi-structured indepth interviews. Participants were offered several interview options based on their preference. Ultimately, data were generated through one recorded video interview, two recorded telephone interviews, and one online chat-based interview. Data were analyzed case by case and then across cases; participants' descriptions of their lived experiences were interpreted and synthesized thematically.

**Results:** Participants described childhood experiences which they viewed as significantly adverse, and ongoing and pervasive impacts of these experiences on their social, emotional, and mental well-being. Overall, adversity influenced 1) social disconnection, 2) emotional and mental health well-being, 3) development into young adulthood, and 4) sense of self. Despite negative childhood experiences, participants found resilience in places of refuge, both externally among attentive adults, accepting communities, and places to belong, and internally by engaging in interests, talents and imaginations; and from within their own identities, through self-understanding, determination, and a sense of pride. Finding resilience was meaningful for future growth and development, as participants described developing new social connections, the ability to adapt and change, and moving forward with their young adult lives.

**Conclusions:** By offering insights into childhood adversity, these findings increase awareness about the importance of considering childhood adversity in determining future directions for supporting the mental health of individuals on the autism spectrum. Also valuable are key findings about resilience and its role in autistic children and adults' ongoing well-being. This knowledge provides evidence and hope that the deleterious effects of adversity may be mitigated by promoting resilience-fostering experiences for children on the autism spectrum. These findings offer consideration regarding means to promote positive social, emotional, and mental health outcomes for individuals on the autism spectrum.

**401.002 (Poster)** A Comparison of Gender Differences in Self-Reported Camouflaging of Autistic Traits between Diagnosed Autistic, Autistic High-Trait and Non-Autistic Young Adults.

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**Background:**

Camouflaging is a term used to describe conscious or unconscious behavioural strategies used to enable a person to "fit in" with a specific environment or conform to social norms (Hull, 2017). Although it is known that everyone will camouflage at some point in their lives (e.g. during a job interview), evidence suggests that autistic individuals camouflage more than the non-autistic population. Other studies have claimed that autistic females are more likely to camouflage than autistic males (Jorgenson et al, 2020), and this may contribute to the under-diagnosis of autism in girls and women (REF).

Addressing several limitations of the current camouflaging literature as flagged by Fombonne (2020), this study includes non-autistic comparison groups and uses a systematically recruited and longitudinal sample.

**Objectives:**

This study aims to compare self-reported scores on the Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull et al, 2019) between diagnosed autistic (Dx), high trait (HT) and non-autistic groups (NA), and between genders.

Hypotheses include:

1. Females will have higher scores on the CAT-Q regardless of sample group
2. There will be group differences for individual subdomains (masking, assimilation, compensating) of the CAT-Q

Methods:

A total sample of 435 participants were recruited from the Social Relationships Study (SR Study), a population based twin cohort and the Gender Differences in Social Coping (G-DISC) study, an online survey study. The sample consisted of 35 Dx males, 43 Dx females, 89 HT males, 88 HT females, 49 NA males and 131 NA females. All participants were aged between 20-25 years and lived in the UK.

Participants completed an online survey which included the CAT-Q and the Social Responsiveness Scale (SRS). For the diagnosed group, formal autism diagnosis was confirmed by participant and their parent.

Results:

A two-way ANOVA revealed significant main effect of group, but not sex on CAT-Q total and all subdomain scores. Post-hoc analysis revealed for total score, and the compensation and assimilation subdomains, the Dx and HT groups were significantly different to the NA group but not each other (all  $ps < 0.001$ ). For the masking subdomain, HT groups had the highest scores and were significantly different to NA groups ( $p < 0.001$ ), but not Dx groups.

Conclusions:

Results indicate that people with high autistic traits camouflage their traits as much, if not more than, diagnosed autistic people. The increased rates of masking for the high trait group may be a barrier to diagnosis for some autistic people. Future directions for this work include exploring consequences associated with camouflaging such as loneliness and quality of life.

**401.003** (Poster) A Meta-Analysis and Critical Review of Metacognitive Accuracy in Autism Spectrum Disorder  
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**Background:** Metacognitive monitoring refers to awareness of our own mental states (Flavell, 1979). It is crucial for how we live our lives, and it underpins how we make sense of, predict, and control our own actions. There is a rich history of theorising about a potential link between metacognitive monitoring and mindreading (the ability to represent mental states in others). While some theories claim metacognition relies on the same cognitive processes as mindreading (Carruthers, 2009), others claim they rely on distinct processes (Nichols and Stich, 2003). Therefore, it is important for clinical practice and theory building to study metacognition in neurodevelopmental conditions, such as autism, which involve difficulties with mindreading.

**Objectives:** The aim of the current meta-analysis is to draw together all the research examining metacognitive monitoring accuracy in individuals diagnosed with autism to increase our understanding of the relationship between mindreading and metacognition, and to establish if individuals diagnosed with autism have difficulties with metacognition.

**Methods:** A literature search was conducted using Web of Science, PubMed and PsychInfo using the search terms “autism” AND “metacognition” for all articles published prior to June 2020. Eligible studies included participants of any age with a diagnosis of autism spectrum disorder and neurotypical controls. The tasks within the studies had to involve online explicit (i.e., verbal) metacognitive judgements and did not include any aspect that could result in improved metacognitive performance such as feedback or training. This resulted in a final sample of 17 independent studies with 20 different effect sizes.

**Results:** A total of 412 ASD and 453 NT control participants were included in the meta-analysis and a random effects model was used. The weighted effect size for the between-group difference in meta-monitoring ability was  $-.39$  (SE 0.14, 95% CI -0.69 to 0.08) and statistically significant,  $z = 2.67$ ,  $p < .01$ . This suggests a moderate impairment of metacognitive accuracy in ASD. However, the homogeneity test was significant ( $Q = 77.23$ ,  $p < .001$ ), indicating that the variance across the effect sizes was greater than expected by sampling error. The heterogeneity suggests that deficits in metacognitive accuracy may be domain

specific rather than domain general. A subgroup analysis showed that metacognitive task may explain some of this variability, other issues including the age of the samples and will also be discussed.

**Conclusions:** The meta-analysis suggests there is a moderate difference in meta-cognitive accuracy among those diagnosed with autism and neurotypical controls. However, further analysis showed that these differences may be domain specific. Implications of the results for both theory development and clinical practice will be discussed, as will other important issues that require consideration when interpreting case-control studies of meta-cognition in ASD.

#### **401.004 (Poster) A Novel Measure of Adaptive Functioning in Young Adults with ASD**

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#### Background:

While adaptive functioning, or one's ability to accomplish tasks necessary for independent life in society, has repeatedly been shown to be impaired in individuals with autism spectrum disorders (ASD), virtually all adaptive functioning measures are parent or self-report questionnaires. In this study, we implemented a more ecologically valid computer administered laboratory task called i-Function, which can be used to both assess and train adults in skills that are important for independence (e.g., using an ATM, buying Metro tickets, renewing prescriptions), and has been validated in older adults with mild cognitive impairment and schizophrenia (Harvey et al., 2020; Czaja et al., 2017). Two task modules from i-Function were pilot tested in a group of adolescents and young adults with ASD to determine if i-Function detects deficits in the ASD group compared to the typically developing group (TYP) and if it validly measures adaptive functioning.

#### Objectives:

1. Determine if this high-IQ ASD group performs more poorly than the TYP group on i-Function.
2. Validate i-Function in ASD by examining its associations with other self-report questionnaire and laboratory measures of adaptive functioning.

#### Methods:

Participants were part of a longitudinal study of ASD and brain development. 25 ASD (Age  $\mu$  = 20 years (2.8); FSIQ4  $\mu$  = 103(15)) and 25 TYP participants (Age  $\mu$  = 19 years (3.2); FSIQ4  $\mu$  = 110(10)) completed the preassessment portion of the ATM and Metro Ticket Machine modules, in which seven written scenarios prompted participants to operate a virtual machine designed to simulate a real world task. The number of errors and total time to completion were recorded. Autism diagnosis was confirmed using the Autism Diagnostic Observation Schedule-2 (ADOS-2) and the Social Communication Questionnaire (SCQ). Participants completed the Adaptive Behavior Assessment System, Self-Report (ABAS-3). The general adaptive composite (GAC) and Community Use subscale, which includes ATM use, are reported. The Maps Task (McLaughlin et al., 2016), another ecologically valid laboratory based adaptive functioning measure involving completing fictional errands, first developed for use in psychosis, was also administered.

#### Results:

Errors and time were averaged across the two modules. A Wilcoxon rank sum test revealed the ASD (median=5.5) group made significantly more errors than the TYP (median=3.5) group ( $z=3.04$ ,  $p<.01$ ), but time did not differ between groups (Fig. 1). In the ASD group, Spearman's correlations showed that higher ADOS severity scores, higher errors on the Maps task, lower Verbal IQ, and lower ABAS Community Use subscale scores were significantly associated with longer completion times. Higher average errors were associated significantly with lower ABAS GAC scores and Maps Task Capacity Scores (combines error rate and time) (Table 1).

#### Conclusions:

While the ASD group did not on average take longer to complete the modules, they made significantly more errors. Associations with scores on both the Maps and the ABAS-3 (a well-validated self-reported inventory) suggests i-Function does measure adaptive functioning. Future work should further investigate i-Function performance in those with lower IQs and determine if the

training portions improve performance in ASD.

**401.006 (Poster)** Adults with Autism Spectrum Disorder Show Steeper Age Relationships with Decreasing Amygdala Size: Sex Differences and Associations with Autism Symptoms

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**Background:** While abnormal amygdala volumes have been observed in various age groups of individuals with autism spectrum disorder (ASD), little research has explored how volumes change across the adulthood lifespan, whether men and women have different aging trajectories, and what changes in symptomatology coincide. Children with ASD have enlarged amygdala which reach neurotypical size around adolescence and becomes smaller in adulthood, suggesting the developmental arc in ASD is altered compared to neurotypicals (NTs). Amygdala sizes strongly correlate with anxiety and social symptoms in ASD, however it is still unclear if age-related changes in volume have consequences on these symptoms.

**Objectives:** In this cross-sectional study of adults ages 18-71 years, amygdala volumes in men and women with ASD (n=143) were examined and compared to aging trajectories in NT men and women (n=86). We also explored relationships between amygdala size and ASD and anxiety symptoms in adults with ASD.

**Methods:** Participants completed self-report measures for anxiety (State-Trait Anxiety Inventory, STAI) and ASD symptoms (Social Responsiveness Scale-2, SRS-2) and T1 MRI images were processed in FreeSurfer and amygdala volume estimations were corrected by total intracranial volume.

**Results:** A MANOVA for left and right amygdala volume revealed a significant three-way diagnosis-by-sex-by-age interaction ( $F(7,106)=2.147, p=0.045$ ). Post-hoc correlations showed a significant negative relationship between age and amygdala volume bilaterally for men with ASD (right:  $r(98)=-0.517, p<0.001$ ; left:  $r(98)=-0.481, p<0.001$ ) and in the right hemisphere for women with ASD ( $r(34)=-0.343, p=0.021$ ). Age correlations in this age range did not reach significance for NT men or women. Behavioral correlations showed relationships between amygdala volumes and SRS-2 subscales 'Awareness' (right hemisphere:  $r(128)=-0.187, p=0.034$ ), 'Cognition' (right hemisphere:  $r(128)=-0.291, p=0.001$ ; left hemisphere:  $r(128)=-0.261, p=0.003$ ), and 'Communication' (right hemisphere:  $r(128)=-0.207, p=0.019$ ) for adults with ASD. Surprisingly, there were no significant correlations with anxiety symptoms in adults with ASD.

**Conclusions:** These findings support a larger body of work which suggests an altered developmental arc in neuroanatomical structures in ASD and extend our knowledge by showing age-related volumetric changes in the amygdala are associated with ASD symptoms across the adult lifespan. Future work should seek to confirm these findings using longitudinal designs. Understanding age and sex effects may provide insights into the contribution of the amygdala in symptom presentation in ASD.

**401.007 (Poster)** Ageing on the Autism Spectrum: Mental Health and Quality of Life across the Adult Lifespan

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**Background:** Research in Autism Spectrum Disorders (ASD) has shown that mental health and physical health conditions are common in at least half of autistic adults. In the general population, poor mental health is known to adversely affect functional abilities and is a common contributor to poorer quality of life and greater social isolation. Stress and anxiety-related difficulties have substantial implications for the social, cognitive, and adaptive functioning of autistic individuals. Mental health and wellbeing are further adversely affected by intolerance of uncertainty, emotional aversiveness and difficulties identifying and interpreting emotions. Relatively little is known about how/if these conditions change or affect quality of life of autistic adults as they grow older. It is, therefore, crucial to consider the long-term effects of mental health conditions, and the implications for service provision to support autistic people across the lifespan.

**Objectives:** Aims: to find out how mental health and physical health conditions affect the quality of life of autistic adults in older age. Our objectives were to understand the extent of: (i) autistic traits, co-existing physical and mental health conditions between younger and older autistic adults; and (ii) their impact on everyday living and QoL.

**Methods:** We worked with a community group of younger (mean age 58.5 years, SD 7.6 years) and older adults (mean age 58.5 years, SD 7.6 years) across 4 years. Fifty-two autistic adults (6 F: 46 M; age 18-79 years) participated in the first study (Time 1); 28 (6 F: 22 M) took part in a follow-up (Time 2; mean retest interval 2.5 years). Participants completed standardised self-report

questionnaires of autistic traits (ADOS-2; SRS-2), mental health (anxiety, depression), physical health and QoL at both time-points.

**Results:** The reliable change index (RCI) was used to establish individual and group-level changes over time. At T1 and T2, over half of autistic adults experienced at least one co-existing condition, and over a third met criteria for 3+ conditions, including anxiety (74%), depression (69%), alexithymia (41%), sleep disturbances, and hypersensitivities (85%). Depression symptoms were particularly high in autistic women. Both younger and older adults reported the impact on their daily lives as “somewhat” to “very difficult”, but few had access to any health or social care supports. Mental health difficulties and autistic traits were strong and consistent predictors of poor QoL at Time 1 and Time 2, for both younger and older autistic adults.

**Conclusions:** Most autistic adults in the study experienced mental health difficulties from multiple co-occurring conditions. These conditions also persisted into older age and did not reduce over time. Findings also highlight reduced access to health and social care services for community-dwelling autistic adults. Further work is urgently needed to mitigate the long-term impacts of poor mental health for autistic adults, particular for individuals with complex co-occurring conditions. We suggest how individual differences in mental health and wellbeing – such as those between men and women at various life stages – could be explored in future work to support autistic adults as they grow older.

**401.008 (Poster) Aging and Autism: A Qualitative Exploration of Quality of Life in Older Age.**

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**Background:** Previous research has indicated that younger autistic adults report lower quality of life than non-autistic adults. Despite older age also being associated with lower quality of life in some respects, little is known about the experiences and influences of quality of life in older autistic adults.

**Objectives:** This study used semi-structured interviews to explore the factors that influence quality of life in both autistic and non-autistic older adults.

**Methods:** A total of 33 participants (autistic n = 15) aged 50 to 89 years were interviewed. Participants were asked a set of semi-structured interview questions covering a broad range of topics, including social connections, health, any recent personal life changes, environmental factors, support needs, and hobbies and interests. A final open-ended question asked about any other undiscussed factors that might influence their quality of life. Responses were thematically analysed, and group themes were compared to identify similarities and differences between the autistic and non-autistic groups.

**Results:** The autistic and non-autistic groups reported many similarities in their quality of life experiences; however, subtle differences were found. For both groups, family bonds and friendships were an important influence on quality of life. While both groups reported similar social network sizes that decreased with age, the non-autistic group were less satisfied with their social life throughout adulthood.

Health was also an important factor. Both groups expressed concerns about their physical health and sleep changing with age; however, the autistic group more often discussed mental health difficulties throughout adulthood and how this influenced their wellbeing now in older age. The autistic group also discussed their difficulties coping with change, and their sensitivities to environmental factors (e.g. noise) throughout their lives. These experiences were reported to often lead to burnout.

Acceptance was also a common theme related to age-related changes, with both groups frequently discussing the need to adopt support-seeking behaviours as they have aged. However, the autistic group expressed more willingness to ask for support when required, while the non-autistic group were often reluctant to ask for additional support, which was felt to represent a loss of their independence.

**Conclusions:** The findings of the current study highlight similarities and differences in aspects relevant to quality of life for autistic and non-autistic older adults. While the two groups shared many similarities, the autistic group experienced subtle differences in their lived experiences. These experiences - such as with social connections and coping with change – could be possible targets for increased support and intervention, which could improve the quality of life and experiences of older autistic adults.

**401.009 (Poster) Alexithymia, Autistic Traits, and Depression Predicts Poorer Quality of Life**

**Background:** Quality of life (QOL) has been extensively examined with autistic samples; findings often report that QOL is significantly lower for autistic people compared to general population norms. Relatively few studies have explored how autistic traits are related to QOL with general population samples. To the authors' knowledge, no studies have examined the role of alexithymia in predicted QOL alongside autistic traits; which is important because alexithymia predicts poorer QOL in general population samples and, alexithymia is more common in autistic samples than rates reported in the general population.

**Objectives:** To examine whether alexithymia predicted QOL in addition to autistic traits. Moreover, to test whether an interaction effect between autistic and alexithymic traits (such that the effect of alexithymic traits on QOL would be greater with higher levels of autistic traits) was supported.

**Methods:** A total of 163 responders completed our survey. Participants were aged between 18 and 72 (mean age=31.9, SD=13.1); there were 41 males (25.2%), 109 females (66.9%), and 13 (7.9%) who reported some other gender identity. There were 141 autistic participants (86.5%), only 13.5% (N=22) of the sample reported having no diagnosis, nor did they self-identify as autistic. Participants provided demographic information (e.g. employment) and completed the Autism Quotient-10 (AQ-10), Toronto Alexithymia Scale (TAS-20), Patient Health Questionnaire-9 (PHQ-9), Generalised Anxiety Disorder-7 (GAD-7), World Health Organisation Brief QOL (WHOQOL-BREF) measure, and the Autism Specific QOL (ASQOL) measure.

**Results:** As expected, each QOL domain (Physical, Psychological, Social, Environment, Autism Specific) were significantly inter-correlated (rs ranged from .42 to .71). AQ-10, TAS-20, PHQ-9, and GAD-7 scores were all significantly negatively correlated with all QOL domains (neither AQ-10 nor TAS-20 scores correlated with Environment QOL) with rs ranging from -.35 to -.77. Physical, Psychological, and Social QOL was negatively predicted by PHQ-9 score. AQ-10 was a significant predictor of these domains in subsequent models, these models did not explain a significantly greater amount of variance. Planned analyses with just AQ-10 and TAS-20 scores (plus their interaction) revealed that both AQ-10 and TAS-20 scores predicted Physical and Psychological QOL (accounting for 22% and 26% of the variance, respectively); neither predicted Social or Environment QOL. A MANOVA analysis revealed that, whilst diagnosis was a significant main effect, the groups only significantly differed on Physical QOL (those in the diagnosed group reported significantly lower QOL). No analyses identified a significant interaction between autistic traits and alexithymic traits.

**Conclusions:** This study found that, whilst considered in isolation, alexithymic traits and autistic traits significantly predict some QOL domains (Physical and Psychological QOL). However, depression appears to attenuate this relationship. Thus, it seems that, when considered dimensionally, depression has a bigger effect on QOL than either autistic traits or alexithymic traits. However, when examining those low in PHQ-9 scores but high in TAS-20 scores, correlation coefficients between QOL domains and TAS-20 scores increased. This may suggest that alexithymia is still an important factor pertaining to QOL for those with low depression scores. Future research, with larger samples, may shed more light on this potentially important finding.

**401.011 (Poster)** An Exploration of Caregiver-Reported Strengths and Challenges of Adults with Autism and/or Intellectual Disability

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**Background:** It is essential to acknowledge that individuals develop new skills throughout childhood and into adulthood (Bal et al., 2018). Yet, aside from savant skills, there is limited autism research exploring strengths in adults. While two studies interviewed autistic participants and parents on personal strengths, they limited ages to 16-22 years (Carter et al., 2015; Teti et al., 2016). Samson and Antonelli surveyed autistic adults (18-58 years) on several character strengths but focused analyses on humor (2013). More research is needed to advance understanding of strengths and positive qualities in autism. A better understanding of an autistic individual's strengths can inform education, treatment and employment (Kapp, 2018; Riosa, 2017) and foster well-being (Diener et al., 2015; Lanau et al., 2012).

**Objectives:** 1) To examine what themes emerge when caregivers of adults with autism and/or Intellectual Disability (ID) are given open-ended prompts querying the strengths and challenges of their adult child. 2) To explore the associations between number/type of strengths and challenges and other individual characteristics.

**Methods:** Participants were 68 individuals ranging from 15 to 30 years old with diagnoses of ASD-only (52.9%), ASD+ID (20.6%), or ID-only (26.5%; see Table 1). Qualitative analysis of two open-ended questions from the CBCL/ABCL were used to

identify strengths and challenges: “Please describe the best things about him/her,” and “What concerns you most about him/her?” Seven themes emerged for strengths (sociability, personality characteristics, community participation, interests or activities, work ethic and motivation, specific skills and other) and five for challenges (social, independent daily living skills, future concerns, health/mental health and other; Table 2).

Results: Almost all individuals had at least one reported strength ( $n=66$ ; 97%) and challenge ( $n=62$ ; 91%). Groups did not differ on number of positive qualities ( $F(2,65)=0.19$ ,  $p=0.83$ ) or challenges ( $F(2,65)=1.99$ ,  $p=0.15$ ).

Personality characteristics, such as kind, positive, humorous, were the most commonly reported strength for all groups. Sociability was next most common for the ASD-only and ID-only groups. No demographic or clinical characteristics were associated with number of strengths. Work ethic and motivation were associated with older age ( $t(64)=-2.09$ ,  $p=0.04$ ) and specific skills with higher nonverbal IQ ( $t(63)=-2.27$ ,  $p=0.03$ ). Those with reported positive personality characteristics had higher ADI-R RRB scores ( $t(59)=-2.30$ ,  $p=0.03$ ).

The most frequently reported challenge for the ASD-only group was independent daily living skills, while social challenges were most commonly reported for both the ASD+ID and ID-only groups. Number of caregiver-reported challenges was associated with ABCL/CBCL Total Problem domain score ( $r=.33$ ,  $p=.01$ ).

Conclusions: The majority of caregivers in each of the three groups reported both strengths and challenges for their adult child, highlighting the need to assess strengths in individuals across the ability range. Themes identified were similar to previous studies of younger samples, with personality characteristics the most commonly reported strength. Somewhat surprisingly, sociability was also commonly reported. Further understanding of individual strengths in adults with ASD and/or ID is important to build supports and foster well-being. Future studies must incorporate autistic adults’ perspectives on their own strengths.

**401.012 (Poster)** Assessing Theory of Mind in Young Adults Who Have Lost the ASD Diagnosis Using the Social Attribution and Reading the Mind in the Eyes Tests

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Background: The ability to infer others’ mental states and intentions, known as theory of mind (ToM), shows delayed development in autism spectrum disorder (ASD). ToM has implications for social relationship skills (Bauminger et al., 2010). Some individuals diagnosed with ASD in early childhood later lose their diagnosis; by adolescence, they display no or minimal symptoms of ASD, and their language and social abilities are generally indistinguishable from those of typically developing (TD) peers (Fein et al., 2013). When assessed at 5-9 years, children with this ‘loss of autism diagnosis’ (LAD) outcome showed subtle ToM deficits (Kelley et al., 2006). This study evaluates ToM abilities in young adults with LAD, compared to peers with ASD or typical development (TD). The Social Attribution Test (SAT) assesses the ability to attribute intentionality and mental states to geometric shapes in a silent animation by answering 19 multiple-choice questions. Individuals with ASD perform less accurately on the SAT (Burger-Caplan et al., 2016). The Reading the Mind in the Eyes Task (RMET) probes emotional theory of mind by asking participants to select an emotion label to describe 36 facial displays (eyes only) of mental states. The RMET task differentiates ASD and TD, and performance is inversely related to autistic traits in TD individuals (Baron-Cohen et al., 2001).

Objectives: We compared SAT and RMET performance among individuals with LAD, ASD, and TD, and evaluated associations with verbal abilities.

Methods: Participants were adolescents and young adults with a history of LAD ( $n=9$ ), ASD ( $n=10$ ), or TD ( $n=17$ ), ages 18-23 (Table 1); data collection, interrupted by COVID-19, is ongoing. Measures, administered via Qualtrics, included the SAT, RMET, and estimates of nonverbal IQ [Computerized Ravens Progressive Matrices (CRPM); Gur et al., 2001] and verbal abilities [Verbal Reasoning Task (VRT); *ibid*]. Many TD participants participated during a prior study; VRT or CRPM data were unavailable for this subset.

Results: A one-way MANOVA revealed group differences on RMET and VRT, but not SAT or CRPM; Table 1. Post-hoc t-tests showed that REMT scores were higher for LAD versus ASD groups; the LAD>TD group difference approached significance. VRT scores were significantly lower in ASD compared to LAD and TD groups. RMET and VRT were correlated for the LAD group only,  $r(DF)=.78$ ,  $p=.02$ .

Conclusions: Results suggest that young adults with LAD outperform those with current ASD on an emotional ToM task (and were non-significantly more accurate than TD controls). Contrary to previous reports (Burger-Caplan et al., 2016), groups did not differ in the less-verbal intention attribution SAT task. The results are preliminary and underpowered, given small current sample sizes, but in contrast to previous reports of residual ToM deficits in children with LAD (Kelley et al., 2006), our results indicate age-appropriate emotional ToM skills in young adults with LAD, potentially reflecting superior knowledge of emotional vocabulary words. Next steps will compare cognitive (e.g. contemplative, reflective) versus affective (e.g. upset) RMET labelling across groups, to test the hypothesis that individuals with current ASD will show relatively more difficulty in identifying emotions as compared to cognitive states.

**401.013 (Poster)** Associations between Social Communication Difficulties, Genetic Risk of Autism and Adult BMI in a Population-Based Cohort

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Background:

Overweight and obesity in adulthood are risk factors for adverse health outcomes such as cardiovascular diseases and cancers. In previous studies, autism has been associated with elevated BMI in childhood, adolescence, and adulthood. However, many of these studies are limited by cross sectional designs, recruitment of selected clinical samples, and lack of a control group.

Early puberty is associated with adult overweight and obesity. Early onset of puberty itself is associated with childhood BMI. It is not known whether autistic adolescents are more likely to experience early puberty and whether this increases their risk of being overweight/obese in adulthood.

Objectives:

1. Assess the associations between genetic liability to autism and the phenotypic expression of autism as social communication difficulties on adult BMI in a large, prospective longitudinal birth cohort.
2. Assess whether differences in pubertal growth mediate associations of interest.

Methods:

Genotypic and phenotypic data were from child participants in the Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort study, United Kingdom. The latest autism GWAS summary statistics data were used to construct standardized, weighted polygenic risk scores (PRSs) at 12 p-value thresholds. Pronounced social communication difficulties (SCDC) identified at age ~7.5 years, and PRSs were exposures of interest. BMI at age ~25 years was the outcome of interest.

Seven repeated measurements of height spanning from 9 to 20 years were included in sex-specific longitudinal analysis. We used Super Imposition and Translation and Rotation (SITAR) to derive age at peak height velocity (APV) and peak height velocity (PV) which quantify individual-level differences in pubertal growth.

Multivariable regression was used to assess whether there were associations between the autism-related exposures and adult BMI. PRS analyses were adjusted for 10 genetic principal components whilst non-genetic analyses were adjusted for socioeconomic measures, maternal age, total gestational weight gain and pre-pregnancy BMI. We performed mediation analysis with APV and PV within a Structural Equation Modelling framework.

Results:

The sample size was up to 3,055 in analyses. Social communication and genetic risk for autism were associated with higher adult BMI in the combined sample (SCDC: mean difference  $\beta$  1.10 [95% CI 0.37, 1.82];  $p=0.003$ ; PRS: standardized difference  $\beta$  0.26 [95% CI 0.08, 0.44];  $p=0.004$ ). These associations are driven by associations observed in males. The relationship between social communication and elevated adult BMI in males was not mediated by APV or PV (indirect effect of APV: mean difference  $\beta$  0.07 [95% CI -0.15, 0.28];  $p=0.54$ , and PV:  $\beta$  0.04 [95% CI -0.09, 0.17];  $p=0.55$ ). However, there was strong evidence that the association between genetic risk of autism and elevated adult BMI was mediated by onset of rapid pubertal growth (indirect effect of APV: standardized difference  $\beta$  0.15 [95% CI 0.08, 0.22];  $p<0.001$ , and PV:  $\beta$  -0.05 [95% CI -0.06, -0.002];  $p=0.07$ ).

## Conclusions:

Adults with genetic risk of autism and pronounced social communication difficulties are at risk of elevated BMI. The association of autism genetic risk with elevated adult BMI is partially mediated by earlier than average pubertal onset.

**401.015** (Poster) *Autistic-Led Post-Diagnostic Peer Support for Adults: A Qualitative Examination of Community Priorities.* **C. J. Crompton<sup>1</sup>, S. Hallett<sup>2</sup>, A. C. Stanfield<sup>1</sup> and S. Fletcher-Watson<sup>3</sup>, (1)Division of Psychiatry, University of Edinburgh, Edinburgh, United Kingdom, (2)Autistic Mutual Aid Society Edinburgh, Edinburgh, United Kingdom, (3)Salvesen Mindroom Research Centre, University of Edinburgh, Edinburgh, United Kingdom**

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**Background:** Diagnosis in adulthood can be a life changing event, impacting identity, relationships, and mental health. The lack of post-diagnostic support has been highlighted by autistic adults, the families of autistic people, clinicians, and service providers. The unavailability of post-diagnostic support can be a source of distress for autistic adults, reinforcing feelings of social isolation and rejection.

Peer support may be a cost-effective, flexible and sustainable model to provide community-based support for autistic adult. Research has found that social interaction improves autistic people's mental health, and that interactions with other autistic people may be particularly effective: autistic adults have described interacting with other autistic people as comfortable, fulfilling and validating. Self-acceptance and pride in being neurodivergent is linked to lower depression scores, and feeling part of an autistic community is related to lower suicide risk. However, there is little evidence base for peer support for autistic adults, despite calls for peer support research from the autism community.

**Objectives:** The first step to creating a post-diagnostic peer support framework is to identify what autistic adults would want from peer support. This qualitative research explored autistic experiences and needs post-diagnosis, identifying the specific ways that peer support may benefit them, and exploring the limitations of peer support.

**Methods:** Twelve autistic adults (4M, 1 NB; age mean = 45, range 30-66) completed a semi-structured interview specifically developed by the research team in consultation with autistic collaborators, which focused on the diagnostic experience, post-diagnostic support needed and provided, engagement with the autistic community, and post-diagnostic peer support. All participants had received an autism diagnosis in adulthood through the NHS between 2-10 years prior. Hour long interviews were conducted in person, via skype, or phone.

**Results:** Thematic analysis of interview transcripts resulted in four themes extracted from the data:

- **Mismatch in post-diagnostic support needed and provided:** currently, services do not meet the needs of autistic adults post-diagnosis. Support should involve advocacy, strategies for wellbeing, and communicating with non-autistic people. Autistic-led peer support could offer unique insights and methods of support that are currently not being offered.
- **Community connection:** engaging with other autistic people enhances self-understanding, reduces internalised stigma and ableism, and builds connections with others.
- **Flexible and personalised support:** peer support offers a flexible way to meet the needs of autistic people over time which may vary between and within individuals, for example 1:1 or group support, online or in person, covering a variety of issues and topics.
- **Sustainability:** to ensure peer support is sustainable, training, payment and supervision for peer facilitators is essential, alongside administrative support and secure long-term funding. It is important to recognise the boundaries and limitations of peer support and acknowledge that autistic adults may require additional support from other healthcare providers including mental health care.

**Conclusions:** Peer support may be a useful mechanism to support autistic adults post-diagnosis, and offers unique opportunities not available through other support channels. Though informal peer support exists, participants felt it could be more sustainable and effective if well-supported and funded.

**401.016** (Poster) *Being an Autistic Parent : Benefits and Challenges* **M. Désormeaux-Moreau<sup>1</sup>, V. Rochon<sup>2</sup>, S. Powell<sup>3</sup>, M. H. Poulin<sup>3</sup>, C. L. Normand<sup>4</sup>, E. Héroult<sup>5</sup> and M. Couture<sup>6</sup>,** (1)École de réadaptation, Université de Sherbrooke, Sherbrooke, QC, Canada, (2)Université de Sherbrooke, Sherbrooke, QC, Canada, (3)Psychoéducation, UQAT, Rouyn-Noranda, QC, Canada, (4)Psychoéducation et psychologie, Université du Québec en

**Background:** As researchers increasingly investigate autistic adults' experience, varieties of roles need to be addressed, exceeding those of employees or workers that have been studied until now. Very few studies have looked at the reality associated with the role of parents, as experienced by autistic adults (Pohl et al. 2020). Two focussed on motherhood - more specifically, on pregnancy and childbirth (Donovan 2017; Gardner et al, 2016), while others were interested in satisfaction with parenthood (Lau & Peterson, 2010) and parenting efficacy (Lau, Peterson, Attwood, Garnett & Kelly, 2016). It is only recently that the experience of raising children was investigated by Pohl et al. (2020).

**Objectives:** To explore (1) the benefits and (2) the challenges of being an autistic parent from the perspective of mothers and fathers with ASD.

**Methods:** This study was part of a broader study on social participation, by autistic adults in Quebec, Canada (n= 316). Participants (16-40 years old) answered an online survey about their life habits and social roles, within the theoretical framework of the Disability Creation Process (Fougeyrollas et al., 2010). Four open-ended questions pertained to parenthood and answers were analyzed through an inductive content analysis (Mucchielli, 2006). Data were independently co-coded and validated by three authors and subdivided into categories and sub-categories as the analysis progressed.

**Results:** A sample of 47 participants answered the questions related to parenting, most of those being mothers (89%) over 31 years old. Five participants stated being fathers. Participants were parents of one child (30%), two (34%), three (23%) or four or more children (13%). Nearly two-thirds (64%) of the parent sample reported having at least one autistic child. Participants related the benefits of being an autistic parent to personal characteristics as well as the creation of a strong emotional bond with the child, especially when he was also autistic. The experience of being an autistic parent was associated with: 1) an opportunity to access and apply knowledge; 2) an understanding of the child(ren)'s needs; 3) an ease to foster and support one's child(ren)'s development; 4) an inclination toward unconditional acceptance of one's child(ren). On the other hand, participants reported challenges of being an autistic parent. The parent's as well as the child's personal characteristics were stated, but more importantly, environmental factors were described as challenging. These referred to: the management of: 1) emotions; 2) energy; 3) everyday family life; as well as to 4) communication and social interactions; 5) understanding and responding to the family's needs; 6) lack of appropriate support; 7) negative perception of one's parental ability by others; as well as that perception's impact on 8) one's sense of parenting competence.

**Conclusions:** Being a parent can be challenging for everyone at times. Indeed, most of the participants mentioned challenges that are similar to those experienced by non-autistic parents. However, the benefits are different due to the shared reality and experience of autistic parents and their autistic child(ren). This study provides a new and unique insight into the lived experience of autistic adults.

**401.017 (Poster) Biology Interrupted: How Autistic Adults Develop Anxiety through an Intolerance of Uncertainty Framework**  
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**Background:** Recent studies have suggested that at least 20.1% percent of autistic adults have a co-occurring anxiety disorder, compared to around 8.7% of neurotypical adults. Models of the overlap of anxiety in autistic adults have proposed relationships between autistic traits, including restricted interests and repetitive behaviors and atypical sensory processing alongside alexithymia and intolerance of uncertainty (IU). Several models have focused on the role of IU, which has biological and evolutionary bases, as a cognitive explanation for the high prevalence of anxiety in autism. This framework suggests that all people are born with a healthy level of intolerance of uncertainty, and as we develop, this intolerance is lessened as we learn when situations are safe and begin to understand and manage the uncertainty.

**Objectives:** To examine the competing models regarding the relationships between intolerance of uncertainty, atypical sensory processing, anxiety, and autistic traits in a sample of autistic and neurotypical adults.

**Methods:** Data from a group of 254 adults (55 autistic, 199 neurotypical) were examined. We report the data for the two groups combined, as regression plots of the means of the groups showed no significant differences in slope between groups. We conducted two path analyses. The first model tested the idea that disruptions in intolerance of uncertainty, as an evolutionary phenomenon common for all people, could explain some of the cognitive aspects of anxiety in autism. This model suggests that

intolerance of uncertainty increases sensory sensitivity and sensory seeking behaviors, which then add to feelings of anxiety, which may together contribute to some core autistic traits. The second model suggests that primary neurodevelopmental differences associated with autistic traits underlie the sensory sensitivity and sensory seeking behaviors, which in turn increase intolerance of uncertainty and subsequent anxiety.

Results: The “biological uncertainty” model, with intolerance of uncertainty at the beginning of the model, had poor fit,  $\chi^2(2) = 31.22$ ,  $p < .001$ ; RMSEA = .24; CFI = .93 (see Figure 1a). The “neurodevelopmental” model, with autistic traits at the beginning of the model, had much better fit,  $\chi^2(2) = 5.58$ ,  $p = .06$ ; RMSEA = .08; CFI = .99 (see Figure 1b).

Conclusions:

Discussion: These results suggest that the neurodevelopmental impact of higher levels of autistic traits could moderate a neurotypical trajectory of learning to manage uncertainty as children develop and understand that uncertainty is common and acceptable. For adults with higher levels of autistic traits and atypical sensory processing, uncertainty is frightening and leads to elevated levels of anxiety.

**401.018** (Poster) COVID-19 Effects on the Transition Support Networks of Autistic Young Adults and Their Parents  
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Background: The COVID-19 pandemic has greatly impacted people’s social networks, due to lock-downs, school closures and restricted interactivity due to social distancing and other preventative measures. Autistic youth who were experiencing transition during the COVID-19 pandemic potentially faced severe restrictions on their transition engagements, due to reduced or revoked access to services (Manning, Billian, Matson, Allen, & Soares, 2020). In non-pandemic conditions, many autistic youth experience poor outcomes post-secondary school. Over 66% of young adults on the autism spectrum are disconnected from opportunities for work or schooling in the first few years after high school, especially low-income young adults on the spectrum (Shattuck et al., 2012). They experience a “service cliff”(Shattuck et al., 2012) which often includes disruptions in access to needed supports as they age out of eligibility for school-based and pediatric care. We conducted a preliminary analysis to investigate if COVID-19 impacted transition support networks of autistic young adults and their parents.

Objectives: To investigate changes in transition support network contact during COVID-19 for autistic youth and their parents.

Methods: A social network survey was conducted with autistic youth (N=22) and their parents (N=22), where they were asked to name transition supporters and changes in their interactions during COVID-19. A multi-level ordinal linear regression was fit to predict change in frequency of interaction for the young adults and their parents in our sample. Sociograms were configured for each youth for visual analysis of network structure and COVID-19 related changes in contact.

Results: Analysis of COVID-19 network data demonstrated that approximately 1% of connections for young adults and 2.4% of connections for caregivers were developed post-COVID-19 outbreak. A dependent samples t-test between parents and young adult networks was used to compare the mean change in contact,  $t(19)=.967$ ,  $p=.350$ . This shows that even though parents on average had a 7.5% lower network frequency contact, there was no significant difference in their frequency in contact with their networks after COVID-19. Among alters (people named as supporters in the youth or parent transition network), family members and cohabitators showed significantly more contact while community members and professionals showed decrease in contact (Figure 1).

Additionally, we created a sociogram visualizing each young adult’s social network to qualitatively investigate the location of people in the network who increased, decreased or stayed the same during the first three months of the COVID-19 pandemic. Figure 6 illustrates the sociogram of one of our autistic young adult participants, suggesting that the most central people in the young adult’s network were family members and increased in contact with others in the youth’s transition support network. The central people in the youth’s network were also connected to professionals and educators who decreased in contract with the youth during COVID-19 (Figure 2).

Conclusions: We provide preliminary evidence suggesting that expanding networks and maintaining contacts with professionals during the COVID-19 pandemic is limited. Longitudinal data and future non-COVID-19 impacted cohorts will establish necessary comparisons. Further investigation of the role that central people play in transition support networks for autistic youth.

**401.019** (Poster) Camouflaging in Autistic Adults: A Qualitative Study Exploring Camouflaging Onset, Continuity, Change over Time and Psychosocial Influences

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**Background:** Some autistic people have developed strategies over time to mask underlying autism-related neurocognitive, social/communication and/ or behavioural differences in order to achieve goals such as establishing and maintaining social relationships, seeking and maintaining employment, or accomplishing daily tasks for independent living within predominantly non-autistic societies. These strategies have come to be known as social camouflaging. To date, most research on camouflaging has been conducted with autistic adults, but there is emerging observational and qualitative evidence that autistic children and adolescents also engage in camouflaging. Camouflaging in autistic children has also been implicated as one plausible explanation for why many autistic adults, especially women, may be missed in childhood and only diagnosed later in life. Indeed, autistic adults have described camouflaging as a “lifetime of conditioning, [training] to act normal”, involving “years of effort and practice”, suggesting that camouflaging occurs over the autistic person’s lifespan. Yet, little is so far known about the onset, course, continuity and changes in camouflaging behaviours over autistic people’s lives. Furthermore, though recent research suggests that autistic people’s motivations to camouflage may evolve over time, along with the strategies they employ, no study to date has explicitly explored the psychosocial factors that may influence these trajectories over time.

**Objectives:** In an exploratory qualitative study interviewing autistic adults in depth about their life experiences in relation to camouflaging, we aimed to understand when and why autistic adults begin to camouflage, how their motivations change or remain the same over time, how their strategies dynamically evolve over time and what individual and social factors may influence or explain continuity and change in their camouflaging motivations and strategies.

**Methods:** Eleven Singaporean autistic adults (aged 22-45 years) participated in an in-depth semi-structured individual interview with (i) questions relating to participants’ earliest memories of camouflaging; and (ii) questions on how participants’ camouflaging has remained the same, or changed and developed over time at different periods in their lives. Braun and Clarke’s (2006) six phases of reflexive thematic analysis were applied to all interviews, with data analysed inductively and themes identified semantically and explicitly.

**Results:** Two core themes (camouflaging motivations; camouflaging strategies) and 34 subthemes were identified and organized into four developmental phases of camouflaging, namely (i) pre-camouflaging, (ii) origins, (iii) continuity and (iv) change. We found that the earliest motivations to camouflage were relational, and linked to the development of a negative self-identity after experiencing repeated negative social sanctions from others. Overall, the autistic adults reported their camouflaging strategies increasing in complexity over time, and becoming better integrated to one’s sense of self. They also described learning to camouflage selectively over time, with some opting for disclosure of their condition and needs in some contexts.

**Conclusions:** These findings highlight the role of social pressure and experiences triggering the motivation for and onset of camouflaging. They also emphasize the need for individual psychological and societal-level changes from pathologizing and stigmatizing autistic differences towards acceptance and inclusion, in order to alleviate pressure on autistic youth and adults to camouflage.

**401.021** (Poster) Combining Statistical Approaches to Capture Age-Related Cognitive Differences in Autistic Adults

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**Background:** Cognitive aging in autistic adults has become of increasing interest in autism research. Whilst our first high-powered study (Lever & Geurts, 2016) on age-related cognitive effects showed largely parallel (similar) aging, and even protective (less) aging, other studies have found contrasting results. Therefore, we conducted a follow up study to determine which findings will be replicated in an independent sample.

**Objectives:** (1) We hypothesize to replicate our previous findings of mostly parallel or protective aging in several separate cognitive domains (2) Furthermore, we explore whether using a multivariate approach (multivariate normative comparisons; MNC) would enable us to detect differences on an individual level which would typically remain undetected.

**Methods:** We combine the methods of two pre-registered analyses plans (#28816 and #40091 on AsPredicted.org). In a sample of 87 autistic adults and 106 non-autistic comparisons (age range: 30-85 years), we first assess group differences and its interaction

with age on six different cognitive tasks (visual and verbal memory, working memory, generativity, theory of mind (ToM) and processing speed). After which we combine data from the previous, and current study ( $N_{TOT} \sim 423$ ,  $N_{ASC} \sim 198$ ) to perform MNC.

Results: Preliminary results indicated worse performance for the ASC group on verbal memory, generativity, and ToM ( $p < .05$ ), however only the latter survived multiple comparisons corrections ( $p < .01$ ). Worse performance was associated with older age for processing speed, and verbal- and visual memory. No age x group interactions were observed, thus we did not replicate certain protective aging effects (i.e. ToM, visual memory). Due to delays caused by the COVID-19 pandemic, results from the second part are yet to be analysed and will be presented at INSAR 2021. However using MNC in a subsample, we detected a distinct group of 26 out of 111 autistic individuals (23.4%) with a deviant cognitive profile, compared to a group of only 3 out of 118 (2.5%) in the comparison group.

Conclusions: Even though group-based statistics do not give much evidence for altered age-related effects in ASC adults, MNC showed that there might be a systematically lower performing group within the ASC sample.

#### **401.022 (Poster) Community Participation in Autistic Young Adults**

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Background: Many autistic adults experience poor postsecondary outcomes, including limited community and social participation (Roux et al., 2017). Participation in community activities declines as high school students transition into adulthood (Myers et al., 2015). Identification of barriers to participation from multiple reporters may identify essential targets for developing services and programs to promote community participation.

Objectives: The objectives of this study were to (a) describe community participation in young autistic adults who have recently exited high school, (b) compare community participation from self and parent reports, (c) examine barriers to participation, and (d) examine differences among participation patterns by biological sex, income level, and race and ethnicity.

Methods: Participants included 160 autistic adults ages 17-25 ( $M = 20.31$   $SD = 1.61$ ). 83.5% of the sample identified as Male, 15.8% as Female, and .70% as Nonbinary, and 69.8% were White. Young autistic adults and parents each completed the Adolescent and Young Adult Activity Card Sort (AYA-ACS; Berg et al., 2015) by identifying a) the activities the young adult engaged in during the previous six months, then b) if the activities not engaged in were of interest and c) if so, the barriers to participation. The AYA-ACS uses photographs to capture participation in 63 everyday life activities in 6 domains (chores, leisure, social, health, education, and work) and has demonstrated reliability in autistic adults without intellectual disability (McCullum et al., 2016). A paired-samples t-test was used to compare total participation between self- and parent-reports. Nonparametric statistics were used across participation domains to examine participation profiles, compare reporters, and evaluate group differences.

Results: Young adults ( $M = 44.12$ ,  $SD = 9.50$ ) reported a higher number of activities than parents ( $M = 41.48$ ,  $SD = 9.88$ ),  $t(83) = 2.34$ ,  $p = .02$ . Figure 1 shows participation frequencies. Wilcoxon Signed Rank Tests showed that autistic adults and parents reported similar frequency of chores, health and wellness, education and learning, and work. Young adults reported more social activities,  $z = 3.54$ ,  $p < .001$ , and leisure activities,  $z = 2.74$ ,  $p = .01$ , than parents. Young adults and parents reported that autistic adults were most interested in going on a date and being in a long-term relationship. Young adults also reported wanting to learn to drive. Young adults and parents reported a similar number of overall barriers but differential types of barriers. Young adults were more likely to report that they were not able to (e.g., no transportation, no opportunity, others do it for them),  $z = 3.84$ ,  $p < .001$ , and parents were more likely to report it made the young adult uneasy (too crowded, environmental sensitivities, anxiety),  $z = 3.47$ ,  $p = .001$ , and that they needed support from others,  $z = 2.22$ ,  $p = .03$ . Types of barriers differed by racial and ethnic groups and income but not biological sex.

Conclusions: Young autistic adults and their parents report a range of participation in activities following high school. Differential patterns of barriers among reporters highlight the importance of including self-report of community participation in autistic adults. Romantic relationships and transportation were identified as important areas to target barriers to support participation. Targeting preferences and barriers may lead to increases in community participation outcomes for autistic adults.

#### **401.023 (Poster) Comparing Fitness Levels of College Students with and without Autism Spectrum Disorder**

Background:

Young children and adolescents with the Autism Spectrum disorder (ASD) demonstrate a lifestyle with high levels of sedentary behavior and low levels of physical activity (Memari & Must, 2013; 2014). While the information on children and adolescents with ASD is vast, the literature does not demonstrate whether these behaviors continue into young adulthood and the college years. Researchers suggest that poor motor skills, social skills impairments, and sensory challenges may contribute to low levels of physical activity (Curtin & Zuckerman, 2014) and that these challenges may be barriers to engaging in regular physical activity. Regular participation in physical activity is a key indicator of good health, therefore it is important to assess physical activity and fitness levels in young adults with ASD. The purpose of this study is to compare the fitness levels of college students with and without ASD.

Objectives:

The purpose of this study is to better understand health-related fitness in college students with ASD.

Methods:

Twenty college students with and without ASD between the ages of 18-30 years were recruited for the study (7 males, 3 females without ASD; 7 males, 3 males with ASD). Participants were matched based on sex and age. Informed consent and the Physical Activity Readiness Questionnaires (PAR-Q) were signed by all participants. Participants performed fitness testing, which included aerobic fitness (VO<sub>2</sub> Max), muscular strength and endurance (push-ups and sit-ups), and flexibility (sit-and-reach). Fitness variables were analyzed with an independent sample *t*-test.

Results:

A comparison of estimated VO<sub>2</sub> max using an independent sample *t*-test revealed a statistical significance difference between college students without ASD ( $M = 48.94$ ) and college students with ASD, ( $M = 37.15$ ,  $p = .012$ ). There was also a statistically significant difference in the number of completed push-ups between the group without ASD ( $M = 11.60$ ) and the group with ASD (Mean = 25.6,  $p = .007$ ). There was no significance in the number sit-ups completed and the sit-and-reach test.

Conclusions:

These results suggest that college students with ASD have poor cardiorespiratory fitness and less upper body muscular strength than college students without ASD. This provides a basis to begin to understand health disparities and create evidence-based physical activity interventions for college students with ASD.

**401.024 (Poster)** Comparison of Age of Diagnosis and Sex Differences in Parent Report of Autism Characteristics  
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Background: One of the most consistent differences reported in the literature is that many females with autism spectrum disorder (ASD) are diagnosed later than males, leading to missed opportunities for early supports which have been associated with better outcomes. It is therefore critical that researchers and clinicians alike understand diagnostic expression in females as early as possible. Conflicting results have emerged in studies examining sex differences in ASD diagnostic profiles. Zwaigenbaum et al. (2012) found that females showed slightly fewer ASD symptoms using the Autism Diagnostic Interview-Revised (ADI-R: LeCouteur Lord, & Rutter, 1994), while Koenig and Tsatsanis (2005) emphasized that even the gold standard diagnostic instruments are not sensitive enough to the differences in presentation of ASD in females and males. Lai et al. (2019) found that girls tended to be more interested in other people and imitated more than boys imitate. They also evidenced more echolalia and continual questioning, both features of language that develop earlier in girls than in boys (Andersson, Gillberg, & Miniscalco, 2013). The language and social imitation skills of females with ASD may mask a core ASD deficit, thus resulting in later diagnosis for females.

Objectives: The objectives of this study included comparing parental report of ASD symptomatology at age of diagnosis on the ADI-R, in males and females who receive an initial diagnosis between 3-5 and those who receive an initial diagnosis between the

ages of 8-10. Given the under-representation of females in ASD, it is possible that current diagnostic instruments are not sensitive enough to detect the subtleties of ASD symptoms in females and that the profiles of females who are diagnosed later are different from those of females who are referred at a younger age.

**Methods:** Forty boys and 40 girls were matched on developmental functioning and age, with 20 boys and 20 girls receiving their initial diagnosis of ASD between the ages of 3-5 (early diagnosis group), and 20 boys and girls who received their initial diagnosis of autism between the ages of 8-10 (late onset group). Sex differences as assessed on the algorithm domains of the ADI-R parental interview.

**Results:** Significant differences emerged on the ADI-R algorithm scores, with girls receiving higher pathology scores in the social-affect domain and lower pathology scores in the communication domain. The only significant difference between the early and later diagnosis group emerged in the communication domain, with significantly more pathology emerging in the early diagnosis group. Comparing all four groups revealed that girls who received an early ASD diagnosis manifested significantly more impairment in the communication domain while no differences emerged among the other three groups.

**Conclusions:** The results of this study suggest that age and sex have an impact on the manner in which ASD is expressed. The reexamination of diagnostic profiles in females can provide the groundwork for possible changes in the male-female bias in prevalence, and should be a research priority. This will allow for earlier identification of ASD, associated with better outcomes, in females.

**401.025 (Poster)** Comparison of Gender Cognition, Gender Dysphoric Feelings, Mentalising, and ASD Traits Among Neurotypical Cisgender, Neurotypical Transgender, and Autistic Cisgender Individuals.  
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**Background:**

In recent years, increasing evidence has emerged for a link between autism spectrum disorder (ASD) and gender incongruence. Yet, it remains unclear whether or not this link reflects true comorbidity, with the same underlying cause or some of the core features of ASD predispose autistic people to discontent with their birth-assigned gender.

**Objectives:**

We conducted a case-control study to identify similarities and differences in gender cognition, mentalising, ASD traits, gender dysphoric feelings, and cross-gender behaviour in childhood, among neurotypical cisgender, neurotypical transgender, and autistic cisgender individuals. We also explored, for the first time, the role of alexithymia in the link between ASD and gender incongruence.

**Methods:**

One hundred and four neurotypical cisgender, 78 neurotypical transgender, 112 autistic cisgender, and 26 autistic transgender adults took part. Participants completed explicit and implicit measures of gender cognition, plus the Reading the Mind in the Eyes measure of mentalising, the Autism-spectrum Quotient, the Gender Identity/Gender Dysphoria Questionnaire, the Recalled Childhood Gender Identity/Gender Role Questionnaire, and the Toronto Alexithymia Scale.

**Results:**

In keeping with predictions, neurotypical transgender and autistic cisgender participants showed different patterns of gender-related cognition. Autistic cisgender participants reported significantly more current gender dysphoric feelings ( $p < .001$ ,  $d = 1.10$ ) and cross-gender behaviour in childhood ( $p < .001$ ,  $d = 0.67$ ), than neurotypical cisgender people. Furthermore, neurotypical transgender individuals reported significantly more ASD traits, than neurotypical cisgender individuals ( $p < .001$ ,  $d = -0.55$ ). However, further analysis revealed that increased levels of alexithymia among neurotypical transgender individuals had confounded these results. In contrast to predictions, neurotypical transgender participants did not show any impairment in mentalising ability ( $d = -0.09$ ,  $p = .536$ ), whereas both autistic groups did as expected. Among autistic cisgender individuals, performance on the mentalising task was positively associated with the number of gender dysphoric feelings reported (high scores on the Gender Identity/Gender Dysphoria Questionnaire = less gender dysphoric feelings;  $r = .47$ ,  $p < .001$ ) and partially mediated the relation between explicit gender cognition and current gender dysphoric feelings. However, this was not the case among neurotypical transgender people.

## Conclusions:

Results provide evidence that ASD and gender incongruence do not share the same underlying causes. They also support the hypothesis that mentalising might be one of the possible mechanisms that increase autistic people's liability to discontent with their birth-assigned gender and tendency to develop gender dysphoria. Implications of results for clinical practice, as well as theory-building, will be discussed.

**401.026** (Poster) Coping Strategies and Service Needs of Autistic Adults in the SPARK Cohort during the COVID-19 Pandemic  
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**Background:** In daily life, many adults with autism have difficulty coping with change compared to a neurotypical population (Blomquist and Hirvikoski, 2015). Studies indicate that in comparison to children and adolescents, ASD adults are less likely to receive services, while also reporting a greater need for services (Turcotte et al. 2016). Little is known about the coping strategies of ASD adults to the COVID-19 pandemic's stay-at-home mandates and shutdowns of non-essential services.

**Objectives:** To use a qualitative approach to identify the most commonly reported coping mechanisms and greatest service needs reported by independent adults with ASD in early April 2020 during the early phase of the COVID-19 pandemic.

**Methods:** SPARK is a U.S. based online research study with a cohort of over 97,000 individuals with autism. From March 30 through April 10, 2020, SPARK surveyed independent adults to examine the impact of COVID-19 on their lives. 407 participants completed the surveys and 338 participants responded to open text questions about the impact on service needs and coping strategies. Participants without completed Background History Questionnaires previously collected from SPARK were excluded. A qualitative approach was used to code the remaining 278 open-text comments using a 3-step process of open, axial, and selective coding. Comments were coded and inter-coder reliability was established.

**Results:** Table 1 includes demographic information on the respondents.

A total of 35 codes emerged from open coding methods from 278 open text comments. Specific coping mechanism codes were categorized into broader categories established in the Coping Inventory for Stressful Situations (CISS): 1) task-oriented, 2) emotion-oriented, 3) avoidance-oriented. Definitions and frequencies of codes can be found in Table 2. 72% of avoidance-oriented codes were related to task-oriented avoidance, with the remaining 28% pertaining to person-oriented avoidance. Person-oriented avoidance also included reports of the desire to employ person-oriented avoidance (e.g. calling a friend), but having no social support available resulted in emotional distress.

Autistic adults reported a variety of service-related needs, broadly categorized into comments on service implementation, service access, and attitudes and perceptions on services received. Comments on telehealth delivery methods (including phone calls and video conferencing) were varied. While some individuals had positive experiences with telehealth, others reported discomfort due to concerns over lack of privacy and unreliable connections resulting in unsatisfactory visits.

**Conclusions:** This study provides insight into the coping mechanisms and service needs of independent adults with ASD during the onset of the COVID-19 pandemic. 13% of participants reported using task-oriented coping mechanisms, highlighting a need for strategies to cope with the negative impact of the pandemic on their mental health. These findings also underscore the need to quickly disseminate data to service providers and autism organizations to better serve independent adults with ASD during the pandemic or, more broadly in periods of elevated stress. Additional qualitative studies are needed to identify which coping mechanisms and telehealth services are effective for autistic adults as COVID-19 disruptions continue.

**401.027** (Poster) Decreased GABA Concentration in Supplementary Motor Area Disrupts Hand-Foot Coordination Movements in Individuals with Autism Spectrum Disorder  
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Background: Most individuals (79%) with autism spectrum disorder (ASD) exhibit difficulty in coordinated movements (Green et al., 2009). When healthy individuals moved their limbs (e.g., left hand and left foot) rhythmically, opposite directional movements tended to shift to same directional movements (“directional constraint”: Baldissera et al., 1982). Supplementary motor area (SMA) is suggested to be an essential brain area that inhibit “directional constraint” (Nakagawa et al., 2016) and our previous study showed that lower gamma-aminobutyric acid (GABA) concentration in SMA was associated with poorer skills of coordinated movements (Umesawa et al., 2020). Based on these, we hypothesized that decreased inhibitory metabolite, such as GABA levels in SMA are associated with strong “directional constraint” that resulted in lower skills of coordinated movements of individuals with ASD. Objectives: We investigated whether stronger “directional constraint” between rhythmic movements of two limbs are more pronounced in individuals with ASD. We also determined if lower skills of coordinated movements and decreased GABA levels in SMA were associated with the higher degree of “directional constraint.” Methods: We recruited 18 ASD (mean age, 21.7±3.1 years; 7 females, 11 males) and 27 typically developing (TD) participants (mean age, 22.6±4.1 years; 16 females, 11 males) in this study. The participants performed rhythmic movements of two limbs in the opposite direction (antiphase movements) in three separate limb combinations (bilateral hands, contralateral hand and foot, and ipsilateral hand and foot). To evaluate the degree of “directional constraint,” we defined the index of absolute errors (AEΦ) of the relative phase of two limbs from the target relative phase (i.e., 180°). Ten individuals with ASD and 14 TD participants were assessed for coordinated movement skills using a clinical assessment tool (Bruininks-Oseretsky Test of Motor Proficiency Second Edition: BOT-2). GABA levels in SMA were measured in 11 patients with ASD and 12 TD participants using 1H-magnetic resonance spectroscopy (1H-MRS). Results: ASD participants showed significantly greater AEΦ than TD participants in the opposite directional movement with contralateral hand and foot combination ( $t(43) = 4.11, p < 0.01$ ), and ipsilateral hand and foot combination ( $t(43) = 2.37, p = 0.02$ ). In the pooled data of the ASD and TD groups, participants who showed greater AEΦ in those conditions exhibited poorer coordinated movement skills as assessed by BOT-2 (bilateral hand and foot:  $r = -0.48, p = 0.02$ ; ipsilateral hand and foot:  $r = -0.51, p < 0.01$ ). Moreover, GABA levels in SMA tended to correlate with AEΦ in the ipsilateral hand and foot condition in all participants ( $r = -0.34, p = 0.10$ ). Conclusions: Our results suggest that “directional constraint” of two limbs is higher in individuals with ASD. Additionally, lower GABA levels in SMA may underlie stronger degree of “directional constraint.” Since previous studies showed that reduced neural activity in SMA causes strong “directional constraint” (Steyvers et al., 2003), we can speculate that impaired modulation of neural activation in SMA due to decreased inhibitory metabolites (GABA) causes difficulties in inhibiting “directional constraint,” and this may disrupt hand-foot coordination in individuals with ASD.

**401.028 (Poster)** Defining Autistic Burnout Using Grounded Delphi Method: Autistic Burnout through the Eyes of Experts By Lived Experience

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Background:

Autistic burnout is commonly described by autistic people, as evidenced by fervent discussion of #AutBurnout on social media. Yet, the lack of research on this topic means we know virtually nothing about its causes, correlates or consequences. Anecdotal links have been noted with autistic ‘camouflaging’, ‘masking’ and health status in autism.

Objectives:

We sought to redress this lack of academic research. This project aimed to create a thick description (Geertz, 2017) and definition of autistic burnout using Grounded Delphi Method (GDM; Howard, 2018).

Methods:

GDM combines the Delphi method, useful in emerging research areas, with grounded-theory, useful for conceptualisation and theory building. We surveyed autistic adults, as experts by experience. Over three survey rounds, we asked them to report on their experiences of autistic burnout and reached consensus on a definition. Twenty-two experts were surveyed, all had been formally diagnosed with autism and were above cut-off on the Autism Quotient-28.

Round 1 began with open-ended questions asking for experts’ experiences and then targeted questions e.g. differentiating between depression and burnout. We analysed responses from round 1 using grounded-theory concepts. To ensure no dominance of neurodivergent or neurotypical interpretations, open coding was completed independently by the project co-leaders, then, across multiple video conferencing sessions, a consensus on the coding framework was reached and axial coding completed.

An initial definition of autistic burnout was shared with experts and used as the basis for the round 2 survey. In the round 2 analyses, qualitative responses were subjected to a basic template analysis (Brooks et al., 2015), and quantitative analysis to determine degree of consensus to specific features of the draft definition. Few changes were required, and overall consensus was reached in round 3.

#### Results:

Our Phase 1 experts described autistic burnout as preceded by fatigue from camouflaging or masking, cognitive overload and other stressors. It results in exhaustion and interpersonal withdrawal, reduced executive and overall functioning, potentially fugue or dissociation, suicidal ideation and increased visibility of autistic traits. Withdrawal primarily functions as a coping mechanism. A conceptual model developed using grounded theory approaches highlights the overarching impact on energy levels of interactions within an unaccommodating neurotypical world. A DSM-5 style definition has been created aimed at the clinician and autistic communities.

#### Conclusions:

Autistic burnout appears to be a debilitating condition with onset linked to everyday stressors faced by autistic people in an unaccommodating world. The condition appears distinct from non-autistic burnout or depressive episodes. In common with non-autistic burnout, research is needed to establish further whether this condition might be a non-typical presentation of depression, chronic fatigue syndrome or another condition. A follow-up study is underway to validate the definition, by making direct comparisons to the definition from Raymaker et al. (2020), and establishing convergent and discriminant validity.

Therapeutic strategies such as behavioural activation (e.g., encouraging socialisation; Tindall et al., 2017) would be contraindicated in autistic burnout. Understanding commonalities and risk factors related to autistic burnout should inform mental health and preventative health measures for autistic adults.

**401.029** (Poster) Development of the Suicide Ideation Attributes Scale-Modified (SIDAS-M) in Autistic Adults  
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**Background:** There are currently few instruments specifically designed or adapted to assess suicide risk in the autistic population. The Suicidal Ideation Attributes Scale (SIDAS) is a 5-item assessment of suicidal ideation that is commonly used and well-validated in suicide research. Unlike other instruments that primarily assess past suicidal behavior (e.g., Suicide Behaviors Questionnaire-Revised; SBQ-R), SIDAS focuses on recent (4-week) ideation making it useful for identifying current risk. SIDAS demonstrates a single factor, good internal consistency, and convergent validity. In addition to strong psychometric properties, its clear questions and straightforward design make it a strong candidate for suicide risk assessment in the autistic population. Therefore, we followed current gold-standard recommendations for measurement development and modification, as well as co-production with autistic people, to derive and validate a modified version of the instrument (SIDAS-M) specifically adapted for use with autistic adults with a diverse range of abilities.

**Objectives:** 1) Describe the co-production of SIDAS-M; 2) Compare SIDAS-M with SBQ-R and Patient Health Questionnaire (PHQ-9) in a sample of autistic adults.

**Methods:** The study was approved by the university ethics committee (#HEC20235). Preliminary data are reported for 11 (6 female, 4 male, 1 non-binary) autistic adults aged 21 to 56 years ( $M=30.33$ ,  $SD=13.40$ ) who were participating in a larger suicide prevention study. The present study examined relationships between SIDAS-M, SBQ-R and PHQ-9.

**SIDAS-M.** A panel of content experts, including the original author of the SIDAS, academic and clinical psychologists, a psychiatrist, suicide prevention experts, an autistic academic, and an autistic consultant with lived experience, and a panel of 10 autistic adults (who represent gender, cultural, mental health, suicide behavior, and ability diverse populations), revised the original SIDAS based on recommended guidelines. The instrument was circulated amongst all members, incorporating revisions

and recommendations, until consensus on the final version was reached. Modifications to the original version included improved clarity of language and item wording, a visual analogue scale, and addition of response exemplars.

**Results:** Data collection is ongoing, preliminary/pilot data are reported here. Participant scores ranged from mild to severe on the PHQ-9, and eight participants were in the risk range ( $\geq 7$ ) on SBQ-R. Mean scores on the SIDAS-M ranged from 0 to 26 ( $M=6.73$ ,  $SD=8.31$ ; possible range 0—50), revealing a wide range of suicidality from minimal to high risk. SIDAS-M was significantly associated with SBQ-R Total,  $r=.605$ ,  $p=.049$ , BCa 95% CI [.248, .906], and item 1 (lifetime suicide ideation and attempt),  $r=.765$ ,  $p=.006$ , [.360, .983], but was only weakly associated with PHQ-9 Total,  $r=.483$ ,  $p=.133$ , [-.019, .915], and item 9 (thoughts of self-harm),  $r=.440$ ,  $p=.175$ , [-.002, .979].

**Conclusions:** Our study describes the development and co-production of the newly modified SIDAS-M, designed for assessing suicidal thoughts in autistic people. Preliminary data for 11 participants revealed good concordance with SBQ-R, but a weak association with PHQ-9. Future comprehensive validation will include the application of classic test and item response theories to evaluate the factor structure and invariance across key factors of interest (e.g., sex, cognitive functioning) as well as development of optimal cut scores.

**401.030 (Poster) Diagnosis of Autism in Girls: Evidence from India**

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Background:

A consistent finding in the literature is the predominance of autism spectrum disorder (ASD) among boys as compared to girls. Few studies, especially from developing countries, have examined how autism presents in boys and girls and whether this poses a problem in diagnosis.

Objectives:

To examine gender differences among the high functioning autism spectrum disorder (ASD) children with respect to age of diagnosis and clinical characteristics.

Methods:

A retrospective analysis was conducted of the case records with a diagnosis of high functioning autism (HFA) maintained at the outpatient Pediatric Psychology Clinic of the Department of Pediatrics of a tertiary care teaching hospital. Information regarding demographic, socio-economic variables, clinical characteristics such as presence of restricted repetitive behaviors (RRBs), history of developmental regression, hyperactivity, self injurious behaviors and deficits in social emotional reciprocity was extracted from the case records of the patients and scored. Inclusion criterion was children who fulfilled the diagnostic criteria for ASD based on the DSM criteria and an IQ of 70 and above. Children with incomplete records and co-morbid neurological condition such as epilepsy were excluded. The sample retrospectively included a total of 313 cases (256 boys and 57 girls) and the mean age of the sample was 5.02 yrs ( $SD=2.70$ ). Approval to the retrospective study was granted by the ethics committee of the institute.

Results:

Boys constituted 81.8% ( $N=256$ ) of the sample and the M: F ratio was 4.49: 1. The HFA boys and girls were well matched on cognitive functioning. There was a significant difference in the age of diagnosis by gender ( $t=2.79$ ,  $P=0.006$ ) and HFA girls were diagnosed 1.10 years later than boys. No gender differences were found on socio-economic background characteristics (all  $P>.05$ ). The HFA boys and girls differed on several clinical features including presence of RRBs ( $\chi^2=6.06$ ,  $P=.014$ ) and severity of social emotional reciprocity deficits ( $\chi^2=7.11$ ,  $P=0.008$ ). Some of the possible reasons for later age of diagnosis among girls include bias in the way the diagnostic criteria are applied, culturally prevalent gender bias in seeking medical help for girls, physician's bias or lack of knowledge of how autism presents in girls, and social camouflaging skills of girls. Indeed, evidence indicates that girls can maintain brief social interactions and escape early detection, due to better social skills relative to boys.

Conclusions:

Girls with high functioning autism are at a significant risk of being under-recognized and diagnosed at a later age than boys in India. Identifying the gender specific differences in autism symptomatology in high functioning children will help in paving the way for better detection and assessment of autism in girls so as to increase their access to support and intervention services.

**401.031** (Poster) Diagnostic Timing and Gender Diversity: Impacts on Camouflaging Behaviors in Autism

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**Background:** Camouflaging in autism spectrum disorder (ASD) refers to behaviors that mask autism-related social challenges. Factors associated with camouflaging in ASD are beginning to emerge, with particularly strong evidence that those assigned female sex at birth demonstrate elevated camouflaging. Further, relative to cisgender ASD individuals, gender non-binary ASD individuals may also exhibit greater camouflaging. Qualitative reports, which indicate that camouflaging modifies the presentation of core ASD social and communication features, suggest a role for camouflaging in late and missed diagnosis, particularly among ASD females.

**Objectives:** Therefore, the current study seeks to: a) replicate prior findings of increased camouflaging in ASD females; b) examine whether gender diverse ASD individuals report elevated camouflaging; and c) investigate if adult-diagnosed ASD individuals exhibit elevated camouflaging compared to those diagnosed in childhood/adolescence.

**Methods:** 406 ASD individuals aged 18-39 years were recruited via Simons Powering Autism Research and Knowledge (SPARK) to complete a battery of online questionnaires. Measures analyzed here include a question inquiring about age of ASD diagnosis, questions querying gender identity and sex assigned at birth, and the Camouflaging Autistic Traits Questionnaire (CAT-Q). Participants were grouped into those who received an ASD diagnosis during childhood/adolescence ( $n=229$ ) and those who received a diagnosis in adulthood ( $n=177$ ). Multivariate Analysis of Variance (MANOVA) was used to evaluate potential differences in camouflaging between: a) males versus females, b) gender diverse versus gender non-diverse, c) ASD child/adolescent- compared to adult-diagnosed individuals, and d) interactions among a-c. Dependent variables were CAT-Q factors: Assimilation, Compensation and Masking.

**Results:** The MANOVA revealed significant main effects of sex ( $F=8.96, p<.001$ ), gender diversity ( $F=2.87, p=.04$ ), and age of diagnosis ( $F=8.48, p<.001$ ), as well as a significant diagnostic age group  $\times$  gender diversity interaction ( $F=3.19, p=.02$ ). No significant interactions were found with sex assigned at birth ( $ps>.05$ ). Follow-up ANOVAs (Bonferroni corrected  $p<.0167$ ) revealed ASD females reported higher camouflaging across all three factors: Assimilation ( $F=22.12, p<.001$ ), Compensation ( $F=13.27, p<.001$ ) and Masking ( $F=9.84, p=.002$ ). ASD gender diverse individuals also reported greater Compensation than gender non-diverse individuals ( $F=6.38, p=.01$ ). Adult-diagnosed ASD individuals reported higher Assimilation ( $F=24.02, p<.001$ ) and Compensation ( $F=11.29, p<.001$ ) than those diagnosed in childhood/adolescence. Finally, a diagnostic age group  $\times$  gender diversity interaction was found for Assimilation ( $F=6.52, p=.01$ ), wherein ASD gender diverse individuals diagnosed as adults reported the highest levels of this camouflaging factor.

**Conclusions:** Here we replicate findings of elevated camouflaging among ASD females. Our novel findings center around additional factors that distinguish camouflaging utilization among ASD adults. Specifically we find that gender diverse individuals, particularly those diagnosed as adults, report elevated Assimilation compared to gender non-diverse ASD individuals. Specifically, gender diverse adults report that they engage in more behavioral approaches to 'blend in' during social situations. Finally, we find that compared to those diagnosed in childhood/adolescence, adult-diagnosed ASD adults exhibit both greater efforts to 'blend in' as well as strategies that include learning about social interactions by watching and modeling others, and practicing body language and gestures in order to moderate social challenges.

**401.032** (Poster) Earlier MMN Peak in Unaffected Siblings of Taiwanese Adults with Autism Spectrum Disorder

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**Background:** The paradigms of mismatch negativity (MMN) and P3a are frequently used to measure the brain response of novelty discrimination and attention re-orienting. Individuals with autism spectrum disorder (ASD) tend to detect the trivial changes in the environment and are shown to have abnormal MMN response. Our previous study also demonstrated that ASD individuals showed an earlier P3a peak compared to typically developing controls (TDC).

**Objectives:** Given that unaffected siblings of ASD probands may share similar brain function with their affected siblings, this study aims to investigate the MMN and P3a response in the unaffected siblings of ASD probands.

**Methods:** This study recruited 43 unaffected siblings of ASD probands (aged 17.0) and 51 TDC (aged 16.7). All the participants underwent the event-related potential procedures including MMN and P3a paradigms of both duration and frequency deviants. We then compared the peak latency and peak amplitude of MMN and P3a of both duration (dMMN and dP3a) and frequency (fMMN and fP3a) paradigms between the unaffected siblings of ASD probands and TDC groups controlling for sex, age, and full-scale IQ.

**Results:** We found that the unaffected siblings of ASD probands showed an earlier fMMN peak consistently at the electrodes Fz, Fcz, and Cz compared to TDC. Besides, unaffected siblings also showed a trend of shorter dP3a latency compared to TDC. As for the clinical correlates of the fMMN peak latency, we found these parameters were associated with stereotyped behaviors, social emotion problems (of the Social Responsiveness Scale) and mindreading deficits (on the Autism Spectrum Quotient) of the whole sample.

**Conclusions:** The unaffected siblings of ASD probands may have an earlier MMN response towards frequency deviants that may be correlated with their autistic traits. These findings warrant further studies to validate.

#### **401.033 (Poster) Effects of Elevated Autistic Traits on the Aging Cerebellum**

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**Background:** Our knowledge of middle and older age adults with autism spectrum disorder (ASD) is scant. The studies that have been completed are limited by cohort effects and other confounds that obscure our understanding of the relationship between autistic behavior and brain structure in middle and later adulthood. One approach to circumventing these obstacles is to examine the impact of the Broader Autism Phenotype (BAP) on the brain during middle and later adulthood. The BAP represents elevated subclinical autistic traits occurring in approximately 5-10% of the population<sup>1</sup>. Our own research has shown that the BAP during older adulthood (60-91 years) is associated with more executive function and social cognitive challenges<sup>2,3,4</sup>.

**Objectives:** The current study extends this line of inquiry to brain structure. More specifically, for the first time, this study examines links between cerebellar structure (given robust findings of reduced cerebellar gray matter in ASD<sup>5</sup> and aging-related declines in cerebellar gray matter during neurotypical development<sup>6</sup>) and the BAP during middle and older adulthood.

**Methods:** 166 community dwelling adults (76% female) ranging in age from 49-81 ( $M=64$ ) years completed a neuropsychological battery and provided a Magnetization Prepared-Rapid Gradient Echo (MP-RAGE) magnetic resonance imaging (MRI) scan. The BAP was assessed using self-ratings from the Autism Quotient (AQ<sup>7</sup>). Volumes of the cerebellum and its subcomponents (28 regions) were quantified using a novel algorithm, ACAPULCO<sup>8</sup>, and compared between the highest quartile of AQ scorers (BAP;  $n=47$ ) and the other 72% of the sample (non-BAP;  $n=119$ ) using multivariate analysis of covariance (MANCOVA) accounting for the effects of age, gender, and total intracranial volume (ICV).

**Results:** There was a significant 3-way interaction between cerebellar region, hemisphere, and group (BAP vs. non-BAP;  $F=2.59, p=.02, \eta^2=.016$ ) after accounting for covariates. Follow-up analyses revealed that BAP adults had decreased cerebellar volume compared to the non-BAP group in Right Crus I and in Left Lobule VI ( $F_s>4.32, p_s<.04, \eta^2_s>.025$ ), after co-varying the influences of age, gender, and ICV.

**Conclusions:** This study provides the first evidence that the BAP could increase risk for cerebellar gray matter volume reductions during a period of development (middle and older adulthood) when tissue loss is already occurring<sup>6</sup>. Strikingly, similar findings of decreased gray matter of Right Crus I in particular have been shown repeatedly in the literature, including meta-analytic studies of children and young adults with ASD<sup>5</sup>. The BAP might therefore exacerbate aging effects that result in cerebellar volumetric reductions, particularly in areas like Right Crus I, which have been linked previously with clinical expressions of the autistic phenotype<sup>5</sup>. This convergence across subclinical (BAP) and clinical (ASD) samples lends validity to the investigation of the BAP in adult development to inform neurobiological effects of aging in ASD.

#### **401.034 (Poster) Employment Related Changes Following COVID-19: A Longitudinal Examination of Mental Health and Work-Related Need Satisfaction of Autistic Employees**

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**Background:** The COVID-19 ongoing crisis introduces employment related challenges worldwide. Along with soaring unemployment rates, effects on employees who remain employed are also reported. Common implications are changes in working hours, increased work demand, wage reduction, and changes in working conditions and environments, such as working from home (Restubog et al., 2020; Solomon, 2020). Forced changes in work environments could lead to deterioration in work satisfaction, work motivation, satisfactions of employment needs and well-being (Gagné, 2020). Consequences of COVID-19 may be especially challenging for autistic people. Swift changes forced by the pandemic, along with characteristic intolerance to uncertainty and high levels of anxiety, suggest negative psychological outcomes resulting from the pandemic (Cassidy et al., 2020). In the employment arena, outcomes of autistic people are relatively poor to begin with (Nicholas et al., 2019), making this population especially vulnerable at times of employment instability.

**Objectives:** To explore autistic adults' employment related changes, experiences and mental health following COVID-19, compared to pre-COVID measures.

**Methods:** Data were collected from 23 participants diagnosed with ASD (4 females), aged 20–49, who answered an online administered survey at two timepoints: a few months prior to the COVID-19 outbreak, and during the outbreak. Self-reports included measures of background and employment status; mental health (General Health Questionnaire-12); job satisfaction (Minnesota Satisfaction Questionnaire); and satisfaction of psychological needs at work (Psychological Need Satisfaction and Frustration – Work domain).

**Results:** Among the 23 participants who answered the follow-up survey, sixteen (69.6%) were employed, of whom ten (43.5%) reported physically going to work and six (26.1%) worked remotely from home; four participants (17.4%) were in furlough, and three (13%) were unemployed. T1 to T2 comparisons employing Wilcoxon tests for paired samples indicated a significant increase in participants' emotional distress. However, the separate examination by employment status revealed a significant effect among participants who do not work, a marginally significant effect among participants working from home, and no significant change in mental health scores among participants who physically report to work (see Figure 1). Furthermore, while employees physically attending work did not present differences in need satisfaction, employees working from home presented a significant decline in the satisfaction of the needs for competence and autonomy following COVID-19 related restrictions (See Figure 2).

**Conclusions:** Results highlight the positive effects of a stable employment for autistic people, helping to preserve emotional stability even at times of uncertainty. Remote work from home may hold advantages and allow autistic employees to sustain their jobs under COVID-19 restrictions, but possible shortcomings may also arise, such as deterioration in psychological need fulfillment and increased levels of distress. More research is needed to achieve a broader understanding of remote work for autistic employees, and how their employment needs should be best supported.

**401.035 (Poster) Evaluating Employment Outcomes & Perceptions in Adolescents and Young Adults with ASD**  
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**Background:** The employment rate for adolescents and young adults with ASD is extremely low, and poorer than the rate for other disability groups and ex-convicts (Solomon, 2020). The negative implications of this issue extend past financial instability because having a job provides daily structure, socialization opportunities, and mental health benefits. While those with ASD may exhibit non-normative behaviors and social deficits that deter employers during hiring, they are often highly reliable and efficient employees (Scott et al., 2017). In order to reduce misinformation, understand support needs, and improve ASD employment outcome, it is imperative to understand the vocational experiences and self-perceived limitations of adolescents and young adults with ASD.

**Objectives:**

1. Identify differences in employment outcomes between adolescents and young adults ages 16-24 years with and without ASD.
2. Investigate underlying perceptions that influence these differences.

**Methods:** As part of a more extensive study of cognition and adult outcomes, typically-developing participants (TYP;  $n=49$ ; FSIQ4 -  $M(sd)=110.2(13.12)$ ) and participants with gold standard diagnoses of ASD ( $n=49$ ; FSIQ4 -  $M(sd)=101.6(12.6)$ )

completed a self-reported social functioning questionnaire (Birchwood Social Functioning Scale [SFS]; Birchwood et al., 1990). Items from the SFS's employment section were analyzed using a combination of between-group independence tests and within-group *t*-tests. IQ (Wechsler Abbreviated Scale of Intelligence-II [WASI-II]; Wechsler, 2011), ASD symptom severity (Social Communication Questionnaire [SCQ]; Rutter, 2003), and psychopathology (Achenbach System of Empirically Based Assessment [ASEBA]; Achenbach & Rescorla, 2003) measures were then used to identify potential underlying associations with group differences in employment outcomes.

Results: There was a significant difference between distributions of ASD and TYP participants in their responses to "Are you in regular employment?" where TYP was 2.5 times more likely to report they were employed ( $\chi^2 P = 0.0019^{**}$ ; Figure 1a). For both groups, within-group *t*-tests showed that older participants were more likely to report they were employed (ASD  $P = .003^{**}$ ; TYP  $P = .015^*$ ; Table 1). Within the TYP group, participants with lower full-scale IQ ( $P = .025^*$ ), non-verbal IQ ( $P = .034^*$ ) and ASEBA Depression scores ( $P = .026^*$ ) were more likely to report they were employed (Table 1).

Those who were unemployed answered additional questions (TYP – [n = 22]; ASD – [n = 38]). In response to "Are you capable of some sort of employment?", only 63% of ASD participants answered, "definitely capable", relative to 100% of TYP (Fisher's  $P = .0001^{***}$ ; Figure 1b). For the ASD group, those who responded "definitely" had a higher mean SCQ score than those who responded, "would have difficulty" ( $P = .006^{**}$ ; Table 1).

In response to "How often do you make attempts to find a job?", ASD participants primarily responded "never" whereas TYP primarily responded "sometimes". However, this difference was not statistically significant ( $p = .288$ ; Figure 1c).

Conclusions: Adolescents and young adults with ASD (16-24 years) were employed less frequently and expressed they were less capable of working than age-matched TYP. Future analyses will include more detailed participant and parent reports. Within-group interactions with IQ, depression, and social communication scores will be further explored.

**401.036 (Poster)** Every Cloud Has a Silver Lining: Three Case Studies of Community Participation Change in Adults with ASD Following the Onset of the COVID-19 Pandemic  
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Background: Community participation is engagement in natural contexts with others with or without disabilities within the general community outside of supported environments. Following the recommendation for social distancing and the shutdown of many community activities in March, 2020, many people experienced a significant decrease in community participation. Data from 2017 suggests that adults with Autism Spectrum Disorder (ASD) report fewer days of and less varied community participation compared to neurotypical individuals. It is unknown as this time if there was a change in community participation for adults with ASD as was experienced by most neurotypical individuals during this time.

Objectives: To examine changes in community participation in adults with ASD from January-February, 2020 (pre-COVID-19 restrictions) to October-November, 2020 (continued COVID-19 restrictions).

Methods: A randomized controlled trial (RCT) to examine the impact of an intervention to increase community participation in adults with ASD opened in October, 2019. Individuals were enrolled and completed a baseline assessment of their levels of community participation. This project was halted in March, 2020 as a result of the COVID-19 pandemic. The project was re-opened as a longitudinal design in October, 2020. Three individuals who had previously enrolled and were assigned to the treatment have re-enrolled (baseline data is currently being collected). At both time points, participants completed the Temple University Community Participation (TUCP; Salzer et al., 2014) measure which assesses in the past month the number of days spent participating in the community and types of activities. Also, participants completed the Visual Activity Sort (VAS; O'Day, 2020), a card sort of 90 activities which they were asked to sort two ways: feelings towards the activity (like, neutral, dislike) and desire to engage in the activity (want to do more, want to do, currently do, do less, don't want to do). At time 2, each participant will complete a semi-structured qualitative interview including questions such as "How did your participation in community activities change during COVID-19?"

Results: It is hypothesized that the TUCP will reflect preliminary findings of low community participation and low activity variability with little change from early 2020 to late 2020. To date, preliminary findings from the VAS point to higher desire to engage in community activities identified as neutral/like and want to do more/want to do, which is significantly higher than expected given the TUCP results. We expect that this will continue; however, we anticipate that more activities will shift to "want to do more" and "want to do" categories. Finally, we anticipate that conducting a follow-up qualitative assessment will

contribute to the explanation for any changes in community participation following the onset of the COVID-19 pandemic community restrictions.

Conclusions: Capitalizing on a naturalistic experiment examining changes in community participation following the onset of the COVID-19 pandemic, community participation restrictions in adults with ASD is a silver lining. Findings from these case studies may point to the impact of the COVID-19 pandemic on adults with ASD, which may or may not be similar to those of most neurotypical individuals during this stressful time.

**401.038** (Poster) Executive Functioning and Adjustment to College in Students with and without Autistic Traits  
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Background:

Studies estimate that college students may exhibit autism symptomatology without awareness of it in themselves or by others. Thus, this population is often underserved by student accessibility offices, yet encounter similar issues as college students with a formal diagnosis, including executive functioning challenges and adjustment issues (Davidson & Morales, 2020).

Objectives:

The primary objectives were to examine group differences in executive dysfunction and adjustment to college (i.e., academic, social, personal-emotional, institutional attachment) in students with and without autistic traits. Also explored were the relations between executive dysfunction and adjustment.

Methods:

Following IRB approval, 144 college students from a Psychology 101 subject pool participated. Students with autistic traits ( $n = 57$ ;  $M = 19;10$ , range 18;04 – 25;02) and without autistic traits ( $n = 87$ ;  $M = 19;08$ , range 18;10 – 22;07) were determined using T-scores from the Social Responsiveness Scale (SRS-2). The SRS-2 has been shown to be a robust instrument for detecting the presence and severity of social impairment and restrictive/repetitive behaviors associated with autism (Constantino & Gruber, 2012). Students did not differ on gender (72% female), race (65% Caucasian), year in school (first, second), or GPA ( $M = 3.3$ ).

The Behavior Rating Inventory of Executive Functioning (BRIEF-Adult Self Report) and the Student Adaptation to College Questionnaire (SACQ; Baker & Siryk, 1989, 2017) were administered. The BRIEF-A-SR is a standardized, self-report measure that assesses adults' views of their own executive functioning in their everyday environment (Roth et al., 2005).

The SACQ is a widely used measure that examines academic adjustment (beliefs about adequacy of studying and academic efforts), social adjustment (beliefs about successful integration into the social milieu of college), personal-emotional adjustment (students' psychological and physical well-being) and institutional attachment (students' emotional attachment to their university).

Results:

Results for the BRIEF-A-SR and the SACQ are displayed in Table 1. Students with autistic traits exhibited greater executive dysfunction than neurotypical students and were more likely to exceed the clinical threshold on the BRIEF-A-SR. Students with autistic traits also scored significantly lower on social and personal-emotional adjustment than neurotypical students. Students did not differ on academic adjustment or institutional attachment. Executive dysfunction was negatively related to personal-emotional adjustment,  $r(142) \geq .29$ ,  $p \leq .01$ , but only in students with autistic traits.

Conclusions:

Students with autistic traits showed lower social and personal-emotional adjustment to college but did not differ from neurotypical students in terms of academic adjustment. Students with autistic traits also demonstrated worse executive functioning. These findings suggest that students with autistic traits may struggle in ways similar to students with a formal diagnosis of autism (Jackson et al., 2018). Moreover, given the negative association between executive dysfunction and personal-emotional adjustment, the BRIEF-A-SR may help to identify and target treatments for students at risk of experiencing college

adjustment issues

**401.039 (Poster)** Experiences of Social Isolation and Loneliness in Middle-Aged and Older Autistic Adults

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**Background:** Research examining the experiences of autistic children and younger adults have often indicated increased rates of social isolation and loneliness when compared to non-autistic populations. Despite both social isolation and loneliness being associated with older age in non-autistic populations, few studies have examined whether middle-aged and older autistic adults are at an increased likelihood of these experiences.

**Objectives:** This study explored differences in the experience of social isolation and loneliness among middle-aged and older autistic adults with an age and sex-matched non-autistic comparison group. The influence of age, gender, and symptoms of poor mental health was also examined in relation to the experience of social isolation and loneliness.

**Methods:** Using a cross-sectional online survey, a total of 428 adults (autistic  $n = 265$ ) aged 40-93 (mean age = 60.50 years) completed standardised questionnaires related to their experiences of poor social connectedness (i.e. social isolation) and loneliness, and current symptoms of depression and anxiety. Group differences and associations in social isolation and loneliness were examined. These group differences and associations were then examined in relation to age, gender, and symptoms of depression and anxiety.

**Results:** Those in the autistic group reported being less socially connected (i.e. more socially isolated) and lonelier than the non-autistic group. While there were no gender differences in the experiences of social isolation, women reported being lonelier than men in both the autistic and non-autistic group. A similar pattern of results was found when controlling for age and current symptoms of depression and anxiety. Furthermore, social isolation was found to be positively associated with age in the autistic and non-autistic groups. However, loneliness was only found to be positively associated with age in the autistic group. For both social isolation and loneliness, the associations with age were significantly stronger in men than women.

**Conclusions:** The findings from the current study suggest that autistic adults may be particularly susceptible to social isolation and loneliness in older age. Autistic women were found to experience elevated rates of loneliness when compared to autistic men. However, autistic men may be at a greater risk than autistic women of increasing social isolation and loneliness with age. This study highlights the need for evidence-based interventions to address social isolation and to reduce loneliness for autistic people as they age.

**401.040 (Poster)** Exploring Problematic Internet Use and Gaming in Young Adults with Autism Spectrum Disorder

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**Background:** Restricted interests in technology, combined with greater ease in communicating online than face to face could result in young adults with autism spending large amounts of time on internet and potentially becoming addicted to the internet. Despite positive correlations between autistic traits and problematic internet use, few studies have examined problematic internet use in clinical samples of individuals with autism spectrum disorder (ASD).

**Objectives:** 1- To determine how many individuals with ASD in our sample scored within the clinical range of problematic internet use or gaming disorder, 2- to explore whether certain demographic characteristics were related to problematic internet use or gaming.

**Methods:** A convenience sample of individuals with ASD between the ages of 16 and 30 years old was recruited through social media posts and organizations providing services to people with ASD in Canada. Sixty-five individuals with autism spectrum disorder (mean age = 23.77, SD = 4.3) completed an online survey. There were 34 female and 29 male respondents according to birth sex (2 missing data). Two thirds of the participants reported at least one co-occurring mental health condition. The most

common conditions were anxiety disorder (38.8%,  $N = 26$ ), attention deficit hyperactivity disorder (ADHD; 35.8%,  $N = 24$ ) and depression (29.9%,  $N = 20$ ). The survey was designed to measure substance and non-substance use as well as known risk and protective factors to substance related and addictive disorders among individuals with ASD. For the current study, responses were analyzed to determine the number of participants meeting criteria for problematic internet use or gaming disorder. Exploratory analyses examined whether scores were associated to gender, age, employment status, or co-occurring mental health conditions.

Results: Six participants (9.3%) had problematic internet use, while only two (3%) scored above the suggested cut-off for gaming disorder. Both were among the youngest participants (17-year-old males). Exploratory analyses found no relation between problematic internet use or gaming disorder symptoms and gender, age, employment status or co-occurring diagnoses of anxiety, ADHD or depression.

Conclusions: Our data suggest that problematic internet use is more frequent than gaming disorder in a community sample of young adults with autism. Further research is needed and most importantly, a larger number of clinical cases of problematic internet use is necessary, to compare non-cases to cases according to sociodemographic and other mental health variables in autistic compared to non-autistic adults.

#### **401.041** (Poster) Exploring the Experiences of Social Interaction and Communication in Autistic Adults: A Qualitative Approach

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#### Background:

Social communication and interaction challenges are perhaps one of the most well recognised characteristics of the Autism Spectrum (Disorder) (AS). While a large body of research has previously attempted to understand how autistic individuals experience their social world, this research lacks the personal voice and individualised experiences of the autistic community. Qualitative research identifies an individual's perspectives, experiences, and values, allowing for a deeper understanding and additional insight into autistic adults' social experiences.

#### Objectives:

This study sought to explore social interaction and communication from the perspectives of autistic adults, exploring their thoughts and feelings, before, during, and after engaging in social interaction.

#### Methods:

A qualitative study adopting an Interpretive Phenomenological Analysis (IPA) approach and semi-structured interviews, was used to achieve the aim of exploring the experiences of social interaction and communication in autistic adults. A total of 12 autistic adults participated in the study including eight females and four males. The mean age of participants was 30.57 years (SD 12.159 years).

#### Results:

Thematic analysis resulted in a total of 13 sub-themes under the themes of 1) before social interaction, 2) during social interaction and 3) after social interaction which described the participant's thoughts, feelings, and actions before, during, and after engaging in social interactions with autistic and non-autistic adults. Feelings of anxiety and apprehension were common prior to social interactions, with participants using practice and rehearsal to prepare 'socially appropriate' responses and increase their confidence. During social interaction participants reported feeling anxious and uncomfortable, with frequent reports of self-monitoring and adaptive morphing. Participants reported that the environment influenced their comfort in social interactions with quiet settings and conversing with familiar people and other autistic adults found to be less anxiety-provoking. Conversation topics which had a clear purpose and focused on passions, interests and areas of knowledge were more enjoyable than topics such as 'small-talk' which was perceived as meaningless. Reports of negative self-reflection following social interaction was common, with many participants finding social interaction exhausting and contributing to social fatigue.

#### Conclusions:

Exploration of the experiences of social interaction from the perspective of autistic adults revealed that contextual factors such as person, topic and the environment has influence on autistic individuals' perception on whether a social interaction was successful. Anxiety was identified to be a major factor impacting social interaction for autistic adults. Attempts to conform to non-autistic styles of communication resulted in frequent reports of rehearsal and adaptive morphing. Consequence of this monitoring and anxiety left participants feeling exhausted and social fatigue following conversations.

**401.042** (Poster) Factor Structure and Construct Validity of the Transition Readiness and Employability Evaluation  
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**Background:** There is an increasing number of individuals with Autism Spectrum Disorder (ASD) entering the workforce. Adults with higher cognitive ability levels have worse employment outcomes than those with an intellectual disability. “Soft skills” in the workplace, such as executive functioning and social communication, are significant challenges for individuals with ASD without co-occurring intellectual disability (Baker-Ericzen et al., 2018). A systematic review of employment readiness evaluations for individuals with disabilities found that few reliable behavioral rater-administered assessments of “soft skills” exist (Di Rezze et al., 2018). With the growing need to support individuals with ASD in the workforce, valid and reliable objective measures are needed to assess employment readiness.

**Objectives:** The objectives of the current study were to (a) assess the factor structure of the *Transition Readiness and Employability Evaluation (TREE)*, an observation measure of employment readiness for adolescents and young adults with ASD, and (b) examine associations among parent and self-report measures.

**Methods:** The TREE is a 26-item behavioral assessment used to evaluate employment readiness in transition-aged individuals. The assessment consists of two 15-minute entry-level job tasks (i.e., data entry and collating tasks) involving a series of “soft skills” presses for employment-related social communication skills including responses to corrective feedback, interruptions, and conversations. Forty percent of videos were coded for reliability ( $ICC=.87$ ). Participants included 52 adolescents and young adults with ASD ( $M_{age}=18.1$ ;  $SD=1.40$ ) and an IQ above 80 ( $M=104.67$ ;  $SD=15.64$ ). Participants were enrolled in a larger, transition intervention study and completed self-report questionnaires of coping skills (CSE; Chesney et al., 2010) and anxiety (STAI; Spielberger et al., 1983). Parents completed assessments of workplace skills (BWAP; Becker, 2005) and executive function (BRIEF-A; Roth et al., 2005). Item statistics and exploratory factor analysis (EFA) were used to determine the TREE's preliminary factor structure. Because the TREE measures employment readiness on an ordinal scale (e.g., 0,1,2; lower score indicating less impairment), categorical EFA with weighted least squares with mean-variance adjustment using Varimax rotation.

**Results:** Corrected item-total correlations and inter-item correlations were examined. Items with negative correlations and low corrected item-total correlations were removed, resulting in 16-items. A three-factor model best characterized workplace readiness skills as measured by the TREE. This model was supported by fit statistics,  $\chi^2(75)=83.34$ ,  $p=.24$  and  $RMSEA=.05$ . Item loadings on the three-factor solution resulted in the following factor loadings: Factor 1, Social Initiation (6 items), .34-.79, Factor 2, Task Organization and Accuracy (3 items), .29-1.18, and Factor 3, Social Problem Solving (7 items), .26-.93. Internal consistency for these factors was found (Cronbach's  $\alpha$ 's=0.7-0.72). Significant correlations were found between Social Initiation and Verbal IQ ( $r_s=-.338$ ,  $p<.05$ ), Task Organization and Accuracy and Full-Scale IQ ( $r_s=-.372$ ,  $p<.05$ ), and Social Problem Solving and CSE Problem-Focused Coping ( $r_s=-.357$ ,  $p<.05$ ).

**Conclusions:** The results provide support for a 3-factor structure of the TREE and demonstrated internal consistency as a measure of employment readiness including associations with cognitive abilities and coping behaviors. Future research should examine the validity of the TREE in documenting intervention effectiveness and in measuring supervisor-report measures of employment skills.

**401.044** (Poster) Financial Wellbeing of Autistic Adults in Australia  
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**Background:** Many autistic adults experience unemployment or under-employment, which may impact their financial wellbeing due to reduced income. Financial wellbeing is a large component of people's overall wellbeing; poor financial wellbeing has been linked to financial hardship and high levels of stress and anxiety. However, no research has been conducted to examine the financial wellbeing of autistic adults.

**Objectives:** The aim of this study was to explore the subjective and objective financial wellbeing of a sample of autistic adults.

**Methods:** Fifty-five autistic adults aged 18 to 67 years ( $M_{age} = 32.89$ ,  $SD_{age} = 10.98$ ; 55% female) completed a set of questions relating to their financial circumstances, Autism Spectrum Quotient – Short, and Reported Financial Wellbeing Scale. Mann-Whitney U and Kruskal-Wallis tests, correlational analyses with bootstrapping, and general linear modelling were used.

**Results:** The median financial wellbeing value of our autistic sample was 40.00, which is much lower than the value of 55.00 identified in a sample of 5,682 Australians. The subject financial wellbeing scores of autistic adults were not associated with being employed, higher education attainment, having a co-occurring condition, age or gender. Higher levels of subjective financial wellbeing predicted higher income, greater savings, and being able to comfortably repay debts or having no debt predicted (objective measures of financial wellbeing).

**Conclusions:** Our study has showed for the first time that financial wellbeing of autistic adults is much lower than those of the general population. These research findings have implications on how we can improve the financial wellbeing of autistic adults.

**401.045 (Poster)** Health-Related Outcomes, Service Use, and Healthcare Transition Among Adolescents: Preliminary Follow-up of Adolescents Identified with and without Autism during Early Childhood in the United States, 2018–2020

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**Background:** Children with autism spectrum disorder (ASD) often have additional health conditions that persist into adolescence and require greater coordination among healthcare service providers. However, major gaps exist in knowledge about the health, functioning, and healthcare needs of children with ASD as they transition to adolescence. This information is particularly important for ensuring a planned transition from pediatric to adult healthcare.

**Objectives:** To address this gap, a follow-up study is being conducted on adolescents age 12–16 years who were previously enrolled at age 2–5 years in the Study to Explore Early Development (SEED) and identified as having ASD or as population controls (POP) during that time.

**Methods:** Although data collection is on-going, this analysis includes data collected through January 2020. Follow-up surveys, completed by the adolescent's caregiver or guardian, included standardized questions and scales about the adolescent's health and mental conditions, physical difficulties, sleep problems, health and mental healthcare needs, and the transition from pediatric to adult healthcare.

To examine differences in health outcomes among adolescents in the ASD and POP groups, adjusted prevalence ratios (aPR) and 95% confidence intervals (95% CI) were calculated using a modified Poisson regression. The regression models included study group (ASD vs. POP) as the primary predictor and were adjusted for the following sociodemographic variables: mother's education, mother's country of birth, adolescent's sex, adolescent's race/ethnicity, federal poverty level, and type of insurance (e.g., private vs. public).

**Results:** The analytic sample consisted of 296 participants (ASD:  $n = 112$ ; POP:  $n = 184$ ). The average age of adolescents was 14.7 years old (interquartile range = 14.3–15.0 years). Compared to adolescents from the POP group, a higher percentage of adolescents with ASD had 1 or more medical or mental health conditions (aPR = 1.61, 95% CI = 1.21, 2.15), physical difficulties (aPR = 10.94, 95% CI = 4.04, 29.62), sleep problems (aPR = 1.44, 95% CI = 1.12, 1.87), and unmet medical and mental health service needs (aPR = 10.32, 95% CI = 2.02, 52.70; aPR = 3.84, 95% CI = 1.15, 12.90, respectively). Across both ASD and POP study groups, few adolescents received the recommended guidance for transitioning from pediatric to adult healthcare (ASD = 6.3%; POP = 13.0%; aPR = 0.53, 95% CI = 0.19, 1.47).

**Conclusions:** In the current study, adolescents with ASD identified in early childhood were more likely to have poorer health-related outcomes and greater health and mental health service needs compared to adolescents identified as population controls. Additionally, few adolescents in both the ASD and the POP group received the recommended healthcare transition planning from

their doctor or healthcare provider. These findings highlight the need for greater coordination and training among healthcare programs and services to improve adolescent health and well-being, increase the number of adolescents who successfully transition from pediatric to adult healthcare, and to address the unique medical and mental healthcare needs of adolescents with ASD.

**401.046** (Poster) Heterogeneity in Adults with Autism Spectrum Conditions (ASC): Subgroup Identification and Validation  
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**Background:** Autism spectrum condition (ASC) is considered to be marked by heterogeneity, which complicates the search for causes and support for individuals with an ASC diagnosis. This led to the idea that different subgroups may exist in the population of autistic individuals with separate outcomes.

**Objectives:** We aim to identify homogeneous subgroups based on behavioral data in autistic adults using community detection. Furthermore, we aim to test the subgroups' validity by (1) comparing them on external variables and (2) by testing differences between subgroups in their underlying network structures.

**Methods:** Self-report questionnaire data were collected as part of a larger longitudinal study. The input for the community detection analyses were 14 variables: behavioral measures of ASC traits, demographic, and psychological characteristics. As preregistered (AsPredicted #34234 and #49209) we determined subgroups in a data set of N=549 adults (30-85 years, 52% males; 262 ASC, 287 controls). This community detection analysis was repeated for just the autistic participants after which we compared the subgroups on three measures not included in subgroup detection (i.e., external validation). Finally, the network structure was estimated in the identified subgroups using Gaussian Graphical Models.

**Results:** Two subgroups were identified: Subgroup 1 included mainly autistic adults (90%); Subgroup 2 included mainly controls (92%). Within the ASC group, three distinct subgroups were identified ( $N_{\text{subgroup1}}=102$ ,  $N_{\text{subgroup2}}=82$ ,  $N_{\text{subgroup3}}=78$ ), which is a replication of our previous results using a separate training dataset. The subgroups did not differ in age. Subgroup 1 included more women (65%), the other two subgroups included fewer women (40% and 45%). Regarding external validation: Subgroup 1 experienced the most cognitive failures, mental health problems, and reported the lowest wellbeing compared to subgroups 2 and 3. Subgroup 2 experienced the least cognitive failures, mental health problems, and reported the highest wellbeing compared to subgroup 1 and 3.

**Conclusions:** Based on these preliminary findings we can conclude that community detection applied to behavioral data results in three valid ASC subgroups. These subgroups differed in severity of experienced difficulties. Whether these findings can be corroborated with qualitative differences among the underlying network structures will be determined before the INSAR 2021 meeting.

**401.047** (Poster) Identity after an Autism Diagnosis: Gender, Self-Esteem and Wellbeing  
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**Background:** Personal identity can be conceptualised as an individual's cognitive and emotional perception of themselves. There is currently a gap in the literature regarding the impact of acquiring a diagnosis of autism on personal identity development, and how this relates to measures of psychological health and functioning, such as self-esteem and wellbeing. These factors are of particular interest given the widely acknowledged prevalence of mental health difficulties in the autistic population. Furthermore, diagnoses of autism are increasingly being sought by adults and females, who have historically been underrepresented in empirical literature. Little is known, therefore, about their experiences of diagnosis and identity.

**Objectives:** The current study therefore aimed to examine several aspects of personal identity development following a diagnosis of autism, particularly for those late diagnosed and for females. First, the study aimed to investigate the relationship between personal autistic identity and psychological functioning (self-esteem and wellbeing). Second, the study aimed to understand relationships between personal autistic identity and the age and recency of diagnosis, in view of understanding the impact of receiving a late diagnosis on personal identity development processes.

**Methods:** One-hundred and fifty-two autistic adults (118 female, 30 male, 4 non-binary or transgender; mean age = 31.41) from the United Kingdom completed an online survey including measures of self-esteem and wellbeing, plus a measure of two aspects of personal autism identity: autism pride (reflecting perceived importance of or pride in autism being part of oneself) and

'exclusion/dissatisfaction' (reflecting perceived challenges or sense of shame linked to autism being part of oneself). Fifty-four participants also answered a qualitative question about the impact of receiving an autism diagnosis on their sense of self.

**Results:** Hierarchical regression analyses found that personal autistic identity significantly predicted self-esteem and wellbeing in autistic adults. Specifically, higher levels of 'autism pride' (positive affirmations of autism as part of one's identity) predicted higher self-esteem ( $p = .014$ ). Higher levels of 'exclusion/dissatisfaction' (sense of shame attached to autism being part of one's identity) predicted lower self-esteem ( $p = .001$ ) and lower wellbeing scores ( $p = .002$ ). Multiple regression analyses found that age of diagnosis positively predicted agreement with 'exclusion/dissatisfaction' ( $p = .022$ ). Furthermore, recency of diagnosis positively predicted agreement with 'autism pride' ( $p = .029$ ), whilst negatively predicting 'exclusion/dissatisfaction' ( $p = .003$ ). Content analysis of participants' self-reported experiences of their identity post-diagnosis support these findings and are suggestive of an emotive post-diagnostic adjustment process.

**Conclusions:** Greater self-acceptance of autism as part of one's identity related to higher self-esteem and wellbeing in the current study. Age and time since diagnosis also related to the incorporation of autism into self-identity. The results add to the literature concerning the diagnostic experiences of autistic adults and highlight potential mechanisms for improving psychological functioning through identity-based interventions. However, these findings should be understood within the current context of often inadequate provision of post-diagnostic services. Subsequently, recommendations are made with regards to future research on understanding the causal nature of the factors associated with developing personal autistic identity, leading to the design and evaluation of identity-focussed interventions.

**401.048 (Poster)** Impact of COVID-19 on Community Mobility and Participation for Individuals with Autism Spectrum Disorders

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**Background:** COVID-19 has created an unprecedented, rapidly changing environment that has significantly impacted daily life for all. Necessary restrictions have significantly disrupted, limited, or completely shut down participation in occupations related to leisure, work, education, and social participation. While COVID-19 has affected the entire population, people with Autism Spectrum Disorders (ASD) have been more extensively impacted. Not only are people with developmental disorders at higher risk for becoming infected (CDC, 2020), many have co-occurring medical conditions (Jones, 2015) that put them at increased risk of severe illness from COVID-19 (CDC, 2020). People with ASD also experience the social and mental health consequences of COVID-19 restrictions on participation more acutely than the general population (Galea 2020; Serafini 2020). Community mobility is one domain of participation where COVID-19 restrictions have had a significantly impact on people with ASD. New guidelines for transit systems combined with event cancellations and sustained closures or remote operation of schools, programs, and services, limit means or reasons to travel and possible destinations.

**Objectives:** The objective of this study was to use GPS methods and ecological momentary assessment to explore the impact of COVID-19 on activity space use, community mobility and participation in young adults with ASD.

**Methods:** Researchers used a single subject design to examine patterns of change over time in activity space as measured by GPS. Additionally, changes in transportation modes and participation activities were measured by ecological momentary assessment. Six transitional age youth and young adults with ASD between the ages of 21 to 27 (4 males, 2 females) participated in the study. Participants were collecting data using cell phones with the AccuTracking app for another study, allowing researchers to have access to both pre-COVID and post-COVID GPS data. Additionally, participants completed daily activity and transportation logs on the cell phones through Qualtrics. Data was available for two weeks pre-COVID and collected four weeks immediately after post-COVID restrictions were implemented statewide. Data was analyzed using common single subject methodology through visual analysis and a standard deviation band method.

**Results:** Visual analysis identified that all participants demonstrated a decreased in activity space area from pre- to post-COVID time periods. The same trend was observed with the amount of participation in activities in the community. In addition to a decrease in community participation, there was a trend observed in the types of community activities. Participants continued activities often deemed as essential including instrumental activities of daily living (IADLs) and employment, although at a decreased level. Participation in other community activities such as recreational and social activities decreased to very low levels or were non-existent across participants. A decrease in participation in medical and therapeutic services was also identified as a trend for all participants.

**Conclusions:** This study identified important considerations for understanding the impact of the COVID-19 pandemic on community mobility and participation for individuals with ASD. As there are long lasting implications of the current pandemic

and concerns for future ones, it is necessary to understand participation patterns to identify needed supports and resources.

**401.049 (Poster) Impact of Life Events on the Mental Health of Adults with ASD**

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**Background:**

People with autism spectrum disorder (ASD) are at increased risk of developing co-occurring mental health difficulties across the lifespan. There are several environmental and family factors which may make those with ASD vulnerable to experiencing life events as particularly stressful and thus contribute to the development of mental health difficulties.

**Objectives:**

This study investigates the impact of adverse life events and levels of parental stress and mental health difficulties on emotional and behavioural problems in young adults with ASD. Using longitudinal data, the strength of these associations in early adulthood will be considered accounting for the severity of mental health symptoms in childhood and adolescence.

**Methods:**

115 young adults with ASD derived from a population-based longitudinal study were assessed at three time-points (12, 16, and 23-years) on measures of emotional and behavioural problems. Exposure to adverse life events and parental stress/mental health were measured at age 23. We used structural equation modelling to investigate the stability of emotional and behavioural problems over time, and the impact of adverse life events and parental stress and mental health, on emotional and behavioural outcomes at 23-years.

**Results:**

Our results indicate that exposure to adverse life events significantly predicted increased emotional and behavioural problems in young adults with ASD, while controlling for symptoms in childhood and adolescence. Higher reported parental stress and mental health difficulties were associated with a higher frequency of behavioural, but not emotional problems, and did not mediate the impact of adverse life events.

**Conclusions:**

These results suggest that child and adolescent emotional and behavioural problems, exposure to life events and parent stress and mental health are all independently associated with co-occurring mental health difficulties in young adults with ASD.

**401.050 (Poster) Improving Online Employment Training for Transition Aged Youth with ASD/IDD**

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**Background:** It is known that the employment rate for individuals with intellectual and developmental disabilities (IDD) and autism spectrum disorder (ASD) is disproportionately low compared to those with a different disability or without a disability (Brooke et al., 2018). Ample research has stressed that the gap was not a result of these individuals' functional capacity but poor employment readiness, such as the lack of interview skills and work-related social skills.

**Objectives:** Traditional didactic face-to-face training faces two constraints: geographic limitation and poor real-life connection. In response, our aim is to develop a comprehensive pre-employment training that incorporates mixed reality technology. The mixed reality technology was chosen for its immersive features, better generalizability and knowledge translation. In addition, due to the growing needs, the intervention is designed to take place completely online. In this presentation, the authors will share the adopted iterative developmental process and findings from the pilot data.

Methods: A pilot study was conducted in Spring 2020, a survey study is in progress, and a development and innovation trial for a new employment skills training program is planned. The first phase was conducted to assess the acceptability of the mixed reality technology as a tool for the practice of learned employment-related social skills. Five undergraduate students with a clinical diagnosis of ASD participated in an online instructional session, followed by a mixed reality practice session. Participants completed self-report measures of social skills, self-efficacy and rated their satisfaction with training and mixed reality practice sessions. The second phase is an online survey of transition-age youth with ASD and IDD to better understand their online learning patterns and preferences. Participants will report on the types of learning that they engage in currently, and their desired training topics. The final phase that is planned will work with stakeholders to develop, assess and refine a comprehensive online employment training program that utilizes mixed reality practice sessions to improve short and long-term employment outcomes for young people with ASD and IDD.

Results: Nine individuals with ASD were participated in the feasibility and acceptability study. The majority considered the training and mixed reality practice session to be helpful rather than stressful. The survey of online learning patterns and preferences is in data collection with a target sample of 200 transition-age youth with ASD or IDD. Hypothesized findings will identify the electronic means of participating is a familiar and comfortable setting for many youth and young adults. These data will inform the development of the intervention for which federal grant funding is under review and the applied nature of this project will be discussed.

Conclusions: Together, these studies exhibit the commitment of the research team to improve the flexibility, generalizability and efficacy of employment skills training for youth with ASD or IDD. The identification of both the need for these supports as well as the feasibility of the mixed-reality simulation software reach an increased capacity for serving this population of youth. Increasing the employment rate of this group is crucial to improving their long-term wellbeing and independence.

**401.052** (Poster) Interventions for Toe Walking in Individuals with Autism Spectrum Disorders: A Systematic Review  
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Background: Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder. Despite motor impairment is not currently included in the diagnostic criteria or evaluation of ASD, there is increasing evidence that subjects with ASD also have motor impairments, including gait alterations. Toe walking (TW) is a possible finding during gait observation in about 20% of subjects with ASD. TW persistence can contribute to a secondary shortening of the Achilles' tendon.

Objectives: This systematic review aims to summarize the evidence about TW interventions in individuals with ASD.

Methods: The study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations and was prospectively registered in the International Prospective Register of Systematic Reviews (registration no. CRD42020176335). The literature search was performed up to July, 24<sup>th</sup> 2020 on Medline (via PubMed), CINAHL, PsycINFO, The Cochrane Library, Google Scholar and OpenGrey, from the inception of these databases. No restrictions regarding language, year of publication, and age of population were applied. Two reviewers independently screened titles and abstracts for eligibility; then independently screened full-text of potentially eligible studies. A hand searching of the reference list of included studies was also performed (Figure 1). Assessment of the studies' completeness has been conducted using the CARE checklist

Results: After the selection process, a total of 7 articles were included. They were all case reports, considering a total sample of 11 subjects (11 males; age range of 4-9 years). Five studies assessed the effectiveness of behavioural interventions using acoustical feedback or tactile stimulus in addition to positive reinforcement. One study proposed serial casting, and the one evaluated the efficacy of a lymphatic drainage technique. In all 7 studies, a reduction of TW frequency has been reported. A follow-up assessment was conducted only in 2/7 studies.

Conclusions: There is a lack of high-quality studies with a sufficiently large and well-characterized sample to assess the effectiveness of treatments for TW in individuals with ASD. These findings strongly support the need for future research in this area.

**401.053** (Poster) Labor and Delivery Experiences of Autistic Women: A Qualitative Research Study  
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## Background:

Little is known about the experiences of autistic women during childbirth. Current literature emphasizes a lack of support, anxiety around appointments, concerns about being an adequate mother, and sensory overload during pregnancy and delivery. Previous studies also show that healthcare professionals lack sufficient training and knowledge about autism, and autistic mothers frequently feel misunderstood and isolated by health care workers.

## Objectives:

The purpose of this qualitative study was to examine narratives of autistic mothers' birth stories to determine how these women make sense of these events in their lives. Narrative analysis was also used to identify problem areas where health care providers can intervene or provide additional support.

## Methods:

Participants were recruited via online groups and forums relevant to autism. An international sample of 16 autistic women shared 19 written birth stories via an online survey tool. Asynchronous online interviewing strategies were used to ask follow-up clarifying and probing questions. Narratives were analyzed using Burke's narrative analysis, which focuses on a pentad of components considered core to a story, including scene (when/where), agents (who), act (what), agency (how), and purpose (why). Problem areas were identified as aspects of the story where two of these five components were out of balance, called ratio imbalances.

## Results:

Ratio imbalances were most frequently identified between act and agency in these birth narratives. Many participants shared stories in which the health care professional took a necessary action to assist in the delivery (act) but inappropriately communicated this action to the participant or carried out the action in a way that was uncomfortable for the participant (agency). Participants shared examples in which they felt their wishes were ignored, they were not listened to or believed, and they did not understand the rationale for health care actions taken. These imbalances often undermined participant trust in their health care team. Participants shared particular challenges coping with sensory aspects of childbirth, communicating their needs in the midst of an overwhelming situation, expressing and adequately managing pain, and feeling violated by physical touch related to vaginal exams and delivery. In some birth narratives, a balance in act and agency was restored when a support partner advocated on behalf of the participant to ensure her wishes were met.

## Conclusions:

Birth narratives shed light on the unique challenges of autistic women during childbirth. Findings emphasize a need for further training of labor and delivery professionals in working with this underrepresented population. Importantly, the disconnect between act and agency indicates that the primary cause of distress for women on the spectrum is not necessarily what providers are doing, but how they are doing it. Interventions such as developing a specific birth plan during antepartum care and educating women on what to expect during childbirth prior to onset of labor may inform patient expectations and increase provider understanding of patient needs. Presence of a support person during delivery who is informed about the birth plan may also improve the birth experience.

### 401.054 (Poster) Levels of Autism Spectrum Traits Are Inversely Correlated with Psychological Resilience Factors during the COVID-19 Pandemic

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Background: Psychological resilience is the ability to buffer stress and cope effectively with challenges and crises that may arise (Barzilay et al., 2020). While much of the previous work on psychological resilience in the field of autism research focuses on the resilience of family members of autistic individuals, much less has been published about the resilience of autistic individuals themselves or about the relationship of autistic traits to resilience in the general population. We sought to better understand the relationship of resilience factors to autistic traits, depression, and anxiety during the ongoing stresses of the COVID-19 pandemic.

**Objectives:** To evaluate the relationship between autistic traits, severity of anxiety and depression, and resilience factors during the COVID-19 pandemic in adults across the autism spectrum and in the general population.

**Methods:** One hundred sixty-three participants from the Autism Spectrum Program of Excellence (ASPE) genetics study at the University of Pennsylvania, including autistic adults and their family members, were recruited during the COVID-19 pandemic for this study of resilience (60.1% female, 82.8% white, mean of 44.7 ( $\pm 15.3$  SD) years old). Additionally, 596 adults (89.5% female, 90.2% white, mean of 53.4 ( $\pm 14.9$  SD) years old) were recruited online from the U.S. general population during the COVID-19 pandemic. Participants completed self-report questionnaires about their autistic behaviors (SRS-2-Adult), anxiety (GAD7), depression (PHQ2), and a resilience survey probing for five factors: Self-Reliance; Emotion Regulation; Trust and Hostility in close relationships; and perception of Neighborhood Environment (Barzilay et al., 2020).

**Results:** Pearson correlations showed strong negative associations between total resilience factors and autistic traits as measured by the SRS-2-Adult ( $r = -0.62, p < 0.01$ ), anxiety severity ( $r = -0.51, p < 0.01$ ), and depression severity ( $r = -0.46, p < 0.01$ ) in the ASPE study sample, which is enriched for autism spectrum traits. In the general population sample, these negative associations between resilience and autistic traits ( $r = -0.62, p < 0.01$ ), anxiety ( $r = -0.58, p < 0.01$ ), and depression ( $r = -0.54, p < 0.01$ ) were replicated. Hierarchical regression demonstrated that, autistic traits, anxiety, and depression, all independently explain a significant amount of variance in resilience in both samples (see Tables 1 and 2). Autism spectrum traits explain the most variance in resilience in each sample (38-39%), followed by anxiety (8-10%), and then by depression (1-2%).

**Conclusions:** We found that autism spectrum traits explain over a third of the variance in resilience during the COVID-19 pandemic in each of our samples. Additionally, we found anxiety and depression partially explain resilience, though to a lesser degree. Future analyses will examine more specific domains related to autism spectrum behaviors (ex. social motivation, restricted repetitive behaviors) that may be driving the relationship with psychological resilience. We will also seek to expand the generalizability of our results by increasing the racial and gender diversity of our sample. These initial results suggest an inverse relationship between autism spectrum traits and resilience that should be explored to better understand how to reduce the impact of COVID-19 pandemic-associated stress in autistic adults.

**401.055 (Poster)** Longitudinal Investigation of the Impact of Minority Stress and Autistic Community Connectedness on Mental Health in the Autistic Community

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**Background:** Autistic people often have worse mental health and wellbeing than non-autistic people and are at greater risk of suicide. The minority stress (MS) model postulates that belonging to a marginalised group results in an increased stress burden, which can translate into health disparities. Minority stress includes exposure to victimisation, everyday discrimination, expectation of rejection, outness (such as disclosure), concealment (like hiding autistic behaviours), and internalised stigma. The MS model has shown utility in understanding this mental health disparity, as it explains a large proportion of wellbeing for autistic people, even when controlling for general life-stress and demographics in cross-sectional studies. Furthermore, research shows that autistic community connectedness (ACC) appears to moderate the impact of MS on mental health in cross-sectional studies too. To date, no longitudinal studies have been conducted.

**Objectives:** This study aimed to investigate the effect of MS and ACC on mental health, over time using a two-wave, longitudinal study. It was hypothesized that higher minority stress at time one would be associated with worse mental health at time two, while higher ACC at time one would be associated with better mental health at time two, despite controlling for demographics, general life stress, and mental health scores at time one.

**Methods:** A sample of 99 autistic people from a worldwide sample took part in both the first and second wave of this study. Validated measures of general life stress, mental health, MS, and ACC were administered twice, nine months apart. Mental health measures included a measure of psychological distress, depression, and measures of social, emotional, and psychological wellbeing.

**Results:** Regression analysis showed that despite controlling for time one mental health, demographics, and general life stress, higher minority stress scores at time one was associated with significantly worse mental health, and lower wellbeing at time two, across all mental health and wellbeing measures. In particular, higher exposure to everyday discrimination, the expectation of rejection, and internalised stigma was associated lower wellbeing, and higher psychological distress. Higher ACC at time one was consistently associated with higher wellbeing, and lower psychological stress at time two. Interestingly although outness (disclosing being autistic) is associated with worse mental health in cross-sectional studies, over time it was associated with

*better* mental health. The models accounted for a large amount of the variance in wellbeing and mental health scores. Reverse causality was also tested to test support for the hypothesized directions of effects, and the models were non-significant, suggesting support for the hypotheses.

**Conclusions:** Minority stress continues to be a useful model for understanding mental health in the autistic population, and over time increased exposure may be related to worse mental health. Community connectedness may play a protective role against the effects of discrimination and stigma in the autistic community. Interestingly, while outness predicts worse mental health in cross-sectional studies, over time it is associated with better mental health. This may be because disclosing can allow for increased support, and decreased burden of camouflaging.

**401.057 (Poster)** Maternal Autism: Parental Reflective Functioning, Family Adjustment and Children's Outcomes  
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Background:

Autistic mothers face unique difficulties as parents and are more likely to experience postnatal depression, find motherhood isolating and report not coping (Pohl et al., 2020). Higher autistic traits are associated with parenting difficulties mostly unique to autistic parents, such as difficulty coping with sensory stimuli, modelling and teaching behaviours (Dissanayake et al., 2019). Yet higher autistic traits are not related to parenting efficacy (Dissanayake et al., 2019) and autistic mothers' self-reported parenting efficacy is not significantly different from neurotypical mothers' when parenting autistic children (Lau et al., 2016). Nevertheless, autistic mothers face stigma, feeling unable to seek support (Pohl et al., 2020). In spite of these additional burdens, no study to our knowledge has yet investigated the impact of maternal autism and its associated challenges on children's outcomes.

Objectives:

(1) To examine the relationship between maternal autism and children's outcomes. (2) To investigate the impact of the interaction between mother's autism diagnosis and child's autism diagnosis on children's outcomes. (3) To explore the differences of parenting and wellbeing factors between autistic and neurotypical mothers which may be helpful in developing tailored support.

Methods:

295 mothers completed an online survey, collecting demographic information and autistic traits using The Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012). Mothers were split into three groups; those who self-reported an autism spectrum condition (ASC) diagnosis and scored over the cut-off of 70 on the SRS ( $n = 117$ ); those who self-diagnosed (SD) as autistic and scored over 70 in SRS ( $n = 77$ ); and those who were neurotypical (NT), scoring under 70 in SRS ( $n = 101$ ). Participants completed the Depression, Stress and Anxiety Scale (DASS-21; Lovibond & Lovibond, 1995), Parental Reflective Functioning Questionnaire (PRFQ; Luyten et al., 2017), Parenting and Family Adjustment Scale (PAFAS; Sanders et al., 2014), and reported their youngest child's difficulties through the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997).

Results:

A significant effect of mothers' autism on children's total difficulties scores was found,  $F(2, 292) = 23.38, p < .001$ . There was a conditional effect of child autism on children's difficulties scores. The effect of mothers' autism on children's difficulties was only significant when parenting a neurotypical child, with no significant group differences when parenting an autistic child. When comparing NT mothers to all autistic mothers in parenting and wellbeing factors, there was a significant multivariate group effect,  $F(3, 291) = 30.25, p < .001, \eta_p^2 = 0.24$ . Autistic mothers reported significantly poorer psychological wellbeing and less optimal parenting and family adjustment but did not differ from NT mothers in parental reflective functioning.

Conclusions:

Preliminary findings indicate that maternal autism diagnosis may be related to higher children's difficulties. However, maternal autism was not related to higher difficulty scores when the child was autistic. Self-diagnosed mothers with neurotypical children reported the highest difficulty scores, suggesting that they may require support in accessing services, a diagnosis, and tailored support. Psychological wellbeing and family adjustment may be important target areas for specific support for autistic mothers.

**401.058 (Poster)** Medication Frequency and Health Services Utilization in Latin-American Adults with Autism

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**Background:** Autism spectrum disorder (ASD) is a lifelong neurodevelopmental disorder typically diagnosed in childhood. The presentation of ASD varies with each individual yet the disorder's permanence highly impacts the various need for health services which are less available as the individual transitions into adulthood. Latino adults with ASD experience significant barriers accessing health services and are associated with high medication use and comorbid epilepsy diagnosis.

**Objectives:** This study aimed to analyze the relationship of medication frequency by age group in six Latin-American countries and the use of health services received among emerging and middle-aged adults with ASD.

**Methods:** The total sample consisted of 295 caregivers of adults with ASD from six Latin American and Caribbean Countries. Adults with ASD were predominantly males 75.6% (n= 223), with age ranging from 18 to 50 years (x=24.3, SD=6.6). Participants completed the Caregiver Needs Survey (CNS) that gathers information about sociodemographic data, individual characteristics, comorbid conditions, service encounters, and caregiver perceptions. Survey inquired about the weekly number of hours of varied health services , including frequency of medication. Weekly hours of services were categorized using the Council of Autism Service Providers (CASP) recommendations.

**Results:** The analysis of medical comorbidities shows that 73.2% (n=201) of adults had at least one comorbid diagnosis . 48.5% (n=143) of the participants were using medication at the time of the study, more frequent for those with comorbid epilepsy (61.8%, n=55). Of those participants with a reported diagnosis of epilepsy, (23.8%, n=34) reported to have been currently using medication. In contrast, most individuals receiving health services were in the “Zero hours per week” category (84.4-95.6%).

**Conclusions:**

Transition into adulthood for individuals with ASD requires sustenance from a variety of health-related disciplines. Our results indicate an increasing need for adequate health services for Latin-American emerging and middle-age adults with ASD. This population remains highly underserved as medication frequency is higher than the use of health services for both groups. The majority of the sample was not receiving services at the time of the study. In contrast almost half was using medication which could suggest a high reliance on pharmacotherapy in the treatment of ASD symptomology and comorbid disorders. These results need to be understood in the socioeconomic and political context of the region as well. Public spending on mental health is insufficient in Latin American countries, with limited resources available for mental health treatment and provider education. In countries with limited epidemiological resources, caregiver surveys provide a rich source of information on the demographic and clinical characteristics of caregivers and individuals with ASD. The results point out the need for new research looking at how sociocultural variables influence health-related use and frequency in Latino adults with ASD.

**401.059 (Poster) Mental Health Crisis Assessment Among Adults with Autism Spectrum Disorder in an Outpatient Neuropsychiatry Clinic**

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**Background:**

The prevalence of Autism Spectrum Disorder (ASD) has been notably increasing over recent decades. Consequently, as children with ASD approach and reach adulthood, mental health services will need to adapt to meet the needs of this burgeoning population. Prevailing literature suggests that persons with ASD are more likely to suffer from mental health crises and comorbid psychiatric disorders (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Chen et al., 2017; Joshi et al., 2010; Kalb, Hagopian, Gross, & Vasa, 2018; Nayfack et al., 2014; Turcotte et al., 2016; Vasa, Hagopian, & Kalb, 2020; White, McMorris, Weiss, & Lunsky, 2012). Given the increased likelihood of psychiatric emergencies among persons with ASD, and the rising prevalence of adults with this neurodevelopmental disorder, information is needed regarding mental health crises among adults with ASD.

**Objectives:**

To better understand the prevalence and characteristics of mental health crises among adults with ASD, utilizing the Mental Health Crisis Assessment Scale (MCAS). Specifically, the goals of this study are to: 1) assess the criterion validity of the MCAS, 2) determine the prevalence of and behaviors related to crisis, and 3) examine potential correlates of crisis.

#### Methods:

Data were gathered from adults with ASD receiving treatment in a specialty outpatient neuropsychiatry clinic who were part of an on-going Autism Registry and Bio-Repository Project at Sheppard Pratt (n=60). The MCAS was administered at the point-of-care during clinical encounters, which allowed for immediate clinical use of this assessment. The psychiatrist was able to review MCAS data during the appointment and provide a concurrent rating of crisis. The MCAS rating of crisis was compared to the clinician rating of crisis, considered to be the “gold standard” in this context. Sensitivity, specificity, positive and negative predictive values, as well as area under ROC curve, have been calculated, according to a determined optimal cutoff point for the MCAS total score.

#### Results:

86.6% of patients were correctly classified by the MCAS when compared to clinician rating of crisis. Optimal cutoff score resulted in a ROC score of .925, 100% Sensitivity, 84.9% Specificity, 46.7% Positive Predictive Value and 100% Negative Predictive Value. The prevalence of crisis, per the MCAS, was 13.33%. Verbal Aggression, Disobedience, Tantrum(s), and Self-Injury were the most commonly identified problematic behaviors associated with crisis. Gender, age and education were not associated with crisis, though being of Caucasian race was observed to be associated with crisis ( $p = 0.02$ ).

#### Conclusions:

This study is one of the first to assess mental health crisis through a standardized assessment in a population solely consisting of adults with ASD. The MCAS appears to have strong alignment with mental health providers in the identification of crisis behaviors, and thus, has utility as a clinical screening tool and in characterizing the presentation of psychiatric crisis in this population. Because of the increased psychiatric comorbidity in ASD, such insight into the needs of adults with ASD is essential as the prevalence of this neurodevelopmental disorder in adulthood grows, and the need for appropriate mental healthcare and emergency services similarly increases.

#### **401.060** (Poster) Moving (as an) Autistic Person- Preliminary Findings

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**Background:** Independent living outcomes for autistic people tend to be poor. Whilst estimates vary, it is often the case that autistic people rarely live independently from their parents. Many studies have explored the predictors of independent living status. Yet, to our knowledge, no study has explored the actual decision-making process involved in finding somewhere to live, and the consequent moving experience, of autistic people. It could be that uncertainty around these processes is a barrier to independence for autistic people.

**Objectives:** To explore the moving home processes and experiences of autistic people.

**Methods:** We have been conducting an online survey since May 2020 of both autistic and non-autistic residents of the United Kingdom. The survey comprised demographic information (e.g. age, gender, location, employment); closed questions (e.g. number of times the participant has moved); and open questions (e.g. “How did you realise you wanted to, or needed to, move living place?”). We asked participants to report their stress levels across 5 domains; the decision-making process, finding a new place to live, the moving process, being in the new living place, or other. To date, 213 participants have completed the survey, aged 18–71 (mean=35.5, SD=12.9). In total, 161 participants reported having a formal diagnosis of autism, or self-identified as autistic (75.8%) and 37 reported no such diagnosis/self-identity (17.2%). There were 44 males (20.8%), 119 females (56.1%), 30 who reported another gender identity (14.1%).

**Results:** The autism and comparison groups did not differ on the reported stress for making the decision to move (Hedge's  $g=0.30$ ). However, autistic participants reported significantly greater stress for finding a new living place (65.4 vs 50.8, Hedges  $g=0.50$ ); the moving process (75.7 vs 47.6, Hedge's  $g=0.99$ ); being in one's new living place (58.4 vs 33.2, Hedge's  $g=0.79$ ); and “other” stresses (75.8 vs 20.8, Hedge's  $g=1.70$ ). Visual inspection of the open text responses for the autistic group suggested that paperwork/organisation, loneliness, and uncertainty about the decision were common stressors.

Conclusions: Our initial findings indicate that several facets of moving home, decided a-priori by the research team, are reported to be very aversive for autistic people compared to control participants. Both groups appear to find the decision process equally stressful. However, autistic people find the moving process extremely aversive. Our qualitative responses (to be fully analysed) indicate this may be due to organisation difficulties. Intriguingly, being in one's new living home was reported to be moderately stressful (and more so than for the comparison group, with a large effect size). This could be explained by an intolerance of uncertainty (data to be analysed). The other stressors reported by autistic people are consistent with other findings in the literature. That money came up is not surprising given the employment and overall socio-economic prospects for autistic people. In sum, these preliminary data suggest there are systematic differences in how stressful autistic and non-autistic people experience the process of moving home. Further exploration of the data is underway.

**401.061** (Poster) Objective and Subjective Psychosocial Outcomes in Adults with Autism Spectrum Disorder: A 6-Year Longitudinal Study

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Background:

Many autistic adults find it difficult to attain socially “normative” life goals such as holding a job, living independently or finding a romantic partner (Billstedt, Gillberg, & Gillberg, 2011; Howlin & Moss, 2012; Roux et al., 2013). Where some individuals do exceptionally well, many, including those of average or above average intellectual ability, require care and support throughout adulthood (Hofvander et al., 2009; Lord et al., 2020). However, studies of adult outcomes are mostly based on cross-sectional data in primarily male samples (Lord et al., 2020) and sample size is typically small.

Objectives:

The aim of the present 6-year longitudinal study, incorporating five waves of measurement, is to examine the development and predictors of psychosocial functioning, operationalized both objectively and subjectively, in autistic men and women (18 to 65 years).

Methods:

The sample consisted of 917 adults (425 men, 492 women) with a mean age of 43.5 years, recruited through the Netherlands Autism Register (NAR).

A composite measure of objective psychosocial functioning was based on employment, independent living and friendship ratings, with a total score ranging from 0 (very poor outcome) to 8 (very good outcome). Participants' subjective well-being was rated on a 5-point scale. Predictor variables included age, gender, autism traits (Autism Quotient-Short), intellectual ability, age of ASD diagnosis, parental educational level, and presence of co-occurrent psychiatric conditions.

Latent growth curve models (LGM) were used with the intercept representing the initial level of objective or subjective functioning, and the slope term representing increases or decreases from the intercept with each wave.

Results:

On the objective psychosocial measure, averaged across the five waves, 32.6% of the adults demonstrated a (very) good outcome, 53.5% had a fair outcome, and 13.9% had a poor outcome. On the subjective measure, an intermediate level (3) of subjective wellbeing was reported.

LGM's showed small, but significant growth in objective psychosocial functioning and subjective wellbeing across 6 years. Level and change in objective functioning were correlated with level and change in subjective wellbeing (see Figure 1). Predictors of a good initial objective outcome, explaining 23% of variance, were: higher intellectual ability, absence of co-occurrent psychiatric conditions, fewer autism traits, and older age. Predictors of higher initial subjective wellbeing, explaining 13% of variance, were: lower intellectual ability, absence of co-occurrent psychiatric conditions and fewer autism traits. Men and women did not differ in initial levels of or overall change in objective and subjective outcomes over time.

Conclusions:

In comparison with previous research, our findings provide a more positive outlook for autistic men and women with average to high intellectual abilities by showing a fair to good level of objective psychosocial functioning and a small increase in objective functioning and subjective wellbeing over 6 years. The positive, but modest correlations between levels and change in objective and subjective outcomes suggests that societal success may promote subjective wellbeing and/or high subjective wellbeing increases chances of societal success.

**401.062 (Poster) Online Peer Support for Autistic Medical Doctors**

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**Background:** Autistic medical doctors face specific challenges including difficult social interactions with coworkers, sensory issues in the workplace, and mental health conditions commonly co-occurring with autism. This study aims to evaluate the feasibility of providing a support network for autistic doctors via Facebook, collecting data on participant doctors and their backgrounds, common usage patterns for such a support network, and preliminary qualitative data on the experiences of autistic doctors as they navigate their individual employment experiences.

**Objectives:** This study aims to 1) evaluate the suitability of an online platform for autistic doctors to share experiences, 2) identify usage patterns for this platform and examine how use of the platform changes over time, and 3) identify needs and priorities of this population to inform future study.

**Methods:** A platform available by invite only on Facebook was created and made accessible to doctors identifying as autistic through social media and direct personal contact. The activity of participants on this platform was monitored over the course of a year, with measurements including total members, active members, total comments, and total reactions. Participants were asked to describe the benefits of membership and to comment on their experiences as autistic doctors. Through quantitative data on group usage and qualitative data via user responses, we addressed each of the key objectives.

**Results:** The group comprised 53 members at the initiation of the study and grew to 197 members. An average of 55% of members were active on any given day and this percentage remained steady across the course of the study. Activity was fairly constant, with an average of 20 messages posted to the group per day; over the course of the year, no month averaged fewer than 15 messages per day. Themes in qualitative responses included appreciation of a support group of people with the same experiences, concern about how they were perceived by others, and the difficulty of working with an invisible struggle that others might not understand, with responses including:

- I have found a safe source of support in navigating an NT [neurotypical] world where I don't need to worry about being misinterpreted
- I've gone from struggling being an autistic doctor to being ok with being an autistic doctor to being proud to be an autistic doctor. I used to worry about who to tell I was autistic. Now I tell everyone. It's my identity and I love it
- I've never been able to truly compare the things I find difficult with other doctors before. It's a huge relief, and confirmation that I'm not 'broken'

**Conclusions:** An online group proved to be a feasible and successful setting for autistic doctors to share experiences, support one another, and discuss common issues. While overall usage of the boards did not increase during the year, total membership grew steadily and the majority of members were regularly active. Users were eager to share their priorities, needs, and interests for future research, indicating that future study and advocacy will be feasible and include a population of interested participants.

**401.063 (Poster) Parenting on the Spectrum: A Systematic Scoping Review of Parenting Experiences and the Mental Health of Parents with ASD or Autistic Traits**

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**Background:** As our knowledge and detection of Autism Spectrum Disorder (ASD) has improved over recent decades, the number of people diagnosed with ASD in their adult years has also increased. Little research has been conducted into the parenting experiences, and mental health status of parents who either have a diagnosis of ASD, or show a number of sub-

diagnostic autistic traits, commonly referred to as the 'Broader Autism Phenotype' (BAP). To our knowledge, there are no reviews that bring together the current literature in this area.

**Objectives:** This systematic scoping review aims to explore the literature regarding parenting experiences of parents who either have a diagnosis of ASD, or those who self-report has having a number of sub-diagnostic autism traits (BAP), as well as the prevalence of mental health difficulties in this population. Findings from this review will be used to help identify gaps in the research literature pertaining to parenting on the spectrum, and whether parenting programs may need to be adapted to serve the specific needs of this population.

**Methods:** This systematic scoping review follows the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist. In September 2020, PsycINFO, Cochrane Library, MEDLINE, EMBASE, and SCOPUS were searched, using the following broad search terms, adapted for each database as needed: (ASD OR autism OR autistic OR child development disorders OR Childhood schizophrenia OR child\* OR pervasiv\* OR kanner\* OR Pervasive development\* disorder\* OR PDDs OR PDD-NOS OR autism spectrum disorder OR asperger syndrome, autistic disorder) AND (parent\* OR difficult\* OR problem\* OR issue\* OR emotion\* OR Family function\* OR coping OR stress\* OR psychopatholog\* OR mental health OR mental wellbeing\* OR psychological OR psychopathology OR mental health OR mental disorders OR adaptation OR emotional adjustment OR feedback OR personality). Articles were uploaded into the COVIDENCE software for title and abstract screening, followed by full text screening. For an article to be included in the final review, the following criteria must be met 1) at least one parent of any age and sex identifiable with ASD or BAP; 2) Quantitative or qualitative data on the mental wellbeing of the parent, parenting problems or experiences or issues/difficulties in the family functioning and; 3) the parent can have a typically developing child or have a child with ASD or BAP.

**Results:** 15,244 articles were located initial search. After the duplicates are removed, 8,948 articles are currently being screened by 2 review authors.

**Conclusions:** Despite the rising number of adults with ASD or BAP, little research has focused on the parenting experiences of these individuals, or the impact that this can have on the parent-child relationship, mental wellbeing of the parent or wider family functioning. The initial search has revealed that some research has been conducted in this area, and a narrative synthesis of this will significantly add to the limited research in this area, to support best clinical practice with these parents.

**401.064 (Poster) Peas in a Pod: Oral History Reflections on Autistic Identity in Family and Community By Late-Diagnosed Adults**

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**Background:** This paper reports on an oral history study documenting the lives of late-diagnosed Autistic adults in Australia. This qualitative study, co-produced with Autistic researchers, offers insight into the lived experience of Autistic adults.

**Objectives:** A qualitative oral history methodology was adopted to document the experiences of Autistic adults who grew up in an era when autism was not well known. The overall objective of this project was to increase understanding about the lives of late-diagnosed Autistics. This study analyses Autistic perceptions of the self and ideas about shared identity that emerged as salient themes in these interviews.

**Methods:** Twenty-eight participants were recruited. All were born before 1975 and received a clinical autism diagnosis after the age of 35. All interviews (M length = 129 minutes) were conducted by Autistic researchers, transcribed and then thematically analysed by a team of Autistic and non-autistic researchers using the six-step process outlined by Braun and Clarke. The team met weekly to discuss coding, themes and subthemes to co-produce an iterative and reflexive analysis of the data.

**Results:** We identified three major themes within these oral history reflections relating to shared Autistic identity. The first theme, 'conceptualising the Autistic family', included reflections on both immediate and extended family. Interviewees talked about how they identified with their children diagnosed with autism, describing themselves as 'peas in a pod'. They also spoke about retrospectively identifying other family members as Autistic. The second theme, 'creating Autistic community', refers to a sense of shared identity participants expressed in relation to Autistic communities, both online and face-to-face. This sense of community was often referred to using the metaphor of 'tribe'. Interviewees also stated that they had developed an ability to identify other people as Autistic thereby extending the idea of community to potentially encompass others not formally identified by diagnostic professionals. The third theme, 'Contesting Autistic identity', suggests that these processes of identity formation and community creation are not always straightforward. Sometimes other people, including family members and professionals,

rejected the Autistic identity of interviewees. This rejection was reported to cause considerable distress. At other times, interviewees indicated that there have been times when they have questioned their own identity as Autistic or even the coherence of the current diagnostic construct of 'Autism Spectrum Disorder'.

**Conclusions:** These themes reflect the complexity of all processes of identity construction, including membership in diagnostic categories. In identifying family members and others as Autistic, our participants asserted the value of their own embodied understanding of autism, providing an implicit alternative to the dominance of professional diagnostic practices. Their accounts of finding a 'home' in Autistic communities extend the idea of family, creating a safe space in which to belong. Reports of questioning Autistic identity provide insights into identity formation as both processual and, on occasion, contested. Overall, these ideas about identity and community challenge orthodox understandings of autism, which is understood as an increasingly common and, as one interviewee expressed it, 'natural part of the human spectrum'.

**401.065 (Poster)** Perceived Negative Impact in Caregivers of Individuals with Autism Spectrum Disorders: A Longitudinal Study from Late Childhood to Early Adulthood

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**Background:** Research demonstrates caregivers raising a child with autism experience increased parental burden and stress, often resulting in negative effects on families and relationships. Similar to parental burden, perceived negative impact is the degree to which a caregiver reports negative experiences (i.e., financial, social, or emotional burden) due to having a child with a disability (Messer et al., 1996) and is considered a significant predictor of long-term parenting stress (Trute & Hiebert-Murphy, 2005).

**Objectives:** This longitudinal study aims to define distinct, parental perceived negative impact trajectory classes across three time points making comparisons between classes.

**Methods:** Participants ( $n = 209$ ) were drawn from an ongoing longitudinal sample, comprised of caregivers whose child received an early ASD diagnosis or had developmental delay (see Lord et al., 2006). Perceived negative impact was assessed at three times ( $Mage = 10, 13, 19$ ) via caregiver interview using Child and Adolescent Impact Assessment (CAIA; Messer et al., 1996). Characteristics examined include autism severity, adaptive skills, race, gender, caregiver education, cognitive abilities, and social support.

**Results:** Latent class growth modeling determined three trajectory classes (i.e., low impact decreasing ( $n = 68, 31.7\%$ ), medium impact fluctuating ( $n = 98, 45.8\%$ ), and high impact decreasing ( $n = 43, 22.5\%$ ) (See Figure 1 for trajectory groups). Chi-square test of independence revealed non-white caregivers ( $X^2(2, N = 209) = 15.93, p < .00$ ), with less than a bachelor's degree ( $X^2(2, N = 209) = 15.16, p < .00$ ), and strong social supports ( $X^2(2, N = 115) = 7.96, p < .02$ ), to more likely be in the low impact class. Significant differences were found between classes in autism severity ( $F(2,128) = 5.57, p = 0.005$ ) and adaptive functioning ( $F(2,142) = 4.96, p = 0.008$ ). Post hoc comparisons revealed the low impact class (ADOS-2:  $M = 4.23, SD = 2.36$  & VABS-II:  $M = 72.23, SD = 23.49$ ) to be statistically significantly different from the medium and high impact class in autism severity (ADOS-2:  $M = 5.71, SD = 2.17, p = 0.005$ ; ADOS-2:  $M = 5.59, SD = 2.35, p = 0.043$ , respectively), and adaptive functioning (VABS-II:  $M = 60.68, SD = 20.87, p = 0.027$ ; VABS-II:  $M = 57.2, SD = 57.23, p = 0.012$ , respectively).

**Conclusions:** This longitudinal study extends our knowledge of trajectory classes in perceived negative impact into young adulthood. Results indicated perceived negative impact decreases across time, but at varying degrees. In this sample, caregivers in the low impact trajectory were more likely to be minorities, less educated, more socially supported, and have young adults with less severe autism and higher adaptive skills. These findings are consistent with previous research (Bishop, Richler, Cain, & Lord, 2007; Carr & Lord, 2012). In contrast, high negative impact class was more likely to have young adults with low adaptive skills and increased autism symptomology. In sum, information gathered from this study may improve clinicians' ability to understand families, may inform clinical practices and interventions to improve the lives of individuals with autism.

**401.066 (Poster)** Performance on the Transition Readiness and Employability Evaluation (TREE) in Transition-Age Youth with and without Autism Spectrum Disorder

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**Background:** Although many adults with autism spectrum disorder (ASD) are cognitively capable of obtaining competitive employment, they are often unemployed or underemployed (Taylor&Dawalt,2017). Self-reported "soft skills" related to

employment success in individuals with and without ASD have been previously identified (Gal et al., 2015), but few measures are available to identify specific differences in transition skills between adolescents and young adults with and without autism. An objective measure that documents specific challenges experienced by individuals with ASD is needed.

**Objectives:** 1) Compare differences in transition readiness using the *Transition Readiness and Employability Evaluation* (TREE) and 2) Characterize the samples on level of coping skills, executive function, and anxiety.

**Methods:** Participants included 52 students with ASD ( $M_{age}=18.1, SD=1.40$ ; 78.8%-male) and 20 university students without ASD ( $M_{age}=19.10, SD=1.05$ ; 25%-male). Students with ASD were assessed before participation in a college-based intervention, the T-STEP. Non-ASD participants were excluded if their Social Responsiveness Scale score (SRS-2 self-report; Constantino & Gruber, 2012) was above the clinical cutoff ( $n=2$ ). Participants completed the TREE, an objective behavioral assessment of employment readiness consisting of two typical office tasks (e.g., data entry, collating skills) with a series of social communication presses to assess employment readiness soft skills (e.g., corrective feedback, disruptions to work, conversation). The TREE factor structure derives three domains (Social Initiation, Task Organization and Accuracy, and Social Problem Solving) with higher scores indicating more impairment. SRS-2 profiles (informant or self-report) were compared between the groups using independent samples t-tests. Performance on the TREE, Coping Self Efficacy Scale (CSE), Behavior Rating Inventory of Executive Function for Adults (BRIEF-A), and Trait Anxiety Scale (STAI) was compared between groups using Mann-Whitney U tests.

**Results:** The SRS-2 confirmed the presence of autism features in the ASD group ( $M_{ASD}=67, SD=9.68$ ;  $M_{Non-ASD}=48.94, SD=5.36$ ),  $t(52)=-8.88, p<.001$ . Results on the TREE indicated that Social Initiation ( $U=630.5, p=.028$ ) and Social Problem Solving ( $U=636, p=.009$ ) scores were lower in the non-ASD group, with no significant difference in Task Organization and Accuracy ( $U=591.5, p=.079$ ; see Figure 1). Mann-Whitney tests indicated that those in the non-ASD group had higher scores on the CSE problem-focused coping ( $U=115, p<.001$ ) and get support from friends and family ( $U=169, p=.006$ ) subscales. Young adults in the non-ASD group had fewer difficulties on the BRIEF-A behavior regulation ( $U=450, p=.036$ ) and metacognition indices ( $U=582, p<.001$ ). Clinical levels of anxiety were high in both groups (82.4%-ASD, 70.6%-non-ASD).

**Conclusions:** TREE results demonstrate impairment in employment readiness in ASD in social workplace functioning (Social Initiation and Social Problem Solving domains). The similar work quality in both groups (Task Organization and Accuracy domain) highlights the many strengths in adults with ASD in the workplace (e.g., attention to detail, memory skills; Russell et al., 2019). Analyses revealed differences in students with and without ASD in coping skills (e.g., seeking social support and problem-focused coping) and executive function (e.g., ability to regulate behavior and emotion, planning, organizing, problem-solving). Both groups presented with high anxiety and similar abilities in emotion-focused coping. These results indicate that “soft skills” are an important area for intervention in transition-age youth with ASD and the TREE might be a good objective measure of social initiation and problem-solving challenges.

**401.067 (Poster)** Physical Health and Quality of Life Differ By Biological Sex and Age of Autism Diagnosis in an Adult SPARK Sample.

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**Background:** Autistic adults appear to experience more physical health problems (Croen et al., 2015; Cashin et al., 2017) and poorer quality of life (QoL; Mason et al., 2018) than their neurotypical counterparts. Recent findings suggest that autistic women may be susceptible to poorer QoL (Holmes et al., 2020) and physical health (Weir et al., 2020) than autistic men; it is unclear how this relates to evidence that autistic women are underdiagnosed or diagnosed later in life in comparison to their male peers (Hull et al., 2020).

**Objectives:** We aimed to examine whether birth-assigned sex and age of first autism diagnosis were associated with physical health symptoms and QoL in a large autistic adult sample. We hypothesized that female sex and later diagnosis each would be associated with a greater number of physical health symptoms and lower QoL, and we planned to test the interaction of these predictors.

**Methods:** N=749 participants (age 18-46 years, M=31 years; n=473 females) were recruited through the Simons Foundation Powering Autism Research (SPARK) registry to complete online questionnaire batteries as part of a larger study. Mean age of autism diagnosis was 19.64 years. The Patient Health Questionnaire (PHQ-15; Kroenke et al., 2002), World Health Organization Quality of Life assessment (WHOQoL-BREF; WHO, 1998), and the Autism-Specific Quality of Life assessment (ASQoL; McConachie et al., 2018) were used to operationalize physical health, general quality of life, and autism-specific quality of life respectively. Linear regression models were used to examine whether sex, age of autism diagnosis, and their interaction predicted

PHQ, WHOQoL, and ASQoL scores. We controlled for chronological age in the PHQ model, and for PHQ scores in the QoL models.

**Results:** Birth-assigned sex was a significant predictor of physical health symptoms ( $\beta=-0.217$ ,  $t(738)=-6.079$ ,  $p<0.001$ ), with females ( $M=7.44$ ,  $SD=4.52$ ) experiencing greater physical health problems than males ( $M=5.44$ ,  $SD=4.02$ ). Greater physical health symptoms ( $\beta=-0.272$ ,  $t(738)=-7.524$ ,  $p<0.001$ ) and later age of diagnosis ( $\beta=-0.137$ ,  $t(738)=-2.930$ ,  $p=0.003$ ) were significantly associated with lower WHOQoL scores. Physical health symptoms ( $\beta=-0.272$ ,  $t(738)=-7.737$ ,  $p<0.001$ ), age of autism diagnosis ( $\beta=-0.203$ ,  $t(738)=-4.466$ ,  $p<0.001$ ), and biological sex ( $\beta=0.090$ ,  $t(738)=2.585$ ,  $p=0.01$ ) each predicted ASQoL scores, with female sex, later age of diagnosis, and greater physical health symptoms independently associated with lower ASQoL scores.

**Conclusions:** Birth-assigned female sex was associated with greater physical health problems and poorer autism-specific quality of life, though it was not associated with general quality of life. Greater physical health symptoms and later age of autism diagnosis were both independently associated with poorer general and autism-specific quality of life. Notably, we observed no significant interactions between female sex and later age of diagnosis on these outcome variables within our regression models. These findings suggest that detecting ASD earlier in life may provide long-term benefits that ultimately lead to better quality of life in adulthood. More research is needed to understand the mechanisms by which autistic women (vs. men) may experience poorer physical health and more difficulties related to autistic status.

#### **401.068 (Poster) Positive ASD-Traits: The Self-Perceptions of Adults with ASD**

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**Background:** Autism spectrum disorder (ASD)-traits are commonly described using deficit language. The focus on deficit contributes to stigma around ASD (Gillespie-Lynch et al., 2017; Kapp et al., 2013; Kenny et al., 2016). Feelings of stigmatization may prevent individuals with ASD from disclosing their diagnosis, and advocating for higher education or workplace accommodations (Anderson, 2013). A body of research seeks to reframe the deficit language narrative using a strength-based approach to recontextualize ASD-traits (Kapp, Gillespie-Lynch, Sherman & Hutman, 2013). The current study examines the extent to which individuals with ASD identify with positive ASD-trait descriptors.

**Objectives:** This study examined a taxonomy of positive ASD-trait descriptors (Wong et al., 2019), and the degree to which specific traits and categories within the taxonomy are relevant to adults with ASD. Secondary aims explored the relationship between self-perceptions of positive ASD-traits, and the extent to which adults with ASD disclose their diagnosis, and advocate and receive higher education and employment accommodations.

**Methods:** A convenience sample of participants with ASD ( $n=85$ ; age 18+, with 64% > age 29) was recruited through social media (Twitter, Reddit). Participants reported a formal diagnosis of ASD (80%), or a self-diagnosis (20%). A majority of participants (57%) had a minimum of a 2-year college degree, and 69% were employed ( $n=59$ ; 39=full time, 20 part-time).

Participants completed the ASD-ness Taxonomy (Wong et al., 2019) questionnaire online. The ASD-ness Taxonomy asked participants to review a list of 38 positive ASD-trait descriptors listed within eight different categories, and to select the descriptors to which they identified. Participants also responded to 22 questions about (a) their perceptions of positive ASD-traits, and (b) the extent to which they disclosed their diagnosis and advocated for higher education and workplace accommodations. Frequency data per unique response, category, and trait were calculated. A rank order categorical unique response determined the relevance of each trait-category, and each individual trait descriptor per participant. Regression analysis was used to examine the predictive ability of beliefs about positive ASD-traits on disclosure and self-advocacy

**Results:** Participants rated all ASD-ness trait descriptors as relevant. The categorical ranking identified the following trait-categories as most relevant: (a) Focus (80%), Fair/Just (76%), Cognitive/Visual (73%), and Humor (73%). The highest rated individual trait descriptor included: Prefer to spend time alone (91%), Unconventional, open minded and tolerant (88%), and Retain/Absorb large amounts of information about specific topics of interest. Linear regression analysis revealed a significant positive relationship between individual perception of positive ASD-trait endorsement and disclosure,  $R^2=.225$ ,  $F(1,83) = 24.10$ ,  $p = .000$ . A majority of participants (80%) reported a need for workplace or school accommodations, but few participants (28%) reported having accommodations available.

**Conclusions:** The findings corroborate prior research advocating for a strengths-based ASD-trait descriptors (Kapp, 2020; Russell et al., 2019), as the majority of participants identified with the positive ASD-ness taxonomy. The relationship between

perceptions of positive ASD-trait and disclosure, as well as the discrepancy between the need for and access to accommodations, suggests that efforts to promote positive ASD-trait descriptors may be useful to reduce ASD stigma.

**401.069** (Poster) Post-High School Daily Living Skills in Autism Spectrum Disorder

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**Background:** Daily living skills are predictive of positive outcomes in individuals with autism spectrum disorder (ASD), yet little is known about trajectories of daily living skills in adults with ASD. Further, longitudinal research on DLS in ASD is relatively rare. The current literature suggests DLS age equivalents, though not necessarily standard scores, tend to increase throughout childhood, but the DLS of children with ASD are lower and increase more slowly than in typical children and children with ID. It has been suggested that DLS age equivalents may begin to decline as individuals with autism enter their mid- to late-twenties, though evidence for this is inconclusive. Given the relationship between higher DLS and positive outcomes, this is troubling. This study investigated the impact of high school exit on participants' trajectories of daily living skills age equivalent (DLS-AE) scores from ages 2-26 and the relationship between DLS-AE trajectories and employment and education outcomes.

**Objectives:** To investigate the impact of high school exit on participants' trajectories of daily living skills age equivalent (DLS-AE) scores from ages 2-26 and the relationship between DLS-AE trajectories and employment and education outcomes.

**Methods:** 98 adults with ASD were drawn from an ongoing longitudinal study. The Vineland Adaptive Behavior Scales were administered 8 times from ages 2-26. Employment and education data were compiled from parent-report demographic forms. Group-based trajectory modeling was used to identify trajectories in DLS development. Binary logistic regressions were used to examine the relationship between DLS trajectories and post-high school education and employment outcomes.

**Results:** A two-group model was determined to be the best fit, based on the percentage of variance explained (Figure 1). The Lower DLS-AE group's linear trajectory was characterized by slow gains from ages 2-21, with a small dip in DLS-AE at age 26. The higher-DLS group's quadratic trajectory was characterized by an increase in DLS-AE from ages 2-18, followed by a marginal increase in DLS-AE at age 21 and a decrease in DLS-AE at age 26. Participant characteristics by trajectory are presented in Table 1. DLS-AE trajectories increased with age prior to exiting school, at which point DLS-AE trajectories plateaued, then declined. A significant ( $p < .01$ ) decrease occurred in the slope of DLS-AE trajectories following school exit. DLS-AE scores predicted participation in post-secondary education ( $\chi^2(5, n = 73) = 27.83, p < .001$ ). Autism symptom severity predicted participation in employment ( $\chi^2(5, n = 58) = 27.54, p < .001$ ).

**Conclusions:** These findings provide evidence that DLS declines in adults with ASD, specifically after school exit, and highlight the importance of DLS in normative adult outcomes. Extending prior work in this sample, we found participants' DLS-AE trajectories increased prior to leaving the school system, at which point DLS-AE trajectories appeared to plateau, then decline. High DLS-AE scores predicted participation in post-secondary education, though ADOS CSS was a stronger predictor of obtaining employment after school exit. Future work is needed to examine the trajectories of DLS in later adulthood and to consider intervention targets for bolstering DLS following school exit.

**401.070** (Poster) Postsecondary Education Achievement and Employment Success in Adults with Self-Reported Autism Diagnosis

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**Background:** There is a rapidly growing number of adults entering adulthood with an autism diagnosis. This means that there are more autistic adults who are seeking postsecondary education and employment opportunities. Previous studies indicate that, regardless of cognitive and verbal ability, autistic adults have a more difficult time than non-autistic adults in entering work and educational settings and tend to have a less successful experiences in these settings. Despite these well-known difficulties, only a limited number of studies have examined the specific predictors of unfavorable outcomes in postsecondary education and employment. Even fewer studies to date have examined multiple predictors at once.

**Objectives:** The present study aims to add to the literature by looking at interactions of several key variables that contribute to the postsecondary and employment outcomes and their relationships in verbally-fluent autistic adults, including intolerance of uncertainty, camouflaging (masking autistic traits to mimic neurotypical styles), depression and anxiety.

**Methods:** The present study sampled 300 autistic adults (200 who were recruited from social media, and an additional 100 recruited from our previous studies including ADOS-2 confirmation of autism diagnosis). Structural equation modeling included Mental Health as a latent variable comprising scores from the NIH PROMIS anxiety and depression measures. Vocational and education success (called Outcome from this point on) was represented as a latent variable comprising of scores from the Vocational Index and the WHODAS 2.0. The SEM contained three mediational analyses: intolerance of uncertainty (IUS) mediating the relationship from autism traits (AQ) to Mental Health; Mental Health as a mediator for the relationship from AQ to Outcome; and Mental Health as a mediator for the relationship from camouflaging (CATQ) to outcome. Sex (male or female) was also included in the model as a possible predictor. We added additional questions about the effect of the COVID-19 on overall well-being.

**Results:** All pathways were in the expected direction showing particularly strong impact from IUS and camouflaging to mental health, and links from mental health to job and educational outcomes. Sex did not significantly predict for Outcome. Qualitative analysis showed that participants have experienced added burdens regarding unemployment, financial constraints, increased stress and anxiety, and loss of health due to the COVID-19 pandemic.

**Conclusions:** Many activities of independent living, such as successfully navigating a job interview, require meeting expectations of neurotypical interaction styles, and organizing complex workloads. Yet research including our results shows that camouflaging behavior negatively impacts mental health which negatively impacts job and educational success, resulting in a difficult tension. Our results suggest that effective supports for long-term independent living outcomes in autism must account for the “building blocks” of mental health that have specificity for autism including IUS and camouflaging.

**401.072 (Poster) Predictors of Perceived Stress Among Independent Adults with Autism during the COVID-19 Pandemic**  
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**Background:** The COVID-19 pandemic has been disrupting daily life and routines, resulting in stress for many adults with autism. Research indicates that individuals with ASD are more vulnerable to developing comorbid anxiety and mood disorders compared to neurotypical individuals (Hofvander et al., 2009, Kanai et al., 2011). However, less is known about the impact of prolonged stressful life events on perceived distress and factors that may affect an individual’s likelihood of perceiving higher distress. One study has shown that emotional vulnerability in people with ASD varies according to gender and age, with adult females at high risk (McGillivray & Evert, 2014).] Our study sought to identify the differences in self-reported distress experienced during the COVID-19 pandemic by independent adults with autism in the SPARK cohort.

**Objectives:** To identify demographic predictors of distress among independent adults in the SPARK study during the COVID-19 pandemic.

**Methods:** SPARK is an online research study of individuals with a professional diagnosis of autism and their family members. SPARK surveyed 636 independent adults with autism from 3/10/20–4/10/20 and 396 adults again from 5/27/20–6/9/20 to better understand the impact of COVID-19. Data for this study are from the second timepoint. Participants without Background History Questionnaires previously collected were excluded from analysis. Ordinal regression analysis was used to identify predictors of the level of family distress. The primary dependent variable was the single-item scale from the Brief Family Distress Scale. Responses were categorized into 3 levels of impairment: none, moderate, and marked. Independent variables used for analysis included age, race, household income, sex at birth, education level, and sexual orientation. Analyses were completed using SPSS.

**Results:** A total of 321 autistic adults between 18-74 years old were included in the study. Table 1 includes demographic information on the participants. The majority of participants did not endorse any distress (59%); 21% endorsed moderate distress and 10% marked distress.

Significant predictors of higher perceived distress included being female, identifying as non-heterosexual, and having lower income ( $p < .05$ ). Independent adults who identify as non-heterosexual were 1.96 times more likely to report higher distress compared to heterosexuals (95% CI: 1.22, 3.13). Having higher income protected against experiencing distress, with those in the lowest income bracket 3.2 times more likely to report distress than those in the highest bracket ( $> \$81K$ ; 95% CI: 0.16, 0.62). Females were 1.6 times more likely to report higher distress compared to male counterparts (95% CI: 1.02, 2.67).

**Conclusions:** This study found that female at birth, non-heterosexual sexual identity, and lower income level were associated with greater perceived distress among autistic adults. Autism researchers, community partners, and healthcare providers should be aware of the distress experienced by independent adults with autism during the COVID-19 pandemic and create accessible

resources for patients to help identify and manage distress. Special attention should be dedicated to investigating specific risks for autistic adults with intersectional identities.

**401.073 (Poster)** Preliminary Evidence of Dynamic Control Differences in Curve Negotiation in Drivers with and without Autism Spectrum Disorder

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Background: Negotiating horizontal curves is a high-risk tactical control maneuver when operating a motor vehicle, as drivers must simultaneously and adeptly control their steering adjustment, speed, and lane positioning, as well as accurately perceive the curvature of the road segment and adjust to proprioceptive cues. Given known differences in upper body motor control, coordination, proprioception, and attention, this maneuver may be particularly difficult for drivers with autism spectrum disorder (ASD). However, no study to date has investigated how curve negotiation among these drivers may differ from that of their typically-developing (TD) counterparts.

Objectives: The objective of this study is to examine how vehicle dynamic variables differ during horizontal curve negotiation among drivers with ASD compared to TD drivers. Given that effective curve negotiation involves employing various tactical skills at different segments of the curve, it is also of interest to explore how steering control differs at varying segments of a curve.

Methods: Thirty-one licensed adolescent and emerging adult drivers ( $n_{ASD} = 13$ ,  $n_{TD} = 18$ ) matched on age ( $M = 20.00$  years;  $SD = 2.75$ ), gender (61.3% male), and IQ ( $M = 105.97$ ;  $SD = 16.12$ ) were recruited. Participants completed a 13-mile experimental drive in a high-fidelity driving simulator. During this drive, participants navigated 2 residential horizontal curves (1 left, 1 right) with a radius of approximately 200m, an angle of approximately 60°, and a distance of approximately 510m. For analysis, the curves were segmented into 6 sections to compare driving performance at each segment (curve approach, curve entry, apex entry, apex exit, curve exit, exit tangent). Outcome measures of interest included longitudinal velocity (mean and SD) and longitudinal acceleration (mean and SD).

Results: Driving performance was averaged across the 2 curves. A 2 (Group) x 6 (Curve Segment) mixed-model analysis of variance (ANOVA) revealed a significant Group x Curve Segment interaction for mean acceleration,  $F(4.1, 110.73) = 2.82$ ,  $p = .03$ , partial eta-squared = .10. Drivers with ASD had a faster average acceleration than TD drivers at apex exit ( $M_{ASD} = .001$ mph/s,  $M_{TD} = -.00006$  mph/s), and a slower acceleration at curve exit ( $M_{ASD} = -.002$  mph/s,  $M_{TD} = 0$  mph/s). Other variable comparisons were non-significant, all  $p > .05$ .

Conclusions: When navigating curves, drivers typically begin accelerating slowly at the apex of a curve and continue to accelerate through the end of the curve, allowing the driver more time to visually scan and limit potential vulnerability to opposing traffic during the curve (Hough 2008). There is evidence to suggest that drivers with ASD may follow a different acceleration profile than TD drivers. Drivers with ASD may have curve negotiation profiles similar to novice drivers, whose turns are started earlier as opposed to delayed apexing in experienced drivers. Further investigation into the nature of steering control within this population is needed to better understand how this population maintains a controlled vehicle heading throughout curve negotiation. Better quantification of difference can help inform future training and education protocols to ensure safe driving among young drivers with ASD.

**401.075 (Poster)** Quality of Life and Associated Factors in Adolescents and Young Adults with Autism Spectrum Disorder: Evaluation of Self-Reports and Parent Proxy-Reports in a Danish Clinical Cohort Followed for 8-18 Years.

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Background: Quality of life (QoL) and factors associated with QoL, considering the perspectives of both parents and their offspring, are not well understood in adolescents and young adults (AYA) with autism spectrum disorders (ASD), despite that ASD is known to have a persistent adverse effect on physical and mental health.

**Objectives:** Examine self-reported and parent proxy-reported QoL and factors associated with QoL in a clinical cohort of AYAs diagnosed with ASD in childhood and followed for 8-18 years.

**Methods:** The study cohort comprised all consecutive referrals for an ASD evaluation of children  $\leq 7$  years old and residing in Aarhus County, Denmark, 2000-2010, and who received an ASD diagnosis before the end of follow-up in 2016 (n=621). Analysis was restricted to AYA with ASD and/or parents (n=194; 31%) who completed a questionnaire survey, Oct 2018 - Jan 2019, on QoL and other factors. Data for analysis included diagnoses, cognitive level and clinical features at initial assessment; registry-reported demographic and health information; and questionnaire data on QoL (KIDSCREEN-27), autism symptoms (Social Communication Questionnaire SCQ) and other behavioral symptoms (Social Difficulties Questionnaire SDQ), social relationships and bullying. QoL reports were compared with normative data (z-test of proportion) and between AYA-parent pairs (intra-class correlation coefficient ICC). Multivariate linear regression models assessed the effects of demographic characteristics, autism symptoms, co-occurring symptoms, parental educational level and social relationships on QoL.

**Results:** Characteristics of AYA with ASD at follow-up comprised: mean age 18 years; 79% male; 81% IQ>70 at baseline; co-occurring ADHD 28% (most frequent co-occurring diagnosis); 81% lived with at least one parent; 57% with at least one parent with  $\geq 15$  years of education; mean SCQ lifetime score 19.2; and mean SCQ current score 13.2. Compared to normative levels for the KIDSCREEN-27, AYA with ASD and their parents reported significantly lower QoL in *physical wellbeing*, *psychological wellbeing*, *social support and peers*, while *autonomy and parent relations* were similar; for *psychological wellbeing* and *social support and peers*, AYAs with ASD scored on average a full standard deviation below the mean of the normative data. Agreement between AYA and parents on most QoL dimensions was moderate (ICC 0.50-0.70). All factors, except age, IQ and parental educational level, were individually associated with QoL. In fully adjusted models and both self-reports and parent proxy reports, *emotional problems* (SDQ emotional domain score regression coefficient, self-report -15.47, 95%CI (-23.2;-7.8), parent report -6.84, 95% CI (-13.1; -0.6)), *peer problems* (SDQ peers domain score regression coefficient, self-report -6.43, 95%CI (-11.8; -1.0), parent report -5.12, 95% CI (-9.5; -0.8)), and *bullying* (regression coefficient, self-report -6.06, 95%CI (-10.5; -1.6), parent-report -5.13, 95% CI (-9.7; -0.6)), explained most of the variance in QoL total scores.

**Conclusions:** For a complete picture of QoL in autistic youth both AYA and parent perspectives are important. Interventions targeting symptoms of emotional disorders, peer problems and bullying may have greatest QoL impact in AYA with ASD.

**401.077 (Poster) Ready 2 Work: Development of a User-Informed Employment Website for Job Seekers with Autism**  
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**Background:** Employment success has been identified as a top priority for people with autism in Canada, both locally and nationally. Despite evidence indicating that people with autism are motivated to obtain employment, rates of unemployment and underemployment remain among the highest in the country. Considerable research has focused on personal and social characteristics that contribute to meaningful employment for people with autism; however, an exploration of the complimentary skills or tools that job seekers with autism need to engage in the job-seeking process is lacking. Online resources may be helpful; however, little is known about what people with autism need to effectively engage in job-seeking, networking, and marketing of their skills to potential employers. **Objectives:** The purpose of this research is to 1) understand what job seekers with autism, caregivers, and employment professionals perceive to be important for job seekers with autism to successfully enter the workforce (Phase 1) and to use this end-user feedback to develop an online employment platform (Phases 2 and 3). **Methods:** In Phase 1, five focus groups were conducted with 29 participants (i.e., 7 autistic self-advocates, 6 caregivers of people with autism, 16 professionals from relevant vocational and employment organizations) about the employment needs of job seekers with autism that could be addressed through an online platform. A thematic analysis of the focus group data was conducted. Currently, these results are being used to develop (Phase 2) and refine (Phase 3) an online platform that will be assessed by collecting additional survey, interview, and website analytics data from participants who will be interacting with it. **Results:** The participants from the Phase 1 focus groups described a variety of structural (e.g., unavailability of suitable positions) and social barriers (e.g., negative attitudes toward people with autism) that job seekers with autism face. Participants provided several recommendations for helpful website content including career exploration and assessment, employment accommodations, advocacy and disability rights in the workplace, networking, and job skills training. Participants highlighted the value of including distinct resources for family members and support persons (e.g., how to support a job seeker in their employment search), job seekers (e.g., how to dress for an interview), and employers looking to hire job seekers with autism (e.g., understanding job accommodations). Regarding the interface of the platform, participants indicated a preference for clear and interactive multi-media options to present content (e.g., pictures, videos, straightforward text) in addition to an interactive and dynamic section for networking (e.g., discussion board). Website development, factoring in the findings from our focus groups, is currently underway. **Conclusions:** This innovative research approach to developing an online employment resource focuses on engaging end-users and key stakeholders throughout

the process. The results of this study will add to the limited knowledge about the work readiness skills and resources that are tailored to the idiosyncratic needs of job seekers with autism.

**401.078 (Poster)** Remembering to Remember: Contextual References As a Mechanism to Support Time-Based Prospective Memory in Autistic Adults

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**Background:** Time-based prospective memory (TBPM) is remembering to perform an intended action, at an appropriate future time. TBPM is essential for autonomous living and everyday functioning. For instance, TBPM is when we remember to turn the oven off after an hour or attend a medical appointment next week. A growing body of research suggests that both autistic children and adults experience difficulties with TBPM. Research within the typically developing literature has investigated ways to improve prospective memory. For example, by simply giving individuals an idea of the context in which a future task will occur. However, crucially, to date no studies have explored the extent to which such techniques can improve TBPM difficulties for autistic individuals.

**Objectives:** Aims: to investigate how contextual references can be used as a mechanism to facilitate improved TBPM for autistic individuals.

**Methods:** A community sample of 80 autistic (AS, n=40) and non-autistic (NT; n=40) adults completed online TBPM tasks (counterbalanced between-subjects; see Figure 1). Groups were matched on age, gender, and IQ across conditions.

We compared TBPM accuracy for no contextual information (baseline) vs accurate (Correct Context) or inaccurate (False Context) information. The TBPM task was embedded in a 6-minute online computer task to sort words (block 1) and pictures (block 2) as food or non-food items (ongoing task). Participants were instructed to monitor time via the on-screen timer (press 'z'). The TBPM action was to 'log the time' (press 'space') when the clock showed 3-minutes (target time, +/-10s lenience). In the Correct Context and False Context conditions, participants were given information (cue) that the target time would likely appear in block 2. In the case of the former this cue was correct, but incorrect in the latter. If the switch to block 2 did serve as a cue to make the TBPM response, then we predicted improved TBPM accuracy in the Correct Context condition.

**Results:** Partial analysis of (fully collected) data (2 (Group) x 3 (context) ANOVA) are reported for TBPM accuracy and time monitoring. Preliminary data (AS=30; NT=17) show, on average, that TBPM accuracy for both groups was within +/-10s, across conditions. AS adults were more vigilant in time monitoring (i.e., more clock checks) and showed improved PM accuracy in the Correct Context (~25%) compared to No/False Context conditions ( $t(28) 2.58, p=.02, d=.48$ ).

Further analyses of individual differences are ongoing (to be completed January 2021), and some findings may be subject to change.

**Conclusions:** The preliminary findings indicate that the use of targeted contextual information may help to ameliorate TBPM difficulties for autistic adults. Furthermore, where autistic adults monitored the time more often, this might suggest important differences in reliance on external supportive strategies (e.g., more clock checks) as well as contextual information, rather than strategically self-monitoring their internal memory. Our discussion of these findings will provide important implications for novel strategies that can support TBPM to facilitate autonomy in everyday life.

**401.080 (Poster)** Seeing in the Mind's Eye. a Study of Aphantasia in Relation to Episodic Memory and Episodic Future Thinking in Autistic Adults

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**Background:** Autistic individuals are reported to have specific difficulties related to episodic memory (EM; personally experienced past events), episodic future thinking (EFT; thinking about oneself in the future) and prospective memory (PM; remembering to perform an intended action, at an appropriate future occasion). A core component of PM, EM and EFT tasks is the ability to mentally visualise oneself in relation to past or future potential events (i.e., self-generating future thinking visualisations). Recent research has shown how this ability falls on a spectrum from substantially impoverished mental visual content (*Aphantasia*) to high clarity of vivid imagery (*Hyperphantasia*). It is, therefore, important to establish whether autistic people experience greater levels of Aphantasia and whether EM or EFT are more difficult for autistic people because of more

pervasive difficulties in visualisation (the ability to create vivid mental imagery). To our knowledge, this is the first study of Aphantasia in autism.

**Objectives:** We explored whether (i) autistic adults have increased Aphantasia, and (ii) if Aphantasia might be related to EM and EFT difficulties.

**Methods:** 200 autistic (AS; n=102) and non-autistic (NT, n=97) adults completed online questionnaires of autistic traits, Aphantasia, Episodic Memory and Future Thinking (Table 1). Other questionnaires required participants to complete sentence stems related to how they think about themselves in terms of past (episodic memory) and future experiences (episodic future thinking), and measures of autistic traits. The questionnaires took approximately 20 minutes to complete.

**Results:** Preliminary analysis showed significant Group differences in Autistic traits and Aphantasia (Table 1; all  $F(2,201) \geq 5.68$  all  $p \leq .018$ , all  $\eta^2_p > .03$ ), with AS adults showing greater visualization difficulties than NT adults. Furthermore, AS reported greater difficulties with mentalizing, social anxiety and sensory reactivity aspects of autism. Regression analysis indicated that social anxiety was the strongest predictor of Aphantasia, in both AS and NT adults ( $F(1,47) = 20.51, p < .001, R^2 = .30$ ).

Post-hoc Bayesian analysis confirmed the likelihood of these effect sizes, indicating 'decisive' ( $BF_{10} > 100$ ) to 'moderate' ( $BF_{10} > 3$ ) evidence to support visualization difficulties related to Mentalizing ( $BF_{-0} = 236.4$ ), and Social Anxiety ( $BF_{-0} = 8.75$ ) and Sensory Reactivity ( $BF_{-0} = 3.47$ ), respectively (Figure 1). However, the distribution of scores requires further investigation to individual differences in autistic adults.

We investigated how Aphantasia is related to EM and EFT (Table 2). Analyses of (fully collected) data are underway, with transcription of responses and reliability coding to be completed by January 2021.

**Conclusions:** The preliminary findings suggest that autistic adults experience greater difficulties in generating mental imagery (Aphantasia) than non-autistic adults. Aphantasia was strongly related to high levels of autistic traits, specifically mentalizing and social anxiety. It also appears to affect Episodic Future Thinking, but further analysis is required (and currently underway) to confirm the strength of association. These findings offer promising insights to the pattern of cognitive variability that might explain some of the differences and related prospective memory difficulties that autistic people experience. With these insights we hope to inform potential indicators for future targeted interventions to support autistic people in everyday remembering.

#### 401.081 (Poster) Self-Advocacy in Autistic and Non-Autistic College Students

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#### Background:

It is important for adults on the autism spectrum to be their own self-advocates in a post-secondary setting. Self-advocacy leads to a better quality of life, including better adaptation to college environments, career success, maintenance of a positive identity, and management of stress in college students on the autism spectrum (Kim, 2019). A prior study looked at students' beliefs about self-advocacy (Gillespie-Lynch et al., 2017). However, students' engagement in self-advocacy has not been explored. In the current study, students on the autism spectrum and their non-autistic peers, including those with a learning disability and those without a known diagnosis, were asked to rate their self-advocacy practices in the college environment.

#### Objectives:

The purpose of this preliminary study was to understand if college students on the autism spectrum differed from their peers in their self-advocacy practices.

#### Methods:

This study adopted a survey design. Participants included adult-aged (18 years of age or older) students enrolled in 4-year-universities in the United States with college-level reading and writing abilities. See Table 1 for demographic details. The self-advocacy questionnaire (Kosine, 2006) was used to collect data on students' use of self-advocacy in classrooms and within the university campus. This questionnaire includes 22 items. Example statements include: "I feel comfortable talking to my instructors." and "I am afraid to talk in class discussions."

Results:

Results below are based on preliminary data collection. We will complete data collection in March 2021. Our research questions were:

1. **What common challenges are reported by college students?**

All participants self-reported greatest challenges in motivating themselves to study. Interacting with professors and making friends were reported as challenges by a greater percentage of autistic participants. A smaller percentage of autistic participants reported accessing resources and finding the motivation to study as challenges.

2. **Do college students on the autism spectrum differ in self-advocacy practices from their peers?**

When all three groups were combined, 60% of the students rated their overall self-advocacy as “average”; 25% rated it as “above average”, and 16% provided a “poor” rating. Between group differences can be observed in Figure 1. Students in the two non-autistic groups were similar in their overall rating of self-advocacy. However, a greater number of autistic students (N=11) reported poor self-advocacy when compared to the other two groups.

3. **What factors relate to perceptions of low self-advocacy for college students?**

61% of participants who had a diagnosis (autism or other diagnosis) and 50% of participants who were not employed reported poor self-advocacy scores. Factors such as gender, having a friend or not, and education status did not impact self-advocacy ratings.

Conclusions:

Although our caveat is having unequal sample sizes in each group, this preliminary analysis indicates that autistic students experience more challenges in social aspects than academic aspects of college. While a large number of autistic students reported having low self-advocacy, autistic students are more similar than different when compared to their peers in their self-reported rating of self-advocacy. Therefore, education on self-advocacy may be important for all students irrespective of their diagnostic status.

**401.082** (Poster) Self-Determination As a Mediator between Autism Traits and Quality of Life

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**Background:** Autistic people report lower quality of life (QoL) than non-autistic people (Ayres et al., 2018), with a similar association between autistic traits and QoL found in the general population (Lawson et al., 2020). One factor that may explain this relationship is self-determination. Self-Determination Theory is a meta-theory of motivation, that reflects the perception of oneself as a causal agent (Deci & Ryan, 1985), and is suggested to develop through the satisfaction of three psychological needs: autonomy, competence and relatedness (Deci & Ryan, 2000). Self-determination has been positively associated with QoL (Ayres et al., 2018), and autistic people tend to report lower self-determination than the general population (Ayres et al., 2018).

**Objectives:** This study aimed to test whether meeting the psychological needs of autonomy, competence and relatedness (i.e., self-determination), mediated the relationship between autism traits and four domains of QoL (psychological, social, physical and environment; see Figure 1).

**Methods:** Participants were 262 people (167 Females) from the general population recruited through Prolific, aged 18 to 71 years of age (Mean 37.6, SD 11.92). Participants completed an online survey measuring autistic traits (AQ-28; Hoekstra 2011), psychological needs (Basic Psychological Needs Satisfaction Scale – General; Gagné, 2003), and four domains of QoL (WHOQOL-BREF; Orley et al., 1997). Executive functioning (The Adult Temperament Questionnaire-Short-Effortful Control Subscale; Rothbart et al., 2000) and a self-created item measuring the impact of COVID-19 on daily life (1 – has become a lot worse, 5 – has become a lot better) were expected to influence QoL and included as covariates.

**Results:** Correlational analysis between all variable indicated that executive functioning was significantly associated with autistic traits,  $r = -.33, p < .001$ , psychological needs  $r_s = -.30$  to  $-.50, p_s < .001$ , and QoL domains,  $r_s = -.25$  to  $-.46, p_s < .001$ . The impact

of COVID-19 was only significantly associated with all QoL domains,  $r_s = .15$  to  $.28$ ,  $p_s < .001$  to  $.018$ . Importantly autistic traits were significantly associated with all psychological needs,  $r_s = -.37$  to  $-.49$ ,  $p_s < .001$ , and QoL domains,  $r_s = -.21$  to  $-.38$ ,  $p_s < .001$ , and all psychological needs were significantly associated with all QoL domains,  $r_s = .38$  to  $.70$ ,  $p_s < .001$ . Model 4 of The Process Macro for SPSS (Hayes, 2018), was used to test four separate parallel mediation models. Overall, the direct relationship between autistic traits and QoL was only significant for Social QoL (Table 1). While the total indirect effect was significant for all QoL domains, the individual paths via psychological needs told a more nuanced story. While all psychological needs mediated the relationship between autistic traits and Environmental QoL, only competence and relatedness were significant mediators for both the Psychological and Social QoL domains, and autonomy and competence for the Physical QoL domain.

**Conclusions:** This study suggests that individuals with higher autistic traits may have poorer QoL, in part, because they have difficulties meeting important psychological needs. While these findings need to be tested in an autistic populations, it suggests that interventions targeting self-determination, may improve QoL in autistic people.

#### **401.083 (Poster) Self-Reported Mood-Changing Life Experiences in Adults with Autism: What Makes Them Happy and Unhappy?**

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#### Background:

Life experiences can affect mood and have a downstream impact on mental health. Studies in the general population have identified life factors, such as social relationships and self-perceptions, that influence people's mood and perceived happiness (Singh & Jha, 2008; Cheng & Furham, 2002; Vanderhorst & McLaren, 2005). Moreover, adults with autism encounter unique life experiences that might further contribute to changes in mood. While previous studies have focused on self-reported lived experiences of individuals with autism (Depape & Lindsay, 2015; Russell et al., 2019; Ward & Webster 2017; Milner et al., 2019; Humphrey & Symes, 2010), findings do not extend to the impact of life experiences on mood. Understanding the effects of possible mood-changing life experiences could provide significant information for potential treatment targets to improve mental health and life satisfaction in adults with autism.

#### Objectives:

To describe self-identified everyday life experiences that make adults with autism happy and unhappy using qualitative data.

#### Methods:

315 self-reporting independent adults (age 18 to 35 years old, 52% male) with a childhood diagnosis of autism recruited from a national research registry completed an online survey with the open-ended questions: "Looking back at the past week, what are some of the things that made you unhappy?" and "What are some of the things that made you happy?" The open text responses for each question were coded for themes using the inductive coding approach, and the final coding scheme was derived based on consensus discussions within the research team through an iterative process of reviewing and revisiting the responses and coding structure. Once the consensus was reached for the final coding structure, the codes were organized by their relationship to "Happy" and/or "Unhappy" mood.

#### Results:

Adults with autism reported a range of life experiences that made them happy and unhappy when reflecting on the past week (see Figure 1). Themes reported by participants that made them both happy and unhappy include relationships and interactions with social partners, work, school, finances, social supports, and perceptions of self-efficacy. There were also factors that were exclusively identified as making them happy, such as achievements, positive social interactions, participation in individual or social activities, and practicing self-care. Likewise, participants reported additional life factors only related to feeling unhappy, including common themes of communication difficulties and misunderstanding, negative or lack of social interactions and mistreatments by others, lack of activities, and disruptions in routine.

#### Conclusions:

Adults with autism experience and recognize a range of life experiences that affect their mood on a day to day basis. Participants reported life experiences that had both positive and negative impact on mood and were largely consistent with predictors for life satisfaction and perceived happiness found in the general population. Life factors specifically related to happy-mood could provide avenues to foster positive experiences; whereas life aspects unique to unhappy-mood may have implications on intervention to target improvement of mood and mental health in adults with autism.

**401.084 (Poster)** Self-Reported Real-World Executive Function Skills and Associations with Anxiety and Depression in Autistic Adults

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**Background:** Executive function (EF) difficulties in youth on the autism spectrum persist into adulthood, but literature on EF in autistic adults is limited and largely reliant on lab-based tasks. A more ecologically valid EF measure is the Behavior Rating Inventory of Executive Function Report-Adult version (BRIEF-A; Roth et al., 2005). In a sample of 35 autistic adults, Wallace et al. (2016) found that inflexibility was associated with increased anxiety, while planning/organization difficulties were associated with increased depression. However, they used only informant reports. It is important to include the perspectives of autistic adults to better understand their perceived strengths and challenges.

**Objectives:** Among autistic adults, we aimed to examine 1) real-world EF profiles utilizing the self-report version of the BRIEF-A, and 2) associations between EF, anxiety, and depression.

**Methods:** Diagnostic evaluations were conducted across statewide autism clinics. Data from 52 autistic adults (71% male; 71% white; age:  $M = 30$  years, range 18-59; IQ:  $M = 104$ , range 74-147) who provided consent to participate were included. Participants completed the BRIEF-A Self-Report, the Adult Self-Report (ASR; Achenbach & Rescorla, 2003) as a measure of depression and anxiety, and an IQ assessment. A one-sample  $t$ -test was used to examine autistic adults' level of impairment on BRIEF-A subscales, relative to the population mean. A repeated measures ANOVA assessed the profile of EF scores across subscales. We also conducted hierarchical multiple regressions to examine the effects of EF on depression and anxiety symptoms, controlling for participant age, IQ, and sex. To measure EF in these models, we first used the Behavioral Regulation Index (BRI) and the Metacognition Index (MCI) of the BRIEF-A. We then repeated the analyses with the peak subscale from each index.

**Results:** Across all nine subscales of the BRIEF-A, we found EF impairments relative to the population mean of 50 ( $ps < .001$ ). Participants showed a variable EF profile ( $F = 10.12, p < .001$ ), with the greatest difficulties in Working Memory and Shift (Figure 1). Working Memory was significantly higher than all other subscales ( $ps < .02$ ), except for Shift. As shown in Table 1, BRI was a significant predictor of depression ( $p < .01$ ), but not anxiety, and the MCI did not emerge as a significant predictor. Working Memory predicted both anxiety ( $p = .02$ ) and depression ( $p < .01$ ), whereas the Shift was not a significant predictor.

**Conclusions:** This study is one of the first to show that autistic adults without intellectual disability exhibit self-reported real-world EF difficulties, with the greatest impairments in working memory and flexibility. These findings differ from recent research with the informant report of the BRIEF-A, suggesting the need for future EF research directly comparing autistic adults' and their parents' perspectives. Although overall behavioral regulation skills were associated with depression, working memory from the metacognition index emerged as a significant predictor of anxiety and depression (above and beyond the influence of sex, age, and IQ). Targeting EF, specifically working memory, in treatment could have a cascading effect on improving autistic adults' mental health.

**401.086 (Poster)** Sibling Relationships in Families of Children with and without Autism: Specificity and Commonality

According to the Siblings' and the Mothers' Perspectives

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Background:

Sibling relationships are often the most enduring life-long relationships, influencing development (Brody, 2004). Sibling relationship qualities such as companionship and intimacy, alongside conflict and rivalry, are common across families (Furman &

Buhrmester, 1985). Research on families of children with autism has yielded mixed results regarding the nature and quality of the sibling relationship and their similarity to typical sibling relationships. This study investigates specificity and commonality in sibling relationships in families of children with and without autism, according to the siblings' and the mothers' perspectives.

Objectives:

To compare children's perspectives on their relationship with their siblings (diagnosed with autism *or* typically developing [TD]) to that of their mothers.

Methods: Seventy-five families participated. Twenty-nine TD children whose younger siblings were diagnosed with autism and their mothers constituted the 'autism group'. Forty-six TD children with younger TD siblings and their mothers constituted the 'TD group'. Children and mothers completed the Sibling Relationship Questionnaire (SRQ; Furman & Buhrmester, 1985) and participated in an open-ended interview. Thematic analysis was used to identify key elements of the participants' perspectives of the sibling relationship.

Results:

Siblings of children with autism reported less intimacy and quarreling than siblings in the comparison group. Mothers of children with autism reported their children to have less warmth/closeness, conflict, intimacy, quarreling, prosociality, sibling nurturance, similarity, and competition in the siblings' relationships than mothers in the comparison group (table 1). Children and mothers in the autism group correlated only in self-reported conflict between siblings ( $r_{(29)}=-.457, p<.05$ ). Children and mothers in the TD group correlated in conflict ( $r_{(46)}=.410, p<.01$ ) and warmth/closeness ( $r_{(46)}=.472, p<.01$ ) between the siblings.

Thematic analysis revealed two themes common to mothers and children in both groups: '**Inseparable**' - references to the siblings' joint routine, things in common, enjoyment, affection, quarrels, and statements on the connections between these; '**The younger versus older**' - references to each sibling's role, disparities, and asymmetry in the relationship. One theme, specific to mothers in both groups ('**The bigger picture**'), referred to changes and processes in the relationship. One theme, specific to the autism group, included references to the younger sibling's condition without explicitly mentioning the term 'autism' ('**The unsaid word**').

Conclusions:

We asked whether sibling relationships fundamentally differ in families with and without autism according to the mothers' and the siblings' perspectives, or are there commonalities regardless of autism. Children's reports illustrate more commonalities than specificity across groups, while mothers' reports indicate specificity. More disagreement was found between mothers and children in families with autism than in families without autism. Consistent with previous literature (Braconnier et al., 2018), children's perspectives of their relationship with a sibling with autism were more positive than those of their mothers.

The qualitative analysis pointed to the importance of further investigating autism disclosure in the family.

The different perspectives of parents and children, as evidenced by questionnaire analyses, and the specificity and commonality in the foci of parents and children, as suggested by the qualitative analysis, should be considered in research and intervention in families of children with autism.

**401.087** (Poster) Social Connection and Assurance, Anxiety, and Autism in Adulthood

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Background: We know that there are inherent social communication challenges in autism (American Psychiatric Association, 2013). We also know that autistic individuals have higher rates of anxiety and other internalizing symptoms (Levy & Perry, 2011). Studies have shown a mediating effect of social relationships on internalizing symptoms such as depression and loneliness (Mazurek, 2014), but less attention has been paid to anxiety and the specific domains of social connectedness and assurance, which have implications for intervention work. This study examines the relationship between these intrapersonal social domains and anxiety symptoms in adults with and without autism.

Objectives:

- To understand the relationship between social connectedness and assurance and anxiety symptoms in adults
- To determine if there is a difference in this relationship for neurotypical versus autistic adults

Methods: A total of 132 adults participated in this study from across the United States, representing 23 states and most geographic regions. Participants included both adults with autism spectrum disorder (ASD) without intellectual disability (44 ASD) and neurotypical adults (88 NT). Diagnostic group was based on self-report. Mean age was 26.89 (SD = 5.929). Participants completed a set of anonymous online surveys; measures for this survey included the Social Connectedness and Social Assurance Scales (SCSAS; Lee & Robbins, 1995), the Beck Anxiety Inventory (BAI; Beck & Steer, 1993), and the Autism Spectrum Quotient (AQ-10; Allison, Auyeung & Baron-Cohen, 2012). Pearson's correlation coefficients were calculated for the whole sample as well as within diagnostic groups.

Results: The AQ-10 was significantly positively correlated with the BAI for the whole sample ( $r = .459, p < .001$ ) and within groups (NT  $r = .225, p < .01$ ; ASD  $r = .436, p < .01$ ). The AQ-10 and SCSAS were significantly negatively correlated for the whole sample ( $r = -.282, p < .01$ ) and the NT group ( $r = -.316, p < .01$ ). The BAI and SCSAS were significantly negatively correlated for the whole sample ( $r = -.309, p < .001$ ) and the NT group ( $r = -.434, p < .001$ ). While not statistically significant, the BAI and SCSAS were positively correlated for the ASD group ( $r = .288, p = .058$ ).

Conclusions: Difficulty with social connection and anxiety are both pressing issues facing the autistic population. Despite research showing the mediating effects of social connectedness on mental health (Stice & Lavner, 2019), this study showed a positive relationship between social connectedness and assurance and anxiety for the autistic but not neurotypical population. Though we cannot know causation between these variables, the fact that autistic adults who experience higher anxiety also feel more socially connected and assured indicates that they may not be avoiding social connection due to anxiety feelings in the same way that was indicated by the neurotypical sample in this study. Future exploration into the other domains of social functioning, including quantity and quality of friendships, frequency of social interactions, and other interpersonal areas may lead to a better understanding of the connection between anxiety and social functioning as well as implications for interventions that address both factors.

#### **401.088** (Poster) Social Support and Psychological Distress in Autistic Adults in Quebec

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Background: Autistic people often deal with anxiety or mental health difficulties and can be expected to have a higher level of psychological distress than the general population. Social support is recognized as a factor of protection. However, little is known about psychological distress and social network support for autistic people in Quebec.

Objectives: This descriptive research aims to measure psychological distress reported by autistic adults in Quebec and its association with social aspects such as formal support, social network, perceived violence, and stigmatization in everyday life.

Methods: An online questionnaire was completed by 226 autistic adults from Quebec (19-74 years old,  $\mu=37.0$  and  $SD=11.1$ , female: 58%, male: 30%, identifying with other gender identities: 12%) (convenience sample). Questions addressed mental diagnosis, interests and social aspects (socio-demographics, unmet needs regarding professional and social support [ASSIS, Barerra 1981], violence and stigmatization). Psychological distress was measured with the K6 scale ( $\alpha=.89$ ;  $\alpha=.84$  in this study) (Kessler et al. 2003).

Results: 79% of respondents received a formal diagnosis of autism and the others were self-diagnosed. Many had anxiety (42%), mood, bipolar or depressive disorders (24%), learning disabilities or AD(H)D (28%). Most of them had a job (67%). One third (32%) had an annual income of less than \$15K CAD (\$11K US approx.).

Respondent's psychological distress mean score was 12.4 (SD=4.72), which corresponds to the presence of "mild-moderate mental health problems".

Many reported that they were not able to see a professional as often as they would have liked (health care: 43%, psychosocial services: 58%) and experienced significant unmet needs: recreational activities (40%), advice on social interaction (34%), information (24%), intimate interactions (20%), physical assistance (16%) and material assistance (12%). The majority (68%)

reported having people who made them “feel bad” in their entourage. However, 64% said that they have someone to share their interests with. Nevertheless, more than half (53%) felt they cannot devote enough time to their interests.

Regarding stigmatization, 41% consider their qualities are “not at all” or “a little” recognized and many felt that they are somehow ashamed of being autistic (48%) or found it difficult to talk about their autism (72%). Some respondents reported being victims of physical violence (10%) in everyday life and violence on social media (29%), and one third (34%) attributed this violence to being autistic.

All these variables were significantly associated with psychological distress, except for gender (no difference between the three groups) and physical violence (too few participants in this category). Furthermore, not having an official diagnosis was associated with a higher mean of psychological distress but this difference was not significant.

Conclusions: This research reports a high level of psychological distress among autistic adults in Quebec. Part of this could be explained by the amount of unmet needs for support, perceived violence and stigmatization, and mental health diagnosis. Further analysis is required to fully understand the role of social support in the development of psychological distress in autistic people and the lack of differences between gender groups.

**401.089 (Poster) Speech Rhythm Hierarchy: Towards Understanding of Phonological Characteristics in Autism Spectrum Disorder**

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Background: Speech rhythm consists of a nested hierarchy of phonological units including prosody, syllable, and phoneme. This hierarchy can be identified from speech waveforms: The prosodic, syllabic, and phonetic rhythms are represented in the amplitude modulation (AM) hierarchy at delta, theta, and beta/gamma bands, respectively. The AM hierarchy of speech sound also has a relatively straightforward neurophysiological interpretation. The delta, theta, and beta/gamma oscillators in the auditory cortex couple with the prosodic, syllabic, and phonetic phases respectively, underpinning each of phonological intelligibility. A body of previous studies has shown evidence that individuals with autism spectrum disorder (ASD) have specific characteristics of their speech rhythm, particularly in the prosodic domain. However, the characteristics of speech rhythm hierarchy in ASD remained unclear.

Objectives: The present study aimed to reveal the phonological characteristics of the speech rhythm hierarchy in adult individuals with ASD and typical development (TD). We examined the slow (<40 Hz) temporal modulation structure (prosody: 1-4 Hz, syllable: 4-12 Hz, phoneme: 12-30 Hz), using two complementary modeling approaches (i.e., filtering vs. probabilistic).

Methods: Adult speech sounds in ASD (N = 8, 87 samples in total) and TD (N = 6, 72 samples in total) were applied for this study. During speech recording, the participants were asked to tell their recent experience (episodic memory) about 12 topics (sweet, gloomy, etc.). The first modeling approach utilized a low-dimensional representation of the speech signal based on the cochlear filterbank in the human brain. The second utilized probabilistic amplitude demodulation based on Bayesian inference, a signal-driven modeling approach that makes no adjustments for the brain.

Results: Both models revealed a very similar hierarchical structure of the speech rhythm. As suggested by previous studies, a weaker prosodic rhythm was found in ASD compared to TD ( $p < .001$ ), while no significant group difference was detected in the syllabic and phonetic rhythms ( $p = 1.00$ ) (Fig 1). A transfer entropy analysis was also applied to estimate “dynamical” interdependencies between the hierarchies of speech rhythm. The results indicated that the transfer entropy from a higher hierarchical rhythm to a lower hierarchical rhythm (e.g., from the prosody to syllable) was smaller in ASD than TD ( $p = .028$ ), whereas no group difference was detected in the transfer entropy from a lower to a higher hierarchical rhythms ( $p = .283$ ) (Fig 2). This may imply that the top-down controls are weaker in ASD than TD.

Conclusions: This study revealed that the weak prosodic rhythm is a robust phonological characteristic of ASD. Further, the dynamical interdependencies between the hierarchies of speech rhythm discriminate ASD from TD. A closer analysis is, however, necessary to examine how the characteristics of speech rhythm hierarchy are involved in a hierarchy of neural oscillation.

**401.090 (Poster) Successful Employment Experiences of a Large Sample of Adults with Autism**

Background: Extant research in the field of employment for adults with autism describes bleak outcomes—high rates of unemployment and less time employed as compared to their neurotypical peers (Scott et al., 2015). However, research has also elucidated a number of desirable workplace traits that individuals with autism possess (Baldwin et al., 2014; Hillier et al., 2007). Often, it is assumed that individuals with autism would find success in STEM-related fields of employment. However, there is little research to validate this, or to identify other employment fields where individuals with autism may flourish.

Objectives: The current study aimed to: (1) describe a large sample of employed adults with autism in terms of age, gender, comorbid diagnoses, and duration of employment; (2) further analyze aspects of their employment experiences.

Methods: The current study utilized a previously collected sample of adults with and without autism who responded to an online survey (Schwartzman et al., 2015). From this sample, a smaller sample of adults with autism who had reported being employed at the time of initial data collection was selected (N = 131). Survey questions included self-reported autism diagnoses, comorbid diagnoses, highest level of education achieved, current employment status, duration of employment, and employment satisfaction, as well as other demographic categories such as age, gender, and ethnicity. Current employment entries were then coded into fields of employment using the US Department of Labor's Standardized Occupational Classification (SOC) system (e.g., Roux et al., 2013). Overemployment, underemployment, or appropriate employment were determined by matching an individual's level of education (e.g., participants who reported having a college degree) to their level of employment (e.g., jobs that require a college degree).

Results: Participant demographics, education levels, comorbid diagnoses, average duration of employment, and average employment satisfaction are displayed in Table 1 (image attached). Of the Department of Labor SOC categories, the most common job types were "Arts, Design, Entertainment, Sports, and Media" (N = 19), "Computer and Mathematical" (N = 19), "Life, Physical, and Social Science" (N = 13), "Educational Instruction and Library" (N = 13), and "Office and Administrative Support" (N = 11). 22 of the 23 Department of Labor SOC categories had at least one individual coded in that category. Data for each of these categories and corresponding average job satisfaction for each category is displayed in Table 2 (image attached). Ninety-six individuals were determined to be appropriately employed, 25 underemployed, and 7 overemployed.

Conclusions: Results from the current study indicate that individuals with autism are capable of experiencing employment success across a wide variety of job fields. Current literature on employment of individuals with autism often lumps this diverse population into a cohort of individuals who experience employment challenges. While this may be true of a majority of individuals with autism, to better inform future employment-related interventions for those experiencing unemployment and underemployment, it is essential to further develop an evidence base which describes the wide range of job experiences of individuals with autism who have found employment success.

#### **401.091 (Poster) Systematic Review of Evidence-Based Practices for Improving Daily Living Skills in Young Adults with Autism Spectrum Disorders**

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Background: Independent living skills are an integral component in the transition to adulthood (Bal et al., 2015). However, many young adults with ASD have difficulty in these skills (Roux et al., 2017). According to a survey of 3520 adults with ASD, only 10% of adults with ASD live independently, and 43% of respondents also indicated that they do not independently manage or make choices in their daily routines such as when to sleep or eat meals (Roux et al., 2017). Thus, there is a need to address independent living skills in youth with autism but there is a paucity in the literature to guide practice.

Objectives: The purpose of this systematic review is to address the following question: "What are the evidence-based strategies for increasing Independent living skills for young adults with ASD?"

Methods: A systematic review using the Cochrane guidelines was conducted on literature published from January 2009 to May 2019 (Higgins et al., 2019). Two reviewers independently screened titles, abstracts, and full articles for inclusion and exclusion criteria, and convened for a consensus meeting at each stage. Risk of Bias was independently performed in duplicate using the Cochrane guidelines (Higgins et al., 2019), and using the single case design risk of bias tool (Reichow et al., 2018). Results were synthesized.

Results: Twenty-four articles met the inclusion criteria. Seven evidence-based strategies that improved Independent living skills were identified in the literature: video prompting, video modeling, reinforcement, roleplay/rehearsal strategies, prompt hierarchy, group engagement/training strategies and social story strategies. All had high risk of bias indicating an overall low quality of evidence.

Conclusions: While all of the strategies demonstrated improvements in Independent living skills, the findings are impacted by the risk of bias in the studies. Future research with high rigor is needed to evaluate strategies used to improve independent living skills in youth with ASD. This research should include the use of blinded evaluators to assess outcomes; blinded participants; and use of performance-based outcome measures.

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**401.092** (Poster) The Association of Sleep Quality and Loneliness with Perceived Physical and Mental Health Status in Autistic Adults

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Background: Individuals with autism experience significantly greater rates of physical (e.g., epilepsy) and mental health (e.g., depression and anxiety) challenges than the general population. These secondary challenges lead to increased mortality rates and greater healthcare burden on families and healthcare systems. However, little is known about those primary factors that impact the physical and mental health of these individuals. In the general population, factors such as loneliness and sleep quality have substantial impacts on physical and mental health in the general population but little research has investigated their impact in adults with autism.

Objectives: We examined the association of self-reported sleep quality and loneliness on the self-reported physical and mental health in adults with autism. Multiple regressions were employed to predict associations within each group.

Methods: Data were collected from neurotypical controls ( $n = 21$ ), individuals with insomnia ( $n = 23$ ), and individuals with autism ( $n = 22$ ). All measures were completed by the individuals at a single time point. Sleep quality was measured using the Patient-Reported Outcomes Measurement Information System Sleep Disturbance Questionnaire – Short Form 8a (PROMIS-SD-8a), loneliness was measured using the UCLA Loneliness Scale, and physical and mental health were measured using the 36-Item Short Form Survey (SF-36).

Results: The autism group scored worse than the neurotypical group across all variables. The autism group had comparable sleep quality to the insomnia group. As expected, reduced sleep quality was significantly associated with reduced perceived physical health in the insomnia group ( $p = .002$ ) and with increased loneliness in the neurotypical control group ( $p = .049$ ), accounting for 38.4% and 31.8% of the variance, respectively. However, neither sleep quality nor loneliness were significant predictors of physical health in the autism group. The story was different for perceived mental health, which was significantly associated with both reduced sleep quality ( $p = .007$ ) and increased loneliness ( $p = .030$ ) in the autism group, together accounting for 40.7% of the variance. Increased loneliness was significantly associated with lower perceived mental health for both the insomnia group ( $p = .024$ ) and the neurotypical group ( $p = .012$ ), accounting for 19.7% and 43.3% of the variance, respectively.

Conclusions: Differences in association were observed for sleep quality and loneliness and their association with perceived physical and mental health for each group. Sleep quality and loneliness appear to be particularly important factors in the

perceived mental health, but not perceived physical health, of autistic adults. In many clinical settings, these factors are not routinely investigated or screened for. Given the high rates of mental health challenges in this population, these results suggest that closer attention to sleep quality and loneliness may be warranted. It is also notable that the autism group had comparable sleep quality to the insomnia group and emphasizes the need for further attention in this area.

**401.093 (Poster)** The Cognitive Profile of Older Adults with High Autistic Traits.

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**Background:** Research with autistic and high autistic trait children and younger adults has indicated performance differences in a wide range of memory and executive functioning tasks. However, despite memory and executive functioning being sensitive to age-related change, little is known about the cognitive profile of older adults with high autistic traits.

**Objectives:** This study will explore differences in performance on a variety of memory and executive functioning tasks in a large sample of older adults with/without high autistic traits.

**Methods:** Using baseline cross-sectional data from the ongoing online PROTECT study, a total of 22,285 adults aged 50 to 80 years reported whether they experience longstanding social communication difficulties characteristic of autism. Approximately 1%, 325 individuals, were identified as endorsing high autistic traits in childhood and currently, referred to henceforth as the Autism Spectrum Trait (AST) group. Differences between the AST and an age mean/range, sex ratio, and education history matched Comparison Older Adults (COA; n = 11,744) group were explored in performance on a variety of memory and executive functioning tasks administered through a well-validated online platform.

**Results:** The AST group had lower performance than COA on tasks measuring verbal working memory (digit span), visual episodic memory (paired associates learning), spatial working memory (self-ordered search), attention and information processing (choice reaction time), sustained attention (digit vigilance), and cued episodic secondary memory retrieval (picture recognition). However, no differences between AST and COA were observed in verbal fluency or simple reaction time. A similar pattern of results were observed when controlling for age, and symptoms of current depression and anxiety.

**Conclusions:** The findings from the current study of a large sample of older adults suggest that autistic traits are associated with cognitive functioning throughout middle and later life. Older adults with high autistic traits experienced more performance difficulties in a range of memory and executive functioning tasks when compared to the comparison group selected for low autistic traits. This pattern of results remained when controlling for age, and current symptoms of depression and anxiety. Further longitudinal work is needed to examine age-related change in both older autistic and autistic trait populations.

**401.094 (Poster)** The Effect of Aging on Prospective Memory in Autism Spectrum Condition

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**Background:** Prospective memory is an essential cognitive function for independent daily living. As such, it becomes more and more important with increasing age. However, how age affects prospective memory, and which aspects of PM age influences in autism remains unknown.

**Objectives:** To investigate the effects of age on prospective memory in autism spectrum conditions (ASC).

**Methods:** In this preregistered study (Aspredicted#34249), 193 individuals, aged between 30 and 85 years (82 ASC, 111 comparison (COMP) performed the lab-based Amsterdam Breakfast task, containing both event and time based tasks, and several naturalistic prospective memory tasks.

**Results:** Preliminary results show that both ASC and COMP perform worse on time versus event based laboratory tasks. No difference in performance is found between ASC and COMP on either type of task. Older individuals (over 55 years) performed worse than younger (under 50 years) individuals on both time based and event based laboratory tasks, independent of group.

**Conclusions:** Our preliminary results show that age affects prospective memory, but it appears that both ASC and COMP are affected equally. We will perform Bayesian analyses to assess the robustness of this null finding. Furthermore, we will explore the differences between lab based and naturalistic tasks.

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**401.095 (Poster)** The Employers' Perspective: From Qualification to Sustainable Employment of Persons with ASD  
*K. Reich, BBW Abensberg, Abensberg, Germany*

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### **Background:**

Despite of good school leaving certificates and vocational training degrees, persons with autism are still disadvantaged in getting jobs in the general labour market. There is a lot of research about getting or maintaining a job with ASD by taking the perspective of professionals and persons with ASD, but very little research was conducted to investigate the perspectives and experiences of the employers.

### **Objectives:**

The main objective is to gain new insights of the transition process from qualification to sustainable employment with special consideration of the employers' perspective. Therefore, existing helpful and inhibitory attitudes and experiences were investigated.

### **Methods:**

A semi-structured questionnaire was sent to N=2844 employers (first labour market). The sample was gained from address files of Vocational Training Centers ('BBW' - training youth with different disabilities or autism in qualified jobs), support and transition agencies and social enterprises. The addresses included both: employers, who doubtless employ/have employed autistic persons (N=886) and employers of whom this information was not available.

### **Results:**

Response rate 8% (n=222)

123 companies employ/have employed persons with autism

### **Companies (n=123):**

- Companies responded pointed out an industry wide dispersion
- Persons with ASD are employed in companies of different sizes (1-9 employees=24%; 10-49 =31%; 50-249 =24%; over 250 = 15%)
- 66% employ persons with ASD at the moment (48% in the past)

### **Matching:**

- (n=123): 77% of the actual (65% past) employment status are equivalent or higher than the level of training; 26% actual (20% past) lower than the level of training
- Main reasons of recruiting persons with ASD (n=114): "social aspects" (33%) followed by "convinced in probationary period/internship" (23%)
- Workplace adjustment (n=118): 22% of the companies interviewed indicated that workplace adjustment isn't necessary, 14% indicated an adaption of the workplace was necessary

### **Support for Employers:**

- Support for employers during recruitment phase/at the beginning of the employment relationship (n=116): 76% have received support (financial or personal); 26% haven't received any support. There is a moderate correlation between permanent employment contracts and the receipt of consulting in the past ( $\phi=0,37$ )
- (n=111): 91% employers stated, that consulting to cope with arising difficulties is important/very important; employers value consulting (83%), contact to ASD specialised services (81%) and training (80%) as important/very important
- (n=94): Most important advantage of employing a person with ASD: positive effect on colleagues (36%)
- (n=99): Biggest challenge: create acceptance among the colleagues (34%); adaption of workplaces (27%)

### Conclusions:

There are many indications in the present study that the vocational qualification activities specialised for persons with ASD as well as the assistance given during the recruitment process lead to permanent contracts of employment. But the importance of awareness-raising actions in the companies relating to autism were underestimated as well as an ongoing assistance of the working relationship. The transition services have to deepen their performances especially in providing information and awareness to colleagues and in giving assistance to employers in the creation of autism friendly workplaces.

### 401.096 (Poster) The Phenomenology of Gender Dysphoria in Autistic Adults

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#### Background:

Gender dysphoria is distress relating to a discrepancy between one's gender identity and sex assigned at birth and is associated with poor mental health. A disproportionate number of attendees at gender clinics have an Autism Spectrum Disorder (ASD). Autistic people and those with gender dysphoria often receive inadequate care in health services, and there is little research on how autistic individuals experience gender dysphoria to guide service improvements for this group.

#### Objectives:

To understand the phenomenology of gender dysphoria in transgender autistic adults, with a particular focus on how and if the experience of being autistic and gender diverse intersect. This will help to inform clinical services of the particular needs of autistic people who experience gender dysphoria, and what adaptations may be needed for this group.

#### Methods:

Qualitative methods were employed due to the exploratory nature and experiential focus of the research question. Purposive sampling was used to recruit 21 autistic adults who had experienced gender related distress for interviews about the lived experience of gender dysphoria. All participants had received a formal diagnosis of autism, identified as transgender or non-binary and had experienced distress in relation to their gender identity. Semi-structured interviews adapted for autistic participants were analysed using Interpretative Phenomenological Analysis.

#### Results:

Preliminary analysis indicated that there were two overarching themes: 'uncomfortable in my skin' and 'wrong planet'. The 'uncomfortable in my skin' theme underlined the discomfort that individuals felt for a number of reasons. First, distress was experienced due to dissonance between their gender identity and body, which for some participants was difficult to describe or described in behavioural terms, but for others was described in detail and as overwhelming. Second, distress due to a need to understand the self, including gender and autism identity. Third, there were multiple causes of distress with numerous difficulties that individuals faced including conflict of autism and gender needs as well as previous traumatic experiences; for some individuals these factors amplified dysphoria and for others they existed alongside dysphoria.

The 'wrong planet' theme described the discrepancy between the individual's needs and societal structures and included the struggle of being different including being bullied and othered, gender as social behaviour and social expectations and the need to be acknowledged and supported as an individual (taking into account gender, autism and other aspects of the self).

#### Conclusions:

Being autistic can influence the experience of gender dysphoria, and there are multiple complexities for the autistic person experiencing gender dysphoria to navigate in relation to their embodied sense of self as well as in the social world.

**401.097 (Poster)** The Relationship between Repetitive Behaviours and Sensory Processing in Autistic and Non-Autistic Adults and Impact on Self-Efficacy

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**Background:** Repetitive behaviours (RB) are a core feature of autism. RBs are described as “stims” and many autistic individuals report pressure to hide or suppress “stims” due to social pressures. “Stims” are suggested to be a barrier to learning in childhood however recent studies suggest that “stimming” may have beneficial effects. In qualitative studies, “stimming” is often described as a way of coping with overwhelming sensory or emotional situations. Few studies have yet examined the relationship between RBs, sensory sensitivities and feeling able to cope (known as self-efficacy) among autistic adults.

**Objectives:** We examined (1) the relationship between RBs and sensory sensitivities, and whether there were group difference in the pattern of associations; (2) whether there were group difference in RBs, sensory sensitivities and self-efficacy; and whether self-efficacy was impacted by the ability to “stim”.

**Methods:** Adults recruited through social media completed a set of questionnaires online. Participants reported whether they had a formal diagnosis of an Autism Spectrum Condition (ASC, n=182), self-identified as autistic or were seeking an ASC diagnosis (Suspected ASC, n=165), or did not identify as autistic (Non-ASC, n=146). Participants were predominantly female (ASC, female=140; Suspected ASC, female=146; Non-ASC, female=125). Due to the method of recruitment and task demands, we expect all participants to have abilities in the normal range. Self-report questionnaires examined RBs (Adult Repetitive Behaviours Questionnaire-2) and sensory sensitivity (The Glasgow Sensory Questionnaire). If participants performed repetitive behaviours (“stims”) they also answered five self-efficacy questions for when able to or not able to “stim”.

**Results:** In the whole sample RBs correlated significantly with sensory sensitivities ( $r=.867, p<.001$ ). Similar patterns and magnitudes of results were observed for each group. ASC and Suspected ASC groups reported significantly higher rates of RBs and sensory sensitivities than the Non-ASC group (Table 1). The effect of ability to “stim” or not on self-efficacy was examined between groups. Results demonstrate a significant main effect of “stimming” ( $F=196.98, p<.001$ ) and significant interaction effect ( $F=5.39, p=.005$ ), but no effect of group ( $F=.757, p=.470$ ). In all groups, being able to “stim” significantly increased self-efficacy. Not being able to “stim” lead to significantly lower ratings of self-efficacy in the autistic groups compared to the Non-ASC group. A similar pattern of results is observed when analysing only females.

**Conclusions:** Results suggest that RBs may help manage sensory sensitivities. The same pattern of associations was found in all three groups, but the Non-ASC group reported lower rates of RBs and sensory sensitivities than autistic groups. The ability to “stim” (versus not “stim”) lead to higher self-efficacy in all groups. Although only 20% of the Non-ASC group reported “stimming”, results suggest this behaviour is beneficial to many individuals, increasing feelings of being able to cope with difficulties. The impact of not being able to “stim” was more detrimental to autistic groups compared to the Non-ASC group, suggesting that “stimming” may be particularly beneficial for autistic individuals. Results suggest that RBs may help people to manage sensory sensitivities and help them feel able to cope with everyday difficulties.

**401.098 (Poster)** Topics and Timing of Sexuality and Relationship Education for Autistic and Neurotypical Adults in the United States

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**Background:**

The lack of sexuality and relationship education (SRE) has become particularly problematic in autistic population due to the negative impact on physical health outcomes, mood and self-esteem, as well as the increased risk of abuse (Holmes & Himle, 2014). As new programs are being developed, we are in need of important details to inform design of these programs, such as what to cover and when. In this study, we explored SRE gaps on topics that are more socially laden, such as gender identity, sexual orientation, and relationship building skills.

**Objectives:**

The purpose of this study is to identify differences in the topics, timeline and rated knowledge of SRE exist in learning and comfort outcomes for autistic and neurotypical (NT) adults for SRE.

#### Methods:

An online anonymous survey was distributed to adults in the United States and included questions about SRE, sexual and relationship experiences, and autistic traits. A total of 132 participants (44 with autism, 88 without; average age of 26.82 years ( $SD = 6.8$ ) were recruited, representing 23 states). Participants completed the Autism Quotient-10 (AQ-10), a brief self-report instrument designed to screen for autism in adults. Some SRE-related questions were developed specifically for the purposes of this study, including whether they were interested in more information on nine SRE topics, at what age they first engaged in various romantic, sexual, and identity experiences, and how they rated their SRE knowledge compared to their same-age peers. Chi-square and correlations were used to analyze diagnostic group differences (autistic and NT).

#### Results:

Comparisons by diagnostic group revealed significant differences in which topics each group wanted more information about. Autistic individuals were significantly more likely to indicate that they wanted to learn more about gender identity,  $\chi^2(131)=10.14, p < .005$ , sexual orientation,  $\chi^2(130)=7.32, p = .007$ , consent,  $\chi^2(130)=7.19, p = .007$ , and assertiveness than NT peers,  $\chi^2(129)=4.50, p = .03$ . There were no significant differences in timing of sexual experiences. Analyses of one's own knowledge relative to peers indicated that the higher someone rated themselves on the AQ-10, the lower they rated their knowledge relative to peers for kissing ( $r = -.26, p = .003$ ), flirting ( $r = -.32, p < .001$ ), consent ( $r = -.24, p = .007$ ), and assertiveness ( $r = -.27, p = .002$ ).

#### Conclusions:

Analyses revealed important differences in SRE needs for autistic adults, which likely reflects the increased diversity in identity and orientation reported by autistic adults and there is a need to adapt these topics in programming for autistic learners (Bleakley et al., 2009). Findings highlighting the lack of difference in timeline for first experiences are the first data to capture the timeline of identity development and exploration across NT or autistic individuals. We also need creative solutions to provide the peer-based learning experiences to individuals who may not have a peers group from which to draw, either by choice or by lack of social network. The importance of incorporating needs of autistic learners into program design is also highlighted for future work.

#### **401.099** (Poster) Trajectories of Major Health Issues throughout Adulthood in Autistic Individuals *K. Byrne, K. Sterrett and C. Lord, University of California, Los Angeles, Los Angeles, CA*

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**Background:** Physical and psychiatric health conditions affect adults with autism. However, relatively little is known about individual trajectories in autistic individuals' physical health from adolescence to adulthood.

**Objectives:** The current study uses a longitudinal design to describe the prevalence of seizures, medication use, and obesity in adulthood, to examine how these physical health challenges changed within individuals from early adolescence into adulthood, and to explore how intellectual disability and meeting ASD diagnostic criteria impact these medical conditions.

**Methods:** The present study uses a well-characterized longitudinal sample ( $n = 253$ ) to investigate rates of seizures, medication use and obesity, from early adolescence (age 10) into adulthood (age 30) among individuals with autism and other neurodevelopmental disorders.

**Results:** Seizure onset continued well into adulthood. Seizures and neuropsychiatric medication use were both higher for those with lower IQs. Medication use increased over time for these individuals, while those with higher IQs saw a reduction in medication use with age. In contrast, BMI increased throughout adulthood, especially for those with higher IQs.

**Conclusions:** Overall, continued risk for developing seizures, high rates of neuropsychiatric medication use, and significant and increasing rates of obesity from adolescence to adulthood underscore the importance of monitoring health issues in individuals with autism or other neurodevelopmental disorders throughout the lifespan.

**401.100 (Poster)** Understanding How Young Adults with Autism Spectrum Disorder Are Coping with the COVID-19 Pandemic  
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**Background:** The COVID-19 pandemic has ignited an unprecedented time disrupting and altering individuals' with autism spectrum disorder's (ASD) participation in everyday routines, habits, roles, and meaningful activities. The suspension of in-person educational and therapeutic entities has caused disruptions in routines and social opportunities for adults on the spectrum. These sudden alterations in daily routines and meaningful activities may be especially challenging for adults with ASD due to the frequent co-occurrence of social isolation and depression in this vulnerable group.

**Objectives:** (1) To examine how young adults with ASD are coping with the COVID-19 pandemic (2) To understand how they have adapted to the prolonged disruption to their routines, as well as their participation in meaningful occupations.

**Methods:** This convergent parallel mixed-methods study was completed in two phases. During *Phase One* participants completed online surveys (Brief Demographic Survey, Depression Anxiety Stress Scale [DASS]-21, Friendship Questionnaire, Routine Disruptions Questionnaire [RDQ]) through Qualtrics. During *Phase Two* participants were invited to a semi-structured virtual interview about their social and emotional experiences during the COVID-19 pandemic. Participants included adults (ages 18-35 years) with a self-reported diagnosis of ASD (n=15, expected n=20) who were able to independently complete a survey, recruited through snowball sampling from local agencies serving adults on the autism spectrum. Quantitative data was analyzed through the statistical analysis software, R. A linear regression was used to analyze and evaluate connections between the COVID-19 pandemic and emotional disturbances (i.e. high anxiety, increased depression) associated with routine disruptions. Also, relevant mean responses were noted and interpreted in relation to research findings. Qualitative data was collected with interviews that were manually transcribed and coded line-by-line to identify themes. Quantitative and qualitative data were merged and connected by using quantitative results and qualitative themes together to explain findings.

**Results:** The majority of participants reported either severe or extremely severe anxiety (n=15, 100%), depression (n=9, 60%), or stress (n=15, 100%) as indicated by the DASS-21. During interviews, participants shared several sources of anxiety including: individuals in the community not following rules, uncertainty about what information in the news is true, and the uncomfortable sensory experiences of wearing a mask. Unsurprisingly, participants reported high degrees of routine disruptions as indicated by the RDQ ( $M = 3.6$ ) which was not related to anxiety ( $t[1, 13]=0.11, p=0.91$ ). During interviews, participants discussed how the routine disruptions associated with the COVID-19 pandemic actually reduced previous stresses. Participants shared how protective measures such as social distancing were preferred even for non-pandemic times. Additional findings and themes will be presented.

**Conclusions:** Study findings contribute a valuable perspective to the experience of the COVID-19 pandemic for adults with ASD. Because of the novelty of the COVID-19 pandemic, the evidence is limited and there is a need for further research regarding the impact of the pandemic on participation in everyday routines, habits, roles, and meaningful occupations for adults with autism spectrum disorder.

**401.101 (Poster)** Understanding the Relationship between Comorbid Psychopathology and Social Skills Gains for Young Adults with ASD Following the UCLA PEERS® Intervention

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**Background:** Prior research suggests that adults with autism spectrum disorder (ASD) have higher levels of psychiatric comorbidity compared to clinical populations of adults without ASD (Joshi et al., 2013). Comorbid psychopathology has been found to have a negative effect on social skills for youth with ASD (Waters & Healy, 2012). Research suggests that psychiatric comorbidity may affect social skills treatment gains in children with ASD (Antshel et al., 2011); however, more research is needed to examine the effects of comorbid psychopathology on treatment outcomes for young adults with ASD following social skills treatment.

**Objectives:** The current study examines symptoms of social anxiety, depression, and ADHD as predictors of social skills outcomes and problem behaviors among young adults with ASD following the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson, 2017), an evidence-based caregiver-assisted social skills intervention (Laugeson et al., 2015).

**Methods:** Fifty-one young adults (males=38; females=13) with ASD ranging from 17-35 years of age ( $M=23.18$ ;  $SD=4.208$ ) and their caregivers participated in the study. All participants had clinically elevated ASD symptoms, as indicated by a caregiver-reported total score  $\geq 60$  on the Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber, 2012). Participants presented for social skills treatment through UCLA PEERS<sup>®</sup> Clinic. Participants and their caregivers attended 90-minute group treatment sessions over 16-weeks to learn guidelines related to the development and maintenance of social relationships. To assess young adults' baseline social anxiety and ADHD symptoms, caregivers completed the Social Anxiety Scale (SAS; La Greca, 1999) and the Swanson, Nolan, and Pelham Questionnaire-4<sup>th</sup> edition (SNAP-IV; Bussing et al., 2008), respectively. To measure young adults' baseline depression, young adults completed the Major Depression Index (MDI; Olsen et al., 2003). Treatment outcome was assessed by examining caregiver-reported change in social skills and problem behaviors on the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008) pre and post-intervention.

**Results:** Paired samples t-tests reveal significant improvement in caregiver-reported social skills ( $M=7.961$ ,  $SD=11.228$ ,  $t(50)=5.063$ ,  $p<.01$ ) and problem behaviors ( $M=-5.216$ ,  $SD=11.839$ ,  $t(50)=-3.146$ ,  $p<.01$ ) among young adults following treatment. Linear regressions were used to assess baseline social anxiety, depression, and ADHD symptoms as potential predictors of treatment outcome. Results reveal change in social skills was not related to baseline social anxiety ( $R^2=.013$ ,  $F(1,49)=.658$ ,  $p>.10$ ), depression ( $R^2=.036$ ,  $F(1,49)=1.807$ ,  $p>.10$ ), ADHD-inattentive ( $R^2=.00$ ,  $F(1,49)=.021$ ,  $p>.10$ ), or ADHD-hyperactive/impulsive ( $R^2=.041$ ,  $F(1,49)=2.103$ ,  $p>.10$ ). Similarly, change in problem behaviors was also not related to baseline social anxiety ( $R^2=.072$ ,  $F(1,49)=3.778$ ,  $p>.05$ ), depression ( $R^2=.000$ ,  $F(1,49)=.001$ ,  $p>.10$ ), ADHD-inattentive ( $R^2=.011$ ,  $F(1,49)=.529$ ,  $p>.10$ ), or ADHD-hyperactive/impulsive ( $R^2=.031$ ,  $F(1,49)=1.556$ ,  $p>.10$ ).

**Conclusions:** Findings reveal that baseline social anxiety, depression, and ADHD are not predictive of improvement in social skills or problem behaviors for young adults with ASD following the UCLA PEERS<sup>®</sup> intervention. These findings are important because they reveal that young adults with ASD and comorbid psychiatric conditions can still make significant treatment gains through the UCLA PEERS<sup>®</sup> program. Future studies might examine treatment outcome for young adults with comorbid psychopathology and ASD with regard to other social skills interventions.

**401.102 (Poster)** Verbal, Social and Motor Skills in Minimally-Speaking Autistic Children: Baseline Profiles and Intervention Effects on Observational Assessments and Movement Kinematics

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**Background:** Point OutWords <<http://PointOutWords.online/>> is a caregiver-delivered, iPad-assisted intervention targeting motor and cognitive skills prerequisite to communication (doi:10.1186/s13063-019-3931-1), designed for and with those minimally verbal autistic children whose severe deficits in expressive language are coincident with impaired motor skills (doi:10.3389/fnint.2013.00047).

**Objectives:** Assess 1) Relationships amongst verbal and motor functioning using parent-report and direct observational measures 2) Motor functioning measured by interactions with the iPad touchscreen, within the intervention group 3) Any change in these measures during this short-term treatment.

**Methods:** Our parallel-groups randomised controlled design recruited 30 autistic children aged 3–15 years, speaking fewer than 100 words functionally. The intervention group used Point OutWords 5 times a week for 8 weeks; controls used other iPad apps. Communication (Vineland, Mullen), motor, oromotor (VMPAC) and daily living skills were tested at baseline and post-intervention. Data were analysed with mixed ANOVA for behavioural and questionnaire measures. Children's touchscreen interactions were separated from their caregivers' modelled movements by Gaussian mixture modelling, then each movement was assessed for mean jerk (3<sup>rd</sup> derivative of position), mean direction error, and time to completion. These derived measures were regressed against time in treatment. As a secondary analysis, because clients and caregivers were most distinguished in terms of jerk (see figure), jerk effects and jerk-by-time interactions in a mixed-effects model served to confirm baseline abnormalities and treatment effects, respectively, in the autistic clients' movements in contrast to their caregivers' models.

**Results:** With reference to age norms, language and social skills were more impaired than motor though these were still significantly impaired (all  $p < 0.001$ ). Gross motor skills were superior to fine ( $p = 0.03$ ). Only 2 children had stronger expressive than receptive language. All children had severe impairments of fine oromotor control. There were no consistent effects of treatment versus control, although Mullen motor and language scores improved across both groups ( $p = 0.027$ ). On the iPad measures which were available only within the treatment group, 8 of 12 children significantly lessened the time to complete movements (each  $p < 0.02$ ), and every child showed significant increase in jerk ( $t(11) = 5.81$ ,  $p = 0.000118$ ). In slight ( $r^2 = 0.045$ ,  $0.0115$ ) but significant ( $p < 0.0001$ ) effects, greater jerk at baseline was associated with greater error in movement direction and longer movement paths, but the jerk-by-time interaction decreased both.

**Conclusions:** This study recruited a highly impaired group of children with minimal spoken language. Across a variety of assessments, the majority demonstrated better gross than fine motor skills, better motor than verbal skills, and better receptive than expressive verbal skills. For some, atypical motor interactions improved following intervention. Increased jerk for all subjects, alongside faster task performance for a majority, suggests that subjects were developing more frequent, finer-grained corrections for movements that are faster overall, yet still executed in an open-loop manner where error accumulates and is corrected piecemeal. The secondary analysis suggests that autistic subjects began with high direction error and long paths, and reduced these slightly but meaningfully over this brief intervention. Future work will investigate predictors of such changes, and their implications for augmentative and alternative communication.

**401.103 (Poster) What Is Autistic Burnout? a Thematic Analysis of Autistic Adults' Online Forum and Twitter Posts**  
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**Background:** Compared to adults in the general population, autistic adults are more likely to experience poor mental health leading to greater risk for suicidal ideation, self-harm and death by suicide (Cassidy et al., 2018; Hedley & Uljarević, 2018; Hirvikoski et al., 2016). The autistic community have long identified autistic burnout as a significant mental health risk, but despite the wealth of anecdotal reports, until recently, studies about autism-related burnout focused on the experiences of parents, teachers, and peers of autistic children (Boujut et al., 2017; Varghese & Venkatesan, 2013). Early research (Raymaker et al., 2020) has highlighted the harmful impact of autistic burnout among autistic adults and the urgent need to better understand this phenomenon.

**Objectives:** The aim in this qualitative study was to explore the lived experiences of autistic adults to identify the characteristics and underlying mechanisms of autistic burnout and, in so doing, to improve current knowledge about the aetiology, symptoms, and impact of autistic burnout, as well as prevention and recovery strategies.

**Methods:** Data scraping was conducted using a computer algorithm that extracted publicly shared posts from Twitter and WrongPlanet containing one or more of the terms, 'Autistic Burnout', 'Burnout' or '#AutisticBurnout'. The participant sample comprised 683 adults (559 from Twitter; 124 from WrongPlanet) aged 18 years and above. Each post and user profile were examined and excluded if ineligibility was indicated. Privacy regulations prevented collection of demographic data for Twitter participants. The average age of WrongPlanet users was  $M = 41.4$  years ( $N = 80$ ; range 21-76). A total of  $N = 121$  participants from WrongPlanet disclosed their gender, with 60 users identifying as male, and 61 users identifying as female. Autistic status was presumed through the individual's self-reference as autistic or use of the #ActuallyAutistic hashtag.

**Results:** A total of 1,127 posts (955 tweets; 172 forum posts) were analysed using reflexive thematic analysis. An inductive, 'bottom-up' approach was used to understand the lived experiences of autistic burnout, with seven primary themes and three subthemes identified. 1. Systemic, pervasive lack of awareness. 1.1. Discrimination and stigma. 2. A chronic or recurrent condition. 3. Direct impact on health and wellbeing. 4. A life un-lived, or a blessing in disguise? 5. Self-awareness and personal control influence risk. 5.1. "You need enough balloons to manage the weight of the rocks". 6. Masking: Damned if you do, damned if you don't. 7. Autistic people are the experts. 7.1. Stronger together. The overarching theme was that a pervasive lack of awareness and stigma about autism belies autistic burnout.

**Conclusions:** This study contributes to the scant knowledge about autistic burnout. We identified a set of distinct, yet interrelated factors that characterise autistic burnout as a recurring condition that can, directly and indirectly, impact a person's functioning, mental health, quality of life and wellbeing. The findings suggest that increased awareness and acceptance of autism could be key to burnout prevention and recovery.

**401.104 (Poster) Why Should I Disclose? Providing Clear Information for Autistic Individuals to Consider**

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**Background:** Disclosure is an important topic which can influence the nature of an individual's daily activities and relationships. Whether or not to disclose is an individual decision, this is clear from the literature. What has not yet been established, however, is what exactly the outcomes in a natural environment are when one does choose to disclose. Providing this type of evidence can help individuals make informed decisions in their own lives. While there is a wealth of research on disclosure for autistic individuals, making sense of the literature and finding objective or consistent results that can guide one's decision on whether or not to disclose is difficult. This is partly due to a substantial discrepancy between research that is informed by autistic perspectives and research that is informed by the opinions of those who autistic people may disclose to. Research that focuses on the autistic perspective often indicates negative outcomes related to disclosure, while research that focuses on others' perspectives (mainly research that uses vignettes) indicates positive outcomes.

**Objectives:** Two research questions guided two phases of study:

Research question phase 1: What is the association between an individual's intersecting identities (e.g., cultural, sexual, autistic) and their decisions around disclosure?

Research question phase 2: What are the real life outcomes related to disclosure as reported by autistic people? Does this vary by age, gender or context?

The findings from this research will yield important information about how intersecting identities may or may not influence an individual's decision to disclose, and what exactly happens when individuals do disclose. The study aims to fill the gap of current disclosure literature, which has focused mostly on vignette and qualitative research.

**Methods:** Participants for this study were autistic adults. For Phase 1, participants completed a questionnaire about their personal identity and disclosure habits. For Phase 2, we used Experience Sampling Methodology and asked participants to keep a diary of their disclosure experiences. Their diary entries were prompted by answering a short survey every time they have a disclosure opportunity. We used SEMA<sup>3</sup> to collect data, which is a suite of software and a platform designed at the University of Melbourne for longitudinal survey research (Koval, 2019). This research was co-produced with autistic collaborators in all phases of the project.

**Results:** Data collection for this project is ongoing, but results will be completed by the INSAR 2021 conference. Quantitative analyses will be conducted for both phases of the study. Regression analyses will be used to determine which predictors lead to disclosure of autism, among other things.

**Conclusions:** This project directly answers the call for new research following two recent reviews (Lindsay et al., 2019; Thompson-Hodgetts et al., 2020), and in response to an increase in research on this topic in the last 10 years. The results will provide objective data for autistic individuals to make an informed decision about disclosure in their lives.

**401.106 (Poster) 'Autistic Burnout': Exploring Experiences of Stress and Burnout in Autistic and Non-Autistic Adults**  
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**Background:** Despite many first-person accounts and clinical anecdotes of stress and 'autistic burnout', only one (autistic-led) study has been published to date. 'Autistic burnout' has been described as exhaustion, loss of skills and decreased tolerance to sensory stimuli (Raymaker et al., 2020). Unlike occupational burnout, autistic burnout may occur in any context where expectations outweigh abilities and support is insufficient.

**Objectives:** This study explored differences in self-reported perceived stress and burnout in autistic and non-autistic adults. Sex differences, current mental health difficulties (depression and anxiety), current age, and the influence of early vs. late ASD diagnosis/self-identification were also explored.

**Methods:** Using a cross-sectional online survey, a total of 462 adults (autistic n = 373; non-autistic = 89) aged 18-75 (mean age = 31.77 years) completed standardised questionnaires related to their experiences of perceived stress, (personal, work

and social) burnout, current symptoms of depression and anxiety, and autistic traits. Participants also completed a bespoke stress and burnout questionnaire. Group differences were examined.

**Results:** Those in the autistic group reported significantly higher scores of personal, work and social burnout, as well as perceived stress. These significant differences remained when adjusted for age, depression and anxiety. Sex differences were also found in the autistic group, with autistic females reporting significantly higher levels of personal burnout than autistic males. No sex differences were found in work or social burn out, nor perceived stress. Additionally, no group differences were found between autistic adults diagnosed in childhood vs. those diagnosed in adulthood.

**Conclusions:** The findings from the current study suggest that autistic adults may experience higher levels of perceived stress and burnout than non-autistic adults, as has been previously highlighted in personal accounts and Raymaker et al. (2020). Autistic females were found to experience elevated rates of personal burnout, compared to autistic males. Therefore, this study highlights the need for further exploration of reasons for high stress levels and burnout in autistic people, and future environmental adaptations and supports to address these. Additionally, longitudinal studies may elucidate the mechanisms which underpin the experience of stress and burnout in autistic people.

**401.107 (Poster)** “It’s Nice to Connect to People without the Pressure of in-Person Meetings”: Autistic Women’s Experiences during the COVID-19 Pandemic and Attending a Virtual Peer Support Group

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**Background:** The unpredictability of the COVID-19 pandemic, the social isolation associated with physical distancing measures, and the ensuing economic instability, could increase the risk of mental health problems and exacerbate health inequities experienced by autistic women. There is a timely need to adapt supports and this period of uncertainty highlights opportunities for sustainable improvements to care delivery. Important first steps are to identify the challenges and opportunities that the COVID-19 pandemic poses for autistic women, from their own perspectives, and seek their input as services and supports evolve to meet their needs.

Asperfemme Toronto offers a monthly peer support group for autistic women, which provides a forum for members to support each other in areas of mutual interest. The group is co-facilitated by a therapist who specializes in autism, and an autistic graphic designer/technical illustrator who supports other autistic individuals. In response to the COVID-19 pandemic, Asperfemme Toronto transitioned their monthly face-to-face meetings to virtual meetings.

**Objectives:** This exploratory, co-production research study aimed to describe the experiences of autistic women during the COVID-19 pandemic, including their experiences of attending virtual peer support group meetings.

**Methods:** Participants were recruited from postings on Asperfemme Toronto’s Facebook group and an associated email list. Interested participants were directed to an online survey and provided with open-ended questions about their experiences during the COVID-19 pandemic and attending virtual peer support group meetings. Data were analysed using a summative content analysis approach (Hsieh & Shannon, 2005). An autistic self-advocate and an academic researcher independently read the participants’ responses to identify key words and subsequently sorted the data into like categories and sub-categories. Identified categories were compared and discussed until a consensus on the final conceptualization was reached.

**Results:** The sample consisted of 35 autistic women, ranging in age from 21 to 63 years (M= 39.29 years, SD=11.16). Key categories pertaining to participants’ experiences during the COVID-19 pandemic included: 1) Less Means More; and 2) Change is Difficult. Participants noted that they experienced fewer social and sensory demands as a result of public health restrictions during the pandemic, which enabled them to focus more on activities of personal importance, and helped them to live more authentically. However, participants also acknowledged difficulties adapting to changes to their routines, and the quickness and urgency in which changes were enacted during the pandemic. Overall, participants largely appreciated having the opportunity to attend virtual peer group support meetings with other autistic women during the pandemic. Responses regarding their likes and dislikes of virtual peer support group meetings were categorized as: 1) (In)Convenience; 2) (Dis)Comfort; and 3) (Dis)Connection.

Conclusions: As the COVID-19 pandemic continues to bring about changes to service delivery models, the current study offers preliminary insights into promising areas for expanding virtual peer support programming for autistic adults.

**401.108 (Poster) “Just Invite Us”:** Autistic Adults’ Recommendations for Developing More Accessible Physical Activity Opportunities.

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Background:

Autistic adults engage in lower levels of physical activity (PA) than their non-autistic peers, and over sixty percent do not meet national guidelines for PA. Additionally, autistic adults face myriad barriers to PA participation that can make accessing physical activities challenging. As many of the cooccurring conditions that are associated with autism in adults can be moderated by PA, it’s vital that opportunities are accessible and meaningful for autistic individuals. Yet, research on PA participation in autistic adults is limited, with most studies focusing on the perspective of parents and other caregivers.

Objectives:

To support the inclusion of autistic adults in PA, the current study sought to explore first-hand recommendations for PA participation from autistic adults' perspective. In doing so, this study has sought to amplify the accounts of autistic adults so that practitioners have practical solutions to better include autistic individuals into PA experiences and make these opportunities more accessible.

Methods:

A qualitative descriptive design with a constructivist lens was used to examine autistic participants' recommendations for engaging in PA. Participants were recruited through online groups, university autism networks and a snowball sampling to leverage personal connections of autistic participants. Participants (n=23) ranged in age from 18 to 75 years (m=40.45, SD = 17.79); 12 participants identified as male and 11 identified as female. Twenty participants had a formal diagnosis of autism and three were self-diagnosed. The AQ-10 was used as a confirmatory measure of likelihood of an autistic diagnosis and all participants scores confirmed likelihood. Interview questions were developed to elicit participant perspectives of their PA experiences across their lifespan. Within a larger grounded theory study, the authors embedded questions that allowed participants to share recommendations on how to improve PA experiences for individuals "like themselves." The presented data form those recommendations.

Results:

Two themes were developed during the data analysis process: 1) It’s helpful to have someone there to support; and 2) It’s that sensory thing, it always is. Theme 1 encapsulates the importance of having vocal advocates willing to encourage and support the autistic persons in both individual and group activities. Theme 2 highlights the critical role that sensory factors play in the success of PA experiences for autistic adults across the lifespan, and how unique sensory needs may be met.

Conclusions:

Consistent with prior research, autistic adults in the present study faced a multitude of barriers to accessing PA. Yet, uniquely within this study, the authors asked adults to give recommendations for how they believe those barriers should be addressed. Though simple, the presented recommendations would show a radical balancing of the power dynamic between practitioners and autistic clients. Educators, service providers, and families should take these recommendations not only as direction from those who understand autistic adults best, but as a way to explore with those you work with and love how to provide PA programming and access best.

## POSTER SESSION — AFFECTIVE NEUROSCIENCE

### Poster 402 - Affective Neuroscience Posters

**402.001 (Poster)** Brainstem Morphometric Differences in Children with Autism Spectrum Disorder, Developmental Coordination Disorder and Those Typically Developing

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**Background:** The brainstem is a neglected topic in autism research, despite major lines of evidence indicating its active involvement in sensory, motor, affect, arousal, and social regulation (Dadalko & Travers, 2018). It is the substrate of what affective neuroscience identifies as the ‘Core Self’ (Alcaro, Carta, & Panksepp, 2017), and disruption to its growth and function appears to disturb core conscious experience in autism (Delafield-Butt & Trevarthen, 2017; Trevarthen & Delafield-Butt, 2013). Yet, although evidence indicates brainstem growth is disrupted in early childhood (Bosco et al., 2018), how these growth differences compare to closely related neurodevelopmental disorders, such as a Developmental Coordination Disorder (DCD), is not yet understood.

**Objectives:** To determine brainstem morphometric differences between children with ASD, DCD, and those typically developing (TD).

**Methods:** Study participants were 87 youths ages 8 to 17 assigned to the ASD ( $n = 30$ , 7 female), DCD ( $n = 24$ , 12 female) or TD ( $n = 33$ , 12 female) group. Exclusion criteria for all groups included IQ <80. TD were excluded if they had any neuropsychological or psychopathological disorder. DCD eligibility additionally included performance 16<sup>th</sup> percentile on the MABC-2 and no concern about an ASD diagnosis. ASD participants had a previous clinical diagnosis confirmed by ADOS-2 and ADI-R. Individuals were excluded if they had another neuropsychological disorder, except attention deficit or anxiety disorder. T1-weighted MPRAGE (1mm isotropic resolution) MRI data were acquired on a 3T MAGNETOM Prisma (Siemens). Brainstem morphology was analysed using SPHARM-MAT (<http://lisenlab.com/spharm/>), a 3D Fourier surface representation method. A typical surface was calculated for the TD group, and distances from this norm computed for each vertex. Mean distances at each vertex were computed for each group (ASD, DCD, TD) and compared, taking into account age, gender and supratentorial volume as covariates.

**Results:** Significant brainstem morphological differences were identified between all three (TD, ASD and DCD; Figure 1). Significant differences between TD and ASD ( $p < 0.01$ ) were identified in a large region of the anterior-most surface, extending caudally along the right posterior surface. Differences between TD and DCD groups were similar with reduced significance ( $p > 0.01$ ), and the pattern diverged with more inclusion of the anterior ventricular surface and less pronouncement at the right anterior border. Finally, significant differences were found between ASD and DCD groups ( $p < 0.01$ ), specifically at the anterior midline either side of the ventricular surface, and especially in two long anteroposterior columns on the left side adjacent and parallel to the fourth ventricle.

**Conclusions:** Surface morphology differences indicate alterations in local nuclei and/or tract growth within the brainstem, especially approaching the anterior surface in ASD and DCD children, and differentially between them at the ventricular surface. The former may relate to specific nerve growth of the pons, and the latter to cerebellar peduncle connectivity differences, superficial nuclei growth such as the hypoglossal, intercalatus, or vagus and associated tracts, or deeper nuclei such as the inferior olivary nucleus. Brainstem structural differences likely disturbs the integrative function of the Core Self. Higher resolution 7T MRI is required to resolve the underlying differential composition.

**402.002 (Poster)** Frontal Alpha Asymmetry As a Predictor of Emotion Regulation and Strategy Use in Toddlers with ASD and TD

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**Background:** Children with ASD have difficulties with emotion regulation. The extent to which this difficulty is specific to core symptoms (e.g., changes in routine), or is more global in nature, differs for each child. In adults and older children, the relative difference between resting left and right frontal alpha EEG power (i.e., asymmetry) may be related to approach and avoidance behaviors and, subsequently, challenges with emotion regulation. There is little evidence as to the relation between asymmetry and affective regulation in typically developing preschoolers, and less still for young children with ASD.

**Objectives:** (1) To characterize frontal alpha asymmetry in preschoolers with ASD and typical development (TD); and (2) to explore whether asymmetry is related to behaviorally coded and parent-report measures of emotion regulation.

**Methods:** Children with ASD (n=18) and TD (n=30) completed 4 minutes of alternating eyes open/closed resting EEG data collection at 2 or 4 years of age. Concurrently, emotion regulation strategy use was coded from a 5-minute parent-child play interaction into five behavioral categories, following the Process Model of Emotion Regulation (Gross, 1998). Of relevance to this project is the Situation Modification scale, which captures attempted changes in the environmental context to modulate emotional response. Parent-report BASC-3 Aggression and Withdrawal scales (T-scores) assessed approach- and avoidance-related emotional and behavioral functioning. EEG power was derived from the BEAPP EEG processing pipeline as the natural log of mean power per hertz within the alpha (8-13 Hz) frequency band (Levin et al., 2018). Unique frontal activation relative to each hemisphere (i.e., asymmetry) was calculated by generating residual values, which are more sensitive than traditional difference scores (Meyer et al., 2017). Left relative activation was derived from a model of right power (F4) predicting left power (F3) (i.e., left power, controlling for right). Right relative activation was the inverse. Nonverbal IQ differed by group and was controlled for in all analyses. Data collection is ongoing.

**Results:** While there was no diagnostic group difference in degree of asymmetry,  $b=.11$ ,  $p>.05$ , and direction of asymmetry was not different by group,  $X^2(2)=3.00$ ,  $p>.05$ , qualitative observations suggested wide variability. Situation Modification scores did not differ by group,  $b=.05$ ,  $p=.60$ . Children with ASD had higher Withdrawal T-scores than TD children,  $b=.26$ ,  $p=.04$ . When split by diagnostic group, there were no significant relations between frontal asymmetry and emotion regulation. For all children, greater relative right frontal activation was correlated with less frequent use of situation modification strategies for emotion regulation,  $r=-.33$ ,  $p=.03$ . Greater relative left frontal activation was correlated with lower (i.e., more adaptive) Withdrawal T-scores on the BASC,  $r=-.39$ ,  $p=.02$ .

**Conclusions:** For children with and without ASD, greater right asymmetry, which may relate to avoidant or inhibited behavioral styles, related to less adaptive emotion regulation strategy use. Greater left asymmetry, which may relate to increased approach behaviors and impulsivity, here appears adaptive, in that these children have less clinically impairing withdrawn or inhibited presentations. Future work should examine the predictive power of frontal asymmetry in longitudinal designs and examine whether ASD diagnosis moderates these brain-behavior relations.

#### **402.003 (Poster) Intervention Engagement and Social Motivation Predict Increased Social Reward Response in ASD**

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**Background:** The PEERS social skills intervention has been shown to improve social behaviors in adolescents with ASD (Laugeson et al., 2012); however, factors impacting intervention outcomes are relatively unknown. In broader therapeutic settings, participant engagement, measured through active participation in intervention, is associated with better outcomes (Chu et al., 2010). Quantifiable measures of treatment outcome, including brain-based measures, along with objective measures of participant engagement, and standardized measures of social functioning may illuminate factors influencing individual outcome.

**Objectives:** We sought to answer the following questions: (1) Do neural correlates of social reward responsivity change from pre- to post- PEERS intervention when compared to brain activity of neurotypical (TD) adolescents who did not participate in PEERS? (2) For ASD participants, do parent-report measures of social motivation (SM) and engagement during PEERS sessions predict individual changes in neural correlates of social reward from pre- to post-intervention?

**Methods:** Electroencephalographic (EEG) recordings were conducted to measure event-related potentials in ASD adolescents (n=12, mean age=14.2) before and after the 16-week PEERS intervention. TD teens (n=14, mean age=13.2) were age and gender-

matched to teens with ASD, and had brain activity measured at two time points—16 weeks apart, but did not partake in the intervention. The reward positivity (RewP) was utilized to measure reward processing. Adolescents were presented with rewards accompanied by incidental face (social) or arrow (nonsocial) stimuli. To measure change in the RewP from pre- to post-intervention, a difference score was created by subtracting pre-intervention from post-intervention RewP mean amplitudes. The SM subscale from the Social Responsiveness Scale, Second Edition (Constantino, 2012), was collected at pre- and post-intervention. Participant engagement was quantified as the number of times adolescents raised their hands to answer/ask questions, provide suggestions, or comment on lesson-related material across all 16 sessions.

Results: (1) A 2(group)x2(condition)x2(time) repeated-measures ANOVA revealed no significant main effects or interactions for RewP mean amplitude. (2) Two separate linear regressions were conducted in the ASD group to test if pre-intervention SM or in-session participation predicted change in RewP mean amplitude from pre- to post-intervention. 44.9% of the variance of the change in social reward responsivity (RewP mean amplitude in response to faces) was accounted for by SM pre-intervention scores,  $\beta=-0.7; F(1,10)=8.14, p=0.01$ . 43.9% of the variance of the change in social reward responsivity was accounted for by participant engagement,  $\beta=0.7; F(1,10)=9.60, p=0.01$ .

Conclusions: This is one of the few investigations to include objective (EEG) and observable (participant engagement) measures of outcome and/or prediction measures of intervention. Our findings underscore the importance of SM and active engagement during intervention, as ASD adolescents who had better SM skills before intervention and those who participated more during PEERS sessions displayed increased social reward responsivity after intervention completion. This indicates that engagement during intervention and baseline levels of social motivation may distinguish teens who make mild improvements from those who make more considerable improvements. This is particularly relevant when determining nuanced effects of intervention on an individual basis, which may not be detectable when examining average group differences.

#### **402.004 (Poster)** Oxytocin Modulates Visual Attention Depending on the Social Context: A MEG Study in Adolescents with ASD

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#### Background:

Autism spectrum disorders (ASD) are neurodevelopmental conditions characterized mainly by social dysfunction and deficits in social perception. It has been shown that in this population, intranasal administration of Oxytocin (OT) can enhance attention toward social cues and modulates social perception in both behavioral and neural level. However, there is a gap in the literature regarding the effects of OT on oscillatory brain activity in ASD compared to typically developing (TD) individuals.

#### Objectives:

This study aims to explore the impact of OT on temporal dynamics in ASD using magnetoencephalography (MEG) during a well-validated social perception paradigm. We focused on: M100, M170, and M250, social perception related components, which tend to show atypical patterns in ASD. We hypothesize that OT will modulate these components' amplitudes to resemble an aged-matched TD group.

#### Methods:

Twenty-eight adolescents with ASD and 25 TD adolescents participated in this study. All participants were scanned using magnetoencephalography (MEG) and were asked to identify pictures of emotional facial expressions and pictures of vehicles. In two experimental sessions, approximately one week apart, individuals with ASD received a single dose of intranasal OT or placebo in a double-blind controlled study.

#### Results:

We first established that OT enhances accuracy in individuals with ASD in social and non-social conditions. Our results show that such individuals with ASD differed from the TD group in the PL sessions only. Next, Cluster-based nonparametric analysis using beamforming revealed differences between the ASD and TD groups in the 140-220 ms window (M170, a face processing related component). While TD individuals presented higher occipito-temporal activations for faces than vehicles, individuals with ASD presented elevated neural activation in the same regions for both faces and vehicles equally. Administration of OT reduced the observed activity for vehicles only, creating a neural differentiation that was closer to that of the TD group. In addition, we show that individuals with higher IQ benefited more from OT administration.

## Conclusions:

Our results show that OT administration modulates the neural balance between social and non-social stimuli making occipito-temporal regions more attuned to social cues. For the first time, we show an optional mechanism for OT's influence on adolescents' early social perception stages with ASD. Studies like this allow a better understanding of OT's influences on social perception in individuals with ASD and enhance our ability to improve their social difficulties.

### **402.005** (Poster) Predicting Electrophysiological Indices of Change in a RCT of a Group-Based Social Skills Intervention for Youth with ASD

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Background: Group-based social skills interventions are the most widely-used treatment approach for social deficits among youth with autism spectrum disorder (ASD) and have evinced moderate effects overall (Gates et al., 2017). One such intervention, socio-dramatic affective-relational intervention (SDARI), is designed to offer an “enriched social environment,” whereby changes in social information processing (SIP) and behavior are driven by repeated opportunities for motivated engagement within social contexts. Results from a recent trial demonstrated SDARI's effects on target neural mechanisms (EEG-indexed markers of early-stage SIP), N170 event-related potential [ERP] latency to faces (Kang et al., 2018) and N100 ERP amplitude to voices (Lerner et al., 2013). While SIP in ASD is thought to vary as a function of demographics (age, sex), social motivation, and social cognition (Mendelson et al., 2016), it is unknown whether such variables predict intervention-related *change* in SIP, thereby indicating prospective treatment responders.

Objectives: We assessed key demographic factors, ASD symptoms, social motivation, and Theory of mind (ToM) as putative moderators of electrophysiological changes following a randomized-controlled trial of SDARI.

Methods: 53 teens ( $M_{age}=11.7$ ,  $SD_{age}=3.1$ ; 39 male), with  $IQ \geq 70$  and ADOS-2-confirmed ASD diagnoses were randomly assigned to 10-week SDARI or an active control (AC) for 1.5 hours/week. AC was identical to SDARI in structure, minus SDARI-specific content. N170 and N100 ERPs were measured at baseline, endpoint, and 10-week follow-up during an emotion recognition task (DANVA-2; Nowicki, 2004). Parents completed measures of youth's social motivation (DMQ; Morgan et al., 2009) and ToM (ToMI; Hutchins et al. 2012) at baseline. Generalized estimating equations (accounting for group nesting) were used to examine moderators of change trajectories (across all 3 time points), with independent correlation matrix providing the best model fit.

Results: SDARI group showed accelerated N170 latency and increase in N100 amplitude relative to the AC group (Figure 1), with effects only present in boys (all  $ps < .05$ ). The N170 latency effect was greater in participants who were older or had fewer ASD symptoms (all  $ps < .005$ ), and present only in those with low or high social motivation ( $p < .028$ ; Figure 2), or poorer ToM ( $p = .031$ ). The N100 amplitude effect was driven by participants who had more ASD symptoms ( $p < .001$ ), and present only in those with medium social motivation or ToM ( $p < .019$ ).

Conclusions: SDARI led to specific improvements in EEG-based metrics of early-stage SIP, which have themselves been implicated as potential biomarkers of ASD. These effects vary by key correlates of SIP (age, sex, ASD symptoms, social motivation and cognition), suggesting directions for a precision medicine approach to impacting neural mechanisms of social deficits in ASD. For instance, SDARI may confer specific and durable improvements in face-related SIP in participants who have fewer ASD symptoms, or are highly motivated as they successfully engage in SDARI's enriched social contexts, but findings also suggest perhaps a distinct group of responders who have poorer ToM or low social motivation. Moreover, results provide further insights into the complex and often inconsistent relationship of SIP with social motivation and ToM (Garman et al., 2016; Jaswal & Akhtar, 2020).

### **402.006** (Poster) Vocal Emotion Recognition in Adolescents with and without ASD in Response to Child Versus Adult Voices

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Background: Autism Spectrum Disorder (ASD) is characterized by social communication impairments including difficulty recognizing other people's emotions (Uljarevic & Hamilton, 2013). These emotion recognition impairments are present across modalities (i.e., faces, body movements, and voices; Phillip et al., 2010), with most work focused on facial emotional recognition (FER; Harms et al., 2010). Recent research examining individual differences in FER in ASD has demonstrated that, similar to peers without ASD, adolescents with ASD exhibit “own-age bias,” or better performance recognizing same-age peers due to

frequent interaction with faces of similar age (Hauschild et al., 2020). While some studies have considered whether FER deficits extend into other modalities (e.g., vocal emotion recognition; VER; Jones et al., 2010), few have examined whether individual difference predictors (like own-age bias) do so as well. Such individual differences implicate variation in neural mechanisms during VER processing which can be measured using event-related potentials (ERPs). For instance, the N100 indexes intensity of and attention to early auditory information (Schirmer et al., 2011; Wang et al., 2017), while the P200 differentiates vocal emotions from neutral expressions and may differ based on the specific emotion and speaker (Paulmann & Kotz, 2008). Past studies have found differences in these components associated with ASD and VER performance (Korpilathi et al., 2007; Lerner et al., 2013), yet it is unknown if they relate to factors such as VER own-age bias.

**Objectives:** This study examined VER abilities and processing (N100, P200) in response to child versus adult voices in adolescents with and without ASD.

**Methods:** 122 adolescents with and without ASD participated in a standard voice emotion recognition task (Table 1) while electroencephalography (EEG) was collected (Table 1; Figure 1). Two-way ANOVAs were used to examine whether VER abilities and ERPs differed between groups or by (adult/child) condition.

**Results:** Participants made more VER errors in response to adult, compared to child, voices ( $p < .001$ ). Participants with ASD, compared to peers without ASD, made more VER errors ( $p = .001$ ). Compared to child voices, adult voices elicited larger P200 amplitudes across groups ( $p = .012$ ). No differences in N100 amplitude, N100 latency, or P200 latency emerged.

**Conclusions:** Own-age bias was present in VER in adolescents with and without ASD, consistent with prior work in FER (Hauschild et al., 2020). Compared to adolescents without ASD, adolescents with ASD made more errors identifying vocal emotions, supporting findings of multimodal emotion recognition difficulties in ASD (e.g., Phillip et al., 2010, Lerner et al., 2013). Across groups, the P200 amplitude was enhanced in response to adult, compared to child, voices. Given own-age bias was present across groups, an enhanced P200 in response to adult voices may reflect more effortful processing of adult emotional voices. Yet differences in ERPs between adolescents with and without ASD did not emerge, suggesting similar early processing of VER in ASD, despite behavioral differences. This diverges from the FER literature in which behavioral performance is intact while neural response is atypical (Harms et al., 2010), highlighting the importance of examining emotion recognition abilities across modalities and levels of analysis.

## Animal Models

### ORAL SESSION — ANIMAL MODELS

#### Oral 302 - Modeling Autism Mutations from Fish to Human Cells

##### 302.001 (Oral) Altered Brain-Wide Auditory Networks in a Zebrafish Models of Autism

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**Background:** Individuals with autism usually present with hyper or hypo responsivity to auditory stimuli, however the neurological underpinnings behind these differences remain unclear.

**Objectives:** We looked at sub-cortical auditory processing *in vivo* in an autism model of zebrafish, to determine if there are any differences in auditory sensitivity or processing between the *fmr1* zebrafish and their wildtype siblings. We are also carrying out similar experiments on other genetic models of autism.

**Methods:** We use selective plane illumination microscopy with GCaMP6 calcium indicators to record the entire brain at cellular resolution, looking at whole-brain and regional auditory networks and neural responses to acoustic stimuli in larval zebrafish *in vivo*.

**Results:** Auditory responses in the *fmr1* fish were more plentiful, compared to their wildtype siblings, at a brain-wide level. The primary auditory region, the octavolateralis nucleus (homologous to the cochlear nuclei), was significantly better at decoding auditory at lower volumes in the *fmr1* fish. Three brain regions—the thalamus, torus semicircularis and tegmentum—had clusters of neurons that more strongly responded to auditory stimuli, indicating filtering is reduced. Inter-regional functional connectivity networks in the *fmr1* fish responded to sound intensities of half the amplitude (a -3 to -6 decibel shift) as wild type larvae.

**Conclusions:** Using larval zebrafish we can look at whole brain processes in *fmr1* and other genetic models of autism to determine if there are any differences in sensitivity and auditory processing. The *fmr1* results reflect the hypersensitivities documented in humans with FXS and autism, thereby providing possible network-level mechanisms by which sensory processes are altered at the sub-cortical level.

##### 302.002 (Oral) Germline Nuclear-Predominant Pten Murine Model Exhibits Impaired Social and Perseverative Behavior, Microglial Activation, and Increased Oxytocinergic Activity

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**Background:** Germline mutations in the gene encoding Phosphatase and Tensin homolog deleted on chromosome TEN (*PTEN*) account for ~17% of all cases of autism spectrum disorder (ASD) with coincident macrocephaly. Animal modeling of cell-specific *Pten* loss or mutation has provided insight into how disruptions to the function of PTEN affect neurodevelopment, neurobiology, and social behavior. As such, there is a growing need to understand more about how various aspects of PTEN activity, cell-compartment-specific functions, contribute to certain neurological or behavior phenotypes. To explore the importance of cytoplasmic PTEN in the development of ASD and macrocephaly, we generated a mouse model with predominantly nuclear localization of Pten (*Pten*<sup>Y68H</sup> model).

**Objectives:** To further understand the relationship between Pten subcellular-localization and downstream effects on neurodevelopment and behavior.

**Methods:** We subjected the *Pten*<sup>Y68H/+</sup> mouse to morphological and behavioral phenotyping, including the 3-chamber sociability and marble burying tests. We subsequently performed *in vivo* and *in vitro* cellular phenotyping and concluded the work with a transcriptomic survey of the *Pten*<sup>Y68H/+</sup> cortex to profile gene expression in adult (P40) male mice (N<sub>+/+</sub> = 6; N<sub>Y68H/+</sub> = 5).

Results: Nuclear-cytoplasmic fractionation of *Pten*<sup>Y68H/+</sup> cortical tissue confirms Pten subcellular-localization is predominantly nuclear (Median $\Delta$ N/CRatio=0.20; 97%CI 0.15-0.34;  $P=0.029$ ). Additionally, we find *Pten*<sup>Y68H/+</sup> mice presents with macrocephaly (Median $\Delta$ BrainMass=0.15; 97%CI 0.090–0.21;  $P<0.0001$ ), decreased sociability using 3-chamber (Mean $\Delta$ Seconds=162; 95%CI 121-203;  $P<0.0001$ ), decreased preference for novel social stimuli (Mean $\Delta$ DSeconds=101; 95% CI 56.5-145;  $P<0.0001$ ), and increased perseverative activity using marble burying (Median $\Delta$ Marbles=4.68; 97%CI 2.12–7.23;  $P=0.002$ ). Cellular characterization of *Pten*<sup>Y68H/+</sup> cortex reveals significant microglial activation (Mean $\Delta$ MicrogliaArea=0.29; 95%CI 0.12–0.46;  $P=0.002$ ), and *in vitro* analysis of primary microglial cultures isolated from *Pten*<sup>Y68H/+</sup> mice reveal enhanced phagocytosis of latex beads compared to *Pten*<sup>+/+</sup> controls (Mean $\Delta$ BeadsEngulfed=3.2; 95%CI 2.5-4.0;  $P=0.005$ ). Subsequent Western blot analysis of *Pten*<sup>Y68H/+</sup> cortical lysate shows increased expression of Iba1 ( $P=0.029$ ) and C1q ( $P=0.029$ ). Finally, we characterized the neural transcriptome which revealed 332 differentially expressed genes [threshold:  $P<0.05$ ; Log<sub>2</sub>(Fold Change) $\geq 1.0$  or Log<sub>2</sub>(Fold Change) $\leq -1.0$ ], the majority of which are overexpressed and involved in neuroinflammation and neuronal function. Oxytocin transcript was 5-fold overexpressed ( $P=0.0018$ ) and confirmed by immune-fluorescent staining of oxytocin in para-ventricular neurons in the hypothalamus which shows significant increase in oxytocin intensity (Mean $\Delta$ IntDensity=6630; 95%CI 4860-8400;  $P<0.0001$ ).

Conclusions: The nuclear-predominant *Pten*<sup>Y68H/+</sup> model demonstrates that Pten dysfunction is linked to microglial activation and phagocytosis. Notably, we demonstrate that Pten dysfunction associates with changes in the oxytocin system, an important connection between a prominent ASD risk gene and a potent neuroendocrine regulator of social behavior. Ultimately, the findings from this work may reveal important biomarkers and/or novel therapeutic modalities that could be explored in individuals with germline mutations in *PTEN* with ASD.

### 302.003 (Oral) Behavioral and Cellular Characterization of a New Mouse Model for DDX3X Syndrome

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Background: DDX3X syndrome accounts for 1-3% of unexplained intellectual disability (ID) in females, presenting also behavioral problems and motor impairments. This syndrome is mostly caused by de novo mutations in DDX3X, an X-linked gene that regulates mRNA translation and has emerging functions in corticogenesis and synaptogenesis. Even though the genetic cause of the syndrome is known, the cellular and molecular mechanisms driving it remain elusive.

Objectives: The objective of this study is to elucidate the cellular and molecular mechanisms driving DDX3X syndrome during development, particularly during corticogenesis, and link them to the symptoms observed in DDX3X patients.

Methods: We generated the first Ddx3x haploinsufficient mouse (Ddx3x<sup>+/-</sup>) model with construct validity for loss-of-function mutations found in females with DDX3X syndrome. To study the impact of Ddx3x haploinsufficiency on development and behavior we followed a standardized battery for assessing developmental milestones during early postnatal life and cognition, social and motor functions in adults. To study the impact of Ddx3x haploinsufficiency on corticogenesis, we performed MRI studies and assessed cortical lamination using layer-specific markers and retrograde tracing to reconstruct sub-cortical connectivity.

Results: Ddx3x<sup>+/-</sup> mice show physical, sensory, and motor delays that evolve into behavioral anomalies in adulthood, including hyperactivity, anxiety-like behaviors, cognitive impairments, and motor deficits. Motor function further declines with ageing. This phenotype is reminiscent of the symptoms observed in DDX3X patients. The behavioral changes are preceded by reduction in brain volume postnatally, with some regions (e.g., cortex and amygdala) disproportionately affected. Cortical thinning is accompanied by defective cortical lamination, indicating that Ddx3x regulates the balance of glutamatergic neurons in the developing cortex.

Conclusions: While supporting face validity for a novel pre-clinical mouse model, our data shed new light on the developmental mechanisms driving DDX3X syndrome.

### 302.004 (Oral) Modeling Brain Overgrowth in Autism Using Human Pluripotent Stem Cells

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#### Background:

Approximately 15-20% of individuals with Autism Spectrum Disorder (ASD) have disproportionate megalencephaly (ASD-DM), with enlargement in both gray and white matter volume. Individuals with ASD-DM have more severe behavioral and cognitive problems and are less responsive to standard therapeutic interventions, leading to very poor prognoses relative to individuals with ASD and normal head circumferences. Increases in brain size often precede clinical symptoms, suggesting that understanding the underlying mechanisms regulating brain overgrowth could provide a window of opportunity for intervention or mitigation of symptoms.

#### Objectives:

Here, we use human induced pluripotent stem cell (hiPSC) technology to model brain overgrowth in ASD-DM and investigate the underlying cellular and molecular mechanisms involved. The overarching goals are: 1) to investigate whether gray and white matter enlargement are due to an increase in cell proliferation, increase in cell survival, improper elimination of damaged cells, and/or a combination of all; and 2) to identify therapeutic targets by understanding the underlying cellular and signaling mechanisms involved.

#### Methods:

As part of the UC Davis MIND Institute Autism Phenome Project (APP) and Autism Centers of Excellence (ACE), we generated ~30 human iPSCs from cohorts of children (2-4 years old) with complete clinical and phenotypic data, including A) ASD subjects with megalencephaly, ASD-DM; B) ASD subjects with normal sized brains, ASD-N; C) Typically developing (TD) subjects with megalencephaly, TD-DM; and and D) TD subjects with normal sized brains, TD-N. We differentiated each of the iPSC lines into neural progenitor cells (NPCs) and oligodendrocyte progenitor cells (OPCs) and investigated changes at the molecular and cellular levels and alterations in phagocytosis in *in vitro* and *in vivo* models.

#### Results:

In the differentiated neural and glial progenitor cells, we observe increased proliferation and suppressed phagocytosis of NPCs/OPCs by macrophages in ASD-DM. RNA-sequencing of the differentiated progenitor cells reveals important signaling mechanisms related to the neuroimmune system in regulating cellular phagocytosis. Similarly, in genetic models of autism associated with brain enlargement, we show that CD47 (a 'don't eat me' signal) is overexpressed in both NPCs and OPCs in 16p11.2 deletion carriers with macrocephaly contributing to reduced phagocytosis *in vitro* and *in vivo*. Treatment of 16p11.2 deletion NPCs and OPCs with an anti-CD47 antibody to block CD47 restores phagocytosis to control levels. Furthermore, 16p11.2 deletion NPCs and OPCs upregulate cell surface expression of calreticulin (a pro-phagocytic 'eat me' signal), indicating that these cells should be phagocytosed but fail to be eliminated due to elevations in CD47.

#### Conclusions:

While the CD47 pathway is commonly implicated in cancer progression, we document a novel role for CD47 in regulating brain overgrowth in psychiatric disorders and identify new targets for therapeutic intervention. We demonstrate that anti-CD47 treatment can act as a therapeutic agent for clearing unhealthy cells in cellular and mouse models, potentially indicating that these forms of therapy could be translated to selected autistic individuals with brain overgrowth early in the disease. Furthermore, our study highlights that the balance between 'eat me' and 'don't eat me' signals may be more broadly playing critical roles during early neurodevelopment.

## ORAL SESSION — ANIMAL MODELS

### Oral 316 - Perturbing Genetic and Environmental Autism Risk Factors in Mouse Models

**316.002** (Oral) Generating a New ASD/ID Mouse Model By Deleting Epigenetic Factor ASH1L in Developing Brains  
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#### Background:

ASH1L is an epigenetic factor that facilitates gene expression through modifying chromatin. Recent genetic studies reported that mutations of *ASH1L* are highly associated with human ASD/ID. The genetic findings are supported by multiple clinical reports that some children diagnosed with ASD and/or ID acquire various mutations of *Ash1L*. In addition to ASD/ID, patients also display a variety of developmental and behavioral abnormalities including delayed myelination, craniofacial deformity, skeletal abnormality, and feeding difficulties, suggesting critical roles of *Ash1L* in normal embryonic and postnatal development. However, the causal link between *ASH1L* mutations and clinical ASD/ID remains undetermined.

#### Objectives:

In this study we set out to use mice to address: (i) is loss of *Ash1L* in developing brains sufficient to induce ASD/ID-like phenotypes; and (ii) what are the possible molecular mechanisms linking *Ash1L* mutations to the pathogenesis of ASD/ID?

#### Methods:

Global *Ash1L* knockout (*Ash1L*-KO) and conditional *Ash1L* knockout in developing brains (*Ash1L*-nes-cKO) mice were generated to study the function of *Ash1L* in embryonic and postnatal development. Three-chamber tests, novel object recognition (NOR) tests, and open field assays were used to examine the sociability, social novelty, recognition memory, and anxiety-like behaviors of *Ash1L*-nes-cKO mice. RNA-seq analyses were used to examine the gene expression changes in the *Ash1L*-deleted neural progenitor cells (NPCs) during induced differentiation.

#### Results:

The three-chamber tests revealed that the deletion of *Ash1L* in developing mouse brains (*Ash1L*-nes-cKO) caused core autistic-like behaviors including impaired social interaction, repetitive and compulsive behaviors. The NOR and open field tests revealed that the *Ash1L*-nes-cKO mice displayed impaired cognitive memory and increased anxiety-like behaviors. In addition to the core ASD/ID-like defects, the deletion of *Ash1L* caused multiple developmental defects observed in human patients, which included early postnatal lethality, postnatal growth retardation, craniofacial deformity, and skeletal deformity. At the microscopic level, *Ash1L* deletion in developing brains resulted in delayed lamination during embryonic cortical formation and delayed myelination during early postnatal brain development. RNA-seq analysis revealed the deletion of *Ash1L* in neural progenitor cells impaired the expression of multiple genes critical for synapse formation and normal brain development.

#### Conclusions:

In this study, we generated a new ASD/ID mouse model by deleting an epigenetic factor ASH1L in developing brains. The loss of *Ash1L* gene alone in developing mouse brains is sufficient to cause autistic-like behaviors and ID-like deficits in adult mice, as well as multiple developmental defects that are observed in human patients, suggesting *ASH1L* gene mutations found in patients are likely to be the causative drivers leading to clinical ASD/ID. Gene expression analyses revealed that ASH1L plays an important role in activating the genes critical for normal brain development, providing a potential molecular mechanism linking *ASH1L* mutations to genesis of ASD/ID. As the new ASD/ID mouse model generated in this study recapitulates most clinical ASD/ID manifestations found in human patients, it provides an invaluable tool for further exploring the biological mechanisms underlying the pathogenesis of *ASH1L* mutations-induced ASD/ID, developing and testing new therapeutic approaches based on the functions of ASH1L and its regulated genetic pathways revealed by this study.

**316.003** (Oral) Influence of Maternal Genetics on Fetal Neurodevelopment in a Murine Model for PTEN-Associated Autism Spectrum Disorder

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**Background:** The genetic etiology of Autism Spectrum Disorder (ASD) is well established but complex. Most genetic studies in ASD have been focused on the proband, with little understanding of parental genetic contributions. Among parental factors, maternal inflammation due to autoimmunity, infections and toxins is recognized as a significant mediator of ASD. Associations between pregnancy loss/ASD risk and maternal autoimmune-susceptibility genes suggest a role for maternal genetics in *in-utero* inflammation mediated ASD. Murine studies on maternal inflammation in ASD have relied on experimental injection of strong inflammatory insults that elicit ASD-like behavior in the offspring. Therefore, the inherent impact of maternal genetics on ASD pathogenesis during *in-utero* neurodevelopment, without strong pro-inflammatory insults or ongoing inflammation has not been demonstrated. Moreover, the processes through which maternal genetics may modulate the penetrance of high-risk monogenic ASD genes in genetically predisposed offspring have not been investigated. *PTEN* is ranked as a category-1 ASD-associated gene, accounting for approximately 2% of all ASD and 17% of macrocephalic-ASD. With about 23% penetrance for driving ASD pathogenesis, *PTEN* mutations provide a good genetic model system to study additional impacts of environmental and genetic modifiers that help overcome the required threshold for disease development.

**Objectives:** In this study, we interrogated the inherent impact of maternal genetics predisposing to inflammation on fetal neurodevelopment under physiological conditions and in the absence of external inflammatory insults.

**Methods:** We used our *Pten<sup>m3m4</sup>* murine model to demonstrate the impact of maternal genotype on the penetrance of *Pten*-mutation-associated ASD-like phenotypes in the offspring. *Pten<sup>WT/m3m4</sup>* females were bred to *Pten<sup>WT/WT</sup>* males or *Pten<sup>WT/WT</sup>* females were bred to *Pten<sup>WT/m3m4</sup>* males to interrogate the offspring of a heterozygous mutant mother (Mom<sup>m3m4</sup>) versus of a wildtype mother (Mom<sup>WT</sup>). Maternal, placental, fetal liver and fetal brain were analyzed for inflammatory markers and nervous system cellular markers by multiplex ELISA (n=6 per group), immunohistochemistry (n=3 per group), nanostring RNA transcript analysis and bulk-RNA-sequencing (n=6 per group). Marble burying and three chamber sociability behavior tests were conducted on pups derived from mothers with different genotypes (n=10 per group).

**Results:** We show that maternal genetic predisposition to inflammation can alter immune responses to pregnancy leading to inadequate IL-10 mediated immunosuppression (< 4 pg/ml in 71.4% Moms<sup>m3m4</sup> vs 9% Moms<sup>WT</sup>, range 0-6.6pg/ml vs 0-16.2pg/ml, p=0.002). Lack of IL-10 induction in the mother was directly correlated with complement expression in the fetal liver indicating an impact on fetal physiology. Fetuses from mothers with a genotype predisposing to inflammation, had increased breakdown of the blood-brain-barrier, neuron loss and lack of glial maturation. This impact of maternal genotype was also evident postnatally on increased risk of newborn mortality (Chi<sup>2</sup>=66.66, p=0.001), visible macrocephaly (16% vs 0%, p=0.01) and ASD-like repetitive (p=0.0003) and social behaviors (p=0.04). Severity of post-natal ASD-like phenotypes was reflective of both maternal and offspring genotypes. Interestingly, non-predisposed (wildtype) offspring were also affected and disease penetrance was decreased in predisposed pups depending on the mother's genotype.

**Conclusions:** Our study highlights the importance of maternal genetics in fetal neurodevelopment merely via altering the immunosuppressive state during pregnancy.

## POSTER SESSION — ANIMAL MODELS

### Poster 403 - Animal Models Posters

**403.001 (Poster)** A Multifactorial Model for Autism Spectrum Disorder: Studying Gene-Environment Interactions between Genetic CNTNAP2 Deletion and Exposure to Maternal Immune Activation during Pregnancy

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**Background:** Currently, there is a lack of experimental approaches that attempt to target the complexity of causes of neurodevelopmental disorders such as Autism Spectrum Disorder (ASD). The epidemiology of ASD tells us that individual risk factors can only account for a small percentage of cases, and it is likely that multiple risk factors exhibit synergistic effects that lead to the manifestation of ASD.

Two prominent ASD risk factors are a genetic variation in contactin-associated protein like-2 (CNTNAP2) and exposure to maternal immune activation (MIA) during pregnancy. CNTNAP2 is a protein that plays a crucial role in brain development, and genetic variants of CNTNAP2 are linked with ASD. MIA occurs as a result of a viral or bacterial infection during pregnancy. MIA is known to impact the developing fetal brain, particularly when it occurs during early pregnancy. Rodent studies have

shown that either knock-out of the *cntnap2* gene or MIA at gestation day (GD) 9.5 lead to changes in sensory processing and cognitive ability as well as changes in synaptic structure, which potentially underlies the behavioural deficits seen in both rodent models.

**Objectives:** The goal of this study is to examine the interaction of the genetic and environmental impact by investigating whether MIA induces brain and behavioural changes in rats with a partial (heterozygous) *cntnap2* deletion and if it exacerbates phenotypes of rats with a complete *cntnap2* deletion (homozygous knockout).

**Methods:** Heterozygous (het) female *cntnap2* Ko Sprague Dawley rats were mated with het males and exposed to either saline or the immune stimulant polyinosinic polycytidylic acid (poly I:C) at GD9.5. Wildtype (WT), het or *cntnap2* ko animals born from 7 saline or 8 poly I:C dams were tested for changes in sensory reactivity, sensory filtering and sensorimotor gating using habituation and prepulse inhibition (PPI) of the acoustic startle response (ASR) at 6 weeks and 3 months of age. Additionally, attention and impulsivity were assessed in young adult offspring using the touch screen 5-choice serial reach time task (5-CSRTT).

**Results:** *Cntnap2* ko rats exhibited increased sensory reactivity at 6 weeks of age, as measured by amplitude of the ASR to sound intensities of 80 decibels or higher. On the other hand, 6-week poly I:C offspring, regardless of genotype, exhibit decreased long-term habituation (LTH) of startle, as measured by the change in startle reactivity across 4 days of testing. Neither poly I:C nor *cntnap2* deficiency impacted PPI or short-term habituation of startle. Testing of adult offspring is ongoing.

**Conclusions:** Our results indicate that the effects of poly I:C MIA may not synergize with those of *cntnap2* deficiency in our rat model at 6 weeks of age as measured by reactivity and habituation phenotypes of the ASR. Ongoing experiments are investigating these phenotypes as well as impulsivity and attention in the 5-CSRTT in adulthood, which is when more severe behavioural changes are seen in both rodent poly I:C and *cntnap2*<sup>-/-</sup> studies.

#### 403.002 (Poster) Altered Developmental Trajectory in Prenatal Valproate Rat Model of Autism Spectrum Disorder

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**Background:** Converging evidence suggests that intervention programs for children with Autism Spectrum Disorder (ASD) are more effective when provided early in development. Prospective studies in children with high risk for ASD (younger siblings of children diagnosed with ASD) have demonstrated delayed acquisition of developmental milestones in social communication, motor, and sensory domains. This suggests that studying how ASD unfolds over the developmental trajectory from birth until the appearance of core symptoms, is a fundamental requirement for ASD research. Therefore, examining the developmental trajectory in animal models of ASD is crucial for understanding the mechanisms underlying the evolution of this complex developmental disorder and to explore early time windows for effective intervention.

**Objectives:** 1. Comprehensive assessment of the early developmental trajectory in a prenatal valproate (VPA) exposure rat model of ASD. 2. Creation of a composite developmental score integrating physical, sensory, and motor milestones.

**Methods:** Adult female and male rats were kept for overnight mating. Pregnancy was determined by the presence of a vaginal plug on the following morning (designated as embryonic day E1). On E12.5, prenatal VPA exposure (450 mg/kg sodium salt of valproic acid NaVPA, Sigma, dissolved in 0.9% saline solution at a concentration of 100 mg/ml) was administered using a single intraperitoneal (IP) injection while control dams received a single IP injection of 0.9% normal saline solution. Experiments were carried out on male and female offspring of the dams described above. Overall, 8 dams were used in the study resulting in 4 vehicle control (SAL) and 4 valproate (VPA) exposed litters with a total of 51 offspring (11 SAL male, 14 SAL female, 18 VPA male, and 8 VPA female). An extensive test battery encompassing physical, sensory, and motor developmental milestones during postnatal day 4 to postnatal day 21 was used to characterize early development in SAL and VPA pups. Standardized z-scores of all 15 readouts (higher values representing greater developmental delay) were combined to form a developmental composite score with high internal consistency (Cronbach alpha 0.76).

**Results:** VPA rats had significantly delayed milestones for physical (onset of incisor eruption and pinnae detachment), sensory (vibrissae placing, Limb placing, negative geotaxis) and motor (grasping reflex, level screen test, bar holding test) domains. Male and female VPA rats were almost similarly affected. Remarkably, the developmental composite score of individual rats effectively discriminated between VPA and SAL rats, and this contrast was particularly striking in males.

**Conclusions:** Prenatal VPA rats showed significantly altered developmental trajectory in male as well as female rats. Delay in early milestones indicates altered developmental programming of the central nervous system that might precipitate as core features of ASD later in childhood. Our results support clinical findings of altered early development in ASD. Considering the large heterogeneity in ASD phenotype, the developmental composite score provides a robust outcome measure to characterize overall early development in animal models of ASD and can be used to assess improvements after early intervention.

**403.003 (Poster)** Altered Maternal-Pup Behaviours in Developmental Vitamin D-Deficient Rats

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**Background:** Gestational or developmental vitamin D (DVD)-deficiency is an epidemiologically recognized risk factor for autism (Lee et al. 2019). Our lab has established a rat model of DVD-deficiency to investigate the neurobiological mechanisms implicated in DVD-deficiency (Eyles et al. 2003). Previous findings in DVD-deficient animals have pointed out the possible alterations in maternal stress response as a potential mechanism for altered behaviours in adult offspring (Eyles et al. 2006). Indeed, studies show that postpartum maternal care, primarily the frequency of licking/ grooming and arched-back nursing, influence several neural systems involved in offspring development (Meaney 2001).

**Objectives:** This study aims to examine maternal care and pup behaviours in DVD-deficient animals.

**Methods:** DVD-deficient rats were produced by methods already established in our lab (Ali et al. 2019). Postpartum maternal behaviours were video-recorded daily from postnatal day 2 (P2) to P6 in the home cages. Ultrasonic vocalizations (USVs) were recorded from each pup at P7 and P9 in a sound-attenuated chamber. Pup retrieval task was conducted in the home cage for each litter immediately after measuring their USVs at P7 and P9. Statistical significance was measured by multivariate analysis of variance (maternal behaviour and USVs) and student's t-test (pup retrieval).

**Results:** A total of 21 dams ( DVD n=12, Control n=9) were used for the maternal behavioural analysis. We found significantly increased licking and grooming ( $F_{1, 105}=9.918, p<0.05$ ) and blanket nursing ( $F_{1, 105}=4.716, p<0.05$ ) in DVD-deficient dams compared to controls. Similarly, USVs measurement showed that DVD-deficient pups emitted significantly increased number of calls ( $F_{1, 305}=6.194, p<0.05$ ) and longer duration of calls ( $F_{1, 305}=5.692, p<0.05$ ) compared to controls at P9 but not at P7. Call frequency and call amplitude were not different between control and DVD-deficient pups. The latencies to retrieve the pups were also not different between the control and DVD-deficient dams at both postnatal days.

**Conclusions:** Our current results show that maternal-pup interactions are altered in DVD-deficient animals. Studies have highlighted the implication of maternal care on several mechanisms affecting brain development, including altered hypothalamus-pituitary-adrenal function, oxytocin receptor expression, and synaptic plasticity in the offspring that might lead to long term effect on offspring brain development and behaviour. However, there is also a possibility that altered maternal behaviour observed in our DVD-deficient dams might have been driven by the pup's behaviour, such as increased USVs. This latter possibility remains to be explored.

**403.004 (Poster)** Assessment of Autism-Relevant Behaviors in C57BKS/J Leptin Receptor Deficient (db/+)Mice

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**Background:** Gestational diabetes mellitus (GDM), diagnosed by hyperglycemia arising in pregnancy, is a life threatening condition. Associations between GDM and increased risk of autism, either independently or with other risk factors such as maternal obesity or hypertension, have been uncovered. Leptin resistance and high plasma leptin are common in obese pregnancies. Disrupted leptin signaling may contribute to their coincidence, as it is found in both disorders. Given this we examined constitutive leptin receptor (Lepr) deficient (BKS.Cg-Dock7m +/+ Lepr db/J diabetic (db) heterozygous (db/+)) mice for autism-relevant behaviors. The mutation arose in the C57BKS/J (BKS) strain. BKS db/+ females are lean with normal blood glucose, but they develop GDM while pregnant. We hypothesized BKS db/+ offspring might exhibit physiological and behavior traits consistent with autism.

**Objectives:** Our primary goal was to screen db/+, BKS relative to C57BL6/J (BL6) mice for behaviors relevant to autism. An ancillary goal was to compare corticosterone, the mouse equivalent of human cortisol, for which disrupted diurnal cycles and stress responses are adolescent biomarkers shared by autism and fetal GDM exposure.

**Methods:** We compared behavioral and physiological traits of male and female BKS db/+ to less well-characterized BKS mice, and also BL6 mice commonly used as controls for other strains in autism research. Adolescent body weight, fasting blood glucose, and serum corticosterone were measured. Three chamber tests for social interaction and social novelty preference were performed. Self-grooming was measured during these tests, and marble burying was measured afterward. Social dominance was compared using a tube test in which each mouse was matched against 6 different 129S1/SvImJ mice. Mice pushing the other mouse out of the tube are winners, and mice backing out of the tube lose the match. After 3 min if no mouse exits it is considered a draw. Finally cognitive flexibility was compared using a water-T maze test for mice. A pre-training trial determined the preferred arm. A platform was put in the opposite arm from the preferred arm for 10 subsequent training trials. After each trial, mice were dried with towels to rest between trials while other mice were tested. There were 5 acquisition days, and 4 reversal days. Criteria for acquisition was met when mice correctly find the platform 80% of the time for 3 consecutive days.

**Results:** Male db/+ weighed more and had higher blood glucose and corticosterone relative to BKS or BL6 mice. Also, male db/+ had lower social interaction preference, explored arenas less, and buried more marbles than BL6 but not BKS males. Male and female db/+ were more dominant and made more mistakes in water T-mazes locating a sunken platform after its position was reversed than BL6, but not BKS mice. Overall BKS db/+, particularly males, exhibited some autism-like social deficits and restrictive-repetitive behaviors relative to BL6, but BKS strain contributions to BKS db/+ behaviors were also evident.

**Conclusions:** Genetic differences between BKS and BL6 strains are prominent contributing factors to BKS db/+ behavior phenotypes that can potentially impair the ability to detect GDM induced, autism-relevant developmental changes.

**403.005 (Poster)** Attention to the Eyes Is Related to Maturation of the Visual Object Pathway in Infant Rhesus Macaques  
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**Background:** Disrupted attention to the eyes of others in infancy is one of the earliest behavioral risk markers for Autism Spectrum Disorder. Typically, attention to the eyes increases during the first months of life as an adaptive means of scaffolding social development. However, the neural systems associated with this basic mechanism of social attention are currently unknown. Leveraging longitudinal data from rhesus macaque infants, an important model of human social development, we investigate functional connectivity (FC) within the visual ventral object pathway as a potential neural substrate. Connectivity in this pathway ultimately facilitates complex social cognition in rhesus macaques. Minimally developed at birth, this pathway matures in a caudal-rostral direction through the first months of life (Kovacs-Balint et al. 2019). During this period, infant macaques also show intense social development, yet how early visuosocial experiences relate to strengthening connectivity between regions along the ventral pathway is unknown.

**Objectives:** We use two bodies of densely sampled longitudinal data, eye-tracking and resting-state functional magnetic resonance imaging (rs-fMRI), to determine whether patterns of attention to the eyes of others are associated with FC changes in the maturing visual system

**Methods:** Eye-tracking data were collected from 31 male rhesus macaques (13 time-points), whereas rs-fMRI data were collected from a subsample of 21 animals (7 time-points) before 6 months of age. Attention to the eyes was measured as percent fixation while infants watched naturalistic videos of conspecifics (Wang et al. 2020). FC was calculated between regions of the ventral object pathway for the left and right hemispheres: primary visual cortex (V1), extrastriate visual cortex (V3), inferior temporal areas (TEO and TEp), and amygdala (AMY). Group mean and individual developmental trajectories were fit for both datasets using Functional Principal Components Analysis (FPCA) (Yao, Müller, Wang, 2005). Features of the individual trajectories for the 14 subjects with both eye-tracking and rs-fMRI data were extracted to test for relationships between social visual attention and FC development. Social rank for these 14 subjects was normalized to a percentile.

**Results:** Curve-fitting using FPCA reveals the primary component of variance across individual trajectories of FC captures magnitude. The secondary component of variance across individual trajectories of eye-looking captures the developmental timing of local maxima and minima. Linear regression between these components shows that infants with greater increases in FC between left V1 to V3, and left V3 to TEp have an earlier increase in eye-looking before 2 months and a more pronounced decrease in eye-looking at 2-3 months of age ( $p < .08$ ,  $p < .05$ ). Low ranking infants show accelerated trajectories of attention to eyes ( $p < .05$ ; Figure 1).

Conclusions: This is the first study to test associations between trajectories of functional brain development and social visual attention in rhesus macaques during the first 6 months of life. Data show that an infant's early social experiences are associated with earlier developing FC along the visual object pathway. This maturation in FC between areas of the visual object pathway may provide an important neural substrate supporting adaptive transitions in social visual attention during infancy.

**403.006 (Poster)** Bench to Bedside and Back: A Longitudinal Translational Study of Motor Outcome Measures in Individuals and Preclinical Models of Angelman Syndrome

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Background: Angelman Syndrome (AS) is a genetic neurodevelopmental disorder characterized by developmental delay, lack of speech, seizures, intellectual disability, and walking and balance disorders. We have focused on motor ability as an outcome measure as movement disorders affect nearly every individual with AS. In AS, motor outcomes include ataxia, hypotonia, delayed walking, and posture anomalies and motor ability is highly correlated with more sophisticated behaviors such as cognition and communication. Motor outcomes present an outstanding yet understudied opportunity for direct translational studies to investigate pharmacological, dietary, behavioral, physical, and genetic therapies. Clear phenotypes have been widely published on these phenotypes clinically (Wheeler et al., 2017) and preclinically (Born et al., 2017; Berg et al., 2020). One pilot study in children with AS showed abnormal and stunted walking compared to an age matched typical developing group (Grieco et al. 2018).

Objectives: To date, gait studies have not been reported in any preclinical model of AS. Moreover, gait studies in AS patients are not extensive or definitive. The objective of this study was to investigate and precisely define motor abnormalities in AS individuals in parallel with translational behavioral methods in an AS mouse model to assess analogous motor outcomes. Additionally, development of abnormal gait was tracked longitudinally in the AS mouse model and cross-sectionally in AS patients.

Methods: Motor behaviors were assessed with multiple methods in AS patients aged 4-11 years including novel and innovative instrumented gait analysis, alongside more commonly used Zeno Walkway, and EMG recordings in a clinical setting as well as the Actimyo activity monitoring system in patients' home environment. In an AS mouse model, traditional motor behavior assays were used including gold standards of open field and the accelerating rotarod, and nuanced gait was studied using the digital and automated DigiGait treadmill system.

Results: For the first time, we demonstrated marked global motoric deficits in AS individuals and AS model mice on similar metrics. Many nuanced and pertinent differences were identified in quantitative spatial and temporal components and indices of gait between AS and typically developing individuals as well as between AS mice versus wildtype controls, elucidating and highlighting the predictive value of gait. These metrics were followed cross-sectionally in humans and longitudinally in mice to observe the progression of maladaptive gait in AS, clinically and preclinically. Finally, we observed specific kinematic and EMG findings in AS individuals that may underlie these specific motor difficulties.

Conclusions: Taken together, these findings demonstrate the robust translational value in the study of nuanced motor outcomes for AS, as well as other neurodevelopmental disorders that lack rigorous outcome measures, with the broad goal of improving bench-to-bedside successes.

**403.007 (Poster)** C58/J Mice with Autistic-like Phenotype Display Dendritic Spines' Abnormalities in the Prefrontal Cortex and Hippocampus

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#### **Background:**

ASD has a broad range of neurobiological characteristics, including structural plasticity-associated abnormalities, as alterations in dendritic spines. Due to dendritic spines represent approximately 90 percent of excitatory synapses, changes in their number or morphology would be related to the atypical brain communication that people with autism display.

There is evidence of ASD-related-dendritic spines alterations in monogenic mouse models of the disorder, but it is still missing data from spine changes associated with idiopathic autism. The C58/J mice is an inbred strain with autistic-like behavior, and it is considered a potential model for non-syndromic ASD.

### Objectives:

We aimed to analyze the changes in the number and morphology of dendritic spines in the pyramidal neurons from the prefrontal cortex and the hippocampus of C58/J autistic-like strain.

### Methods:

Brains of four male mice from C58/J (autistic-like) and C57 BL6/J (control) strains were stained through the Golgi-Cox technique. Data from the number, length, and width of approximately 6000 spines from the apical and basal dendrites of pyramidal neurons from layer II/III of the prefrontal cortex and CA1 region of the hippocampus were collected and analyzed. Spines were classified according to their morphological characteristics.

### Results:

We observed increased spine density in the apical dendrites of hippocampal neurons and decreased density in both apical and basal dendrites of the prefrontal cortex neurons of C58/J mice compared to control strain. According to length and width measurements, neurons of C58/J mice display longer dendritic spines with narrower heads. The shaped-based classification showed a higher number of long-thin and thin spines in the apical dendrites, along with an increased number of filopodia-like spines and lower mushroom spines with wide head in the basal dendrites of hippocampal neurons from autistic-like mice. In contrast, in the prefrontal cortex, we only observed fewer thin spines in the C58/J strain compared to the control mice.

### Conclusions:

There is a strong correlation between the morphology, function, and maturation state of dendritic spines; our results suggest a higher frequency of immature dendritic spines in the pyramidal neurons of the hippocampus and the prefrontal cortex of C58/J mice. These changes in the morphology of dendritic spines could be involved with atypical neuronal connectivity in both brain areas.

**403.008 (Poster)** Characterization of Behavior and Neurochemistry Following Social Stimulation in Oxytocin-Receptor-Mutants: Zebrafish Autism Model

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Background: Intranasal administration of oxytocin has been recently reported to improve socialization in autistic patients and has shown promise as a potential treatment of social impairments seen in autism. Oxytocin is a neuropeptide that regulates a wide range of mammalian social and non-social behaviors that are relevant to autism, such as bonding, social recognition, and anxiety. As the mechanisms underlying social deficits seen in autism and oxytocin's role in improving social functions in autistic patients are not well-understood, animal models with capacity for sophisticated genetic manipulation and fast throughput screening are necessary. Zebrafish (*Danio rerio*) is a highly social vertebrate with phylogenetic conservation in oxytocin and relevant neurotransmitter systems, and relies more heavily on visual social information (not olfactory) and we exploit these features to improve animal modeling of social deficits present in autism.

Objectives: Involvement of the oxytocin system in mammalian social behavior is well-established, but the homologous system in zebrafish remains less discovered. Our aim is to build behavioral and neurochemical profiles of zebrafish with genetically manipulated oxytocin receptors to characterize the zebrafish oxytocin system and further establish a zebrafish model of social impairments relevant for autism.

Methods: We used adult (both males and females) CRISPR-Cas9-mutants lacking either of the two zebrafish oxytocin receptor genes, *oxtr* and *oxtrl*, and studied them in two different social behavioral tasks. We observed socialization between four fish (same-genotype,  $n \geq 20$  for each group) in a large open-field (40x body length) and measured shoaling, schooling, group excursions, general activity, and specific motor patterns of mutant and sibling control fish. We also measured responses of the mutant fish to automated visual-only social stimulus when individually placed in a separate tank and compared them with wild-type control fish. Following automated social stimulation, we also measured the levels of neurotransmitters and amino acids

(dopamine, serotonin, norepinephrine, glutamate, GABA, and glycine) in multiple brain regions using high precision liquid chromatography for these mutant fish and their wild-type control fish.

Results: Our data show that in the large ethologically-relevant open-field, zebrafish lacking oxytocin receptors display subtle differences in locomotion and anxiety-related behaviors, and significant deficits in social behavior. Group social behavior was affected by both *oxtr* and *oxtrl* mutation in a similar fashion. In contrast, we found that individual responses to automated visual-only stimulus was affected in *oxtr* mutant fish but not in *oxtrl* mutant fish. We also found differences in neurotransmitter levels in the measured brain regions (olfactory bulbs and telencephalon, mesencephalon, diencephalon, cerebellum & hindbrain), indicating a role of oxytocin in regulation of neurotransmitters associated with social and emotional behavior.

Conclusions: These results suggest that the two oxytocin receptor may play important but distinct roles in zebrafish social behavior. Further, these findings advance our understanding of neural mechanisms underlying oxytocin-regulated social interaction in zebrafish and highlight the potential of future investigation of zebrafish oxytocin system towards generating better therapeutic treatments for autism and related disorders.

**403.009 (Poster)** Characterization of KMT5B Haploinsufficiency in Mice Recapitulates Neurodevelopmental Disorder Phenotypes

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Background: Recent sequencing efforts have highlighted lysine methyl transferase 5B (KMT5B) as a high-confidence neurodevelopmental disorder (NDD) risk gene associated with autism spectrum disorder (ASD) and intellectual disability (ID). KMT5B is the primary enzyme that di-methylates the lysine 20 residue of histone 4 (H4K20me2). It has been implicated in several cell processes including chromatin compaction, cell proliferation, cell cycle progression (G1-S phase transition), maintenance of quiescent stem cells pools, and double stranded DNA break repair. However, the role KMT5B plays in the developing brain is largely unknown.

Objectives: The goal of this work was to neurodevelopmentally characterize the effect(s) of KMT5B haploinsufficiency using a mouse model.

Methods: A *Kmt5b* gene-trap (+/gt) mouse line was obtained from the knockout mouse project (KOMP) repository at UC Davis. Wild-type (WT; +/+) and heterozygous (HET; +/-) progeny from WT x HET matings were subjected to a comprehensive neurodevelopmental test battery to assess reflexes, motor movement, learning/memory, social behavior, repetitive movement, and common ASD comorbidities (obsessive compulsion, depression, and anxiety). Given the strong sex bias observed in the ASD patient population, we tested both a male and female cohort of animals (>8 animals per genotype and sex) and compared differences between genotypes and sexes using 2-way ANOVA testing and post-hoc analyses.

Results: Initial HET x HET progeny showed sub-mendelian ratios of knockout (KO; gt/gt) pups starting after E18.5 ( $p=0.035$ ;  $\chi^2$  test) suggesting late-term or perinatal lethality. This was consistent with the absence of human patients carrying homozygous null *KMT5B* variation. Both WT and HET mice appeared healthy and were fertile; however, HET mice were significantly lower weight than WTs (males  $p<0.001$ ; females  $p=0.0001$ ) starting at P10 through young adulthood. This was more severe in males than females. HET neonates showed significantly weaker reflexes than WT littermates ( $p<0.01$ ; grasp strength and surface righting). Again, this was more severe in males. While no significant differences were seen based on genotype in the open field, elevated balance beam, rotarod, buried food, social approach, olfactory habituation/dishabituation, light↔dark, forced swim, and marble burying tests, there were significant differences between genotypes in the foot shock test ( $p<0.0001$ ) and extinction of conditioned fear ( $p=0.0058$ ). We also noted significant differences between sexes (but not genotypes) in the time to fall from the rotarod ( $p=0.0403$ ), first dark entry in the light↔dark test ( $p=0.0077$ ), speed in the elevated plus maze ( $p=0.0086$ ), escape in the Barnes maze ( $p=0.0003$ ), and the social preference test ( $p=0.0163$ ). Interestingly, several sexually dimorphic differences were noted including increased repetitive grooming behavior in HET females (Tukey's  $p=0.0042$ ), an increased latency to hot plate response in HET females versus a decreased latency in HET males ( $p=0.0029$ ), slower reversal learning in males in the Barnes maze (Sidak's  $p=0.0270$ ), and increased brain size in HET females (Sidak's  $p=0.0056$ ).

Conclusions: Our results identified several relevant behaviors impacted by KMT5B loss that may be probed by future studies to better understand the pathophysiology of this putative genetic subtype of NDD. We are specifically interested in the differences identified between sexes that suggest a female protective effect.

**403.011 (Poster)** Enriched Housing Alters the Trajectory of Pup Brain Early Development Via Maternal Behaviour

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### **Background:**

During early life, the brain is particularly sensitive to environmental stimuli during key windows of development and early neurodevelopment is of particular importance in ASD mouse models. Environmental enrichment (EE) regulates adult ASD mouse behaviour and plasticity (Delorme et al, 2013) and induces rapid neuroanatomical changes in adult mice (Scholz et al, 2015). Impact of very early exposure to EE on neuroanatomical development remains unknown.

### **Objectives:**

The aim is to evaluate the impact of EE on early brain development when pups cannot explore their surroundings yet, and when maternal behaviour is the likely means whereby the environment is reflected on the developing brain.

### **Methods:**

Five primiparous pregnant CD1 dams were housed individually in standard housing (SH) or in EE cages (rat sized cage, containing a dome, a running wheel and a multilevel maze) at E13. Maternal behaviour was assessed at P3/P4 in 5 daytime sessions of (35+4x30)min. Pups were perfused at P7. 6 weeks later, dams were mated with their previous sire, and at E13 were housed in the same environment (SH - SH, 2 dams, or EE - EE, 1 dam), or switched (SH - EE, 1 dam, or EE - SH, 1 dam). Maternal behaviour was assessed and pups were perfused likewise. Pups' brains were scanned with a diffusion-weighted ( $b=1917\text{ms}/\mu\text{m}^2$ , 30 directions) 3D fast spin-echo MRI sequence ( $78\times 78\times 78\mu\text{m}^3$  resolution). The images were aligned using a series of iterative linear and nonlinear registrations steps (Avants et al, 2011; Friedel et al, 2014). A voxel-wise analysis was conducted, and multiple comparisons were corrected for using a 10% false discovery rate.

### **Results:**

One dam (SH-SH) delivered a highly disproportionated number of males, and was therefore discarded, as maternal behaviour has been suggested to be dependent on pups' sex. Pups born in EE notably display a volumic decrease in the nucleus accumbens and a volumic increase in the septohippocampal nucleus, the habenula and the periaqueductal grey (Figure 1A). The interaction between housing and litter (Figure 1B) reveals a consistent volume cross-over in these ROIs in the pups of dams who switched environments (from EE to SH or from SH to EE) between their two litters. Although dams' behaviour has to be interpreted cautiously due to the small number of dams, dams housed in EE spend on average more time in contact with their pups and are more engaged in nursing behaviours (Figure 1C). Interestingly, a cross-over matching neuroanatomical changes is observed: attention to pups is increased when switched to EE and decreased when switched to SH. It also seems generally increased for the 2<sup>nd</sup> litter, except for the EE-SH switch.

### **Conclusions:**

EE impacts pups' brain development, even before they can explore their environment (P7). At this stage, and as the behaviour data suggest, the sensitivity of pups' neuroanatomy to the environment likely reflects the different maternal care provided in different environments. Further analyses will explore the litter order effect on neuroanatomy. Exposure to different early environments might have an important and underappreciated impact in ASD mouse models.

### **403.012 (Poster) GABA<sub>b</sub> Receptor Agonist R-Baclofen Reverses Altered Auditory Reactivity and Filtering in the Cntnap2 Knock-out Rat Model for Neurodevelopmental Disorders**

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**Background:** Altered sensory information processing, and auditory processing in particular, is a common impairment in individuals with autism spectrum disorder (ASD). One prominent hypothesis for the etiology of ASD is an imbalance between neuronal excitation and inhibition. The selective GABA<sub>B</sub> agonist R-Baclofen previously improved social deficits and repetitive behaviors in several mouse models for neurodevelopmental disorders including ASD, and R-Baclofen has shown to ameliorate social avoidance symptoms in some individuals with ASD.

**Objectives:** The present study investigated whether selective activation of GABA<sub>B</sub> receptors can remediate ASD-related altered sensory processing reliant on excitation/inhibition imbalance in the auditory brainstem.

**Methods:** We tested auditory reactivity, filtering and sensorimotor gating in form of acoustic startle reactivity, habituation and prepulse inhibition after acute administration of R-Baclofen (0.75, 1.5, and 3 mg/kg) in the *Cntnap2* knock-out (KO) rat model. In order to assess a possible excitation/inhibition imbalance in brainstem circuits mediating sensorimotor gating, we also detected and quantified GABA and glutamate neurotransmitter levels in the startle mediating PnC (nucleus reticularis pontis caudalis) as well as in the auditory cortex of *Cntnap2* wild-type (WT) and KO rats using Matrix-Assisted Laser Desorption Ionization Mass Spectrometry (MALDI MS).

**Results:** R-Baclofen treatment suppressed exaggerated auditory startle responses and improved disruptions in habituation in *Cntnap2* KO rats in a dose-dependent fashion, with the highest doses bringing animals close to control animals. Prepulse inhibition of the acoustic startle response (PPI) – an evaluation of sensorimotor gating – increased across various acoustic prepulse conditions after administration of R-Baclofen in *Cntnap2* KO, but it did not affect PPI in WT rats. MALDI MS analysis indicated differences in GABA and glutamate signal intensity between the PnC from *Cntnap2* WT and KO rats.

**Conclusions:** Our findings suggest that GABA<sub>B</sub> receptor agonists may be useful for pharmacologically targeting sensory processing disruptions involving neuronal excitation/inhibition imbalance in ASD.

We thank SFARI for providing R-Baclofen. This study was supported by CIHR and the Deutsche Forschungsgemeinschaft (MO 3857/2-1)

**403.013 (Poster)** Phenotyping Mouse Models of Angelman Syndrome Using Multidimensional Behavioral Clustering  
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**Background:** Angelman syndrome (AS) is a single-gene neurodevelopmental disorder with a multifaceted behavioral phenotype: deficits in motor function, epilepsy, cognitive impairment, impaired sleep, and other co-morbidities. Effectively modeling this behavioral profile and measuring behavioral improvement will be crucial for the success of ongoing and future clinical trials. Foundational studies have defined a suite of robust and reliable behavioral phenotypes in the AS mouse model. However, no single behavioral test is able to fully capture the complex nature of AS -- in mice, or in children.

**Objectives:** We seek to comprehensively quantify the behavioral profile of AS model mice.

**Methods:** Here, we use multidimensional analyses (principal component analysis + k-means clustering) to quantify combined performance across behavioral domains in a mouse model of AS.

**Results:** This approach successfully predicts the genotype of mice based on their behavioral profile using 2 principal components with >95% accuracy. >90% accuracy could be achieved using a single principle component.

**Conclusions:** Multidimensional analysis provides a platform to ask whether preclinical treatments for AS can improve the behavior of individual mice such that they can no longer be distinguished from their wild-type littermates based on behavior.

**403.014 (Poster)** Prenatal Exposure to Maternal Immune Activation Leads to Altered Dendritic Morphology in Dorsolateral Prefrontal Cortex in a Non-Human Primate Model  
**K. L. Hanson<sup>1</sup>, R. K. Weir<sup>2</sup>, A. M. Iosif<sup>3</sup>, J. Van de Water<sup>4</sup>, C. S. Carter<sup>5</sup>, A. K. McAllister<sup>6</sup>, M. D. Bauman<sup>7</sup> and C. M. Schumann<sup>8</sup>,** (1)Psychiatry, University of California Davis MIND Institute, Sacramento, CA, (2)Innovation & Enterprise Department, University College London, London, United Kingdom, (3)Public Health Sciences, University of California Davis, Davis, CA, (4)MIND Institute, University of California, Davis, Davis, CA, (5)Department of Psychiatry and Behavioral Sciences, University of California Davis, Sacramento, CA, (6)Center for Neuroscience, University of California Davis, Davis, CA, (7)UC Davis MIND Institute, Sacramento, CA, (8)MIND Institute, UC Davis, Sacramento, CA

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**Background:** Women exposed to viral or bacterial infections during pregnancy are at an increased risk for having a child with autism, schizophrenia, or other neuropsychiatric disorders. Alongside genetic and environmental factors, maternal infection

during pregnancy, such as during the current COVID-19 pandemic, may represent a significant risk factor for the development of autism and related disorders by affecting brain development and morphology. Animal models of maternal immune activation (MIA) provide powerful translational tools for understanding the mechanisms that underlie deviations from typical development that lead to differences in behavior and cognition. Our previous studies demonstrated aberrant social behavior and attention in non-human primate offspring born to immune-challenged mothers. Preliminary findings suggest differences in dendritic morphology in the prefrontal cortex in offspring of PolyIC-treated rhesus macaque mothers.

**Objectives:** The present study analyzed the morphology of neurons in the brains of an extended cohort of MIA offspring to determine how maternal immune response during pregnancy may affect offspring brain development.

**Methods:** Pregnant dams were treated with a modified form of the viral mimic PolyIC in the first trimester (on gestational days 43-46, n=5) or second trimester (gestational days 100-103, n=4) or injected with saline (n=4) as a control. Treated dams showed immune responses characterized by increase in IL-6 levels and temperature and sickness behaviors as previously reported. At 3.5-4 years of age, brains of offspring (all male) were perfused with saline, and frontal lobe blocks were stained using the Golgi-Cox method. After 12 weeks, blocks were sectioned and mounted on slides for microscopic analysis. We identified pyramidal cells in the supragranular (II/III) and infragranular (V/VI) layers of Brodmann Area 9/46 in the dorsolateral prefrontal cortex (dlPFC) that met previously published inclusion criteria. Apical and basilar dendrites were traced in their entirety, and morphological measures were taken including cell soma size, total dendritic length, number of dendritic segments (an indicator of dendritic branching), and spine density and type.

**Results:** We found evidence for an increase in dendritic branching in pyramidal cells in both infra- ( $F_{2,10}=11.38$ ,  $P=0.026$ ) and supragranular ( $F_{2,10}=8.698$ ,  $P=0.007$ ) layers in the dlPFC in MIA-offspring brains as compared to controls, but no significant differences between first and second trimester MIA groups. We additionally found a significant effect of MIA on apical dendrite diameter in the infragranular layers of the dlPFC ( $F_{2,10}=7.675$ ,  $P=0.001$ ) in both MIA groups as compared to control, with no significant differences between first and second trimester MIA groups.

**Conclusions:** These results suggest that maternal immune challenge during pregnancy can affect cellular morphology at different timepoints of infection during pregnancy in specific regions of the brain important for executive and social function, with important implications for understanding the etiology of aberrant social behavior in neuropsychiatric disorders.

**403.015 (Poster)** Sex-Dependent Influence of Post-Weaning Environmental Enrichment in Angelman Syndrome Model Mice  
*A. D. Kloth, J. A. Cosgrove, L. K. Kelly and E. A. Kiffmeyer, Department of Biology, Augustana University, Sioux Falls, SD*

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**Background:** Angelman Syndrome (AS) is a rare neurodevelopmental disorder caused by mutations or deletions of the maternal allele of UBE3A. AS in humans is marked by intellectual disability, ataxia, autism-like behaviors, and a happy, excitable demeanor. Considerable preclinical work has characterized the pathophysiology of AS in mouse models and examined possible therapeutic approaches, but so far there is no successful treatment in patients. One route to treatment may lie in the role the environment plays early in postnatal life, when the brain is highly plastic. Environmental enrichment (EE)—in which mice are provided with cognitive and physical enrichment—is one manipulation that has shown therapeutic potential in preclinical models of many brain disorders, including some neurodevelopmental disorders. Here, we examined whether postweaning environmental enrichment can rescue disease-relevant behavioral phenotypes in mice carrying maternal deletion of *Ube3a<sup>m-p/+</sup>* (AS mice), and whether any phenotypic improvements are sex-dependent.

**Objectives:** We investigated the degree to which chronic post-weaning environmental enrichment rescued the most penetrant behavioral phenotypes in AS mice on the C57BL6/J background. We performed these experiments separately in male and female mice to determine whether the response to enrichment was sex-dependent.

**Methods:** Mice (AS mice and *Ube3a<sup>m-p/+</sup>* controls) were randomly weaned with sex-matched littermates into standard shoebox housing (SH) or EE housing at P21. The enriched housing had a larger footprint, a running wheel, toys of different sizes, shapes, and colors and promoted foraging, burrowing, and climbing; toys were rotated twice weekly to add novelty to the environment. Following 6 weeks of enrichment, mice were submitted to a battery of tests that reliably demonstrate behavioral deficits in AS mice (Sonzogni *et al.*, 2018), including rotarod (motor coordination), open field (exploration and anxiety), marble burying (repetitive behaviors); weights were also monitored. These experiments were performed for both male and female mice; in total, there were 8 experimental groups with at least 12 mice per group. Experimenters and behavioral scorers were blind to genotype.

**Results:** We were able to replicate well-established sex-independent deficits in all of the aforementioned behaviors in SH-AS mice. In male AS-EE mice, we found complete restoration of motor coordination to the level of SH-control mice, a partial and statistically significant enhancement of marble burying behavior, and complete rescue of exploratory distance traveled and center

time in the open field, but we found no rescue of vertical behavior in the open field. EE-control mice showed small-to-modest enhancements of these behaviors. AS-EE also had weights comparable to SH-control mice. Intriguingly, in the female AS-EE, we found a complete failure to rescue any of the behavioral deficits relative to female SH-control mice, but weights were at SH-control levels.

**Conclusions:** Environmental enrichment over a relatively short period of time is an effective route to correcting the most penetrant, disease-related phenotypes seen in AS male mice. Future study will examine other highly reproducible cellular and electrophysiological defects to determine if they, too, are rescued in male mice. In addition, we will examine whether altering the parameters of environmental enrichment may lead to similar changes in female mice.

**403.016 (Poster)** The Mitochondrial Transporter Aralar: A New Target for Treatment of Social Behavior Deficits  
*A. K. Kanellopoulos<sup>1</sup>, V. Mariano<sup>1</sup>, T. Achsel<sup>1</sup> and C. Bagni<sup>1,2</sup>, (1)Department of Fundamental Neurosciences, University of Lausanne, Lausanne, Switzerland, (2)Biomedicine and Prevention, University of Rome Tor Vergata, Rome, Italy*

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**Background:** Social impairment is frequently associated with mitochondrial dysfunctions and altered neurotransmission.

**Objectives:** While mitochondrial function is crucial for brain homeostasis, it remains unknown whether mitochondrial disruption contributes to social behavioral deficits.

Our laboratory has recently shown that fly mutants in the homolog of the human *CYFIP1*, a gene linked to autism and schizophrenia, exhibit mitochondrial hyperactivity and altered group behavior (Kanellopoulos et al. *Cell*, 2020).

**Methods:** Here, we used *Drosophila melanogaster* and performed behavioral, genetic, pharmacological and metabolic assays.

**Results:** Our study provides causal evidence linking mitochondrial energy production through the TCA cycle to alterations in GABA metabolism and further uncovers a mechanistic link between these molecular processes and alterations in behavior in social groups. Specifically, increased mitochondrial activity causes GABA sequestration in the mitochondria, reducing GABAergic signaling and resulting in social deficits. We identify Aralar as the mitochondrial transporter that sequesters GABA upon increased mitochondrial activity and identified, through different types of screenings, molecules that modulate Aralar activity.

**Conclusions:** This study greatly increases our understanding of the molecular mechanisms underlying aberrant mitochondrial functions and its impact on brain pathophysiology and social behavior.

*Reference : Kanellopoulos, A. K. et al. Aralar sequesters GABA into hyperactive mitochondria, causing social behavior deficits. Cell 180, 1178–1197 (2020).*

## POSTER SESSION — BEHAVIORAL GENETICS

### Poster 404 - Behavioral Genetics Posters

**404.001** (Poster) A Preliminary Investigation into Childhood Autism and Attention Deficit Hyperactivity Phenotypes in PAX6 Confirmed Aniridia

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#### Background:

Children with visual impairment are at increased risk of neurodevelopmental disorders with attentional difficulties (ADHD) present in up to 15.6% and autism diagnosed in up to 33% of children with profound visual impairment. Inheritance of autism and ADHD is multifactorial, with familial evidence of neurobiological basis in twin to twin studies and only a small number of genes identified as being causative.

Neurodevelopmental disorders have been linked to intragenic mutations of the *PAX6* gene on Chromosome 11p13, which encodes a transcription factor expressed in the early development of the eye, brain and other tissues. These mutations, of which 500 variants have been registered, cause loss of function of one of the genes, resulting in congenital aniridia, a rare sight threatening disorder with a prevalence rate of 1:40,000- 1:100,000. 2/3 of cases occur sporadically with the rest (familial aniridia) inherited in an autosomal dominant fashion.

#### Objectives:

To explore the neurodevelopmental phenotypes of children with isolated familial and sporadic aniridia.

#### Methods:

A retrospective case note review was carried out and screening questionnaires completed by parents of children with complete or partial aniridia. Children with additional genetic mutations or chromosomal rearrangements were excluded. All children had molecularly confirmed *PAX6* variants. Parents completed the Goodman's Strengths and Difficulties Questionnaires (SDQs) and Social Responsiveness Questionnaires - 2<sup>nd</sup> Edition (SRS-2). Verbal subtests of the Wechsler Preschool and Primary Scale of Intelligence or Wechsler Intelligence Scale for Children were administered to children who had undergone a full neurodevelopmental assessment at the time of the study.

Additional tests of attention (TEA-Ch), executive functioning (BRIEF) and direct and indirect observations were made of social communication skills.

#### Results:

23 children were identified, 18 of whom met the inclusion criteria. 6 families were either uncontactable or did not return questionnaires yielding a final cohort of 12 children. Participants were aged between 4.5 -15.5 years, with male: female ratio of 2:1. Best corrected visual acuity was within the moderate-severe range (LogMAR 0.6-1.1). All children but two (siblings) had different intragenic mutations.

66% of the children were of average to above average intellect.

SDQ's-Clinically significant scores:

- 54% of parents reported high levels of stress.
- 50% of the children had emotional difficulties.
- 58% had conduct problems.
- 58% reported peer relationship difficulties.
- 67% had hyperactivity.
- 75% had prosocial difficulties.

SRS-2: 75% scored within the clinically significant range for consideration of autism spectrum with 83% of parents reporting repetitive behaviours.

Co-morbidities: 36% of the children were on medication for ADHD, 24% had mental health concerns such as depression, anxiety or suicidal ideation, with intellectual disability, dyslexia or specific learning disability in 33%.

Conclusions:

Children with molecularly proven *PAX6* gene mutations appear to be at increased risk of hyperactivity, ADHD and autism than their similarly sighted peers. This may in part be due to the effects of visual impairment, but correlation with the *PAX6* gene mutation seems to be a risk factor. Additional mental health co morbidities are present, with reported anxiety, depression and suicidal ideation. Larger studies are required to further quantify genotype-phenotype correlation.

**404.002** (Poster) Binocular Rivalry Dynamic Discriminates Autism Genetic Subgroups

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Background:

Given the striking variability in genetic and phenotypic profiles associated with autism, identifying robust behavioral endophenotypes remains a crucial next step to improve diagnosis and individualized treatment. Close characterization of the neural and behavioral phenotypes caused by rare single-gene alterations with high penetrance for autism provides a promising approach as they may have a relatively more focused effect on neurobiology. Recently, our lab has identified one sensory paradigm as a compelling candidate for objective and non-invasive endophenotype: binocular rivalry. Binocular rivalry is a simple visual task during which two different images, presented separately to each eye, lead to alternations in perceptual awareness over time and has been linked to the balance of inhibition and excitation (E/I) in the visual cortex. Its dynamics are also under substantial genetic control and most importantly have been shown to be altered in individuals with autism and predictive of symptom severity.

Objectives:

The current study aimed to characterize binocular rivalry dynamics – a behavioral index of E/I balance in visual cortex - in individuals with two rare genetic events that are highly penetrant for autism: fMR1 and 16p11.2 deletions.

Methods:

Seventy-three adolescents and adults (28 with 16p; 17 Fragile X; 28 controls) were recruited, 65 of whom were able to complete the rivalry experiment (26 16p; 11 Fragile X) and matched for age. All participants had normal or corrected-to-normal vision.

Participants completed the non-verbal subtest of Kaufman Brief Intelligence Test (KBIT), and the participants or their parents completed the Autism Spectrum Quotient survey. Rivalry experiments were completed in lab or at remote locations at various conferences with portable head-mounted virtual reality (VR) headset to assure standardized testing conditions across locations.

After thorough instruction and practice with the task, participants completed a binocular rivalry paradigm. On each trial (5 trials, 45sec each), two (red/green) images were presented to an individual's left/right eyes and participants continuously reported whether they perceived the red, green or a mixture of the two images by button press. We compared individuals' performance on the binocular rivalry paradigm, as well as control paradigms assessing motor latency (2 trials, 45sec each) and perceptual decision thresholds (2 trials, 45sec each) across genetic groups.

## Results:

We compared rivalry transitions and switch rates in all three populations: fMRI, 16p11.2, and control individuals. On average, controls switched 10.5 times per trial, (14 times per minute). Switch rates for the 16p11.2 group were significantly slower than controls, at 7.8 times per trial (10.4 times per minute;  $p=0.04$ ). In contrast, switch rates for the fMRI group were comparable to controls 10 times per trial (13.3 times per minute;  $p=0.47$ ). We also compared performance on rivalry replay conditions assessing motor latency and perceptual decision thresholds.

## Conclusions:

Here, we find that rivalry dynamics stratify genetic populations with high penetrance for autism. These results suggest that visual functions like binocular rivalry may effectively identify more homogeneous subgroups of the autism spectrum on the basis of on common genetic and neurobiological alterations. Future studies seek to understand the neural basis of these effects.

### **404.003** (Poster) Developmental Milestone Attainment in Genetic Conditions from SFARI Registries

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**Background:** Behavioral phenotyping allows us to understand differences among individuals with specific genetic conditions. While there is scant data on newly identified genetic conditions associated with neurodevelopmental conditions, there is extant literature on more common behaviorally-defined conditions, such as Autism Spectrum Disorder (ASD). Expected ages of milestone attainment are readily available for children with typical development, providing a normative standard by which to compare children with recognizable delays. Charting early milestone attainment in neurodevelopmental conditions, including those with specific genetic etiologies, may allow for the early identification of developmental phenotypes and ultimately inform intervention (Bishop et al., 2017; Vorstman et al., 2017).

**Objectives:** The purpose of this study was to: 1) determine ages of attainment of motor and language skills in genetic conditions associated with ASD and other neurodevelopmental disorders, and 2) determine which genetic conditions, in comparison to idiopathic ASD, exhibit pronounced delays in the attainment of motor and language milestones. Given existing data, we expected that genetic groups would exhibit a greater percentage of delays in motor milestones compared to the idiopathic ASD group. In addition, we expected that groups with genetic conditions would experience a greater percentage of delays and failure to attain skills across all milestones, in comparison to the idiopathic ASD group.

**Methods:** Participants in this study included individuals who consented and completed target measures in one of two Simons Foundation Autism Research Initiative (SFARI)-funded registries: Simons Searchlight and SPARK (refer to Table 1 for participant demographics). For Searchlight, we used data from 14 conditions (i.e., 4 CNVs: 1q21.1 deletion, 1q21.2 duplication, 16p11.2 deletion, 16p11.2 duplication; 10 Single Genes: *ADNP*, *ASXL3*, *CSNK2A1*, *DYRK1A*, *GRIN2B*, *PPP2R5D*, *SCN2A*, *SLC6A1*, *STXBPI*, *SYNGAP1*). Data from SPARK were used as an idiopathic ASD control group. Across both registries, inclusion criteria for analyses were: 1) minimum age of 36 months, 2) confirmed genetic testing results, and 3) availability of milestone data. Implausible ages to attain a milestone were converted to missing data.

**Results:** As shown in Figure 1, the majority of genetically-defined groups exhibited greater motor delays and several showed more language delays than the idiopathic ASD group. Delay and failure to attain language skills were more prominent than motor delays across all conditions. Groups with single gene mutations had the greatest percentage of delays across all milestones, followed by groups with CNVs, in comparison to the idiopathic ASD group.

**Conclusions:** These results increase our understanding of early developmental milestone trajectories in genetically-defined subgroups and idiopathic ASD. It is important to contextualize these results by noting that ascertainment bias is likely at play here, given these samples were enrolled based on genetic testing. Discovering early developmental phenotypes may have important implications for clinical identification as well as treatment targets and outcome measures. Ultimately, this work may be critical for identifying neurobiological mechanisms involved in the manifestation of neurodevelopmental disorder phenotypes.

### **404.004** (Poster) Genetic Risk Profiling of Insomnia in Autism

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**Background:** Sleep problems, particularly insomnia, are common in individuals with autism, and affect their quality of life and daytime behaviour. Insomnia in the general population is heritable and influenced by many genetic risk factors. Studies have indicated that the autism polygenic risk scores (PRS) (i.e., composite measure of genetic risk) can distinguish autism cases from controls and predict autism. Insomnia PRS similarly distinguishes those with insomnia from controls in the general population. However, there is no research to date examining whether insomnia PRS could be used to predict insomnia in individuals with ASD.

**Objectives:** We aimed to characterize sleep problems in the Vanderbilt Electronic Health Records and examine the genetic contribution of insomnia PRS established in the typically developing population, to risk of insomnia in individuals with autism.

**Methods:** We identified 349 individuals with autism and genetic data and confirmed their autism diagnosis through expert curation of their medical charts. We further characterized the sleep problems of these individuals, and constructed PRS of insomnia using the largest Genome Wide Association Study (GWAS) to date. We examined whether the PRS of insomnia predicts insomnia while also adjusting for sex, age at the time of the chart review, and the 10 principal components of genetic ancestry.

**Results:** Sixty-three percent of the individuals with autism had insomnia. The association between the insomnia PRS and insomnia in individuals with autism was not significant ( $b=0.02$ ,  $p=0.48$ ). To examine whether this result is due to low power or whether this is due to different genetic architecture of insomnia in individuals with autism compared to individuals in the general population, we examined whether the insomnia PRS are associated with sleep disorders (as defined using the corresponding ICD9 and ICD-10 codes for sleep disorders) in individuals in BioVU, regardless of whether they have autism. In a sample of 3,097 cases and 42,456 controls, we found that the insomnia PRS were higher in cases than controls ( $b=0.004$ ,  $p=0.0002$ ). We then downsampled this analysis, by randomly selecting 228 individuals with sleep disorders and 121 controls without sleep disorders, to see if the association with the insomnia PRS remains. The results were not significant ( $b=0.03$ ,  $p=0.25$ ). These findings indicate that the reason why we did not see a significant association in the BioVU autism sample, is likely due to power. By the time of the conference, we will provide results using a larger sample of 903 individuals with autism and insomnia and 2,584 controls.

**Conclusions:** Our study is the first to derive genetic risk profiling of insomnia in autism, paving the way for precision medicine in sleep and autism. Our findings indicate the genetic architecture of sleep problems in individuals with autism is likely similar to this of the sleep problems in individuals without autism.

**404.005 (Poster)** Polygenic Contributions to Face-Sensitive Cortical Responses in Infants with a Family History of Autism  
A. Gui<sup>1</sup>, C. Tye<sup>2</sup>, R. Harrison<sup>1</sup>, H. Patel<sup>3</sup>, C. Curtis<sup>3</sup>, G. Pasco<sup>4</sup>, T. Charman<sup>5</sup>, M. H. Johnson<sup>6</sup>, E. J. Jones<sup>6</sup>, **E. Meaburn<sup>7</sup>** and **The BASIS Team<sup>1</sup>**, (1)Centre for Brain and Cognitive Development, Birkbeck University of London, London, United Kingdom, (2)Department of Child & Adolescent Psychiatry, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)King's College London, London, United Kingdom, (4)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (5)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (6)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom, (7)Psychological Sciences, Birkbeck College, London, United Kingdom

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**Background:**

Autism has a strong genetic component and is characterised by early brain processing atypicalities (De La Torre-Ubieta et al., 2016). However, how polygenic liability for autism relates to differences in brain development is not yet clear and there is no consensus on whether general neurodevelopmental or condition-specific mechanisms underlie autism emergence. In this study we examined the link between polygenic liability for general psychiatric or autism-specific outcomes, and early neural signatures of atypical face processing. The latency of the N170 event-related potential (ERP) in response to faces has been consistently considered a biomarker of autism in adults (Kang et al., 2018). Reduced differentiation between face and control non-face stimuli for the latency of the N290, precursor of the N170, has been previously shown to be predictive of autism diagnosis in infants with a family history of autism (Tye, Bussu et al., in press), and might represent an early sign of emerging brain processing atypicality in infants with elevated genetic liability.

**Objectives:**

In a subset of the cohort studied by Tye et al., we investigated group differences in the N290 latency at 8 months in infants at Elevated Likelihood (EL) and at Typical Likelihood of autism (TL) with EL subgroups based on neurodevelopmental outcome at

3 years. Subsequently, we linked this neural marker to autism and cross-disorder (xDx) polygenic scores to investigate polygenic contributions to early neurocognitive profiles.

#### Methods:

Electroencephalography (EEG) data recorded during a face/non-face paradigm and genome-wide genotype data were available for 102 infants (50 females) who participated in the British Autism Study of Infant Siblings (BASIS). 21 were TL infants, 46 were EL infants with typical development (EL-TD), 14 received a diagnosis of autism (EL-Aut) and 21 did not meet criteria for autism but showed signs of other neurodevelopmental difficulties (EL-Other) at 3 years. N290 latency difference between face and non-face stimuli (F-N 290 latency) was compared between the four outcome groups. Polygenic scores for autism (Grove et al., 2019) and xDx (Schork et al., 2019) were computed ( $p_T \leq 1$ ) and regression analyses conducted to test the association with F-N 290 latency.

#### Results:

F-N 290 latency significantly differed by outcome group ( $F(3, 96)=3.361, p=0.022$ ), consistent with Tye et al. Planned contrasts revealed that longer N290 latency to faces was found in the TL compared to the EL groups (TL vs EL,  $p=0.010$ ), with no significant difference based on autism or general neurodevelopmental outcome. F-N 290 latency was significantly negatively associated with xDx polygenic score ( $p_T=0.5$ ;  $R^2=0.063, p=0.014, FDR=0.048$ , Figure 1A) but not robustly associated with the autism polygenic score ( $FDRs>0.213$ , Figure 1B).

#### Conclusions:

These findings suggest that reduced brain responses to faces in infancy might emerge in the presence of general genetic factors that increase the liability for neurodevelopmental and psychiatric conditions. Future studies will need to replicate these results in larger developmental samples and leverage longitudinal data to identify what factors interact with genetic background to shape developmental trajectories in individuals with autism.

#### **404.006 (Poster)** Relationships between Autism Risk Genes, Vascular Signaling, and Behavior in Autism Spectrum Disorder: A Pilot Study

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#### Background:

Autism Spectrum Disorder (ASD) is the most common neurobiological disorder (2%) in pediatric populations. Emerging evidence suggest that genetic factors may constitute up to 80% etiologies in ASD. Physicians are increasingly faced with clinical populations who need a multidisciplinary approach for treatment, and yet lack the tools for precision medicine to personalize treatments. Recent systems biology approaches may provide an unprecedented opportunity to test novel therapeutic strategies targeting molecular pathways such as vascular signaling to alleviate ASD symptoms and behavioral deficits in an ASD.

#### Objectives:

The aims of this study were to: 1) identify gene variants of vascular signaling associated with autism behaviors in specific neural circuits; and 2) identify whether vascular signaling gene variants promote neuroinflammation and BBB dysfunction in an animal model of autism and epilepsy.

#### Methods:

A clinical database of autism subjects (N=775) was queried for individuals both with and without seizures who had a CNV on microarray, Vineland, and Parent Concern Questionnaire scores (N=117 subjects). Pathway analyses of genes from these CNVs ( $P=0.001$ ) yielded 659 genes whose protein-protein interactions (Pearson's coefficient=0.9) and mRNA expression (Pearson's

coefficient=0.7) mapped 121 genes with maximal antenatal expression (PCW12-40 PCW) in 12 brain regions. A map of the neural circuits derived from Research Domain Criteria (RDoC) revealed significant differences in anxiety, motor, and activities of daily living skills scores between CNV genes and normal microarray subjects.

#### Results:

The RDoC neural circuits involved include the Positive Valence (reward), Cognition (IQ), and Social Processes. Among these genes, we did identify that vascular signaling, as a biological process, may influence the function of these neural circuits. ASD pathogenesis may involve various mechanisms including chronic neuroinflammation, GABAergic imbalance, monoaminergic dysregulation and mitochondrial dysregulation. Several lines of evidence point to ongoing neuroinflammation with microglial activation in the brain of individuals with ASD, as well as increased levels of inflammatory mediators. Deletion of one such vascular pathway of the blood-brain barrier (BBB), Semaphorin 3F- Neuropilin 2 (Sema 3F-NRP2) signaling, results in brain weight loss, EEG changes, and autism-like behaviors. Substantial evidence of neuroinflammation, including activation of microglia, iNOS, and 3-nitrotyrosine expression increases are observed. Signs of platelet deposition, activation, and release of serotonin occur in multiple brain regions important in ASD. Finally, along with platelet products, albumin leakage and uptake and outlining of neurons in these regions suggest possible deficits in the blood brain barrier.

#### Conclusions:

Disruption of neurovascular signaling molecules, such as Sema 3F-NRP2, may mediate causative pathophysiology in some subgroups with ASD via neuroinflammation, oxidative stress, and compromised BBB integrity. Although preliminary, these data clearly point at a possible first step toward the development of potential novel therapeutic pathways using clinically derived data, genomics, and cognitive and basic neuroscience methods.

**404.007 (Poster)** Serotonin Transporter Genotype Predicts Adaptive Behavior Outcomes in Children with Autism  
**K. A. Shapiro<sup>1</sup>**, E. DiMarino<sup>2</sup>, S. Goh<sup>2</sup>, N. Hattangadi<sup>2</sup>, E. Hildebrand<sup>2</sup>, B. Johnson<sup>3</sup>, M. Johnson<sup>4</sup>, M. C. Steele<sup>4</sup>, B. Wong<sup>5</sup> and E. J. Marco<sup>4</sup>, (1)Cortica Healthcare, Westlake Village, CA, (2)Cortica Healthcare, San Diego, CA, (3)Cortica Healthcare, Carlsbad, CA, (4)Cortica Healthcare, San Rafael, CA, (5)Cortica Healthcare, Glendale, CA

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**Background:** Longitudinal studies have suggested that the development of adaptive behavior in children with Autism Spectrum Disorders (ASD) can follow multiple distinct trajectories, with some children showing improvement while others plateau or regress. While increased detection of specific genetic etiologies has been helpful for prognostication, we remain limited in our ability to predict trajectory for most children with ASD. One possibility is that common variants in genes that affect the brain's response to different environmental circumstances may play a role. For example, the short (S) allele of the promoter region of *SLC6A4*, encoding the serotonin transporter protein, has been associated with increased susceptibility to cognitive and behavioral stress.

**Objectives:** We sought to determine whether dosage of the *SLC6A4* S allele influences adaptive behavior in children with ASD using retrospective clinical data. As much of the adaptive behavior data was collected during the Covid-19 pandemic, this afforded a unique opportunity to assess the relationship between the S allele and neurobehavioral outcomes at a time of high environmental stress, when differential effects of this variant may be expected to be most pronounced.

**Methods:** We identified 26 children in our clinical population with two administrations of the Vineland Adaptive Behavior Scales (VABS3) at least 4 months apart (mean  $190 \pm 5.1$  days, range 147-271 days), who also had pharmacogenomic testing including *SLC6A4*. We constructed a multivariate regression model to estimate effects of *SLC6A4* variants on VABS3 outcomes. The dependent variables were differences in standard scores for VABS3 Adaptive Behavior Composite (ABC), Socialization (Soc), Communication (Com), and Daily Living Skills (DLS) between the two assessments. The predictor variable was number of copies of the *SLC6A4* S allele. Covariates included level of severity (based on initial ABC scores), sex, age, and epoch – i.e., whether the final assessment was conducted before or after shelter-in-place (SIP) orders were issued in California, where all children in this sample resided.

**Results:** The overall multivariate model accounted for a significant proportion of the variance in ABC ( $R^2 = 0.71$ ,  $p = 0.016$ ) and the subscales Com ( $R^2 = 0.83$ ,  $p = 0.005$ ) and DLS ( $R^2 = 0.70$ ,  $p = 0.019$ ), but not Soc. Dosage of the S allele was a significant negative predictor of improvement in overall ABC ( $p = 0.003$ ), Com ( $p < 0.001$ ), and DLS ( $p = 0.012$ ). Of covariates included in the model, male sex was associated with worse outcomes in ABC ( $p = 0.007$ ) and subdomains. Children assessed prior to Covid-19 SIP showed significantly greater improvements in DLS ( $p = 0.02$ ), but not in other subdomains.

Conclusions: In this sample of 27 children with moderate to severe ASD, number of copies of the S allele of *SLC6A4* was a significant predictor of worse outcomes over approximately 6 months, in most cases coinciding with the Covid-19 pandemic. This may indicate that susceptibility to environmental stress modulates developmental trajectories in children with ASD. Further research will be required to determine whether this association is more generalized, and whether it can be modified by targeted interventions.

**404.008 (Poster)** The Cumulative Load of Early Medical Adversities on the Causal Pathway for Autism - a Population-Based Twin Study

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Background: Autism spectrum disorder (ASD) is largely genetically caused, although environmental factors play an important role. While many possible environmental factors behind ASD have been proposed they often stem from observational studies with little or no control for familial confounding, thus making them susceptible to bias from measured or unmeasured shared genetic and environmental factors. A recent systematic review of all twin and sibling studies investigating environmental factors of ASD, concluded an association, beyond familial confounding, for advanced paternal age, low birth weight, major malformations and perinatal hypoxic stress. Other studies have also suggested that the cumulative load of early environmental factors might contribute to ASD, beyond the contribution of each factor respectively.

Objectives: To assess the existence of an association between the cumulative load of early medical adversities and ASD (measured both categorically and dimensionally), beyond familial confounding.

Methods: Data from 3 nationwide Swedish twin cohorts was used: The Swedish Medical Birth Register (MBR) – founded in 1973 and including data on practically all deliveries in Sweden; the Swedish National Patient Register (NPR) includes all in-patient care in Sweden from 1987, and since 2001 all outpatient doctor visits; and the Child and Adolescent Twin Study in Sweden (CATSS; participants born between January 1992 and December 2008). ASD diagnoses were identified for twins in the NPR, with follow-up to 2018. Questionnaires assigned screening diagnoses of ASD to CATSS participants and assessed autistic traits. A cumulative load of the early medical adversities was calculated for each subject based on the presence of low birth weight, malformations and perinatal hypoxic stress as binary variables, identified from the MBR and the NPR. First, a conditional regression based on generalized estimation equations, adjusting for familial confounding, was used to assess the association of autism and the cumulative load, and with each factor leaved out, respectively. Second, a twin design with a univariate model was used to assess the heritability and the non-shared environmental contribution of the cumulative load, and a bivariate model was used to assess the heritability of the association between the cumulative load of early adversities and ASD. Analyses is ongoing and performed since November 1, 2020.

Results: Data were available for 15280 pairs (4880 female same-sex pairs [31.9%], 5092 male same-sex pairs [33.3%], and 5308 opposite-sex pairs [34.7%]) in CATSS, with linking to delivery related and diagnosis information from the MBR and the NPR. Information has been found for birth weight, perinatal hypoxic stress, and major malformations, enabling a reliable test of the hypothesis.

Conclusions: If confirmed, the presence of a cumulative load of environmental factors beyond familial confounding would point to an overlying mechanism, outside the separate mechanisms involved in the specific factors respectively. Such mechanisms could involve the hypothalamic-pituitary-adrenal axis or environmental endocrine disruptors. Our rigorous hypothesis driven approach using nationwide twin cohorts will enable causal inference.

## Behavioral Neuroscience

### PANEL DISCUSSION — BEHAVIORAL NEUROSCIENCE

#### Panel 208 - The Multi-Level Neurosciences of Sex, Gender and Autism

**Panel Chair: Meng-Chuan Lai**, *The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada*

**Discussant: Meng-Chuan Lai**, *The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada, The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada, Department of Psychiatry, University of Toronto, Toronto, ON, Canada, The Hospital for Sick Children, Toronto, ON, Canada, Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada*

Mechanisms associated with sex and gender play multiple roles influencing the biological mechanisms associated with the emergence of autism, the developmental trajectories and coping experiences of autistic individuals, and the diagnosis and clinical care for people on the autism spectrum across sexes and gender. New discovery and improved understanding of these multiple roles of sex and gender in autism is promising in guiding new research to better understand the etiology and neurobiology of autism, and clinical innovation of sex- and gender-informed support for autistic people. This panel will present overviews and cutting-edge new findings on the rapidly emerging research field of sex and gender impacts on autism, across the levels of genomics, neurobiology across species, neuroimaging, and behavior.

**208.001** (*Panel Discussion*) Transcriptomic Investigation of Intersections between Sex-Differential and ASD Neurobiology in Pre- and Postnatal Human Cortex

**D. M. Werling<sup>1</sup>**, L. T. Kisse<sup>2</sup>, S. Pochareddy<sup>3</sup>, N. Sestan<sup>4</sup>, K. Roeder<sup>5</sup>, B. Devlin<sup>6</sup> and S. J. Sanders<sup>7</sup>, (1)Laboratory of Genetics, University of Wisconsin-Madison, Madison, WI, (2)Neuroscience Training Program, University of Wisconsin-Madison, Madison, WI, (3)Yale University, New Haven, CT, (4)Yale School of Medicine, New Haven, CT, (5)Department of Statistics and Data Science, Carnegie Mellon University, Pittsburgh, PA, (6)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (7)Department of Psychiatry, Weill Institute for Neuroscience, UCSF School of Medicine, San Francisco, CA

Background: Autism spectrum disorder (ASD) is a neurodevelopmental condition with a four-fold male bias in diagnosis and a significant genetic risk component. Genetic studies find that autistic females have a higher incidence of high-impact risk variants than males, consistent with the existence of a female protective effect. Identifying and understanding the biological mechanisms

that protect females and/or increase risk in males may promote the development of therapeutic options that are broadly applicable across genetically heterogeneous individuals. Toward this end, prior transcriptomic work in small samples has reported that expression levels of ASD risk genes do not differ by sex in the human cortex, but that multiple gene sets that are elevated in the ASD brain also tend to have male-biased expression in neurotypical controls, suggesting that sex modulates ASD risk in pathways downstream from risk genes.

**Objectives:** The objectives of this study are to validate and extend prior findings by characterizing sex-differential gene expression in an expanded data set of *post mortem* brain tissue from prenatal and postnatal human donors, and by evaluating current sets of genes implicated in ASD risk and pathophysiology for evidence of sex-differential regulation. These efforts aim to update and further resolve points of intersection between biological processes impacted by sex and those impacted in ASD.

**Methods:** We analyzed RNA-sequencing data from neurotypical *post mortem* human dorsolateral prefrontal cortex tissue from the BrainVar data set separately in both prenatal (N=85, 46 females, 14-21 post-conception weeks) and postnatal (N=28, 9 females, 13-19 years) donors. We ran transcriptome-wide sex-differential expression analysis using limma-voom and applied Fisher's exact and Wilcoxon rank sum tests to evaluate ASD-associated gene sets for enrichment of sex-differential expression. Gene sets included 102 risk genes identified by exome sequencing, genes with altered expression in ASD brain, and cell type markers.

**Results:** We identify 56 prenatal and 35 postnatal sex-differentially expressed genes (DEGs) at a false discovery rate of 0.1, including 6 autosomal transcripts. Consistent with prior work, expanded sets of high-ranking DEGs selected by  $p \leq 0.05$  and fold difference magnitude of 1.2 are not enriched for known ASD risk genes. Here, ASD risk genes are more likely than expected to show female-skewed expression both prenatally and postnatally, though the magnitude of these shifts is minimal. Male-biased DEGs are enriched for ASD-up-regulated, immune function associated co-expression module CTX.M19 (prenatal) and for markers of endothelial cells (prenatal) and microglia (prenatal, postnatal). The absence of DEG enrichment for ASD risk genes and prenatal male-biased DEG enrichment for CTX.M19 and microglial markers remain consistent when previously tested samples are excluded.

**Conclusions:** These results support prior observations that sex effects on autosomal gene expression in both postnatal and prenatal human cortex are generally subtle. Using a larger sample and updated gene sets associated with ASD biology, these results are also consistent with prior findings suggesting that ASD risk genes may not be directly sex-differentially regulated in the cortex during mid-fetal development or adolescence, but that sex effects instead act on downstream or interacting pathways potentially involving glial and immune function.

**208.002 (Panel Discussion) Ube3a Duplication Results in Sex-Divergent Effects on the Connectome and Transcriptome**  
C. Montani<sup>1</sup>, M. Pagani<sup>2</sup>, A. Galbusera<sup>2</sup>, L. Balasco<sup>3</sup>, G. Provenzano<sup>4</sup>, Y. Bozzi<sup>5</sup>, **M. V. Lombardo<sup>5</sup>** and A. Gozzi<sup>1</sup>, (1)Istituto Italiano di Tecnologia, Rovereto, Italy, (2)Istituto Italiano di Tecnologia, Functional Neuroimaging Lab, Centre for Neuroscience and Cognitive Systems, Rovereto, Italy, (3)University of Trento, Rovereto, Italy, (4)University of Trento, Trento, Italy, (5)Center for Neuroscience and Cognitive Systems, Laboratory for Autism and Neurodevelopmental Disorders, Istituto Italiano di Tecnologia, Rovereto, Italy

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**Background:** Autism is more prevalent in males, but the mechanisms underlying this sex-bias remains unclear. *UBE3A* is an autism risk gene duplicated in 15q11-q13 (dup15q) syndrome – a CNV that occurs in 1-3% of all autism cases. *UBE3A* has several functions, but may impact sex-bias as a transcriptional co-factor with steroid hormone receptors. Thus, *UBE3A* could serve as a key transcriptional hub underlying sex-specific bias in autism.

**Objective:** To test for sex-divergent effects in imaging, behavioral, and gene expression data in male and female mice harboring duplication of *Ube3a*.

**Methods:** Multiple approaches were used to investigate sex-by-genotype interactions in male and female mice whom overexpress *Ube3a* (*Ube3a-dup*). These included resting state fMRI (rsfMRI) to map functional connectivity, behavioral assays and post-mortem gene expression with RNA-seq sampled from prefrontal cortex (PFC) and hypothalamus.

**Results:** Consistent with our hypothesis, rsfMRI revealed robust sex-specific divergences in functional connectivity. Specifically, *Ube3a-dup* females show reduced connectivity in hypothalamic and somatosensory cortex, while *Ube3a-dup* males show increased connectivity in PFC. With RNA-seq, while no genes were differentially expressed (DE) in hypothalamus, we further discovered >2800 DE genes in PFC that show a significant sex-by-genotype interaction. The sex\*genotype interaction could be explained by some DE genes that show a WT>*Ube3a-dup* effect in males, but an opposite pattern (*Ube3a-dup*>WT) in females (e.g., *Fmr1*, *Pten*, *Gria2*, *Scn2a*). In contrast, a different set of DE genes show the opposite directionality of effect (*Ube3a-dup*>WT in males, but WT>*Ube3a-dup* in females; e.g., *Shank3*, *Tsc2*, *Deaf1*). The DE gene set was also enriched for autism-risk

genes (SFARI) and DE genes in human dup15q patients, and showed differential glutamatergic and GABAergic cell types enrichments, potentially indicating an effect on E:I balance. Behavioral testing in the same cohort of mice revealed significantly increased self-grooming in Ube3a-dup males, but not in females, pointing to a sex-divergent behavioral phenotype.

Conclusions: *UBE3A* may be key mechanisms for sex-bias in autism due to its downstream sex-specific effects on the functional connectome and transcriptome.

**208.003 (Panel Discussion) Sex Differences in Amygdala Development in Autism from Early to Middle Childhood**  
**C. W. Nordahl<sup>1</sup>, J. K. Lee<sup>2</sup>, D. S. Andrews<sup>2</sup>, B. Heath<sup>2</sup>, M. Solomon<sup>2</sup>, A. M. Iosif<sup>3</sup> and S. Ozonoff<sup>4</sup>,** (1)University of California at Davis School of Medicine, Sacramento, CA, (2)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (3)Public Health Sciences, University of California Davis, Davis, CA, (4)Psychiatry and Behavioral Sciences, University of California at Davis, MIND Institute, Sacramento, CA

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Objective: Females have historically been under-represented in MRI studies of autism, and consequently, little is known about sex-specific trajectories of brain development in autism spectrum disorder (ASD). We evaluated sex differences in amygdala structure and function across early childhood in girls and boys with ASD and neurotypical controls.

Methods: Participants include 294 children with ASD (95 females) and 135 typically developing (TD) controls (61 females) enrolled between 2-4 years of age. Longitudinal imaging was conducted at up to four time points spanning 2-13 years of age. All images were acquired on a 3T Siemens Trio. Children of all developmental levels were imaged, including children with intellectual disability. Analyses included evaluation of sex differences in: 1) amygdala functional connectivity at study entry (mean age 3.5y), 2) amygdala volume and associations with symptoms of psychopathology at study entry, and 3) longitudinal growth of the amygdala and anatomically connected structures across early childhood (2-13 years).

Results: 1) Global patterns of amygdala functional connectivity revealed robust sex differences in TD participants, but these differences were attenuated in children with ASD. However, autistic females exhibited greater differences from TD than their male counterparts in localized regions such as medial prefrontal and posterior cingulate cortex. 2) Amygdala enlargement was observed only in a subgroup of autistic children with high levels of psychopathology, and amygdala volume was positively associated with internalizing behaviors in autistic girls, but not boys. 3) Growth trajectories of amygdala connected regions did not differ in magnitude by sex between ASD and TD groups, but the underlying set of brain regions contributing to diagnostic differences was quite dissimilar in boys and girls.

Conclusions: Given that there are sex differences in normative amygdala development, it is critical to parse out alterations related to normative sex differences versus autism-related differences. Our findings reveal sex-specific patterns of amygdala development in ASD which could be indicative of different underlying etiologies and potentially useful in predicting different outcomes, co-occurring conditions, and tailoring treatments.

**208.004 (Panel Discussion) Will Neuroimaging Research Unveil the Mechanistic Roles of Sex and Gender in Autism? Sex/Gender-Based Heterogeneity, “Female-Protection”, and Compensation in the Human Autistic Brains**  
**M. C. Lai,** The Margaret and Wallace McCain Centre for Child, Youth and Family Mental Health, Centre for Addiction and Mental Health, Toronto, ON, Canada; Azrieli Adult Neurodevelopmental Centre, Centre for Addiction and Mental Health, Toronto, ON, Canada; Department of Psychiatry, University of Toronto, Toronto, ON, Canada; The Hospital for Sick Children, Toronto, ON, Canada

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Various neuroimaging methodologies have been used to investigate the brain characteristics associated with autism. They have great potential to inform the neurodevelopmental pathways and mechanisms associated with the emergence of autism, as well as plasticity of the autistic brains. However, not all neuroimaging studies are well equipped to delineate the influences of sex and gender on the autistic brains. In this integrative presentation I will first provide an overview of the current state of human neuroimaging research in autism in relation to understanding sex or gender influences, with a focus on the MRI literature in the past 20 years. I will then consider findings from these studies to summarize what we know so far about (1) sex-based or gender-based heterogeneity in the human autistic brains, (2) neuroimaging observations that can speak to the “female-protection” model and underlying mechanisms, and (3) compensatory mechanisms in the human autistic brains that may be associated with sex or gender. I will conclude by highlighting designs and methodologies that may further enhance our understanding of the mechanistic roles of sex and gender in the neurodevelopment of autism.

## POSTER SESSION — BEHAVIORAL NEUROSCIENCE

### Poster 405 - Behavioral Neuroscience Posters

**405.001** (Poster) Intrinsic Structural Connectivity of the Default Mode Network and Behavioral Correlates of Executive Function and Social Skills in Youth with ASD

**J. E. Blume<sup>1</sup>**, **C. N. Kahathuduwa<sup>1</sup>** and **A. Mastergeorge<sup>2</sup>**, (1)Department of Human Development and Family Studies, Texas Tech University, Lubbock, TX, (2)Texas Tech University, Lubbock, TX

**Background:** Brain connectivity of individuals with autism spectrum disorders (ASD) is heterogeneous, as are the behavioral manifestations of ASD including hallmark social difficulties (King et al., 2019). A strong relationship exists between executive function and social competencies in youth with ASD (Kouklari et al., 2018). As children with ASD transition to adolescence, executive deficits become more evident, contributing to additional adaptive and behavioral challenges (Gardiner & Iarocci, 2018). Our prior neuroimaging work substantiates the work of others to suggest an inverse association between the strength of functional connectivity between the anterior and posterior nodes of the brain default mode network (DMN) and symptom severity, executive dysfunction and socio-emotional impairments in ASD (Kahathuduwa et al., 2019; Lynch et al., 2017; Odriozola et al., 2019). However, the structural connectivity patterns associated with ASD and their executive, behavioral and social correlates remain to be explored.

**Objectives:** This study aims to characterize the structural connectivity between the anterior and posterior nodes of the DMN using probabilistic tractography and to explore the associations between anterior-posterior DMN structural connectivity strength and measures of executive function and social responsiveness, in order to inform the potential role of underlying cognitive processes in socio-behavioral patterns and trajectories observed in ASD.

**Methods:** This investigation utilized a subset of secondary phenotypic and brain diffusion tensor imaging (DTI) data shared through the Autism Brain Imaging Database Exchange (ABIDE) II ( $N=45$ , 39 male, age= $7.63 \pm 1.72$  years). We applied the following preprocessing algorithms in the FDT toolbox in FSL to the DTI data: distortion correction, brain extraction eddy current correction and motion correction. We calculated anterior-posterior, posterior-anterior, and total connectivity measures from DTI using Bayesian estimation (BEDPOSTX), and probabilistic tractography (PROBTRACX). Subsequently, we performed structural equation modeling by regressing three latent factors, yielded from an exploratory factor analysis with the *Behavior Rating Inventory of Executive Function* (BRIEF; Gioia et al., 2000) Clinical Scales and *Social Responsiveness Scale* (SRS; Constantino & Gruber, 2005) Treatment Subscales, onto total DMN connectivity.

**Results:** The behavioral measures of executive function and social responsiveness yielded three latent factors which uniquely represent three dimensions of mental processing: Social Regulation Processing, Goal-Directed Cognitive Processing, and Self-Directed Cognitive Processing (see Table 1). In the converged model, both Social Regulation Processing and Self-Directed Cognitive Processing factors moderately and negatively correlated with total DMN connectivity (respectively  $r=-.396$ ,  $p=.015$  and  $r=-.386$ ,  $p=.032$ ) while the correlation between Goal-Directed Cognitive Processing and connectivity was non-significant ( $r=-.298$ ,  $p=.069$ ). See Figure 1 for factor covariances and model fit indices.

**Conclusions:** To our knowledge, this is the first study to use probabilistic tractography with the ABIDE II dataset. Our findings support previously observed aberrant intrinsic DMN functional connectivity in individuals with ASD (Padmanabhan et al., 2017) and executive dysfunction (Ikuta et al., 2014). Our model indicates the processes underlying behavior regulation and social functioning are more strongly associated than metacognition and thereby warrant greater emphasis on skills like inhibition, shifting, and emotional control to bolster holistic developmental outcomes when compared to skills such as initiation, planning, organization, working memory, and monitoring.

**405.003** (Poster) Restricted and Repetitive Behaviors and Social Communication: Their Relationship and Underlying Functional Connectivity in Autistic Children

**G. J. Cardon<sup>1</sup>** and **D. Rojas<sup>2</sup>**, (1)Brigham Young University, Provo, UT, (2)Colorado State University, Fort Collins, CO

Background:

Symptoms common to persons on the autism spectrum include restricted and repetitive behaviors (RRBs) and social communication (SC) differences. While some have denied their shared origin, it is possible that these sets of behaviors have common neural mechanisms. Investigating such neural foundations could both increase our understanding of autism and inform support services. Atypical sensory processing is now recognized as central to autism and is functionally related to RRBs and SC

independently. As such, the neural underpinnings of aberrant sensory processing and common autistic traits could be linked. Unfortunately, relatively little is known about the mechanisms of atypical sensory processing in autism. It is plausible that irregular processing in and connectivity between sensory and motor cerebral cortices, as well as supramodal brain regions (e.g., the cerebellum), contributes to such atypical sensory function, and is related to core autistic features.

#### Objectives:

We examined the relationship between behavioral measures of RRBs and SC, and its with functional connectivity between sensory, motor, and supramodal brain regions. We hypothesized that behavioral measures of RRBs and SC would be positively correlated, and that this link would be correlated with decreased functional connectivity between sensory cortices, the cerebellum, and motor brain regions in autistic participants.

#### Methods:

Structural MRI, resting-state fMRI (rs-fMRI) and behavioral data were obtained from a large, open database (ABIDE II) of autistic (n=74; mean age=11.83 years), and nonautistic children (n=76; mean age=11.34 years). Analyses consisted of pre-processing, motion correction, normalization, and a priori selection of regions of interest (ROI) based on their contributions to sensory, motor, and cerebellar function. Then, FDR-corrected ROI-to-voxel functional connectivity was computed for each ROI, controlling for age, sex, and site. Each dataset also included the following phenotypic data: Social Responsiveness Scale (SRS-2)<sup>11</sup>, and Repetitive Behavior Scale-Revised (RBS-R). To evaluate the relationship between RRBs and SC, we performed partial correlations between the RBS-R and SRS-Communication Subtest (SRS-Comm) scores. Differences in the FDR-corrected functional connectivity for each ROI between the Autistic and neurotypical (NT) children were then calculated, controlling for age, sex, and site, via ANCOVA. The ROI-voxel combinations that exhibited significant between groups rs-FC differences were noted. Then, the relationships between the rs-FC of these combinations and the RBS-R and SRS-Comm were assessed using partial correlations.

#### Results:

Behavioral RBS-R and SRS-Comm scores were significantly correlated in the autism ( $r=0.52$ ;  $p=0.00$ ) and comparison ( $r=0.59$ ;  $p=0.00$ ) groups. Additionally, several functional connectivity differences were observed between the groups that were also related to both the RBS-R or SRS-Comm—connectivity in the ASD group between the right precentral gyrus and right and left lateral occipital cortices was significantly negatively correlated with RBS-R scores ( $r=-0.302$ ;  $p=0.01$ ). Connectivity between the right precentral gyrus and several sensory cortical sites was also associated with poorer SRS-Comm scores—i.e., left lateral occipital cortices ( $r=-0.293$ ;  $p=0.013$ ), right lateral occipital cortices ( $r=-0.329$ ;  $p=0.005$ ), and left planum temporale ( $r=-0.349$ ;  $p=0.003$ ).

#### Conclusions:

These results suggest that RRBs and SC in autism may be both functionally and neurologically linked, and that their connection could be related to sensorimotor brain processes.

**405.004 (Poster)** Reward Processing in Young Children with Autism Spectrum Disorder: Evidence of Expectation Violation  
**C. Harrop<sup>1</sup>, J. Wu<sup>2</sup>, K. A. Pelphrey<sup>3</sup>, P. E. Ventola<sup>4</sup> and M. Crowley<sup>2</sup>,** (1)Department of Allied Health Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)Yale Child Study Center, New Haven, CT, (3)University of Virginia, Charlottesville, VA, (4)Yale Child Study Center, Yale University School of Medicine, New Haven, CT

**Background:** Reward processing (RP) encompasses responses to rewarding stimuli, the ability to learn from and anticipate rewards, and engagement in goal-directed behavior towards rewards. RP has been studied extensively in ASD as a mechanism underlying behaviors characteristic of ASD. EEG studies have characterized the neural correlates of RP, focusing on the N1, P2 and Feedback Response Negativity (FRN), with mixed findings between ASD and TD (Larson et al., 2010; McPartland et al., 2012).

**Objectives:** Characterize reward processing during a well-validated monetary reward paradigm in young autistic children (4 to 9 years).

**Methods:** Twenty-nine children (4 to 9; Mean=6.5 years) participated in the study (15 ASD, 14 TD). Twenty-six (13 ASD, 13 TD) provided sufficient EEG data (mean “win” trials= 29.50 (SD=11.31), mean “draw” trials= 29.54 (SD=12.30)). Children completed a feedback-reward paradigm consisting of equiprobable “win” and “draw” outcomes across four blocks of 30 trials.

Children were shown four different colored balloons and were instructed to select one by pressing the corresponding response button (Crowley et al., 2014). If children chose the “correct” balloon, they saw a green dollar sign and would “win” 10 cents. If they chose one of the “unlucky” balloons, they would see an empty white box and not win any money (“draw”). Wins and draws occurred in a random order and a set number of times per block independent of child choice. After each 30-trial block, an image of a jar appeared filling with dimes with accompanying sound.

Electrodes, regions of interest, and ERP components were selected based on prior research: frontal P2 (positive peak, 100-300ms), FRN (negative peak, 200-400ms), slow wave (averaged amplitude, 500-900ms); posterior P1 (positive peak, 50-200ms), N2 (negative wave, 100-300ms), and P3 (averaged amplitude, 250-450ms). Repeated measures ANOVAs were conducted on each ERP component by group and condition.

**Results:** Condition differences were found in posterior P1 latency ( $F(1, 24) = 29.35, p < .001$ ) and posterior N2 amplitude ( $F(1, 24) = 4.64, p = .04$ ). Post-hoc t-tests indicated shorter latencies to “draws” (mean difference = -14.66,  $t(1, 25) = -5.23, p < .001$ ). A significant group difference was found in frontal P2 latency ( $F(1, 24) = 6.78, p = .02$ ). Post-hoc t-tests indicated that autistic children had a shorter frontal P2 latency than the TD group ( $t(1, 24) = -2.60, p = 0.02$ ). There was a significant group\*condition interaction in posterior P3 amplitude ( $F(1, 24) = 4.39, p < .05$ ). Post-hoc t-tests indicated that the ASD group had smaller amplitudes to “draws” ( $t(1, 12) = -2.22, p < 0.05$ ).

**Conclusions:** Our data suggests that young autistic children place greater significance on negative feedback. This findings differs to prior literature suggesting similar neural responses to positive and negative feedback in young TD children (Mai et al., 2011). Enhanced responses to negative feedback could represent a violation of expectation or an intolerance for uncertainty – mechanisms hypothesized to underlie anxiety in ASD (Boulter et al., 2014). Future work is required to characterize developmental changes in RP and associations with the ASD phenotype and common comorbidities.

#### **405.005 (Poster) Visual Processing of the Signatures of Human Movement in Autism**

**S. Ben-Ami<sup>1,2</sup>, Y. Meirovitch<sup>1,2</sup>, D. Israeli<sup>3,4</sup> and T. Flash<sup>2</sup>, (1)Massachusetts Institute of Technology, Cambridge, MA, (2)Faculty of Computer Science and Applied Mathematics, Weizmann Institute of Science, Rehovot, Israel, (3)Psychiatric array, Kaplan Medical Center, Rehovot, Israel, (4)Faculty of Medicine, Hebrew University of Jerusalem, Jerusalem, Israel**

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#### Background:

Individuals with Autism Spectrum Disorder (ASD) do not readily extract information from observing other people’s actions and movements. This is contrary to neuro-typical observers, who exhibit superior processing of visual displays depicting human movement, a remarkably selective behavioral and neural response to such displays, and a heightened spontaneous preference towards them.

A prominent source of information embedded in naturalistic visual input of human action is the kinematic regularity of stereotypical human movement, found critical for decoding others' intentions and for inferring their emotions and goals, a prerequisite for efficient communication and interaction. Several mathematical descriptions have been developed in the field of motor control to describe the kinematic invariants of human movement (herein, Human Movement Signatures).

#### Objectives:

Investigating whether ASD involves a deficit in visual processing of Human Movement Signatures, independently from the documented difficulties with processing complex stimuli and with attending to human body-form and context.

#### Methods:

Stimuli consisted of a single dot moving along a prescribed path. The dot’s speed profile was manipulated (in each trial) to adhere with differing degrees of compliance with the human movement signature formulated by the Two-Thirds Power Law (2/3PL), which describes the spatiotemporal pattern of coupling between movement curvature and velocity typical of human movement.

We utilized a perceptual illusion known to be elicited by observation of the 2/3PL, in which visual motion adhering to this human movement signature elicits an illusion of motion uniformity; despite prominent variations in its speed, it is perceived to be uniform, even more than motions that actually have a constant (Euclidean) speed.

Since this effect is believed to stem from a bias of the neuro-typical visuomotor system toward human movement signatures, we tested if ASD subjects similarly exhibit this human movement uniformity bias.

14 adults with a diagnosis of ASD and 13 age-, gender-, and IQ-matched neurotypical subjects were presented with 1800 pairs of motions each (over eight one-hour sessions), and asked to judge which was moving more uniformly.

To account for ASD subjects' heterogeneity, we implemented a novel individual-focused model which decoupled the subjects' judgments from the contribution of unreliability (in other words, the "noise" inherent to the responses of each individual subject), thus assessing and discerning the relative contributions of decisional from sensory-perceptual processes.

Results:

The visual illusion of motion uniformity was not elicited in most ASD subjects, who, unlike neurotypical subjects, veridically judged motions with constant Euclidean speed as uniform. Subjects' motion-uniformity bias was correlated with their load of autistic traits.

The model closely captured individual response patterns. Subjects' noise parameter correlated with their non-verbal cognitive scores.

Conclusions:

Our results suggest deficient visual processing of human movement signatures in ASD.

We link individual levels of this sensory-motor atypicality to the broader autistic phenotype, implying its relevance to core ASD symptoms.

More broadly, our modelling approach for studying visual perception of individual subjects allowed the discovery of a linkage between modeled "noise" and non-verbal IQ, providing mechanistic insight. This approach is a step of clinical and translational importance towards decomposing heterogeneity in Autism.

## Biomarkers (molecular, phenotypic, neurophysiological, etc)

### PANEL DISCUSSION — BIOMARKERS (MOLECULAR, PHENOTYPIC, NEUROPHYSIOLOGICAL, ETC)

#### Panel 209 - EEG Biomarkers in Neurodevelopmental Disorders: From Mechanisms and Methods to Clinical Trial Readiness

**Panel Chair:** Shafali Jeste, *University of California, Los Angeles, Los Angeles, CA*

As early interventions and etiologically-specific therapies are developed in NDDs, we must be prepared for the design and implementation of successful clinical trials. Quantitative, developmentally sensitive, and mechanistically informed biomarkers are critical for early detection, patient stratification, selection for therapeutics and establishment of drug target engagement. Electroencephalography (EEG) is a functional brain imaging method that assays, with exquisite temporal and developmental sensitivity, neural circuit function and dysfunction in NDDs and holds promise as a robust method for biomarker discovery in NDDs. However, there exist methodological challenges in EEG studies that require robust standardization of methods, well powered sample sizes, replication, and cross disorder and species comparisons. In this panel, we share experiences by experts in EEG methodology across these areas of early detection (Dr. Abigail Dickinson), the process of EEG biomarker approval through the FDA (Dr. Sara Webb), EEG as a translational biomarker across genetic syndromes (Dr. Charles Nelson) and EEG studies in Angelman syndrome that will inform upcoming trials (Drs. Mike Sidorov and Rob Komorowski). Dr. Shafali Jeste (discussant) will share perspectives on next steps needed to ensure that these EEG biomarkers can be applied in clinically accessible and reliable ways to improve care of children with NDDs.

**209.001** (*Panel Discussion*) EEG Biomarkers of Early ASD Detection in Infancy: Signal Processing Considerations and Consortium Building

*A. H. Dickinson, University of California, Los Angeles, Los Angeles, CA*

**Background:** Biomarkers of atypical infant brain development hold promise for expediting detection efforts in neurodevelopmental disorders and are especially crucial in autism spectrum disorder (ASD), where they may create an opportunity for preemptive interventions before behavioral symptoms emerge. Electroencephalography (EEG) represents a powerful tool for identifying early biomarkers, given its sensitivity to functional changes in the developing brain and practical suitability for tracking the infant siblings of children with ASD, who have a 20% risk of developing ASD (Charman et al., 2017). However, specific challenges surround the identification of brain-based biomarkers in infancy that can undermine their clinical usefulness. Typical brain activity patterns change rapidly over the first year of life, necessitating markers that can identify atypical deviations against a background of normative developmental variation. Quantifying these multidimensional spatio-spectral changes introduces further complexities, as traditional dimensionality reduction techniques can obscure developmental trends (Patino et al., 2017). Carefully designed multi-site research must test the robustness of candidate biomarkers, given that clinical application depends upon the ability to detect neural disruptions, despite the sample or setting (Jeste et al., 2015).

**Objectives:** We have focused our efforts to enhance the clinical utility of infant biomarker identification. First, we took a data-driven approach to sensitively characterize oscillatory trajectories over the first year of life in ASD, and now we are testing these strategies in a multi-site prospective study of familial risk infants (IBIS: Infant Brain Imaging Study).

**Methods:** For the first aim, spontaneous EEG data were collected at 3, 6, 9, & 12 months of age from infants with (N=51) and without (N=37) familial risk for ASD. Clinical outcomes were assessed at 36 months of age, with 14 participants meeting diagnostic criteria for ASD. After calculating spectral power across the scalp, functional principal component analysis (FCPA) extracted dominant oscillatory trends over the first year. Generalized linear mixed-effects models then assessed whether these functional changes were expressed differently across the two groups (ASD and non-ASD).

**Results:** FCPA revealed three components which accounted for over 96% of oscillatory variation over the first year. Significant main effects of diagnostic group indicated divergent maturation patterns between ASD and non-ASD participants for eigenfunctions one ( $P<.001$ ) and three ( $P<.001$ ), which captured variation in the amplitude of the emerging alpha peak, and the general redistribution of spectral power from lower (<4Hz) to higher frequencies (>6Hz), respectively. Notably, the expression of these components did not differ according to familial risk status, indicating that deviations from normative oscillatory development are associated with ASD outcome rather than general disorder vulnerability.

**Conclusions:** Identifying neural disruptions during infancy represents a promising biomarker avenue in ASD but presents specific challenges. Oscillatory trajectories deviate in the first year of life in infants who later develop ASD. Specifically, the emergence of a clear alpha peak, and spectral power redistribution, occurs earlier in infants who develop ASD. Our results reinforce that EEG markers of functional dysmaturity may provide early, objective predictors of ASD. We will discuss strategies implemented to assess the reliability of these neural changes across multiple research sites.

**209.002 (Panel Discussion)** A Framework for EEG Biomarker Development: The Autism Biomarkers Consortium for Clinical Trials

**S. J. Webb<sup>1</sup>, J. McPartland<sup>2</sup> and C. Sugar<sup>3</sup>,** (1)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (2)Child Study Center, Yale University School of Medicine, New Haven, CT, (3)University of California, Los Angeles, Los Angeles, CA

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**Background:** Numerous candidate neural biomarkers have been put forward for use in ASD research, with the primary focus on discriminating between individuals with or without ASD or quantifying biomarkers in relation to the clinical phenotype. Advancing biomarkers into use in clinical trials has been hindered by inconsistent results across small studies, substantial overlap in distribution between ASD and non-ASD groups, limited understanding of biomarker psychometric properties, and variable methodology in terms of acquisition and processing. The CDER Biomarker Qualification Program offers a framework for conceptualizing biomarkers for specific contexts of use to address drug development needs. Adoption of this framework has been central to study design and analysis in the Autism Biomarkers Consortium for Clinical Trials (ABC-CT).

**Methods:** The first phase of the ABC-CT was a large multisite, naturalistic study of 6 to 11 year-old children with ASD (n=280) and TD (n=119) designed to investigate EEG biomarkers for use in clinical trials. To this end, the ABC-CT evaluated an EEG battery composed of well-studied assays of resting state activity (Resting), face perception (Faces), biological motion perception (BM), and visual evoked potentials (VEP) for potential use in clinical trials for ASD. The biomarker, the “N170 Latency to Upright Human Faces,” was submitted to the CDER Biomarker Qualification Program (BQP) and accepted into the program for continued evaluation.

**Results:** In keeping with the BQP process priorities, initial analytic goals for the “N170 Latency to Upright Human Faces” biomarker have focused on acquisition rates, construct validity, six-week stability, group discrimination, and association with individual characteristics (including age). For this biomarker, artifact free data was acquired from 76% of the ASD group, construct validity was demonstrated by the expected reduced latency and enhanced amplitude to faces (versus houses) in the TD group, stability was adequate in the ASD group (ICC=.66), the ASD group exhibited delayed N170 latency relative to the TD group (p<.01), and stronger behaviorally quantified face memory was related to shorter latency (p<.05).

**Discussion:** Most existing biomarker research in ASD has focused on identifying group differences or phenotypic relations with EEG signals in individuals with ASD. However, the FDA BQP targets drug development need, with specific attention to measurement interpretation (e.g., construct, precision, decision making, risk/benefit) and measurement quality assurance/control in the context of a specific clinical research objective (i.e., context of use). As demonstrated by the example of the ABC-CT, this process requires specific analytic considerations to support biomarker qualification that must be considered in study design and analytic plans. Critically, attention to these guidelines also benefits rigor and reproducibility.

**209.003 (Panel Discussion)** Using Biomarkers to Characterize Neurobiological Deficits in Neurodevelopmental Disorders: A Case Study in TSC, Rett Syndrome, 16P, and Fragile X Syndrome

**C. A. Nelson,** *Developmental Medicine, Boston Children's Hospital, Boston, MA*

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**Introduction:** EEG biomarkers can provide (a) insight into the neurobiology of NDDs and (b) offer opportunities to predict, stratify, and monitor progression and treatment response over time.

Here, we focus on several disorders, co-morbid with ASD, that differ behaviorally and neurobiologically: Tuberous Sclerosis Complex (TSC), 16p11.2, Rett Syndrome, CDKL5, and Fragile X syndrome (FXS). We (1) present our EEG findings with Fragile X, (2) discuss a cross-disorder comparison using the visual evoked potential (VEP), and (3) summarize our recent translational work.

**Methods:**

**Fragile X:** Resting-state EEG was collected from FXS boys with full mutation of *Fmr1* (2.5-7 years old, n=11) and compared with age-matched (n=12) and cognitive-matched (n=12) typically developing (TD) boys. Power spectra were compared using non-parametric cluster-based permutation testing. Associations between 30-50Hz gamma power and behavioral outcomes were evaluated.

**Cross-Disorder Comparisons:** We compared the morphology of the VEP across the following disorders: Rett Syndrome (n = 38), Tuberous Sclerosis Complex (TSC; n = 17), 16p11.2 variants (deletions; n = 19 and duplications; n = 9), and CDKL5 (n = 4) to TD controls (n = 51).

**Translation:** In animals, VEP morphology can index a form of cortical plasticity (stimulus-selective response potentiation; SRP) when repeated grating stimuli are viewed across days. We have translated the SRP paradigm for use with human adults (n = 25) and children (n = 10).

**Results:**

**Fragile X:** FXS participants showed increased power in the beta/gamma range (~25-50Hz) across multiple brain regions. Both a reduction in the aperiodic (1/f) slope and increase in beta/gamma periodic activity contributed to increased high-frequency power. Greater gamma power, driven by the aperiodic component, was associated with better language ability in FXS. No association was observed between gamma power and behavioral challenges, sensory hypersensitivities, or adaptive behavior.

**Cross disorder comparisons:** The Rett and 16p variant groups had smaller N1 and P1 amplitudes relative to other genetic disorders and TD (all  $p < .05$ ). In addition, the Rett group showed smaller N2 amplitudes relative to all other groups (all  $p < .05$ ). Participants with 16p variants showed longer latency to later components (P1, N2), while those with Rett showed shorter latency to the early N1 component. Preliminary results for the CDKL5 group indicated longer latencies to negative components (N1, N2). In contrast, the TSC group had more negative N1 amplitudes than the Rett group ( $p < 0.005$ ) but did not differ significantly from TD for amplitude or latency of any component (all  $p > 0.05$ ).

**Translation:** Following 2-4 days of habituation to a particular stimulus orientation, VEP amplitude (N2) in both children and adults was larger in response to a novel compared to a familiarized stimulus orientation ( $p < 0.05$ ). Considerable stability in VEP latency and morphology was observed within individuals across days, supporting the use of the VEP as a biomarker to characterize neurodevelopmental disorders.

**Conclusions:** Our findings indicate the promise of EEG-based biomarkers that possess the sensitivity to distinguish among neurodevelopmental disorders and have translational potential, enhancing their utility for clinical trials.

**209.004 (Panel Discussion) Quantifying EEG Oscillations in Angelman Syndromes: Implications for Drug Development**  
*M. S. Sidorov, Center for Neuroscience Research, Children's National Hospital, Washington, DC*

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**Background:** Recent advances in genetics, biology, and chemistry have revealed opportunities for disease-modifying therapies across an array of monogenic neurodevelopmental disorders. Translating therapies from rodent models to the clinic requires objective and translatable biomarkers that can detect early functional improvement in these diseases. EEG reflects a safe and cost-effective way to objectively measure brain function and thus has been proposed as a biomarker with clinical relevance in NDDs. One recent example of the utility of EEG in drug development is in the case of Angelman syndrome (AS). AS is a neurodevelopmental disorder caused by loss-of-function of the maternal allele of the ubiquitin ligase E3A (*UBE3A*) gene. Common features of AS include impaired motor function, lack of speech, developmental delay, seizures, and sleep disruptions. A functional paternal *UBE3A* allele exists but is silenced in neuronal cells by an endogenous anti-sense transcript (*UBE3A-ATS*). Multiple approaches to "unsilence" the dormant paternal copy of *UBE3A* have been successful preclinically, making this disorder especially tractable for treatment. Reliable, objective, and clinically relevant biomarkers are needed to enable the success of clinical trials for AS.

**Objectives:** (1) To evaluate the potential of quantitative EEG biomarkers in the context of AS clinical trials. (2) To highlight a framework for basic science and pharmaceutical collaboration in a pre-competitive space that can be used as a model for other disorders.

**Methods:** We will discuss multiple collaborative projects using quantitative methods to retrospectively analyze EEGs from individuals with AS.

**Results:** Delta rhythms are reliably increased in individuals with AS and in mouse models of AS. Increased delta rhythms can be corrected by interventions at the genetic and circuit levels in rodents. Delta rhythms correlate with cognitive performance in children with AS.

**Conclusions:** Delta rhythms represent an objective and clinically relevant biomarker of clinical severity in AS.

**209.005 (Panel Discussion) Quantifying EEG Oscillations in Angelman Syndromes: Implications for Drug Development - Part II**  
*R. Komorowski, Biogen, West Roxbury, MA*

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POSTER SESSION — BIOMARKERS (MOLECULAR, PHENOTYPIC, NEUROPHYSIOLOGICAL, ETC)

Poster 406 - Biomarkers (molecular, phenotypic, neurophysiological, etc) Posters

**406.001** (Poster) Adversarial Machine Learning for Confound Disentangled Autism Biomarkers

**W. E. Carson<sup>1</sup>**, **D. Y. Isaev<sup>2</sup>**, **S. Major<sup>3</sup>**, **G. Sapiro<sup>4</sup>**, **G. Dawson<sup>5</sup>** and **D. Carlson<sup>6</sup>**, (1)Department of Biomedical Engineering, Duke University, Durham, NC, (2)Duke Center for Autism and Brain Development, Durham, NC, (3)Duke Center for Autism and Brain Development, Department of Psychiatry and Behavioral Sciences, Duke University, Durham, NC, (4)Department of Electrical and Computer Engineering, Duke University, Durham, NC, (5)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC, (6)Department of Civil and Environmental Engineering, Duke University, Durham, NC

**Background:** Biomarkers may contain confounds that obfuscate useful information, impairing our ability to discern underlying causes and characteristics of autism spectrum disorder (ASD). Intellectual disability (ID) is a common comorbidity in individuals with ASD. Due to the overlap between ASD and ID, it is often difficult to determine whether observed differences can be attributed to ASD or differences in cognitive ability. Thus, methods to extract ASD-specific features independent of information attributable to intellectual disability are needed. We used an adversarial machine learning model to create confound-disentangled biomarkers for ASD diagnosis.

**Objectives:** We used an adversarial machine learning model to disentangle information related to a common comorbid disorder, ID, from our biomarkers, ensuring that our biomarkers inform only on ASD.

**Methods:** The cohort consisted of 31 children with ASD and 31 age-matched typically developing (TD) children. Simultaneously recorded EEG and videotaped behavior were collected while participants watched three video stimuli. Behavior features were generated based on participant attention to video stimuli. Specifically, total time attending to a video was divided by the number of looks away from the video. Similar to Principal Component Analysis (PCA), our model is a linear factor model with an analytical solution. Our adversarial factor model (referred to as adversarial PCA or aPCA) balances fitting the observed data while making the factors unpredictable or orthogonal to the confounding information. The degree of this unpredictability is controlled through a tuning parameter. The mean IQ of TD and ASD groups within our cohort were 114.3 (SD = 13.5) and 80.4 (SD = 21.9), respectively. We used aPCA to remove this confounding information on participant intelligence from our behavior features. Representations transformed via aPCA were evaluated on the area under the receiver operating characteristic curve (AUC) achieved when using them to predict diagnosis. For comparison, we also evaluated features transformed via PCA and features not subjected to dimensionality reduction on their ability to predict diagnosis. We evaluated feature sets on performance when predicting IQ group (defined as above or below 100 IQ) to determine the extent to which information on intellectual ability remained in our features.

**Results:** Results of using aPCA to enforce IQ invariance in our features are displayed in Table 1. aPCA generates behavior features completely unpredictable of IQ (AUC = 0.500) while still retaining information pertinent to ASD diagnosis (AUC = 0.631). Conversely, both the raw features and features decomposed via PCA were predictive of IQ group, with AUCs of 0.701 and 0.692, respectively. The leftmost plot in Figure 1 shows the tradeoff between diagnosis predictability and IQ predictability as adversarial strength is increased. The rightmost plot in Figure 1 shows how the correlation between behavior aPCA components and IQ decreases monotonically as adversarial strength increases, thus demonstrating the effectiveness of the adversary.

**Conclusions:** We demonstrated that an adversarial machine learning model can disentangle information related to a common comorbidity, ID, thus ensuring our biomarkers inform on ASD alone. Our framework for creating confound disentangled biomarkers is flexible and provides a template for future biomarker methods.

**406.002** (Poster) Assessing Glutamate Concentration As a Predictor for Social Behavioral Changes in ASD Due to Memantine  
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**Background:** Autism spectrum disorder (ASD) is characterized by repetitive behaviors and impaired social communication. Differences in neural excitability/inhibitory ratios have been previously reported in ASD. Magnetic Resonance Spectroscopy (MRS) has been shown as an effective technique to measure concentrations of the neurotransmitter glutamate, which in general

causes increases in neural excitability. It is therefore possible that this may be used as a predictor for the efficacy of pharmacological interventions in ASD. Pharmacological interventions targeting glutamate have been examined recently, with mixed results found for the NMDA-glutamatergic antagonist memantine.

**Objectives:** To assess glutamate concentrations in brain regions as a biomarker for treatment efficacy of memantine in improving social behavior. To better understand effects of memantine on changes to social behavior in ASD.

**Methods:** MRS data from adult participants with ASD was processed to determine differences in glutamate concentration in the cerebellum and dorso-lateral prefrontal cortex (DLPFC). Social behavior was assessed before and after a 12 week trial of Memantine (titrated to 10mg twice a day) using the Clinical Global Impression (CGI) improvement scale. Changes in social behavior were compared to concentrations of glutamate in both ROIs to determine if glutamate concentration may serve as a predictor of changes in social behavior due to Memantine.

**Results:** A positive correlation was discovered between glutamate concentration in left DLPFC and changes in CGI scores related to social interaction. There was no relationship between glutamate concentration in either cerebellum or DLPFC with regard to aberrant or abnormal behavior, repetitive behavior, verbal or nonverbal communication, hyperactivity, anxiety, hypo or hyper sensitivity, or restricted interests.

**Conclusions:** More work is needed to further assess the efficacy of biomarkers acquired using MRS in predicting treatment response to Memantine, but the current results indicate that it may be possible that these biomarkers can predict changes in social interaction by measuring baseline glutamate concentration.

**406.003 (Poster)** Assessment of Motor Skills VIA a Tablet-Based GAME in Young Children with Autism Spectrum Disorder  
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## **Background:**

Several studies have shown that children with autism spectrum disorder (ASD) exhibit motor skill deficits which are apparent in the first year of life and represent one of the earliest symptoms of ASD. Our goal was to develop a tool for assessing motor skills that leverages recent advances in machine learning and computer vision and could be deployed on ubiquitous devices such as tablets and smartphones, opening the door to scalable, objective, and robust methods for automatically analyzing children's motor abilities.

## **Objectives:**

Develop and deploy scalable ASD behavioral phenotyping tool for assessing children's motor control and exploration via interaction with a touchscreen, based on analyses of behavioral patterns and response to a developmentally-appropriate interactive game under natural conditions with minimal instructions.

## **Methods:**

A series of carefully-designed visual stimuli was shown on an iPhone or iPad while children's behavior is recorded by the camera in the device. During an interactive bubble-popping game, we recorded and analyzed children's motor responses (see Figure 1a). The game features colored bubbles rising to the top of the screen. After a bubble is popped, the same one reappears in the same track, allowing assessment of repetitive behavior. Study 1 involved 18-34 month-old toddlers with ASD (N = 24) versus typical development (TD; N = 115). Study 2 involved 44 older children with ASD (56-99 months of age), 24 of whom had comorbid attention deficit hyperactivity disorder (ADHD). These subsamples were matched on IQ and exposure to digital devices. Age and IQ were used as covariates. On-device high precision inertial and gyroscopic sensors record multimodal information was derived from screen-based features such as bubbles popping and screen touches. Machine learning algorithms were used to automatically reveal motor behavioral features including motor accuracy, prospective motor control, sensorimotor timing and integration, repetitive or exploratory behavior, and overall engagement with the game (Figure 1c).

## Results:

Study 1 revealed that ASD and TD participants had comparable compliance and ASD participants showed, on average, lower fine motor control and accuracy compared to those with TD (Figure 1b), as reflected in the median error - defined as the distance between the centered of the popped bubble and the child's touch - and in the accuracy variability - standard deviation of the accuracy evolution when touching the screen, across all touches. Results of Study 2 indicated that ASD participants with ADHD were more engaged in the game, but less accurate, with less coherent movement and higher variability in the force applied when touching the screen (Figure 1c).

## Conclusions:

We demonstrated that information about motor skills can be automatically extracted from a simple bubble-popping game. These features can be then combined with other features automatically detected from behavioral recordings collected during other parts of the app. Attractive on-tablet games, equipped with high precision sensors, could lead to novel scalable screening and monitoring methods.

**406.004 (Poster)** Biophysical Responses to Pain As Biomarkers for Pain-Induced Stress in Autistic Individuals  
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**Background:** Pain sensation often goes unnoticed in nonverbal individuals such as those with Autism Spectrum Disorder (ASD)[1,2]. Current pain assessments rely on surveys and questionnaires such as numerical and verbal rating scales. Such self-reports – which assume a capacity to understand and verbalize mental/emotional states – and behavioral observation from parents and clinicians are subject to limitations, misinterpretation, and inaccuracies [3]. This in turn influences quality of care and delays appropriate diagnosis and treatment in healthcare[2,3].

**Objectives:** The goal of this study is to uncover signatures in Nervous System (NS) signals of individuals with typical peripheral and autonomic NSs in relation to those with ASD. This study questions how biophysical signals from the NSs are influenced by the introduction of pressure pain on the arm and how this may influence biophysical responses and/or interfere with performance on instructed or prompted motor-cognitive tasks. Using physiological signals to assess how pain influences motor(deliberate) and cognitive(intended) functioning can provide unique insights on the neurobiological mechanisms of pain sensation and perception in general[5].

**Methods:** We target the neurotypical (NT) population to understand signature responses to pain in order to develop digital biometrics that can be used to objectively assess when those with physical pain and/or neurological disorders demonstrate such responses under normal conditions. NT subjects performed various motor and/or cognitive tasks such as resting, walking, pointing, and drawing under different conditions (Figure 1A). ASD subjects then performed the same tasks only under control conditions. Kinematic signals (obtained from wearable motion sensors) representing bodily movements (via the Peripheral NS) were objectively analyzed for deliberate and spontaneous modes[4]. Electrocardiographic (ECG) signals representing cardiac activity (via the Autonomic NS) were characterized via clinically relevant heart rate variability metrics (HRV) to assess sympathetic and parasympathetic NS activation along with additional measures (Figure 1B). Such physiological responses were also compared to subjective numerical ratings to assess their correspondence with common pain assessments.

**Results:** Preliminary findings suggest unique statistical patterns in biophysical responses during the pain condition that is comparable to the responses observed in ASD subjects at baseline. This study identifies several parameters that can be used to stratify subjects based on their NS biorhythms when experiencing pain and/or pain-induced stress and anxiety. In NT subjects, the pain condition elicits a unique cardiac response that is associated with elevated sympathetic activity (fight-or-flight response) and/or decreased parasympathetic tone. Results from Gamma parameterization under the SPIBA [4,5] framework followed consistent patterns with common time & frequency domain HRV metrics (Figure 1B). Pain also appears to influence performance on motor-cognitive tasks of low cognitive load, suggesting disrupted kinesthetic feedback that is commonly found in ASD subjects at baseline [5].

**Conclusions:** Biophysical signals from the PNS and ANS (via motion and ECG sensors, respectively) offer a wealth of data that is useful in characterizing states of pain and stress. This work has several implications in developing a clearer neurophysiological understanding of pain and can ultimately help in objectively detecting internal levels of pain and stress in autistic individuals and the general population.

**406.005** (Poster) Comparison of Blood 25 Hydroxy Vitamin D, Copper, Zinc and Copper Zinc Ratio between Children with Autism Spectrum Disorder and Typically Developing Children: Analytical Cross-Sectional Study  
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Background:

Vitamin D insufficiency is widely prevalent in India across all ages and socioeconomic strata. There is no published data on Vitamin D Status in Indian children with Autism Spectrum Disorder (ASD). Many studies have shown that children with autism also have altered levels of other micronutrients. These vitamins and minerals play important role in handling environmental stress.

Objectives:

### Primary

To compare plasma 25 (OH) Vitamin D level in children with ASD aged 2-5 years with age and gender matched TDC attending pediatric OPD at AIIMS, New Delhi India

### Secondary

To compare following in children with ASD aged 2-5 years with age/ gender matched TDC

1. Serum copper level
2. Serum Zinc level
3. Copper- zinc ratio

Methods:

Study design: Analytical Cross sectional study

Fifty-one children with autism and thirty-three TDC were enrolled after applying inclusion and exclusion criteria as per study protocol. Clinical psychology assessment was done for both groups. ASD group children underwent assessment by Childhood Autism Rating Scale 2, and DQ assessment by Development Profile 3 was done in both groups. Fasting blood samples were collected for micronutrient analysis as per lab guidelines. Samples were analyzed and results were analyzed.

Results:

1. Both groups were comparable for their demographic characteristics ( age and gender matched). Maternal age and paternal age at the time of birth of child was significantly high in ASD group.
2. Perinatal history was significant in ASD group compared to control (p=0.01). ASD group had more vegetarian children (p= 0.006). Milk consumption was significantly high in ASD group (p=0.001). Children in ASD group had less defined outdoor timings compared to controls (17% vs 51%).
3. Mean Serum 25 (OH) vitamin D was 9.86±6.91 ng/ml in ASD group and in control group mean±SD was 18.63±10.87. Both were in insufficiency range and data was skewed with high SD so logarithmic transformation was done; unadjusted logarithmic values were significantly low in ASD group (p 0.0001).
4. Serum copper was within range in all subjects, there was no difference in two groups.
5. Serum zinc was below lower reference range in 92% cases in ASD group and 33% in control group, (p-0.004)
6. Copper to zinc ratio was significantly high in ASD group with mean of 2.45, control group mean value was 1.73 (p:0.0005).

Conclusions:

In this study serum 25 (OH) vitamin D level was significantly low in 2-5 year old children with ASD compared to age and gender matched typical group. Similarly serum zinc level was significantly low in ASD group. Serum Copper to zinc ratio was significantly high in ASD group compared to neurotypicals.

### Recommendations

- Serum vitamin D level and Zinc level should be monitored in children with ASD as they are at risk for deficiency.
- Controlled intervention studies with micronutrients and their effect on core symptoms of autism and behaviour.

**Strength:** Adequate sample size, Both the groups were appropriately age and gender matched, the study selected younger children to see the effect of micronutrients in early years of development.

**Limitation:** doesn't show enough evidence to establish reasons for results and cause and effect relationship

**406.006 (Poster)** Comparison of Levels of Oxidative Biomarkers between Children with Autism Spectrum Disorder Aged 2-18 Years and Typically Developing Children: A Case-Control Study

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Background: Autism spectrum disorders (ASD) constitute one of the most common neurodevelopment disorders. As per the CDC 2019 report, the prevalence of ASD is 1 in 59. But the etiopathogenesis of ASD still remains enigmatic. Though multiple genetic, metabolic and environmental factors are implicated, exact mechanisms are yet to be elucidated.

Objectives:

The primary objective was to compare the levels of methylation pathway biomarkers (blood methionine, cysteine, homocysteine and MTHFR C677T polymorphism) between children with ASD and age and gender matched typically developing children. Secondary objectives were to compare the blood levels of advanced glycation end products (AGEs) [N Carboxymethyl Lysine (CML), N Carboxymethyl Arginine (CMA) and dityrosine], urine uric acid/ creatinine ratio, arterial blood lactate, blood vitamin E, vitamin B12 and folate levels and to correlate the levels of these biomarkers with severity of autism (CARS score), sensory issues (SP2 score), co-morbidities (CBCL score) and DQ/IQ (MISIC/VSMS/BKT)

Methods: In this case- control study, children with ASD between 2-18 years fulfilling DSM-5 criteria were selected as cases and age and sex matched typically developing children as controls. Subjects with any chronic illness or those on any anti-oxidant therapy or multivitamins or anti epileptic drugs were excluded. Sample size was calculated using an effect size of 0.6  $\mu\text{mol/L}$  (difference means of plasma homocysteine level in children with ASD and control) from existing literature,  $\alpha$  error of 0.05, power 80% and case to control ratio of 2:1.

Results:

100 cases (male= 82) and 50 controls (male= 41) were enrolled in the study. The frequency of CC, CT and TT genotypes in ASD group was 84%, 14% and 2% respectively and in control group was 86%, 12% and 2% respectively. The results showed that the C677T polymorphism was not associated with increased ASD risk in any of the comparison models predicted by Hardy Weinberg Equilibrium. The median level of serum homocysteine in ASD group was 9  $\mu\text{mol/L}$  (95% CI: 7-16  $\mu\text{mol/L}$ ) which was significantly higher than median level in the control group 7  $\mu\text{mol/L}$  (95% CI: 4-11  $\mu\text{mol/L}$ ) ( $p=0.01$ ). The prevalence of hyperhomocystinemia ( $\geq 15\mu\text{mol/L}$ ) was 13.4% in ASD group compared to 3.8% in control group with a statistically significant difference ( $p=0.04$ ). There was no statistically significant correlation found between prevalence of hyperhomocystinemia and severity of autism/ DQ/ presence or absence of sensory issues/ presence or absence of behavioral issues. Among AGEs only dityrosine was found to be significantly elevated in ASD group. There was no statistically significant difference between the median levels of plasma cysteine or methionine levels, urine uric acid to creatinine ratio, arterial lactate, serum vitamin E, vitamin B12 and folate levels between the cases and controls.

Conclusions:

Our study shows that MTHFR C677T polymorphism is neither a risk nor a protective factor for autism. The prevalence of hyperhomocysteinemia is significantly higher in ASD compared to controls and is independent of MTHFR polymorphism or vitamin B12 or folate levels. The evidence for the role of increased oxidative stress in the pathogenesis of ASD is also strengthened by the increased tyrosine levels.

**406.008** (Poster) Development of a Plasma Metabotype-Based Biomarker Test Battery to Screen for Children at Risk of ASD  
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#### Background:

Discovery of biomarkers associated with autism spectrum disorder (ASD) can lead to the development of tests useful in the screening for ASD. ASD is a heterogeneous disorder with etiologic and clinical heterogeneity that hampers diagnosis, frequently delaying therapeutic interventions. Stratification of the ASD population based on biochemical phenotypes of metabolic dysregulation (metabotypes) can be used to identify biomarkers amenable for use in diagnostic tests. We previously reported on stratification of 53% of the ASD subjects enrolled in the Children's Autism Metabolome Project (CAMP, ClinicalTrials.gov Identifier: NCT02548442) based on ratios of plasma metabolites that identify dysregulation of metabolism. In this work, we increase the number of metabolites profiled and employ a cross validation approach to identify additional biomarkers that, in turn, identify novel metabotypes associated with ASD in CAMP. These biomarkers are then optimized into a test battery with increased sensitivity compared to our previous reports.

#### Objectives:

The study sought to use quantitative plasma metabolite analyses to identify alterations of amino acid and other amines, purine, and organic acid metabolism to stratify ASD subjects into distinct metabotypes that may be clinically actionable.

#### Methods:

A training set of plasma samples from 499 children with ASD and 209 typically developing (TYP) children, age 18-48 months, were analyzed from CAMP which enrolled children from 8 centers across the US. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) was performed by research reliable clinicians to confirm ASD diagnoses. Quantitative mass spectrometry-based methods were used to measure the concentration of 42 metabolites in plasma samples. Metabotype tests were created by setting a diagnostic threshold to identify a subpopulation of CAMP subjects primarily composed of children with ASD. Four-fold cross validation stratified by age, sex, and diagnosis repeated 50 times was used to identify metabotypes tests with subpopulations that have a minimum average diagnostic performance of 5% sensitivity and 95% specificity. Metabotype tests meeting minimum diagnostic performance were optimized to create a test battery that increases sensitivity of the overall diagnostic approach while maintaining a minimum of 90% specificity.

#### Results:

The cross validation approach increased the metabotype tests from 34 previously reported to 125 metabotype tests comprised of metabolites and ratios of metabolites. The 125 metabotype tests fell into several metabolic clusters associated with citrate and 2-ketoglutarate, lactate and pyruvate, amino acids, taurine, carnitine, 4-hydroxyproline, and ethanolamine and urate. Within these clusters, ASD subjects are often identified by multiple metabotypes. The individual metabotype tests had average sensitivities of 5-11% and specificities of 97-100%. The 125 metabotype tests were optimized into a battery, based on subset of 27 tests, that identified CAMP ASD subjects with a sensitivity of 69% and specificity of 90%.

#### Conclusions:

Our ongoing analyses have increased the number of metabotypes associated with ASD in the CAMP cohort from 53% to 69%. This research holds the prospect of producing a system for identifying risk of autism in very young children. It also establishes a pathway for identifying metabolically characterized subtypes of autism that, in turn, may have implications for targeted treatments.

**406.009 (Poster)** Development of the Pupillary Light Reflex from 9 to 24 Months in Infants with Elevated Familial and Genetic Liability to Autism.

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**Background:** Although Autism Spectrum Disorder (ASD) is highly heritable, the mechanisms through which genetic alterations contribute to behavioural symptom emergence remains unclear. Using a prospective study design, investigating early intermediate phenotypes in infants with a family history of ASD may provide a tool to bridge genotype to behavioural phenotype prior to clinical diagnosis. A candidate early intermediate phenotype is the pupillary light reflex (PLR): the rapid automatic reduction in pupil diameter in response to increased optical luminance. Altered PLR during infancy has been associated with later ASD.

**Objectives:** We aimed to examine whether later ASD diagnosis and symptom severity was associated with developmental trajectory of PLR latency and constriction from 9- to 24-months in infants with and without a family history of ASD. We also aimed to determine whether ASD polygenic score (a weighted sum of ASD-associated common genetic variants) was associated with PLR development.

**Methods:** We collected pupil data longitudinally at 9-, 14- and 24-months from 256 infants; 206 had a family history of ASD. Pupillary light reflex was induced, and pupil diameter was measured using eye-tracking technology. DNA samples were taken and polygenic scores for ASD were calculated for each infant. At 36-months ASD symptom severity was measured using the Autism Diagnostic Observation Schedule; 28 infants received an ASD diagnosis.

**Results:** Separate linear multilevel models with random intercepts were conducted. We assessed the interaction of visit timepoint (9-, 14- and 24-month) with a) 36-month ASD outcome, b) 36-month symptom severity and c) ASD polygenic score, on PLR latency and constriction amplitude. Infants with an ASD diagnosis at 36-months had a larger reduction in constriction amplitude between 9- to 24-months compared to typically developing infants with no ASD family history ( $\beta = 8.10$ ,  $s.e. = 2.07$ ,  $p < 0.001$ ) and typically developing infants with ASD family history ( $\beta = 4.01$ ,  $s.e. = 1.84$ ,  $p = 0.03$ ; Figure 1a). Higher symptom severity at 36-months was associated with larger decreases in constriction amplitude between 9- and 14-months ( $\beta = -0.67$ ,  $s.e. = 0.32$ ,  $p = 0.03$ ). ASD polygenic scores did not associate with PLR constriction amplitude across time. Infants with a later ASD diagnosis showed a larger latency decrease between 9- to 24-months compared to the typically developing group with no ASD family history (Figure 1b;  $\beta = 24.26$ ,  $s.e. = 9.23$ ,  $p = 0.001$ ). Those with a later ASD diagnosis demonstrated a non-significant difference in latency across 9-14 months. Higher ASD polygenic scores associated with increased latency between 9-14 months ( $\beta = 8.27$ ,  $s.e. = 3.05$ ,  $p = 0.01$ ).

**Conclusions:** Taken together, the development of basic pupillary responses is altered in infants with later ASD. Pupil constriction in response to light became attenuated more quickly over time for infants with a later ASD diagnosis compared to their typically developing counterparts. Polygenic liability appeared to associate with stagnating latency changes between 9-14 months. Infants with a later ASD diagnosis showed greater decreases in latency from 14- to 24-months, indicating an apparent 'catching up' profile.

**406.010 (Poster)** Diagnostic, Developmental, and Health Effects on Parasympathetic Regulation and Reactivity in Youth with Autism Spectrum Disorder

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**Background:** The Autonomic Nervous System (ANS) plays an important role in physiological regulation and response to stress. The parasympathetic branch of the ANS promotes calm visceral states, while also serving as a behavioral regulator. A dynamic, flexible parasympathetic system promotes adaptation to changing environmental demands, important for appropriate behavioral and emotional regulation and response. Increasing evidence suggests individuals with autism spectrum disorder (ASD) demonstrate atypical autonomic regulation; however, research remains inconsistent and likely dependent on a number of influential factors, such as developmental influences or physical health.

**Objectives:** The primary goal of the study was to examine parasympathetic regulation and response to the Trier Social Stress Test (TSST), a social evaluative threat paradigm, in a large, well-characterized sample of youth, ages 10-13 years, with and without ASD. The study aimed to identify hypothesized differences between the groups in the response to the TSST. Further, in an effort to address inconsistencies in previous research, additional factors expected to contribute to ANS response were explored.

**Methods:** The total sample included 241 youth with ASD (N=138) or TD (N=103), ages 10-13 years. The ASD group was comprised of 102 males and 36 females, while the TD group included 57 males and 46 females. Participants completed a physical examination, conducted by trained, licensed, study physicians to assess pubertal development, height, weight, and body mass index (BMI). Participants were exposed to the TSST paradigm while parasympathetic response was measured continuously, indexed by respiratory sinus arrhythmia (RSA). Linear mixed effects models examined the effects of baseline RSA, time, age, sex, pubertal stage, BMI, and diagnosis.

**Results:** Initial models demonstrated a significant effect for diagnosis ( $X^2(1)=5.01$ ,  $p=0.02$ ) and time ( $X^2(4)=303.79$ ,  $p<0.0001$ ), revealing youth with ASD had significantly lower RSA on average relative to those with TD. However, there was no interaction for diagnosis and time ( $p>0.05$ ), suggesting the change in RSA during the TSST did not differ between the two diagnostic groups. Further analyses showed a significant main effect for BMI ( $X^2(1)=25.29$ ,  $p<0.0001$ ) but not pubertal development stage (all  $p>0.05$ ), such that elevated BMI was associated with lower RSA on average. Notably, in follow-up models of diagnosis, time and a diagnosis\*time interaction, including BMI, there was no longer an effect for diagnosis ( $X^2(1)=1.54$ ,  $p=0.21$ ).

**Conclusions:** There is an emerging and alarming literature showing higher rates of overweight and obesity in youth with ASD, which may have serious physical and mental health consequences. As lower parasympathetic regulation may increase susceptibility for a number of conditions, such as anxiety or depression, it will be important to further elucidate the link between BMI and the ANS, especially in ASD. Moreover, given the lack of diagnostic effects when controlling for BMI, current findings emphasize the need to account for relevant covariates when examining autonomic response in ASD, as these related variables may be contributing to noted inconsistencies in the literature.

#### **406.011 (Poster) EEG Biomarkers of Social Interaction in Fmr1 Null Mice**

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**Background:** Alterations in neural activity as measured by EEG have promise as biomarkers of neurodevelopmental impairment in both patients with Fragile X Syndrome and Fmr1 mutant mice. Abnormal neurophysiological responses to auditory stimuli in this mouse model correlate with behavioral hypersensitivity, suggesting EEG can reflect behavioral phenotypes.

**Objectives:** To test whether there are similar EEG correlates in the social behavioral domain associated with FXS symptomatology, we characterized the spectral power of cortical EEG in the Fmr1 mutant mouse during social interaction.

**Methods:** Hemizygous Fmr1 and wild-type control male mice (n=12) were implanted with wireless EEG transmitters coupled to a frontal active electrode and a cerebellar reference electrode. EEG was recorded during repeated social interaction sessions with either juvenile or adult conspecifics. The freely-movingly implanted mice engaged in the social recognition task in which they were exposed in a series to 1) a novel conspecific, 2) the same now familiar conspecific and 3) a new novel conspecific. The time spent in olfactory investigation of the conspecific was scored and the spectral power of the EEG was calculated for baseline, non-social and social epochs. The habituation index between the first and second exposure was calculated for both olfactory investigation and spectral power.

**Results:** Both Fmr1 and control mice engaged in high levels of olfactory investigation of both adult female and juvenile male conspecifics and demonstrated a reduction in gamma power during social interaction epochs relative to baseline epochs ( $p<0.0001$ ). However, Fmr1 mice spent more time investigating novel animals ( $p=0.004$ ) and had a corresponding increase in theta power during investigation relative to control mice ( $p=0.005$ ). The Fmr1 animals did not display the species typical behavioral habituation to repeated interactions with the same conspecific indicated by a reduction in olfactory investigation. Control mice, contrastingly, exhibited a reduction in both olfactory investigation ( $p=0.02$ ) and total EEG power across repeated social exposure ( $p=0.05$ ). Consistent with their failure to exhibit a behavioral response, Fmr1 animals also did not show a reduction in total spectral power.

**Conclusions:** A broad EEG signature of social interaction in the reduction in gamma power can be seen across genotypes and social stimuli. The behavioral differences between Fmr1 mutant and control mice, namely increased investigation of novel

stimuli and decreased habituation to repeated stimuli by the Fmr1 animals, correspond to differences in spectral EEG power during social/olfactory interaction. The identification of features within spectral power that correlate with both behavioral states and genotypic differences suggests that EEG could be used as a readout of social circuitry to support preclinical investigations of therapeutic interventions targeted at this domain of impairments.

**406.012 (Poster)** EEG Theta Power and Behavioral Characteristics of Children with Autism with and without Co-Occurring ADHD

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**Background:**

Theta electroencephalography (EEG) band has been related to performance and cognitive control and is implicated in attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD), two disorders which have a high comorbidity rate. Studies support a differential theta response between these groups (ADHD: higher theta, ASD: lower theta) when compared to typical development (TD). Two studies investigated comorbid *ASD+ADHD* and found lower theta power compared to *ADHD-only*. Thus, the underlying physiological mechanisms of *ADHD-only* and comorbid *ASD+ADHD* may be different, and more research is needed to understand the brain correlates of the two disorders.

**Objectives:**

The current study compared EEG absolute theta power measured across frontal-central scalp regions in 4 groups of 3-7 year old children: *ASD-only* (n=41), *ADHD-only* (n=32), co-morbid *ASD/ADHD* (n=30), and TD (n=18). We also explored associations between levels of theta power and levels of social and adaptive skills among children with a diagnosis of *ASD-only* versus those with a diagnosis of *ADHD*. The latter group included children with both *ASD+ADHD* and *ADHD-only*. Finally, we explored these relationships among children with *ADHD-only*.

**Methods:**

We used ANCOVAs to test for differences in absolute theta power (4-6 Hz) during a resting state EEG paradigm (cascading bubbles), averaged across 5 frontal-central channels (F3,F4,Fz,C3,C4). We used linear regression to test the associations between theta power and a standardized measure of adaptive skills, the Vineland Adaptive Behavior Scales-3 (VABS). This scale provides information on several subdomains of skills, including Communication, Socialization, Motor, and Daily Living Skills. 121 children provided artifact-free EEG and were included in the analysis (mean Full Scale IQ = 96 ± 25, mean age = 72 ± 16 months). All models accounted for age, IQ, and sex.

**Results:**

First, we investigated potential differences in theta power between groups, and results revealed no overall group differences. Next, we studied associations between theta and VABS within the *ASD-only* group but observed no associations. Second, in a combined group including *any-ASD* diagnosis (i.e. *ASD-only* and *ASD+ADHD* combined), no associations were observed. Third, in a combined group including *any-ADHD* diagnosis (i.e. *ADHD-only* and *ASD+ADHD* combined), we found increased VABS Personal Daily Living, Motor, and Gross Motor Skills were associated with higher theta power ( $\beta=9.442e-03-0.007$ ,  $p<0.05$  for all). Finally, a similar analysis conducted with the *ADHD-only* group did not yield significant relationships; however, the small sample size makes this finding inconclusive.

**Conclusions:**

Based on these preliminary analyses, we do not find significant differences in frontal-central theta power among children with *ASD-only*, *ASD+ADHD*, *ADHD-only*, and TD. However, our results suggest that, among children with *any-ADHD* diagnosis (i.e. *ADHD-only* and *ASD+ADHD* combined), higher levels of frontal-central theta are associated with higher levels of adaptive and motor behaviors. Theta power may be especially relevant for development of adaptive skills in children with ADHD, regardless of whether or not they have co-occurring autism. It is surprising that a similar relationship was not found when the children with

ADHD-only were examined separately. We are continuing to collect additional data and a larger sample will provide more definitive conclusions.

**406.013 (Poster)** Examining Heterogeneity in Children on the Autism and Broader Autism Spectrum through Latent Factors Underlying Social and Cognitive Variability

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**Background:** Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with high heterogeneity (Waterhouse, 2013). Efforts to embrace a more bio- and neural-marker-driven framework for defining mental health disorders (Insel et al., 2010) and DSM-5's employment of more quantitative scoring systems when assessing autistic traits (Ijichi et al., 2013) highlight the goals of identifying quantifiable markers of disability and also underlying processes of both ability and disability that might otherwise be obscured by categorical diagnostic labels. In this study, our goal is to identify latent developmental profiles that may predispose children towards more or less improved outcomes.

**Objectives:** We use data-driven approaches to identify subgroups of children on the autism and broader autism spectrum with divergent profiles of social-cognitive functioning.

**Methods:** We studied 52 children (42 males) with confirmed ASD diagnoses and an additional 27 (21 males) diagnosed with Broader Autism Phenotype (BAP). Children were part of a high-risk-for-ASD, infant-siblings study design, followed from birth with diagnoses confirmed at 24 and 36 months. Eye-tracking data were collected at 1, 2, 3, 4, 5, 6, 9, 12, 15, 18, 24, and 36 months of age, while children watched videos featuring naturalistic caregivers. Toddlers were assessed via *Mullen Scales of Early Learning* (MSEL) and *Autism Diagnostic Observation Schedule* (ADOS-2) at 24 months. Age-equivalent scores from MSEL domains (visual reception (VR), fine motor (FM), gross motor (GM), expressive language (EL), receptive language (RL)) and ADOS-2 domains (social affect (SA), restricted and repetitive behaviors (RRB)) were subject to factor analysis and spectral clustering. A Friedman test was used to assess whether derived subgroups have distinct social-cognitive profiles. Eye-tracking data were quantified as percentage of time spent fixating on regions-of-interest (ROIs) within the stimuli, and repeated-measures ANOVA were used to examine group differences in visual fixation patterns.

**Results:** A 3-group solution was selected based on spectral clustering. A significant MSEL/ADOS Measure-by-Group interaction ( $F=25.88$ ;  $p<0.001$ ) indicates distinct social-cognitive profiles across groups. Group1 comprised toddlers with higher verbal ability (significantly higher EL than Group1 and Group3; both  $p<0.001$ ), Group2 comprised toddlers with increased social disability and decreased verbal and nonverbal cognitive measures (significantly higher SA ( $p_{\text{Group1}}=0.008$ ,  $p_{\text{Group3}}=0.004$ ) and RRB scores ( $p_{\text{Group1}}=0.043$ ,  $p_{\text{Group3}}=0.014$ ), and significantly lower EL (both  $p<0.001$ ), RL (both  $p<0.001$ ), GM ( $p_{\text{Group1}}=0.002$ ,  $p_{\text{Group3}}=0.007$ ), and VR abilities (both  $p<0.001$ ) than Groups1 and Group3), and Group3 comprised toddlers with higher nonverbal cognitive abilities (statistically higher FM and VR than Group2 (both  $p<0.001$ )). Significant ROI-by-Group interactions indicated that visual fixation patterns were divergent at 15 ( $F=2.394$ ;  $p=0.030$ ) and 36 months ( $F=2.87$ ;  $p=0.013$ ). Group2 looked significantly less at mouths at 15 months ( $p_{\text{Group1}}=0.022$ ,  $p_{\text{Group3}}=0.017$ ), and significantly more at body ( $p_{\text{Group1}}=0.035$ ,  $p_{\text{Group3}}=0.026$ ) and object regions ( $p_{\text{Group1}}=0.002$ ,  $p_{\text{Group3}}=0.005$ ) at 36 months compared to Group1 and Group3.

**Conclusions:** Data-driven approaches can derive meaningful subgroups among children with varying levels of social-cognitive ability. Differences in visual attention to social stimuli between groups reveal the relationship between social visual engagement and early social-cognitive development. Future research will investigate whether and how these empirically-derived subgroups diverge in visual attention profiles over the first 36 months of development.

**406.014 (Poster)** Examining Resting State Alpha Power and Social Motivation Among Carriers of CHD8 Mutations and CHD8-Target Genes

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**Background:** Investigating shared biological pathways of ASD-risk genes may provide greater utility in efforts to parse ASD heterogeneity. One high confidence candidate risk gene for ASD is chromodomain helicase DNA-binding protein 8 (CHD8) (Bernier et al., 2014), which also regulates the expression of other ASD-risk genes (CHD8-targets; Cotney et al., 2015). Research suggests that individuals with ASD with CHD8 and CHD8-target mutations demonstrate greater social motivation challenges on

the Social Responsiveness Scale (SRS-2) compared to individuals with other genetic mutations or idiopathic ASD (Beighley et al., 2020). However, less is known about shared neurophysiological phenotypes among these children and relations with social phenotype. One candidate is alpha EEG frequencies (8-13 Hz), given that individuals with ASD show greater alpha frequency compared to neurotypical controls (Cornew et al., 2012, Wang et al., 2013) and positive associations between social deficits and resting state alpha power (Cornew et al., 2012; Edgar et al., 2015; but see Keehn et al., 2017).

**Objectives:** We examined whether individuals with mutations in shared genetic pathways (CHD8 and CHD8-targets) exhibited shared brain phenotypes that corresponded to atypical social behaviors. Specifically, we tested group differences in alpha power among children with ASD with mutations in CHD8, CHD8-target genes, non-targets, or idiopathic ASD and modulation by social motivation.

**Methods:** Participants were 120 children ( $M_{Age} = 10.93$  years; 29% female) with a CHD8 gene mutation ( $n = 8$ ), CHD8-target ( $n = 14$ ), a genetic mutation not targeted by CHD8 (non-target;  $n = 30$ ), or idiopathic ASD ( $n = 68$ ). Genetic mutations were ascertained via genetic testing; idiopathic participants were confirmed via genetic testing and had an existing ASD diagnosis. Social motivation was measured via primary caregiver report on the SRS-2 (Constantino & Gruber, 2012) social motivation subdomain. Alpha power was acquired during an eyes-open resting state EEG paradigm averaging 2 minutes in duration in which participants were instructed to passively attend to screensaver-like videos.

**Results:** Linear effects models examining alpha power indicated an effect of group,  $F(3,496)=7.51, p < .0001$ , though pairwise corrections did not survive Bonferroni correction for multiple comparisons. This effect was modulated by a significant interaction,  $F(3,496)=7.72, p < .001$ , that indicated increased social motivation challenges were related to higher alpha in the CHD8-target group (slope=.08), lower alpha in non-target group (slope=-.07), and no relationship in CHD8 and idiopathic ASD (slopes <.007) groups. Linear effects models examining SRS social motivation domain scores indicated an effect of group,  $F(3,500)=17.435, p < .001$ , with non-target groups demonstrating fewer social motivation problems relative to all other groups,  $p$ 's < .0125.

**Conclusions:** Our results demonstrated a common alpha phenotype for CHD8 and idiopathic ASD that was not related to social motivation challenges, unlike other pathogenic groups. A more nuanced examination of other frequency bands may illuminate other variability related to shared genetic pathways. Future research should include larger samples to test for interactions with social functioning, and should investigate the role of RRBs, which may drive alpha differences related to ASD.

**406.015 (Poster) Extending the Clinical Utility of Eye-Tracking Assays of Social Visual Engagement to Minority Populations: A Pilot Study of Toddlers with ASD from African American and Non-English-Speaking Families**

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**Background:**

Despite the consensus that early identification optimizes outcomes for individuals with ASD, the median age-of-diagnosis remains at 4-5 years and lags another 1.5 years for lower-income, minority families. These disparities result in adverse impacts on outcomes: African American (AA) children with ASD have an increased burden of intellectual disability than White children with ASD, whereas non-English-speaking Hispanic children with ASD are ascertained at lower rates and display elevated burden of ID relative to English-speaking, White counterparts. There is crucial need for tools that increase access to early diagnosis simultaneously addressing racial/ethnic disparities. A previous double-blinded study tested a standalone investigational device that uses eye-tracking technology to quantify social visual engagement(SVE) -how children look at and learn about their social environment. Tests compared eye-tracking to clinician-best-estimate diagnosis and assessment. Results showed that eye-tracking assays could yield ASD diagnostic sensitivity of 83.9%(77.8-88.6), specificity of 82.3%(76.1-87.2), and explained 78.4% of variance in ADOS total scores, 71.2% and 60.3% of Mullen verbal and nonverbal scores, respectively. Here we extend the utility of these methods to minority populations, aiming to increase access to early diagnosis.

**Objectives:**

To probe the utility of eye-tracking assays of SVE in a sample of AA and Non-E toddlers with ASD relative to their white and English-speaking counterparts, respectively.

**Methods:**

Sociodemographic, clinical, and eye-tracking data were collected from N=204 toddlers referred for an ASD evaluation. Parent-reported child race and home-language was used to assign toddlers with ASD to AA (n=38), W (n=104), English-speaking (n=29) and non-English-speaking (n=33) groups. Additional non-ASD AA (N=11) and non-E (N=6) toddlers completed procedures to pilot diagnostic accuracy. Higher ADOS total scores were observed in AA-ASD toddlers when compared to W-ASD toddlers ( $p < .03$ ). No other significant differences were observed across comparisons.

Eye-tracking data were analyzed by using moment-by-moment visual scanning of social scenes relative to normative data previously collected from typically-developing toddlers. We quantified visual scanning by making nonparametric estimates of the underlying probability density function for visual fixation and scanning at each moment-in-time using time-varying kernel density estimation. These performance-based metrics are used to quantify levels of social disability and verbal/nonverbal ability.

### Results:

There were no significant differences in valid eye-tracking data collection across comparison groups. Results on the eye-tracking-based indices of social disability, verbal and nonverbal ability revealed no significant differences across AA-ASD and W-ASD groups, or across Non-E-ASD vs. E-ASD groups. Diagnostic accuracy for the AA-ASD vs AA-non-ASD comparison was 85.7%(73.0%-93.2%) and 87.2%(72.8-94.9%) for the Non-E-ASD vs E-ASD comparison.

### Conclusions:

Results suggest that eye-tracking assays perform equivalently in AA and non-English-speaking toddlers with ASD relative to their White and English-speaking counterparts. These results bode well for deployment of this technology for traditionally underserved populations that have limited access to early identification services, which ultimately delays access to early intervention. A major limitation of this study is the small samples of non-ASD AA and Non-E toddlers contributing to our estimates of diagnostic accuracy. These estimates should be considered as directional, and not yet robust. To address this, our group continues to expand the samples.

#### 406.016 (Poster) Eye Tracking Entropy from Social and Nonsocial Stimuli As an Attention Dispersion Measure for Autism Spectrum Disorder

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Background: Recent work in the field of autism spectrum disorder (ASD) has highlighted the utility of eye tracking (ET) as a tool for investigating visual attentional differences in individuals with ASD and typically developing (TD) individuals. A typical ET experimental battery presents a subject with visual stimuli relevant to a particular construct (e.g., social information, such as human faces or scenes featuring people), and may also contrast the resulting ET data with ET data collected from presentation of stimuli unrelated to the construct of interest (e.g., non-social information, such as objects). Currently, most ET data analyses in ASD research rely on *a-priori* designation of relevant regions of interest (ROIs) in a stimulus (e.g. eyes, mouth, face) or irrelevant (e.g. image background, landscape features), requiring both the collected ET data and the specific researcher-labeled stimuli to reach analytic conclusions. Information-theoretic approaches, such as entropy, hold promise to successfully characterize the complexity of ET data without reliance on ex-ante ROIs.

Objectives: To characterize the manner in which entropy of looking patterns differs between ASD and TD individuals viewing both socially relevant (i.e., human face) and non-social (i.e., house) stimuli.

Methods: Data was collected from adults with ASD (N=11) and TD adults (N=23). Subjects were presented with a crosshair directing attention to the center of a screen, followed by either a human face image or a house image for one second. ET data was collected by an EyeLink-1000 eye tracking system (SR Research) at 500 Hz and then accumulated by stimulus image to create heatmap visual attention matrices for each face and house image per participant. Shannon entropy was calculated for each face and house image. These entropy values were then averaged by stimulus type (i.e., face or house), and the difference between house-specific entropy and face-specific entropy was used as the final derived variable for each participant.

Results: No significant differences were observed between groups for average face entropy or average house entropy alone. However, a significant group difference in means ( $p = 0.008$ ) was observed in house/face entropy difference values.

Conclusions: Although no significant difference was observed between diagnostic groups when looking at face or house entropy alone, contrast of entropy values for social and non-social stimuli within each participant resulted in a significant difference in

means across groups. These results indicate that Shannon entropy characterizes ASD-specific deviations in visual attention, but only when considered within the context of that individual's unique visual response to houses and faces. Ongoing work will explore whether Shannon entropy derived from visual attention when not contrasted between social and nonsocial stimuli reflects individual variation irrespective of diagnostic status.

**406.017 (Poster)** Infants with a First-Degree Relative with Autism or ADHD Show Altered Brain Activity during Live Social Experiences

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**Background:** While neurodevelopmental disorders like Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are not diagnosed until childhood, differences in neural responses to social and non-social stimuli measured with optical imaging presented on screen at 6 months predicted later ASD (Jones et al., 2016; Lloyd-Fox et al., 2018).

**Objectives:** Because neural differences between infant social and non-social attention appear stronger for live vs screen action (Jones et al., 2015), we investigated how ASD and ADHD likelihood and outcome affect neural activity during live social and non-social experiences at 5-6 months of age.

**Methods:** Eighty-eight five-months old infants with a first-degree relative with ASD, ADHD or typical development watched an experimenter singing nursery rhymes (social) or operating toys (non-social) while EEG was recorded. Theta power (3-5.9 Hz) was extracted from 1-second segments of social and non-social attention. Linear mixed-effects models tested whether relative theta power during social and non-social attention was modulated by ASD and/or ADHD likelihood ( $n = 88$ ; 49 males; mean age: 174.80 days), categorical ASD outcome ( $n = 67$ ; positive  $n = 9$ ) and continuous ADHD outcome ( $n = 59$ ). Further variables were brain region (frontal, parietal, posterior, temporal) and laterality (left, right). Covariates were gender and age.

**Results:** Relative theta power (normalised) was stronger during social vs non-social attention ( $F(1, 84) = 11.67, p < .001$ ). This difference interacted with ADHD likelihood ( $F(1, 84) = 4.58, p = .035$ ), being only present in infants with typical ( $F(1, 61) = 11.15, p = .001$ ), but not with elevated ADHD likelihood ( $p > .6$ ). Further mixed-effects models revealed no stimulus interactions with ASD outcome at 36 months ( $p > .4$ ). No stimulus interactions were observed for ADHD traits measured at 36 months, both in the full sample ( $p > .1$ ) and in a subgroup of infants with elevated likelihood only ( $n = 18, p > .1$ ), with Pearson correlations being  $r \pm < .3$ .

**Conclusions:** Results are consistent with research suggesting that young infants typically show stronger theta power during social vs non-social live action (Jones et al., 2015), and seem to hold across different paradigms. While theta power modulation was reduced in infants with elevated ADHD likelihood, visual data inspection indicates reduced modulation also in infants with elevated ASD. The least modulation in infants with combined elevated likelihood for both conditions highlights the importance of considering ADHD likelihood when investigating emerging ASD. The nonsignificant interaction of ASD likelihood might be explained by insufficient power, or by the young age (5-6 months), with theta modulation differences possibly just emerging. Alternatively, young infants with elevated ASD process social stimuli more typically when presented live, while showing reduced modulation during screen presentation (Jones et al., 2016; Lloyd-Fox, 2018). Future studies may directly compare live and screen contexts. Because theta power during live social vs non-social attention typically strengthens over the first year (Jones et al., 2015), we will analyse EEG data from these infants at 14 months to see whether this trajectory is modulated by ASD and/or ADHD likelihood/outcome.

**406.018 (Poster)** Initial Evidence of Clinical Utility of Optimized FMRP Analysis in Fragile X Syndrome

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**Background:** The Fragile X mental retardation 1 (FMR1) gene-specific protein product, Fragile X mental retardation protein (FMRP), is critical for brain development as it is involved in synaptogenesis and activity-dependent synaptic plasticity. An unstable trinucleotide repeat expansion (CGG repeats  $>200$ ) and subsequent abnormal methylation of *FMR1* located on the X chromosome results in Fragile X Syndrome (FXS) and markedly reduced FMRP levels. Despite being a single-gene disorder, phenotypic heterogeneity is readily apparent in FXS. There are few studies demonstrating relationships between FMRP levels and phenotypic expression. Identifying these relationships may be critical to planning clinical care and understanding development over time.

**Objectives:** In the current study, we optimized a method to reliably and reproducibly detect FMRP at extremely low values in whole blood samples to examine the relationship between FMRP levels and phenotypic features in FXS.

**Methods:** Individuals with FXS were recruited as part of several federally-, foundation-, and institution-funded studies, and were only included in the current study if they completed both blood collection for FMRP processing and resting state EEG. Forty individuals with full mutation FXS (27 males (FXS(M) and 13 females (FXS(F)) aged 13-45 years completed testing. Participants completed a battery of psychosocial, neurocognitive, and neurophysiological measures. Participant whole blood samples, obtained via venipuncture, were spotted onto Whatman Bloodstain cards. Dried blood spots were hole-punched from the cards and proteins were eluted. The eluate was analyzed in triplicate against a nine-point standard curve generated from a recombinant protein, via a Luminex-based immunoassay, to determine participants' FMRP concentration, as described previously.

**Results:** Higher FMRP levels related to higher non-verbal IQ scores in FXS(M) but to higher verbal IQ scores in FXS(F). There was no relationship with neurocognitive variables on KiTAP tests. Higher FMRP levels were associated with less severe stereotyped behaviors, hyperactivity, and speech abnormalities on the ABC. During a social preference eye tracking task, higher FMRP levels were associated with a greater percentage of time looking at social scenes in FXS(M), but at geometric scenes in FXS(F). On resting state EEG measures, higher FMRP levels corresponded to lower peak alpha frequency and increased relative alpha1 power among FXS(M). In addition, correlations between higher FMRP and increased alpha2 and decreased gamma1 power trended towards significance. In a subset of individuals who completed an investigational drug study (n=12), only FXS(M) with complete absence of FMRP demonstrated increased RBANS verbal memory and reduced ABC irritability.

**Conclusions:** Our optimized FMRP analysis which allowed us to reproducibly identify FMRP at extremely low values provides new evidence of the link between FMRP production and phenotypic expression in FXS. Absence of FMRP in full mutation males is associated with more severe cognitive, psychosocial, and neurophysiological phenotypes. Results among females demonstrate a more complicated picture likely due to one unaffected X chromosome. Of note, we identify a subset of patients—males without any FMRP—who demonstrated significant improvement on verbal memory and irritability following two-week course of an investigational, which suggests optimized FMRP analysis may be a highly useful tool in treatment planning and trial stratification.

**406.019 (Poster)** Longer Auditory Brainstem Response Latency before 6 Months Does Not Predict Subsequent Language Impairment in Infants at-Risk for Neurodevelopmental Disorders: A Preliminary Investigation

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**Background:** Abnormal brainstem development has been associated with autism, language delay and social-emotional disorders of at-risk infants. Research has shown that these infants exhibit prolonged auditory brainstem response (ABR) latencies particularly Wave V as early as 0~3 months of age (Cohen et al., 2013; Miron et al., 2016). The findings highlight ABRs as cost-effective presymptomatic markers for neurodevelopmental disorders and the necessity to examine low-level brain structures. Despite the proposed link between ABR abnormality and language delay in infancy, evidence of direct association between the two is still lacking. Given that the brainstem pathways develop rapidly in the first 6 postnatal months, and the neural generators of ABR Wave III-V including nuclei from the superior olive to the inferior colliculus continue to mature through end of first year (Moore et al., 1995), it is unclear whether there exists meaningful relationships between early brainstem function and subsequent linguistic competence in at-risk infants.

**Objectives:** The current study aimed to provide preliminary evidence for the relationship between brainstem integrity before 12 months and subsequent language ability in infants at-risk for neurodevelopmental disorders.

**Methods:** Click-ABRs were recorded prior to 12 months of age from 27 at-risk infants admitted to pediatric rehabilitation unit. Developmental outcomes were obtained 6~22 months later using the Gesell Developmental Schedule. The mean age of ABR testing was 5.2 month, and 18.5 months at the Gesell assessment. One infant was diagnosed with unilateral sensorineural hearing loss. The infants were divided into early-ABR group (tested between 0~6 months of age,  $N = 21$ ) late-ABR group (tested between 7~12 months age,  $N = 6$ ). Pearson correlation was conducted to describe the developmental trajectories cross-sectionally and brainstem-behavior relations.

**Results:** The Wave V latency (mean = 6.21 ms) did not differ from clinical norm, and shortened with increasing age ( $r = -0.518^{**}$ ). The language ( $r = -0.41^{*}$ ) and fine motor ( $r = -0.4^{*}$ ) degraded with increasing age. Language was the only measure on the Gesell that significantly correlated with Wave V latency at younger ages ( $r = .46^{*}$ ). This relationship was driven by the early-ABR group ( $r = 0.64^{**}$ ) whereas suggestively reversed for the late-ABR group ( $r = -0.77$ ).

**Conclusions:** The developmental trajectories indicated that language and fine motor were the most impacted overtime in these at-risk infants. Contrary to our expectations, longer Wave V latency did not predict poorer subsequent language but the opposite in the sample. Given that longer latency indicated earlier testing in our data, it is possible that infants who tested earlier received more extended intervention services, which in turn ameliorated language impairment. Alternatively, ABR before 6 months may not be a reliable and consistent marker for better or worse language outcomes due to the exuberant development of brainstem in this early time window. Our finding can only be considered preliminary due to small sample. Further research is required to investigate factors such as critical periods of subcortical maturation in the progression of neurodevelopmental disorders.

**406.020 (Poster)** Relevance of the Plasma Oxytocin Concentration and Neurodevelopmental Disorders in 5-Year-Old Children Considering Gender

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**Background:**

Previous studies have reported that plasma oxytocin (OT) concentration associated with characteristics of Autism spectrum disorder (ASD). Recently many researchers have investigated the efficacy of intranasal oxytocin infusion. So far, few studies have analyzed plasma OT concentration considering age and gender.

**Objectives:**

This study aimed to investigate the relevance of the plasma oxytocin concentration considering gender differences and neurodevelopmental disorders (NDD) in 5-year-old children.

**Methods:**

Subjects were children who participated in a 5-year-old developmental checkup in a city. They were 119 children with ASD (boys: girls =88:31, mean months age=64.56), 107 children with Attention Deficit Hyperactivity Disorder (ADHD) (68:39, 64.71), 89 children with Other Developmental Disorder (DD) (56:33, 64.63) and 79 children with TD (32:47, 65.25). Psychiatrists diagnosed them according to DSM-5. ADOS was added to diagnose ASD. Their caregivers completed the Autism-Spectrum Quotient (AQ) and the Conners3 Japanese version. The AQ assesses 5 different areas: social skill (AQ-social), attention switching (AQ-switching), attention to details (AQ-details), communication, and imagination. Blood samples were taken in the morning with fasting and plasma OT concentration was assayed by EIA. Statistical analysis was performed using Kruskal-Wallis test, Mann-Whitney U test, and multiple regression analysis ( $p < 0.05$ ).

**Results:**

While there was no significant difference in plasma OT concentration between the gender-specific diagnosis groups, the mean OT of girls (conc.= 5.0983) was significantly higher than that of boys (conc.= 3.7175) in TD ( $p < 0.05$ ) (Fig.1). The OT of girls tended to be higher than that of boys in ADHD and TD. On the other hand, the OT of girls tended to be lower than that of boys in ASD. However, there was no significant gender difference in ASD and ADHD. Multiple regression (independent variable: AQ, dependent variable: OT) showed that negative correlations between OT and AQ-details in total boys ( $R^2 = .104$ ,  $\beta = -.329$ ,  $p < 0.05$ ); OT and total AQ in total girls ( $R^2 = .107$ ,  $\beta = -.336$ ,  $p < 0.05$ ); OT and AQ-details in boys with ASD ( $R^2 = .124$ ,  $\beta = -.369$ ,  $p < 0.05$ ); OT and AQ-social in boys with ADHD ( $R^2 = .099$ ,  $\beta = -.338$ ,  $p < 0.05$ ); OT and AQ-switching in boys with other DD ( $R^2 = .271$ ,  $\beta = -.539$ ,  $p < 0.05$ ); OT and total AQ in girls with TD ( $R^2 = .171$ ,  $\beta = -.437$ ,  $p < 0.05$ ). Multiple regression (independent variable: Conners3, dependent variable: OT) showed that a positive correlation between OT and Oppositional defiant disorder score of Conners3 in boys with TD ( $R^2 = .186$ ,  $\beta = .460$ ,  $p < 0.05$ ); a negative correlation between OT and Executive functioning score of Conners3 in boys with ADHD ( $R^2 = .054$ ,  $\beta = -.261$ ,  $p < 0.05$ ); a negative correlation between OT and Oppositional defiant disorder score of Conners3 in boys with other DD ( $R^2 = .074$ ,  $\beta = -.302$ ,  $p < 0.05$ ); a positive correlation between OT and Hyperactivity score of Conners3 in girls with ASD ( $R^2 = .227$ ,  $\beta = .504$ ,  $p < 0.05$ ) (Fig.2).

**Conclusions:**

This study showed that plasma OT concentration was associated with symptoms in each neurodevelopmental disorder depending on gender. Although the results do not mention the causal relationship between OT and developmental traits, the effects of OT on the developmental traits of preschool children may differ by gender.

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**406.021 (Poster)** Serum Biomarkers Indicate Higher Estradiol Levels and Maternal Insulin Resistance during Pregnancies of Offspring Who Develop Autism

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Background: Maternal diabetes and hypertension (i.e., prenatal metabolic syndrome, PNMS) are associated with increased autism spectrum disorder (ASD) risk, which may be attributable to inflammation and steroid dysregulation that characterize these conditions. Estrogen is an established serum marker for fetal viability, yet elevated estradiol levels have been identified during pregnancies of offspring who develop ASD. Low maternal sex hormone binding globulin (SHBG) levels indicate insulin resistance and precede clinical manifestations of gestational diabetes and hypertension. Interestingly, low maternal serum SHBG in early 2<sup>nd</sup> trimester has also been linked to ASD among offspring born at term.

Objectives: (1) Identify the relationship between prenatal maternal serum sex steroid related biomarkers and ASD, and (2) Using maternal SHBG levels as a proxy for insulin sensitivity, compare insulin sensitivity during pregnancies that differ by diabetes/hypertension exposure, offspring ASD status, and pregnancy duration.

Methods: ASD case status was ascertained among index offspring of Utah's First and Second Trimester Evaluation of Risk of Aneuploidy (FASTER) Study participants (1998-2002) who consented to future use of banked early second trimester maternal serum. ASD case status was determined by the Utah Registry of Autism and Developmental Disabilities, which was enriched with cases identified through Utah's participation in CDC's Autism and Developmental Disabilities Monitoring Network. Birth certificate data identified either diabetes or hypertension exposure, gestational age, maternal age, pregnancy weight gain, and pre-pregnancy BMI. Commercially available ELISA kits measured estradiol (Abcam; Boston, MA) and SHBG (RayBiotech; Norcross, GA). A one-way Analysis of Covariance quantified the association between a four-level measure of ASD/PNMS exposure: ASD-/PNMS- (N=36), ASD-/PNMS+ (N=32), ASD+/PNMS- (N=38), and ASD+/PNMS+ (N=30). Analyses included covariates described above and were repeated following stratification by term/preterm status. Post hoc tests used the Sidak method to adjust for multiple comparisons.

Results: The overall model for serum SHBG concentrations was significant ( $F_{(6,135)}=11.7, p<.001$ ) as was the main effect of ASD/PNMS exposure on SHBG ( $F_{(3,135)}=16.2, p<.001$ ). A dose-response pattern emerged: increasing ASD/PNMS exposure was associated with decreasing SHBG concentrations. After multiple comparison adjustment, mean SHBG concentrations differed significantly between the ASD-/PNMS- and ASD+/PNMS- (lsmean difference = 200.5, 95% CI = 86.2-314.8,  $p < 0.001$ ) and ASD+/PNMS+ (lsmean difference = 266.6, 95% CI = 136.7-396.6,  $p < 0.001$ ); and between ASD-/PNMS+ and ASD+/PNMS- (lsmean difference = 181.5, 95% CI = 62.8-300.3,  $p < 0.001$ ) and ASD+/PNMS+ (lsmean difference = 247.7, 95% CI = 119.8-375.5,  $p < 0.001$ ; Figure 1). When stratified by term/preterm status, the results were similar. The overall model for estradiol was significant ( $F_{(6,134)}=2.5, p=0.03$ ), and ASD+/PNMS+ differed significantly from ASD-/PNMS- (lsmean difference = 410.0 (95% CI= 67.0-753.0,  $p=0.01$ ). Following stratification by term/preterm status, this finding appeared specific to term pregnancies.

Conclusions: Offspring who develop ASD experienced significantly higher maternal insulin resistance as indicated by lower SHBG levels irrespective of whether clinical manifestations of PNMS emerged or the infant was born preterm. This supports the presence of insulin resistance as a common metabolic milieu in early 2<sup>nd</sup> trimester in ASD+ pregnancies. Estradiol's significant relationship with ASD risk was limited to term pregnancies.

**406.022 (Poster)** The Neural Response to One's Own Name in Infants with Elevated Likelihood of Developing Autism Spectrum Disorder: An EEG-Study

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**Background:**

Children with autism spectrum disorder (ASD) often show diminished reaction to their own name compared to typically developing children. Previous research on how the infant brain reacts to hearing one's own name suggests that children who later develop ASD show a different neural response compared to typically developing children (Arslan et al., 2020).

### Objectives:

The current research project investigates reaction to one's own name (RtoN) in infants at 10 months ( $n = 35$ ) and 14 months ( $n = 32$ ) with elevated likelihood (EL) of developing ASD. They participate in an ongoing large-scale prospective longitudinal study. We aim to expand on previous work of Arslan et al. (2020) with a larger sample and by adding a condition to control for mere familiarity. We will investigate whether EL-infants show an enhanced neural RtoN (compared to an unfamiliar name) at 10 and 14 months of age, and whether this can be attributed to mere stimulus familiarity.

### Methods:

Using electro-encephalography (EEG), we investigated the neural RtoN in an auditory event-related potential task where infants are repeatedly exposed to three conditions: their own name, an unfamiliar name, and a familiar reference (e.g. "mama"). We calculated average waveforms within a time window of 300-600ms post-stimulus at three regions of interest (left-frontal, right-frontal, and parietal area).

### Results:

To investigate the frontal region, a 2x2 repeated measures ANOVA was conducted with condition (own vs unfamiliar vs familiar) and laterality (left vs right) as within-subject factors. This revealed a significant interaction effect of laterality and condition in 10-month old EL-infants ( $n = 35$ ,  $F(2,35) = 3.56$ ,  $p = .034$ ). No statistically significant results were observed in 14-month old EL-infants ( $n = 32$ , all  $ps > .084$ ). Closer inspection of the results (see *Figure 1*) in the 10-month old group indicate that, within the left frontal area, the own name evokes a stronger neural response in young EL-infants than in the other two conditions. The results of the right frontal area reveal a different pattern, where the familiar reference evokes a stronger response compared to the other conditions. When left and right frontal areas were analyzed separately, we only found a marginally significant main effect of condition in the right frontal area ( $n = 35$ ,  $F(2,35) = 2.76$ ,  $p = .07$ ). We found no statistically significant results in the parietal region in either of the age groups (all  $ps > .423$ ).

### Conclusions:

The data suggests that socially relevant information may be processed in a lateralized manner depending on the nature of the stimulus. While both the own name and the familiar reference condition are similar in terms of their familiarity to the infant, it appears that they are not processed in the same fashion, indicating that the EL-infant brain is sensitive to one's own name at 10 months of age. This pattern may start to differentiate in some individuals as the infant brain continues to develop, perhaps coinciding with the onset of early ASD-symptoms. While speculative, this could account for the null results in the 14-month old group.

#### 406.023 (Poster) Towards a Personalized Social Intervention for Autistic Adolescents: Utilization of MRI Biomarkers As Predictors of PEERS® Treatment Responders.

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Background: Electrophysiology (e.g., EEG) has previously been used to explore biomarkers of the *Program for Education and Enrichment of Relational Skills (PEERS®)*; Laugeson & Frankel, 2010, Van Hecke et al., 2015), a well-validated social skills intervention (Hill et al., 2017) as treatment outcomes. *PEER®* has shown efficacy for ameliorating social anxiety symptoms in adolescents (Schohl et al., 2014). Biomarkers to predict intervention responders for those whom undergo *PEERS®* has yet to be explored.

**Objectives:** The present study sought to examine social brain structure volume at baseline as a predictor of treatment responders following PEERS®.

**Methods:** The sample comprised of 37 male autistic adolescents randomized to the experimental group (EXP; n=20) and the waitlist group (WL; n=17). Data were collected at pre- and post-intervention time points. Data included adolescent self- and caregiver-reports of social skills, self-report social anxiety, and structural MRI data. Three responder types were defined in the EXP: 1) participants exhibiting a decrease in clinical level severity of social problems on the Child Behavior Checklist (CBCL); 2) participants showing a decrease of social problems in Youth Self-Report (YSR; Achenbach & Rescorla, 2001); 3) Participants exhibiting a decrease in their scores by at least one standard deviation on the Social Anxiety Scale for Adolescents (SAS-A; LaGreca, 1999). Receiver Operating Characteristic (ROC) curves were used to determine significant baseline structural MRI biomarkers and the best cut-off values for discriminating treatment responders vs. non-responders. Structural regions of interests were nominated due to prior function and structural associations with social behavior (e.g., McPartland & Pelphrey, 2012).

**Results:** ROC-Social Domain indexed by adolescent self-report (Figure 1): Left rostral Anterior Cingulate Cortex (rACC) volume at baseline significantly discriminated treatment responders (n = 8) from non-responders (n =12), with 75.0% sensitivity and 83.3% specificity at a cut-off value of 3.382 cm<sup>3</sup>. Baseline YSR social problem scores also significantly predicted treatment responders (n=3) vs. non-responders, (n=17) demonstrating 100% Sensitivity and 91.7% Specificity.

**ROC-Social Anxiety (Fear of Negative Evaluation) Domain (Figure 2):** Left and Right Amygdalae and the Left Insula volumes at baseline significantly predicted treatment responders vs. non-responders, with 100.0% sensitivity and 82.4% specificity at a cut-off value of 2.102 cm<sup>3</sup>, 100.0% sensitivity and 76.5% specificity at a cut-off value of 2.123 cm<sup>3</sup>, and 100.0% sensitivity and 94.1% specificity at a cut-off value of 7.950 cm<sup>3</sup>, respectively. Baseline social anxiety scores were not significantly predictive of treatment responder status. Refer to Table 1 for ROC statistics.

**Conclusions:** Baseline severity of social problems appeared to predict responder status with better sensitivity and specificity than baseline Left rACC volumes did. In contrast, bilateral amygdalae and left insula volumes significantly predicted treatment responder status indexed by social anxiety improvement, while baseline severity of social anxiety did not. These findings are in line with previous work suggesting a link between these two structures with social anxiety (Kawaguchi et al., 2016). Findings hold potential clinical implications for developing personalized social interventions for autistic adolescents (i.e., brain structural markers may be useful in identifying who may be more likely to respond to treatment).

#### **406.024 (Poster) Validating an EEG-Based Biomarker of Socio-Communicative Impairments in ASD**

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**Background:** Processing facial emotional expressions plays an important role in non-verbal communication and may be impaired in individuals with autism spectrum disorders (ASD). Using a novel Fast Periodic Visual Stimulation EEG approach (FPVS-EEG), Van der Donck et al. (2020) showed that school-aged boys with ASD are dramatically less sensitive than matched controls, on a neural level, to implicitly detect emotional faces. Accordingly, this fast and robust technique offers new perspectives for supporting clinical diagnosis.

**Objectives:** The current – ongoing – research is a replication study of the work by Van der Donck et al. (2020), in an independent and larger population, including both boys and girls. Similarly, we expect to find reduced neural sensitivity in the ASD group towards emotional faces.

**Methods:** FPVS-EEG is used to implicitly assess the neural response for emotional (happy, fearful) faces that are presented rapidly among a stream of neutral faces, to children (8-12 y/o) with ASD and neurotypical controls. Neutral faces, with different identities, are presented at 6 Hz, periodically interleaved with emotional faces every fifth image (i.e. 1.2 Hz). The periodicity adds a distinguishable frequency tag to the neutral and emotional stimuli allowing an objective quantification of the emotional face processing responses in only four recordings of 60s per condition.

**Results:** Preliminary analysis indicate that individuals with ASD show a reduced rightward lateralisation for the processing of fearful faces.

Conclusions: These results, combined with the previous findings of Van der Donck et al. (2020), show the ability of the FPVS-EEG technique to detect differences in the emotional face processing mechanism in ASD children on an implicit, fast and straightforward manner and can contribute to the delineation of an objective biomarker for socio-communicative sensitivity in ASD.

**406.026 (Poster)** Visual Evoked Pupillary Response to Distinguish Children with ASD and Children with TD: The Effect of Stimulus Frequency on Classification Results

*Q. Liu, X. He, B. Zhou, H. Wu, C. Zhang, Y. Qin, L. Shen and X. Gao, School of Medicine, Tsinghua University, Beijing, China*

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### **Background:**

Eye tracking technology is widely used in autism research due to its non-invasive and comfortable characteristic. Pupillogram of eye tracking is an effective technique that can describe changes in pupil diameter. Previous research has demonstrated that visual evoked pupillary response is a powerful biomarker for distinguishing children with autism spectrum disorder (ASD) and children with typical development (TD). But no study tells whether the frequency of stimulus is an influential factor. Our study focus on **Tremendously Low Frequency Steady-State Visual Evoked Pupillary Response** (TLF-SSVEPR), trying to find a better experiment for classification of ASD and TD.

### **Objectives:**

Comparing TLF-SSVEPR evoked by **Tremendously Low Frequency Black and White Flicker Stimulus** (TLF-BWFS) of two different frequencies of 0.1Hz and 0.167Hz in ASD and TD children, find out which frequency is better in evoking effective pupillary response and distinguishing ASD and TD.

### **Methods:**

Two groups of 3-6 years old children were recruited, with 53 ASD and 51 TD in group 1 and 47 ASD and 35 TD in group 2.

Different experiment design was applied to the groups. Group 1 with 0.1Hz TLF-BWFS experiment provided valid data from 27 ASD and 50 TD, while group 2 with 0.167Hz TLF-BWFS experiment provided valid data from 14 ASD and 25 TD.

The experiments used SMI RED500 desktop eye tracking system with sample frequency 120Hz. The basic TLF-BWFS experiment is a series of 12 pictures of same size and luminance with 6 black pictures and 6 white pictures. The interval between one black picture and one white picture is corresponding to the TLF-BWFS experiment frequency, i.e. 5s for 0.1Hz in group 1 and 3s for 0.167Hz in group 2.

Subject's pupillogram data in the two experiments were collected. 100 features were extracted from minimum, middle, maximum, average and standard deviation on amplitude, time, velocity and latency of pupillary responses, with 2 additional features of valid counts on different pictures. Further statistical analysis and modeling classification was done by Python. The data of the two experiments were processed in the same way.

### **Results:**

Two experiments both showed significant difference on some features, but the 0.1Hz TLF-BWFS experiment had more features shown significant difference than 0.167Hz TLF-BWFS experiment, refer to attached table 1.

The performance of the classification models from two experiments were compared by their metrics of precision, recall, F1, accuracy and area under curve (AUC). Results showed that model of 0.1Hz TLF-BWFS experiment achieves a better performance on every metrics than model of 0.167Hz TLF-BWFS experiment, refer to attached table 2.

### **Conclusions:**

Lower frequency of 0.1 Hz TLF-BWFS experiment performs better than higher frequency of 0.167Hz TLF-BWFS experiment, which provide us a better and practical TLF-BWFS experimental design in distinguishing children with ASD and children with TD.

**406.027** (Poster) Voice Acoustics As a Biomarker for Autism

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Background:

Autism spectrum disorder (ASD) is a multifaceted disorder that affects social communication. Atypical voice prosody is one of the earliest markers of ASD; yet, genuine acoustic features of the voice are also altered in autism.

Objectives:

We aimed to determine whether acoustic features of the voice could be used as a diagnostic biomarker specific for autism by classifying ASD against a heterogeneous control population: deaf children with a cochlear implant (CI), children with a developmental language disorder (DLD), and typically-developing children (TD).

Methods:

Acoustics data of 108 children (6-12 years) were included in the study: 38 with ASD (1 girl; 8.5 years), 25 with CI (8 girls; 8 years), 21 with DLD (9 girls; 7.9 years), and 24 TD children (12 girls; 8.2 years). Children partook in a nonword repetition task in which they repeated 50 or 70 non-words of varying phonological complexity. Among these, the 20 with less phonological errors were chosen for acoustic analysis (Praat). For each non-word, we extracted 9 acoustics parameters: mean fundamental frequency, mean formant frequencies (F1 to F4), mean formant dispersion, mean harmonic-to-noise ratio, mean jitter and mean shimmer; they were then averaged across logatomes. Data were analyzed two ways with unsupervised and supervised K-means clustering (KC). ROC (Receiving Operator Curve) supervision allows determining the most discriminating acoustic variables in our sample. We used percent of variation (PV) as quality criteria of KC. A first analysis was realized on a sample of 90 participants with good-quality data (Test1). First, we selected randomly 20 children with ASD and 40 other children as train data (this was repeated 100 times); selectivity, sensitivity and PV were measured from unsupervised and ROC-supervised KC (Test1). Cross-validation was run on the remaining 30 participants: percent of correct classification was measured (Test2). Finally, our model was tested with low-quality data (Test3; n=18).

Results:

Unsupervised KC with all acoustics variables had a PV of 78%, a sensitivity of 0.88 and a specificity of 0.56, and correctly classified 51 % of DLD, 38% of CI and 79% of TD children in the non-ASD group (Test1). The unsupervised KC classified the remaining children with an accuracy of 89% for ASD and 58% for controls (Test2). In Test3, classification accuracy was 57% for ASD children and 44 % for non-ASD children.

The ROC analysis determined F1, jitter and shimmer as the most discriminant parameters. The ROC-supervised KC had a PV of 58%, a sensitivity of 0.76 and a specificity of 0.77; it classified correctly 74% of DLD, 81% of CI and 76% of TD in the non-ASD group (Test1). 77% of ASD and 76% of the control population were correctly classified (Test2). With our low-quality data (Test3), the ROC-supervised KC classified children in both groups with a 70% accuracy.

Conclusions:

Here, we showed that an acoustic-based ROC-supervised clustering algorithm successfully discriminated ASD children from a range of non-ASD children including children with other sensory or developmental disorders. Mean f1 frequency, jitter and shimmer can be used as a diagnostic biomarker to help ASD diagnosis.

## Cellular Models/Stem Cells

### PANEL DISCUSSION — CELLULAR MODELS/STEM CELLS

#### Panel 223 - Harnessing the Potential of Induced Pluripotent Stem Cells to Model Autism Spectrum Disorders

**Panel Chair:** Nael Nadif Kasri, *Human Genetics, Radboudumc, Nijmegen, Netherlands*

**Discussant:** Joseph Buxbaum, *Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY*

Genetic analyses of large cohorts of individuals with autism spectrum disorders (ASD) have enabled the identification of numerous de novo and inherited rare DNA variants linked to ASD. Despite this considerable progress in elucidating the genetic architecture of ASD, a major gap exists between the genetic findings and deciphering the cellular and molecular pathobiology of ASD. Capitalizing on new developments in induced pluripotent stem cell technology (iPSCs) we can finally study the cells of interest outside of the patient, capturing features of the human condition in vitro, thereby allowing the pathobiology to be studied in the context of the human genome. Over the past years, significant progress has been made to differentiate iPSCs into robust 2D and 3D neuronal models that recapitulate the main features of human brain development. Much effort has been put in to the establishment of relevant phenotypic assays for mechanistic understanding and drug screening. These include brain-on-a-chip technologies to link genetic deficits observed in patients to neuronal network measurements. Finally, developments in genome engineering and genomic technologies can be leveraged in large screening assays to identify points of convergence between ASD genes. This panel will discuss recent advances and opportunities in this exciting field of research.

**223.001 (Panel Discussion)** High-Throughput Single-Cell Functional Elucidation of Neurodevelopmental Disease-Associated Genes Reveals Convergent Mechanisms Altering Neuronal Differentiation

**M. A. Lalli<sup>1</sup>, D. Avey<sup>2</sup>, J. Dougherty<sup>3</sup>, J. Milbrandt<sup>4</sup> and R. Mitra<sup>1</sup>,** (1)*Icahn School of Medicine at Mount Sinai, New York, NY*, (2)*Washington University in St Louis, St Louis, MO*, (3)*Genetics, Washington University School of Medicine, St. Louis, MO*, (4)*Genetics, Washington University in St. Louis, St. Louis, MO*

**Background:** Genetic studies of autism spectrum disorder (ASD) have been hugely successful and have now discovered over 100 genes harboring mutations conferring large effects on ASD risk. We can leverage these large-effect ASD risk genes to elucidate molecular mechanisms of ASD, but studying each gene one at a time in animal or patient-derived models is a nearly insurmountable task and challenges the comparison of results across studies. As mutations in each ASD gene are individually rare, identifying convergent mechanisms shared between subsets of these genes is critical to understanding and treating ASD. To do so, novel methods are needed for high-throughput functional elucidation of risk genes.

**Objectives:** We sought to establish a scalable functional genomics approach to study large-effect genes linked to ASD and other neurodevelopmental disorders in a human, disease-relevant context and to enable direct comparison of findings across ASD genes.

**Methods:** We used catalytically inactive Cas9-based transcriptional repression (CRISPRi) to knockdown the expression of 13 ASD-related genes in a simple human cellular model of neuronal differentiation using LUHMES human neuronal progenitor cells. We captured the resulting transcriptional consequences of ASD gene knockdown using single-cell RNA-sequencing (scRNA-seq). We performed differential expression and pseudotime analysis to identify individual transcriptional signatures for each ASD gene knockdown and their effects on the trajectory of neuronal differentiation. We then compared results across genes to identify potential shared mechanisms. We used live-cell imaging to confirm our predictions, and validated the results in induced pluripotent stem cell derived neural progenitor cells.

**Results:** We established and validated LUHMES as a tractable human model of neuronal differentiation suitable for high-throughput disease gene perturbation. CRISPRi efficiently knocked down candidate ASD genes and elicited transcriptional dysregulation and changes in neuronal differentiation that could be recovered using scRNA-seq. Pseudotime and differential expression analysis discovered two functionally convergent modules of ASD genes: one that delays neuron differentiation and one that accelerates it. Five genes that delay neuron differentiation (ADNP, ARID1B, ASH1L, CHD2, and DYRK1A) mechanistically converge, as they all dysregulate genes involved in cell-cycle control and progenitor cell proliferation. Live-cell imaging after individual ASD-gene repression validated this functional module, confirming that these genes reduce neural progenitor cell proliferation and neurite growth.

Conclusions: By coupling pooled CRISRPi to scRNA-seq in a simple and highly tractable human model of neuron differentiation, we have established a rapid, scalable, and disease-relevant system in which tens to hundreds of genes can be modulated in parallel and their effects measured in a robust manner. This approach should facilitate the discovery of convergent mechanisms across the numerous and diverse genes implicated in neurodevelopmental disorders.

**223.002** (*Panel Discussion*) Neurons-on-a-Chip to Model ASD  
*N. Nadif Kasri, Human Genetics, Radboudumc, Nijmegen, Netherlands*

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Background:

Recent progress in human genetics has led to the identification of hundreds of genes associated with ASD, including a growing number of genes encoding epigenetic regulators of gene expression. These regulators exert their function through genome-wide posttranslational modification of histones or by mediating and/or recognizing DNA methylation. Several of these ASD-linked epigenetic factors directly interact with one another in complexes that regulate chromatin structure at genes important for neurodevelopment and/or neuroplasticity. Despite considerable progress in elucidating the genetic architecture of ASD, a major gap exists between the genetic findings and deciphering the cellular or molecular pathobiology of ASD. In particular, understanding which transcriptional changes have the most relevant functional consequences, and whether or not those consequences overlap in different patients.

Objectives:

Functional analysis of syndromic ASD genes. More specifically, we aim at generating a phenotypic landscape for ASD genes by combining neuronal network measurements on microelectrode arrays (MEAs) with transcriptomics, i.e. MEASeq.

Methods:

Interrogation of neuronal network activity by growing patient-derived neurons on MEAs offers a robust, efficient and physiologically relevant readout to probe for phenotypes at the neuronal network level. We take advantage of direct differentiation methods toward specific neuronal lineages of excitatory and inhibitory neurons grown on MEAs. Using MEAs, we can repeatedly and passively record the same cultures as they traverse distinct neurodevelopmental transitions without disturbing their development. In addition, since changes in neuronal morphology, intrinsic properties or synaptic connectivity are reflected at the network level, MEA recordings provide a sensitive and unbiased assessment of the neuronal properties. We have benchmarked the robustness and sensitivity of MEA-derived neuronal activity patterns, with patterns derived from multiple different healthy individuals functionally clustering together.

Results:

We generated neuronal networks from multiple patient-derived neurons with mutations in different ASD genes, including *ARID1B*, *EHMT1*, *CHD8*, *CHD2*, *KANSL1*, *KMT2D* and *ANK2*. In addition, we generated genome-edited isogenic lines with heterozygous loss-of-function for each of these genes. We monitored the electrophysiological activity of neuronal networks coupled to MEAs over time and compared their activity to healthy controls and between ASD syndromes. Using independent clustering analysis, encompassing 15 independent MEA parameters, we show that all patient lines deviated from healthy control lines and their respective isogenic lines. Furthermore, we show that neuronal networks with mutations in the same gene, including the isogenic lines, functionally clustered together. At the same time, we show that subtypes of ASD sharply segregated from each other with distinguishable network patterns. The most pronounced differences between ASD subtypes were observed at the level of network activity, either at the level of network burst frequency, or network burst length. Finally, by combining MEA recordings with transcriptomics we identified molecular pathways that underlie specific neuronal network phenotypes observed in ASD subtypes.

Conclusion:

Our data indicate that MEASeq is a robust and sensitive method to perform genotype-phenotype analyses, which can serve as a powerful platform to identify functional points of convergence between ASD genes and be used for high-throughput drug screening assays.

**223.003** (*Panel Discussion*) In Vivo Perturb-Seq Reveals Neuronal and Glial Abnormalities Associated with Autism Risk Genes  
*X. Jin, Society of Fellows, Harvard University, Cambridge, MA*

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## Background:

Human genetic studies have revealed long lists of genes and loci associated with risk for many diseases and disorders, but it remains challenging to systematically evaluate their phenotypic effects. Without any a priori knowledge, these risk genes could affect any cellular processes in any cell type or tissue, which creates an enormous search space for identifying possible downstream effects. New high-throughput approaches are needed to functionally dissect these large gene sets across a spectrum of cell types in vivo.

## Objectives:

Analysis of trio-based whole-exome sequencing has implicated a large number of de novo loss of function variants contributing to Autism Spectrum Disorder and developmental delay (ASD/ND) risk. Such de novo variants often have large effect sizes, thus providing a key entry point for mechanistic studies. We have developed in vivo Perturb-Seq to allow simultaneous assessment of the individual phenotypes of a panel of such risk genes in the context of the developing mouse brain.

## Methods:

Using CRISPR-Cas9, we introduced frameshift mutations in 35 ASD/ND risk genes in pools, within the developing mouse neocortex in utero, followed by single-cell transcriptomic analysis of perturbed cells from the early postnatal brain. We analyzed five broad cell classes: cortical projection neurons, cortical inhibitory neurons, astrocytes, oligodendrocytes, and microglia/macrophages, selecting cells that had received only single perturbations. Using Weighted Gene Correlation Network Analysis, we identified 14 co-varying gene modules representing transcriptional programs expressed in different classes of cortical cells.

## Results:

These modules included both those affecting common biological processes across multiple cell subsets, and others representing cell type-specific features restricted to certain subsets. We estimated the effect size of each perturbation on each of the 14 gene modules by fitting a joint linear regression model, estimating how module gene expression in cells from each perturbation group deviated from their expression level in internal control cells. Perturbations in 9 ASD/ND genes had significant effects across 5 modules across 4 cell classes, including cortical projection neurons, cortical inhibitory neurons, astrocytes, and oligodendrocytes. These results were validated using a single-perturbation model as well as a germline modified mutant mouse model.

To establish whether the perturbation-associated gene modules identified in the mouse cerebral cortex are relevant to human biology and ASD/ND pathology, we performed co-analyses of data from human ASD and control brain and human cerebral organoids. Both gene expression and gene co-variation ("modularity") of several of the gene modules identified in the mouse Perturb-Seq analysis are conserved in human brain tissue. Comparison to single-cell data from ASD patients showed overlap in both affected cell types and transcriptomic phenotypes. These findings suggest that Perturb-Seq can uncover potential shared effects across species.

## Conclusions:

In vivo Perturb-Seq can serve as a scalable tool for systems genetic studies of large gene panels to reveal their cell-intrinsic functions at single-cell resolution in complex tissues. In this work, we demonstrated the application of in vivo Perturb-Seq to ASD/ND risk genes in the developing brain. This method can be applied across diverse diseases and tissues in the intact organism.

### **223.004** (Panel Discussion) Brain Organoids and Next-Generation Assembloid Models to Study Human Development and Disease

*S. Pasca, Department of Psychiatry and Behavioral Sciences., Stanford University., Stanford, CA*

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A critical challenge in understanding the programs underlying the development, assembly and dysfunction of the human brain is the lack of direct access to intact, functioning human brain tissue for direct investigation and manipulation. In this talk, I will describe efforts in my laboratory to build functional cellular models and to capture previously inaccessible aspects of human brain development and disease. To achieve this, we have been using instructive signals to derive, from pluripotent stem cells, self-organizing 3D tissue structures called regionalized brain organoids or neural spheroids that resembles domains of the

developing central nervous system. We have shown that these cultures, such as the ones resembling the cerebral cortex, recapitulate many features of neural development, can be derived with high reliability across dozens of cell lines and experiments, and can be maintained for years in vitro to capture advanced stages of neural and glial maturation and function. Moreover, we demonstrated that regionalized brain organoids can be put together to form integrated structures we named brain assembloids, which can be subsequently applied to investigate cell migration and formation of neural circuits. Lastly, I will illustrate how our modular, stem-cell derived 3D system can be used to study the cellular and molecular consequences of mutations or copy number variants associated with neuropsychiatric disorders, including autism spectrum disorder.

## POSTER SESSION — CELLULAR MODELS/STEM CELLS

### Poster 407 - Cellular models/stem cells Posters

**407.001 (Poster)** Elucidating Molecular Mechanisms of Genetic Interaction and Oligogenicity in Autism Spectrum Disorder  
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**Background:** Analyses of rare genetic variants in autism spectrum disorder (ASD) cohorts have found in a fraction of patients evidence of an oligogenic mode of inheritance, in which two or more mutated genes, individually not sufficient to cause ASD, may act additively or synergistically to produce the clinical phenotype. However, currently little is known about how these ASD-risk variants interact with each other and converge on specific neurobiological pathways underlying ASD. Through whole-exome sequencing (WES) of 280 proband-parent trios of ASD, we identified in one proband compound heterozygous missense variants in the Reelin gene (*RELN*), which we have previously characterized as harmful, and a de novo splice site variant in the Cav3.2 calcium channel gene (*CACNA1H*).

**Objectives:** To investigate whether the variant in *CACNA1H* is functional and interact with mutated *RELN* causing abnormal neuronal phenotypes.

**Methods:** We used induced pluripotent stem cells-derived neural progenitor cells (NPCs) from this proband with ASD and from neurotypical controls as well as a heterologous expression system; we examined calcium influx, the activity of Reelin, Cav3.2 and mTORC1 pathways, and the behaviour of NPCs. Also, we reanalyzed our WES data looking for an increased burden of co-occurring rare and impactful variants in Reelin pathway and Ca<sup>2+</sup> channel genes in ASD individuals.

**Results:** We found that the variant in *CACNA1H* leads to increased Ca<sup>2+</sup> influx into the cells, which overactivates mTORC1 signaling pathway and, consequently, further exacerbates the impairment of Reelin signaling. Also, we showed that mutant Cav3.2-mediated overactivation of mTORC1 pathway acts individually to induce enhanced proliferation of NPCs from the proband and in concert with impaired Reelin signaling to cause abnormal migration of these cells. Finally, reanalysis of our WES data revealed that the co-occurrence of rare and potentially damaging variants in one allele of Ca<sup>2+</sup> channels genes and in both alleles of Reelin pathway genes is significantly enriched in ASD individuals (3/280 probands).

**Conclusions:** Our results suggest an abnormal functional connectivity between mutated *CACNA1H* and *RELN* genes, and also the nonrandom co-occurrence of rare and potentially damaging variants in genes for the Reelin pathway and Ca<sup>2+</sup> channels in ASD individuals, which provide additional evidence supporting the notion that genes with co-occurring deleterious variants tend to have interconnected signaling pathways and act additively to cause oligogenic forms of ASD.

**407.002 (Poster)** iPSC-Derived Innervated Gastrointestinal Organoids to Model the Enteric Nervous System in Autism Spectrum Disorder

*S. J. Walker<sup>1</sup>, D. Leavitt<sup>2</sup> and D. Mack<sup>3</sup>, (1)Wake Forest Institute for Regenerative Medicine, Winston Salem, NC, (2)Wake Forest University, Winston Salem, NC, (3)University of Washington, Seattle, WA*

**Background:** Children with autism spectrum disorder (ASD) are more likely to experience chronic gastrointestinal (GI) symptoms of uncertain etiology than their typically developing peers. Because chronic constipation is a common finding in this population, we hypothesized that in some ASD children an abnormally functioning enteric nervous system (ENS) may underlie colonic hypomotility. We chose to test this hypothesis using a model of Phelan McDermid Syndrome (PMDS) because: (1) ~80% of individuals with PMDS have an ASD diagnosis, (2) >50% of that subset are reported to have chronic GI symptoms and, (3) the

hallmark of PMDS is haploinsufficiency of a key neuronal protein, SHANK3. In the central nervous system (CNS), SHANK3 contributes to the formation and maintenance of postsynaptic density of excitatory synapses. The goal of our study using PMDS patient-specific iPSC-derived GI organoids is to determine the role of SHANK3 in the *ENS* and to identify potential therapeutic targets to correct gut hypomotility.

**Objectives:** To create an *in vitro* model, using iPSCs from PMDS patients, to study ENS function in individuals with ASD and chronic GI symptoms.

**Methods:** PMDS iPSC lines (proband and non-affected parent) were obtained from the NIMH Repository and Genomics Resource Project. Patient-derived iPSCs were used to create an innervated gut organoid through the combination of individually cultured GI spheroids and neural crest cells (NCCs). After the GI spheroids had been passaged 9 times and NCCs had been cultured for 20 days, the two cell types were mechanically aggregated and co-cultured for 5 days. Immunocytofluorescence was used to characterize the individual components (GI spheroids and NCC) and then the innervated gut organoids following co-culture.

**Results:** Immunocytofluorescence staining confirmed the presence of Sox9 demonstrating that the patient-derived iPSCs were successfully reprogrammed to GI spheroids (Fig 1A). NCC identity was confirmed by neuronal communication via axonal extensions of nearby NCCs (Fig 1B) and further supported via immunocytofluorescence staining with HNK1 (Fig 1C). Co-culture of mechanically aggregated GI spheroids and NCC for 5 days resulted in evidence of spheroid innervation (Fig 1D).

**Conclusions:** This pilot study describes the early stages of development of a novel model system to evaluate the contribution of a malfunctioning enteric nervous system in ASD by using iPSCs from a PMDS patient with co-occurring diagnoses of ASD and chronic GI symptoms. Next steps will entail a longer period of co-culture, followed by functional assays.

## POSTER SESSION — CLINICAL GENETICS

### Poster 408 - Clinical Genetics Posters

**408.002** (Poster) Autism Spectrum Disorder Is Burdened By Severely Pathogenic Variations within Core Domains of CHD8 and Its CHD7-Binding Motif

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Background: Several recurrently mutated genetic risk-factors have been implicated in ASD manifestation. *Chromodomain helicase remodeller (CHD8)* is one such master regulator mediating the expression of genes controlling neuron functions. To date, only one study by (An et al., 2020) described the mutational landscape of CHD8 with respect to its domains across three different populations- ASD, cancer and general population. However, they relied on just one parameter, i.e. effect prediction score, for variant prioritisation.

Objectives: Considering the lack of holistic knowledge on the immense genetic burden appended by *CHD8* on ASD manifestation, we aimed to perform a comprehensive mutational burden analysis with emphasis on deciphering the specific roles of ASD-associated CHD8 variations in disease manifestation.

Methods: We collected 8,124 exonic SNPs in *CHD8* from 4 databases representing the general and ASD populations; subjected them to multi-layered function predictions on >25 different computational tools- including SNP effect and stability prediction; protein intrinsic disorder measurement and Molecular Recognition site identification; protein interaction network analyses and molecular dynamics analysis.

Results: We observed that nsSNPs were common in the general population. Distinct hotspots for truncating and nsSNPs were identified within exons encoding the N and C terminals, respectively. Evolutionarily conserved regions involving CHD8 core domains: Helicase-C-terminal, Helicase-ATP-binding and SNF2\_N domains, recorded the lowest density but severely pathogenic SNPs. Conversely, evolutionarily variable regions- CHD7-binding and BRK domains- hosted the highest SNPs, but were benign. Post-Translational-Modifications (PTMS) occurred on residues outside domains (P<0.01) i.e., non-conserved regions of CHD8 including the N and C terminals that were determined to be Intrinsically-Disordered-Protein-Regions (IDPRs) with 9 Molecular-Recognition-Features sites. Contrastingly, ASD population recorded significantly higher incidences of truncating SNPs than general population (P<0.0001). ASD-SNPs frequently occurring within core domains were severely damaging and accounted for >30% of all ASD variations. The CHD7-DNA-binding motif, with most PTMs, recorded the highest recurring truncating ASD-SNPs. The CHD8 PPIs effortlessly recapitulated the phenotypes presented by children with CHD8 mutations like macrocephaly and anxiety (5 genes each), impaired social behaviour (2 genes), formation of the brain (4 genes), gastrointestinal tract (6 genes), body axis and long-term memory (2 genes each). 11/13 (84.6%) interacting molecules were IDPs. We identified 9 CHD8 nsSNPs that produced the strongest long-range disturbances, altering the modelled protein's global conformational dynamics.

Conclusions: *CHD8* is indeed a master regulator of neuronal and GI functions and hence a potent contributor of ASD. Our in-silico analysis provides a blueprint of the mutational landscape and pathogenicity patterns of CHD8. ASD is burdened by the variations occurring within core domains and frequently occurring truncating SNPs- especially within CHD7-binding site.

**408.003** (Poster) Quantitative 3D Analysis of Craniofacial Dysmorphia in DYRK1A Mutations

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Background:

Disruptive mutations to *DYRK1A*, located in the Down Syndrome critical region of chromosome 21, are associated with autism spectrum disorder, intellectual disability, and medical comorbidities (Courcet et al., 2012; Earl et al., 2017; Guedj et al., 2012). Parents often seek genetic testing based on physiological traits observed in their children, and previous literature suggests facial anomalies in children with *DYRK1A* mutations, predominantly around the eyes, nose, and chin (Oegema et al., 2010; Van Bon et al., 2016). Studies of *DYRK1A*'s regulatory functions confirm its role in the expression of several genes, with *DCAF7*, *DYRK1A*'s

highest predicted functional partner, directly involved in craniofacial development (Park et al., 2009; String Consortium, 2020). However, past *DYRK1A* studies have not quantitatively assessed the nature and severity of dysmorphic facial features.

#### Objectives:

To determine if quantitative differences in facial features exist between children with *DYRK1A* mutations and the general population, including unaffected parents.

#### Methods:

From a sample of 28 children with de novo *DYRK1A* mutations, analyses focused on nine white non-Hispanic children ( $M$  age = 11.33 years, 77.78% male) and their unaffected biological parents due to the availability of facial norms. Data were collected using a 3dMDhead System as part of an ongoing genetics-first study. Three-dimensional (3D) imaging tools allow for measurement of craniofacial features while reducing measurement error, and 3dMD's tools in particular demonstrate quality and reliability (Aldridge et al., 2005). Facial landmarks of interest were registered in 3D and measurements between landmarks were calculated using 3dMDvultus software. FaceBase's 3D Facial Norms for European Caucasians were used as a control group, and Z-scores were calculated for all complete measures using FaceBase norms (Brinkley et al., 2016). Six measures—intercanthal width, outercanthal width, palpebral fissure lengths, cranial base width, and philtrum width—were selected for analysis based on Van Bon et al., (2011). Wilcoxon sign-rank tests were performed to compare Z-scores between probands and each biological parent, assessing familial influence on dysmorphologies (Earl et al., 2017).

#### Results:

Outercanthal width in probands was significantly different from both biological parents (subject-mother  $Z = -2.67$ ,  $p = .01$ ; subject-father  $Z = -2.55$ ,  $p = .01$ ) and significantly smaller than average. Additionally, palpebral fissure lengths significantly differed between probands and fathers (right  $Z = -2.43$ ,  $p = .02$ ; left  $Z = -2.07$ ,  $p = .04$ ); both measurements were below population averages for probands. All other Z-scores did not significantly differ between parents and probands.  $P$  values were not corrected for multiple comparisons due to small sample size.

#### Conclusions:

Facial morphology of individuals with *DYRK1A* mutations significantly differs from the general population and unaffected parents when examining eye regions. This bolsters the link between *DYRK1A* and genes coding for craniofacial development (e.g., *DCAF7*). The absence of other significant discrepancies between parent and proband measurements suggests the facial phenotype associated with *DYRK1A* mutations may be more nuanced than expected, presenting challenges for clinical assessment. Future analyses will extend to non-white participants. Additional research should examine how *DYRK1A* interacts with genes that code for eye regions and possible differences in dysmorphology between sexes.

**408.004** (Poster) Return of Individual Genetics Results in the Largest Recontactable Cohort of People with Autism  
**J. R. Wright<sup>1</sup>**, S. D. Barns<sup>2</sup>, J. B. Hall<sup>1</sup>, S. Ganesan<sup>1</sup>, B. Han<sup>1</sup>, C. Diggins<sup>1</sup>, T. Greene<sup>1</sup>, S. Consortium<sup>3</sup>, N. Volfovsky<sup>2</sup>, P. Feliciano<sup>1</sup> and W. K. Chung<sup>4</sup>, (1)SFARI, Simons Foundation, New York, NY, (2)Simons Foundation, New York, NY, (3)SPARKForAutism.org, New York, NY, (4)Department of Pediatrics, Columbia University, New York, NY

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**Background:** SPARK — the largest recontactable cohort of people with autism spectrum disorder (ASD) — seeks to engage at least 50,000 individuals with autism and their family members in research. A tenet of the study is to form a partnership with participants and return research results to them — including any genetic variants believed to be a major contributing risk factor to their ASD.

**Objectives:** More than 250,000 individuals are currently enrolled in SPARK, making it the largest autism study to return genetic results to families. SPARK is rapidly increasing the number of families receiving genetic results and has identified several challenges in returning individual research results at this scale.

**Methods:** SPARK returns genetic findings associated with ASD that meet ACMG criteria for likely pathogenic (LP) and pathogenic (P) variants. Currently, SPARK is returning LP/P variants within a pre-defined list of 176 high-confidence ASD genes or copy number variants (CNVs). Starting in 2021, SPARK will also return secondary findings in a subset of genes on the ACMG SF v2.0 list. All variants are confirmed in a CLIA (Clinical Laboratory Improvement Amendments) laboratory. At the time of enrollment, each participant can set preferences to accept or decline to receive genetic results related to autism; a parent

consents for children and dependent adults. Participants may receive their result from a genetic counselor (at no cost to them) or from their own provider. SPARK provides gene-specific guidebooks that explain the features associated with the individual's genetic result.

Results: SPARK has identified more than 800 returnable genetic results in nearly 10,000 individuals with autism. Preliminary evidence suggests that the total yield will be roughly 10% of all SPARK participants with autism. Clinically significant results are roughly equally split between CNVs, single nucleotide variants, and small insertions/deletions. 53% are de novo; 17% are inherited and a quarter are of undefined inheritance.

Being a female with autism increases the odds of having a clinical genetic result by 2 times, compared with males. The odds of having a clinical genetic result goes up by 2 to 3 times if a participant has cognitive impairment, is non-verbal (and 5 years or older), reports a birth defect, or has seizures. However, nearly a third of the participants with clinical genetic results had none of these features. The odds of having a result are 0.28 times lower if the participant has above-average cognitive ability.

93 percent of participants with completed returns from genetic counselors said that result return was a positive or valuable experience; 6 percent seemed indifferent and 1 percent provided little to no feedback.

Challenges to result return include decreasing the time from sequencing to return, reaching all participants, and re-consenting independent adults who have aged out of the study. Iterative analysis adding additional samples identifies novel autism genes.

Conclusions: Large-scale return of genetic results is feasible and benefits from reanalysis. A commitment to the return of genetic results is an important goal for genetic research studies. SPARK's experiences can inform the process for other genomic research studies.

## POSTER SESSION — CLINICAL TRIAL DESIGN

### Poster 409 - Clinical trial design Posters

**409.001** (Poster) Autistic People's Views on the Acceptability of Participating in Randomised Controlled Trials  
*L. Beasant<sup>1</sup>, N. Mills<sup>1</sup>, A. X. Realpe<sup>1</sup>, S. Douglas<sup>2</sup>, L. Kenny<sup>3</sup> and D. Rai<sup>4</sup>; (1)Bristol Medical School, University of Bristol, Bristol, United Kingdom, (2)Bristol, United Kingdom, (3)Centre for Research in Autism and Education (CRAE), London, United Kingdom of Great Britain and Northern Ireland, (4)Population Health Sciences, Bristol Medical School, Centre for Academic Mental Health, Bristol, United Kingdom*

**Background:** Randomised controlled trials (RCTs) are the gold standard to understand the effectiveness of healthcare interventions, but few involving autistic adults have been conducted to date. There is minimal published research on how autistic adults perceive or engage with RCTs. Uncertainty is a central component of RCTs, but intolerance of uncertainty is common in the autistic population and may be a barrier to participation.

#### Objectives:

1. To explore autistic adults' views about health-related research, specifically RCTs.
2. To ascertain understanding and acceptability of key components of RCTs; randomisation, blinding and placebo.
3. To identify potential barriers and facilitators to recruiting autistic people to RCTs.

**Methods:** Participants were purposefully sampled from those who responded to an advert to ensure a spread of clinical and socio-demographic factors. Sampled individuals were sent an information leaflet explaining the study, accompanied by an example of a double blinded RCT of treatment for anxiety in autistic adults. Participants were invited to interview using their preferred method (e.g. face-to-face, video, phone, email). Interviews were audio-recorded with consent, transcribed verbatim, anonymised, and analysed thematically from an inductive perspective. Sampling, data collection and analysis occurred until the point of data saturation. Two authors analysed data, drawing on a contextualist framework of critical realism.

**Results:** Approximately 150 individuals expressed an interest in the study following advertising via Twitter and the UK charity Autistica. The final sample included 49 autistic adults aged 21-67 years (24 male, 22 female, 3 non-binary). Half were employed (49%) and over two-thirds had degree-level education (69%). Four themes were identified:

1. Understanding and acceptability of RCT processes

RCT concepts were understood as being utilised to reduce or avoid bias, and to ensure research findings were trustworthy. Participants reported varied levels of tolerance for uncertainty and some had concerns about side-effects in medication RCTs. There was an assumption that an active drug would be more beneficial than a placebo.

2. RCT design: Issues unique to autism

RCT processes were viewed as acceptable because they maintained fairness, not just for participants, but also to achieve a fair and valid study outcome. Randomisation and blinding were viewed as a means of facilitating equality between clinicians and participants.

3. Trust and health inequalities

Potential barriers to RCT engagement included health inequalities and a lack of accessible healthcare. Some participants discussed negative experiences of past healthcare interactions which resulted in a lack of trust in the medical community.

4. Altruism

Participants were altruistic and mindful about helping others in society, progressing medical research in the autistic community, and highlighted the importance of including autistic people in all stages of the research process.

**Conclusions:** The concept of RCTs and its processes was well understood and acceptable to the adult autistic population interviewed herein, although some concerns and barriers were also identified. These findings have informed the design of an RCT for the treatment of anxiety in autistic adults, and it is hoped will contribute more broadly to develop future RCTs to improve the evidence base and reduce health inequalities in this population.

**409.002 (Poster)** Concomitant Medication Use in Children with ASD: Data from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT)

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**Background:** Children with ASD are prescribed a variety of medications to address complex behavioral issues, with targets such as irritability, anxiety, insomnia, inattention, and hyperactivity. In clinical trials, concomitant medications often are excluded in order to maintain homogeneity of the sample and to prevent contamination of biomarkers or clinical endpoints. However, this choice may significantly diminish the clinical representativeness of the sample. In a recent multisite study designed to identify biomarkers and behavioral endpoints for clinical trials (ABC-CT), children with ASD and typically developing (TD) controls were enrolled without excluding for medications, thus providing a unique opportunity to examine characteristics of medication use in a research cohort and supplying data to guide future decisions on medication-related inclusion criteria.

**Objectives:** (1) Quantify the frequency and type of medications reported in school-age children enrolled in the ABC-CT and (2) Examine behavioral features of children with ASD based on medication classes.

**Methods:** Data regarding medication use were gathered via caregiver interview (ASD n=280 ASD; TD n=119 TD; 6-11 years). Groups were sex-matched (ASD 77% male; TD 70% male). Medications were classified based on whether they have a known effect on the central nervous system (CNS), and then further classified into 16 categories (see Figure 1). Behavioral measures of interest included the Aberrant Behavior Checklist (ABC), Vineland Adaptive Behavior Scales (VABS), and the Social Responsiveness Scale (SRS). For objective 1, rates of medication use in each group were described. For objective 2, behavioral characteristics were compared between ASD participants on CNS medications and those that were not.

**Results:** 66% (185/280) of children with ASD and 30% (36/119) of TD children endorsed some type of medication use. 43% (119/280) of children with ASD and 2.5% (3/119) of TD children reported taking CNS medications. Within the ASD group, the following medication classes were most commonly endorsed (percent of total ASD sample provided): Melatonin (28%), Stimulants (24%), SSRIs (21%), Alpha agonists (19%), and antipsychotics (11%). Children taking CNS medications were significantly older (9.2 years vs 8.13 years,  $p<.001$ ), had higher verbal IQ (99 vs 94,  $p=.04$ ), lower VABS socialization scores (67 vs 72,  $p=.01$ ), higher ABC hyperactivity (0.52 vs 0.21,  $p=.006$ ), higher ABC irritability (0.74 vs 0.22,  $p<.001$ ), and higher SRS scores (76 vs 72,  $p=.002$ ). Mean scores across assessments for the top five medication classes are provided in table 1. As some participants were taking multiple medications, medication groups were not mutually exclusive and, therefore, not compared statistically.

**Conclusions:** A considerable number of school age children with ASD report use of CNS medications that may have an impact on both behavior and biomarkers. The most commonly reported CNS medications included melatonin, stimulants, SSRIs, alpha agonists, and antipsychotics, each of which may reflect common comorbidities in ASD (e.g. insomnia, inattention/hyperactivity, anxiety). In order to optimize the clinical representativeness of clinical trial cohorts, future studies may consider stratification based on medication class and the potential comorbid conditions that may underlie medication use. Next steps in this consortium study include comparing electrophysiological and eye tracking biomarkers between medication classes.

**409.003 (Poster)** Feasibility of a Randomized Clinical Trial for Children with Autism Spectrum Disorder and Co-Occurring Attention-Deficit/Hyperactivity Disorder: Addressing Enrollment and Retention Challenges

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**Background:** Approximately half of children with autism spectrum disorder (ASD) have co-occurring attention-deficit/hyperactivity disorder (ADHD). Unfortunately, long-term outcomes of individuals with both conditions are significantly worse than for either condition alone. We hypothesize that ADHD compromises an individual's ability to benefit from autism specific behavioral interventions and that combining ADHD treatment with ASD behavioral intervention may improve functional outcomes for children.

**Objectives:** We designed a randomized double-blind placebo-controlled study of flexibly dosed Adzenys-XR-ODT or matched placebo and Early Start Denver Model (ESDM) informed caregiver coaching, in order to evaluate the benefit of optimized ADHD medication treatment and behavioral intervention on social-communication skills in children with both ASD and ADHD. The initial trial (design 1) failed to enroll an adequate sample size, necessitating modifications and implementation of a second trial (design 2). This analysis compares recruitment, enrollment, and retention for two different study designs in order to identify factors that will improve success of enrollment in future trials.

**Methods:** Design 1 included children between ages 36 and < 96 months of age with both ASD and ADHD who received medication management for 10 weeks prior to behavioral intervention. Participants received combination treatment for 14 weeks and follow-up assessments at 52 weeks. To address challenges in enrollment/retention for design 1, we expanded the upper age limit to 11 years, reduced the period of medication optimization prior to behavioral intervention and total study length. These adjustments occurred due to difficulties with diagnosis of co-occurring ADHD and ASD in young preschool age children. Caregivers also reported that the study length was too burdensome and that attention difficulties were less impairing prior to the onset of school. As a result, design 2 is a 24-week study, which includes 2 weeks of medication optimization prior to 8 sessions of ESDM informed caregiver coaching.

**Results:** Trial design 1: 138 participants completed a telephone screening, 28 were diagnosed with both ASD and ADHD, 3 enrolled for the treatment study, and 0 participants were retained until week 52. Trial design 2: 112 participants completed a telephone screening, 30 were diagnosed with both ASD and ADHD, 16 enrolled in the study, and 13 participants were retained until week 24.

**Conclusions:** Clinical trials of combined medication and behavioral interventions in young children with ASD and ADHD are vitally important, given the prevalence of these co-occurring conditions and the lack of a sufficient evidence base to guide early treatment. The most common reasons that potential participants declined study enrollment were hesitancy about medication treatment in young children with a new diagnosis of ASD and/or ADHD, concern about medication side effects, study length, and number of sessions. Enrollment was also enhanced by early and frequent contact with the study team during the diagnostic portion of the study. Our experiences illustrate the challenges in enrollment of participants and suggest important considerations for future studies, including the importance of including a broader age range of participants, less burdensome length of study, and discussion of a treatment study early and often during the diagnostic evaluations.

**409.004 (Poster)** Multicentre, Randomized Controlled Trial of the Frankfurt Early Intervention Program for Toddlers and Preschool Children with Autism Spectrum Disorder – a-Fip

**Z. Kim, J. Kitzerow, K. Teufel and C. M. Freitag, Autism Research and Intervention Center of Excellence Frankfurt, Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, University Hospital Frankfurt, Goethe University, Frankfurt, Germany**

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**Background:**

Naturalistic developmental behavioral interventions (NDBI) have been shown to improve autism specific symptoms in toddlers and preschool aged children with ASD. Studies on early and longitudinal development in children with ASD point to many impaired core domains, which need to be targeted by complex, individualized NDBI approaches focusing on the child's individual strengths and weaknesses. Cost-effective interventions which can easily be implemented in the local health care / social welfare system are necessary. A-FFIP is such a complex, low-intensity, manualized approach. It has shown medium effects in a small clinically controlled study on autism symptom improvement measured by the ADOS severity score after one year (Kitzerow, J., Teufel, K., Jensen, K., Wilker, C., & Freitag, C. M., 2019). Therefore, an adequately powered, randomized-controlled, multi-centre efficacy study is currently performed. Here, we present essentials of the study design of the multicentre, randomized-controlled A-FFIP trial.

**Objectives:**

(1) To establish one-year efficacy of the low intensity, manualized early intervention program A-FFIP in toddlers and preschool children aged 2;0 to 5;6 years old with ASD compared to early intervention as usual (EIAU). It is hypothesized that A-FFIP will result in improved autism specific symptoms compared to EIAU; (2) To assess A-FFIP effects on the child's cognition, language and behavior; on parent's competences, anxiety, depression and stress, and family quality of life; (3) To study the child's and parents' characteristics as predictors and moderators of outcome; (4) To explore treatment mechanisms (mediators) related to parents' and child's competences.

#### Methods:

The trial is designed as a confirmatory phase III, prospective, randomized, multi-centre, controlled, parallel-group study with two treatment groups (134 subjects, i.e. 67 subjects per treatment group) and six measurement time points. Study participants are recruited at four study centres in Germany. Experimental intervention is the manualized Frankfurt Early Intervention program for children with Autism Spectrum Disorder (A-FFIP; Teufel, K., Wilker, C., Valerian, J., & Freitag, C. M., 2017). Two hours of intervention/week with two therapists working with the child are provided. Control intervention is early intervention as usual (EIAU). For EIAU, individual or group therapy intensity of 1-10 hours/week as well as waiting time prior to intervention onset is allowed.

#### Results:

The data collection is currently in process (descriptive data of the current sample will be presented at the conference). The primary endpoint is the absolute change in the total score of the Brief Observation of Social Communication Change (BOSCC-AT) between baseline and 12 months after the first intervention session. The secondary endpoints include measures on the child's and parent's characteristics and competences.

#### Conclusions:

If efficacy of A-FFIP is established, the current study will change clinical practice strongly towards implementation of evidence based methods in ASD early intervention in Germany. Additional positive effects by the trial will be: (1) Improvement of care including diagnosis as well as treatment in underserved areas in Germany; (2) Alerting many different professionals working in early intervention to effective methods; (3) Establishing an effective method and setting of training professionals to high treatment fidelity of evidence based early intervention.

# Clinical Trial Endpoints

## PANEL DISCUSSION — CLINICAL TRIAL ENDPOINTS

### Panel 230 - Digital Outcome Measures

**Panel Chairs:** Christopher Chatham, *Neuroscience and Rare Diseases (NRD), Roche Pharma Research and Early Development, Roche Innovation Center, New York, CA*

**Gahan Pandina,** *Janssen Research & Development, Titusville, NJ*

To better help individuals with autism lead healthy & happy lives, we must first find more efficient ways to learn from them: with higher resolution, at a larger scale, and across a broader scope of behaviors than classical approaches have afforded so far. This paradigmatic shift will require innovation to be coordinated across traditional divides between basic and applied work, and to align emerging insights from autism screening with the analysis of scalable assessments deployed in the context of interventional trials. For robust insights to emerge, this shift will also require a careful marriage of new and old - incorporating new digital biosensors, machine learning approaches, and sensor/modality fusion with older and irreplaceable traditions of gathering meaningful feedback from qualitative interviews; of rigorous work at the intersection of psychometrics, psychophysics and physiology; and of regulatory-grade trial design & inference. We will showcase the many facets of this shift, as it is already occurring today, by bringing together cutting-edge academic insights with new industrial efforts and regulatory perspectives on this evolving space.

**230.001** (*Panel Discussion*) A New Digital Biomarker Platform Tracking Core & Associated Symptoms in Two Clinical Trials **D. Nobbs<sup>1</sup>** and **C. H. Chatham<sup>2</sup>**, (1)Roche Pharma Research and Early Development, Roche Innovation Center Basel, Hoffmann-La Roche, Basel, Switzerland, (2)Neuroscience and Rare Diseases (NRD), Roche Pharma Research and Early Development, Roche Innovation Center, New York, CA

#### Background

Historical approaches to characterizing autism and associated interventions typically involved the laborious collection of subjective data (often second- or third-hand) or complex research-grade technology (e.g., eye-trackers). These assessments often take alternate forms for different ages and intellectual abilities, requiring in-person expert administration, challenging their use across demographically- and geographically-diverse populations. These assessments nonetheless continue to represent a gold-standard in clinical practice, clinical trials, and fundamental research alike.

Newly-tractable computational techniques and the emerging ubiquity of computing hardware (including smartphones and wearables) create new opportunities here. For example, these technologies naturally enable remote administration, increasing access and feasibility for the intensive longitudinal characterization of time-evolving individual experience. However, key challenges remain: many new approaches were adapted *ex post facto* from traditional test modalities without design input from individuals on the spectrum and without rigorous theory-driven mathematical foundations for analysis; further, these technologies are not always appropriate across a wide range of ages and cognitive abilities, and hence for the long-term intensive longitudinal assessments that would ideally accompany next-generation interventions.

#### Objectives

To develop a platform of computationally-enhanced assessments (a) through participatory design with autistic individuals which is (b) appropriate for diverse ages and cognitive abilities, (c) scalable to enhance global deployment & access, (d) well-characterized through rigorous validation & formal modeling, and (e) sensitive to individual differences & longitudinal change.

#### Methods

Respectively for the objectives above, we will provide the first empirical overview of the “Wavelength” digital biomarker platform for autism, including 5 active tests and multiple passive monitoring modalities, (a) collaboratively designed in two international focus groups (n=55) including males and females with autism (b) stratified by age & intellectual ability and (c) deployed transatlantically. We will then introduce the (d) formal computational models used to refine the assessments & quantify key results (e) both in terms of practice effects as well as correlations with gold-standard assessments used to motivate subsequent confirmatory tests.

## Results

Participatory design critically informed specific changes to difficulty, stimulus selection, and termination rules for several assessments within the “Wavelength” suite, including our assessments of spatial working memory, cooperative behavior/theory of mind, emotion recognition, and interpersonal interaction. In response, computational techniques were employed at both acquisition and analysis (including psychometrically-normed staircasing for emotion recognition, Bayesian non-player characters for cooperation, and both agent-based and neural network models of spatial working memory) to drive an evaluation of Wavelength’s potential, both in terms of its convergent validity and reliability. Finally, we demonstrate how this set of computational models and exploratory analyses enables us to prioritize “Wavelength” endpoints for confirmatory test in two (ongoing) double-blind, placebo controlled interventional trials evaluating the effects of different GABA modulators in autism.

## Conclusion

We demonstrate how a combination of modelling and participatory design enables the creation of next-generation markers that are meaningful, powerful and feasible for high-frequency, remote testing in intensive longitudinal designs. Ultimately, we plan to make “Wavelength” available to the field at large.

### 230.002 (Panel Discussion) Scalable Computational Behavioral Phenotyping for the Assessment of Attention and Gaze in Autism

*G. Sapiro<sup>1</sup>, Z. Chang<sup>1</sup>, J. M. Di Martino<sup>1</sup> and G. Dawson<sup>2</sup>, (1)Department of Electrical and Computer Engineering, Duke University, Durham, NC, (2)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC*

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**Background:** Early detection of autism spectrum disorder (ASD) is a critical first step toward access to intervention which can influence long term outcome. ASD screening questionnaires are useful, but they require literacy and have lower performance with families from minority racial/ethnic backgrounds and lower education. Based on computer vision and machine learning, we have developed a scalable digital assessment tool for ASD symptom detection and monitoring. This computational behavioral phenotyping tool is delivered on ubiquitous mobile devices by designing an application (app) consisting of several brief movies shown on an iPhone or iPad screen while the child’s behavior is recorded via the device’s front-facing camera. This presentation will discuss how this computational approach assess attention and gaze patterns in toddlers with ASD.

**Objectives:** Describe a computational behavioral phenotyping approach to the assessment of attention and gaze behaviors in toddlers with typical development (TD) and toddlers with ASD.

**Methods:** The sample included 993 children 17–37 months, 40 of whom were subsequently diagnosed with ASD. Gaze information was extracted from the video of the child captured with the device’s frontal camera while the children were watching the carefully-designed movies presented on the device’s screen. Movies consisted of an engaging person shown on one side of the screen who was blowing either bubbles or a pinwheel located on the opposite side of the screen. Another movie showed two women standing on opposite sides of the screen engaged in a back-and-forth conversation. We first automatically computed attention to the stimuli, exploiting both pre-defined filters and machine learning techniques. For the attending frames, gaze information was then extracted; specifically, the percent of frames attending the right versus left side of the screen (social vs. non-social; percent right), strength of the left and right clusters (silhouette score), and the time correlation of the gaze with the conversational flow between the two women.

**Results:** A trained attention network achieved 89% accuracy (preliminary result), sufficient for the subsequent gaze analysis. The percent right and silhouette scores revealed significant differences between the TD and ASD groups, with toddlers with ASD showing reduced attentional preference to the social stimuli (‘Spinning pinwheel’:  $P < .001$  and effect size = .51 for percent right,  $P < .001$  and effect size = .52 for silhouette score; ‘Blowing bubbles’:  $P < .001$  and effect size = .47 for percent right,  $P < .001$  and effect size = .51 for silhouette score). We also observed significant differences between the ASD and TD groups for the gaze-speech time correlation ( $P < .001$ , effect size = .42). Whereas children with TD show a tight correlation between their gaze and the alternating speech of the two adults in a conversation, the children with ASD show a more variable pattern, less coordinated with speech.

**Conclusions:** We demonstrated for the first time that ubiquitous devices can be used to collect and quantify, in a scalable framework, attention and gaze information relevant to ASD. This is an important step toward developing computational behavioral phenotyping tools for advancing methods for early detection and reducing disparities in access to screening and diagnosis.

**230.003** *(Panel Discussion)* Digital Signals and Approaches to Drug Development in ASD  
**G. J. Pandina**, Janssen Research & Development, Titusville, NJ

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The use of digital signals may improve clinical trial methodology for patient selection and outcome measurement in ASD. These range from novel outcome measures and sampling techniques, to task paradigms with biosensor signals designed to parse the brain's responses to social information. These methods will also benefit from translational efforts to link human clinical and animal models of disease neurobiology, and to consider the utility of the different types of signals across stages of drug development. Traditional measures and biosensors may provide independent information to better understand or predict drug response, and combinatorial approaches should be explored, particularly in early development. Areas of overlap and divergence in biosignatures for ASD as compared with typically developing and other clinical populations may also be informative, given the challenges in classifying subgroups of individuals with ASD. Efforts must also be made to establish measures that can be informative across nonspecific factors such as age, IQ, communication ability, and severity. Illustrative examples will be provided from eye-tracking, facial affect recognition, and novel clinical measures.

**230.004** *(Panel Discussion)* Regulatory Considerations on the Use of Digital Health Technologies to Aid Drug Development for Autism Spectrum Disorder  
**V. Mantua<sup>1</sup>**, **M. Davis<sup>1</sup>** and **T. R. Farchione<sup>2</sup>**, (1)FDA, Silver Spring, MD, (2)Office of Neuroscience - Division of Psychiatry, FDA, Silver Spring, MD

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Drug development for autism spectrum disorder (ASD) faces several challenges, including phenotypic and biological heterogeneity and lack of consensus on novel targets and outcome measures. Digital health technologies (DHTs), in combination with existing clinical assessments, could help overcome some of these challenges by enabling drugs to be tested for their impact on new digital phenotypes or symptom clusters, enriching patient populations, and allowing continuous and objective measurements of highly variable outcomes.

DHTs can meet the definition of biomarkers or clinical outcome assessments (COAs), depending on whether they measure defined biological characteristics or how patients feel, function, or survive.

DHTs that measure biomarkers may have different roles, depending on how their use impacts the clinical trial or drug development program. The FDA Center for Drug Evaluation and Research (CDER) has a drug development tool (DDT) qualification program through which DHTs can be qualified for use in drug development programs for a specific context of use.

COAs using DHTs necessitate clinical and patient input from the target patient population to ensure the parameter(s) assessed using the DHT are important to patients and relevant to the disease or condition under study. Validation and implementation of DHT measures requires a multidisciplinary approach, which includes evaluating relationships with other outcomes (e.g., patient-reported outcomes) as well as characterizing changes that would be clinically meaningful to patients.

Despite the fact that some of the steps to develop a DHT for use in drug development are similar to those needed for a traditional measure, DHTs have some unique characteristics that involve software and hardware development in conjunction with clinical development. This uniqueness necessitates early discussion with regulatory agencies to ensure that the DHTs will be suitable for use in clinical trials intended to support marketing applications.

The FDA is developing guidance on the use of DHTs for remote data acquisition in clinical investigations, as well as guidance on the conduct of decentralized trials, which frequently use DHTs to engage and assess remote study participants. CDER has also recently launched the Innovative Science and Technology Approaches for New Drugs (ISTAND) pilot program to encourage development of DDTs that may be out of scope for existing DDT qualification programs, including tools that leverage DHTs.

Overall, DHTs have the potential to overcome hurdles in drug development for ASD, but their use requires additional considerations from a clinical development and regulatory perspective.

## POSTER SESSION — CLINICAL TRIAL ENDPOINTS

### Poster 410 - Clinical trial endpoints Posters

**410.001** (Poster) Analysis of the Childhood Autism Rating Scale 2 (CARS-2) in Two Item Sets Aligned on DSM-5 Core Symptoms of ASD. Application to a Bumetanide Oral Liquid Formulation Clinical Trial  
*V. Crutel<sup>1</sup>, E. Lemonnier<sup>2</sup>, E. Lambert<sup>1</sup>, S. Kyaga<sup>1</sup>, D. M. Ravel<sup>3</sup> and S. Serret<sup>4</sup>, (1)Servier, Suresnes, France, (2)centre expert autisme du limousin, CHU de limoges, Limoges, France, (3)R&D, Neurochlore, Marseille, France, (4)Child and Adolescent Psychiatry Department, CHU Children Hospital of Nice, Nice, France*

#### Background:

The Childhood Autism Rating Scale revised in 2010 (CARS-2) and the Social Responsiveness Scale (SRS-2) have been recommended as a primary efficacy measure in the 2017 EMA guideline for the clinical development of medicinal products in ASD. The guideline states that a treatment effect must be demonstrated on at least one out of two core symptoms. The SRS-2, in alignment with DSM-5 criteria provides two sub-scales corresponding to the two symptom domains: Social Communication and Interaction (criterion A) and Restricted Interests and Repetitive Behavior (criterion B).

The objective of this study is to propose a similar approach on the CARS-2, using data from a phase 2 dose-ranging study of bumetanide in a pediatric population with ASD, where CARS-2 was the primary endpoint. In this study, 88 patients were randomised to bumetanide oral liquid formulation twice daily (bid) 0.5mg (n=20), 1.0mg (n=23), 2.0mg (n=22), or placebo (n=23). Bumetanide safety in children and adolescents was consistent with earlier adults studies and the dosage considered to provide the best benefit/risk was 0.5mg bid.

Objectives: N/A

#### Methods:

In the CARS-2 manual, all items (except item 15 omitted because it is a summary and subjective impression score) are grouped by similarity of feature that address broad domains of behavior and apply for main intervention strategies, the so called 5 areas of interventions. The items of Social interactions and Communication related to DSM-5 criterion A were grouped. The same was done for the items of Restrictive patterns and Sensory issues related to DSM-5 criterion B. The categorization of items according to the areas of intervention and their correspondence with DSM-5 criteria A and B are shown in Table 1.

This grouping leaves item 14 (intellectual response) not considered but this can be consistent with the DSM-5 approach clarifying between Autism and Intellectual Disability as separate diagnoses implying that their co-presence will require different levels of individual support.

The categorization of CARS-2 into two subscales was applied to the bumetanide trial using data from 20 patients included in the bumetanide 0.5 mg group and 23 patients included in the placebo group. The change between baseline and Day 90 in CARS-2, expressed as two subscales, was analysed using a general linear model with baseline value as covariate. Dunnett's multiple comparison procedure was used to take into account the multiplicity of doses.

#### Results:

The difference between bumetanide 0.5 mg versus placebo on the change from baseline for DSM-5 criterion A was: -2.55 [-4.30; -0.81] p=0.002 and for DSM-5 criterion B was: -2.34 [-4.34; -0.35] p=0.017, both statistically significant.

#### Conclusions:

To our knowledge, this is the first report assessing change in CARS-2 items in relation to the two core symptoms defined in DSM-5. Although further investigation and validation is required, the approach allows for the assessment of treatment efficacy on each of the two core symptoms. Applying this new analysis of CARS-2 to a phase 2 study suggests that bumetanide improves both Social Communication and Interaction (criterion A) and Restricted Interests and Repetitive Behavior (criterion B) in ASD.

**410.002 (Poster)** Feasibility and Acceptability of the Parent Mediated Group Intervention Coping with Uncertainty in Everyday Situations (CUES)

**J. Rodgers<sup>1</sup>, M. Freeston<sup>2</sup>, D. Garland<sup>3</sup>, V. Grahame<sup>3</sup>, J. Goodwin<sup>4</sup>, A. Kernohan<sup>4</sup>, M. Labus<sup>5</sup>, M. R. Osborne<sup>6</sup>, J. R. Parr<sup>1</sup> and C. Wright<sup>7</sup>,** (1)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Newcastle University, Newcastle Upon Tyne, United Kingdom, (3)Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, (4)Population Health Sciences Institute, Newcastle University, Newcastle Upon Tyne, United Kingdom, (5)Research and Enterprise Services, Faculty of Medical Sciences, Newcastle University, Newcastle Upon Tyne, United Kingdom, (6)South Tyneside's Kids And Young Adults Klub - Special needs support group (KAYAKS), South Shields, United Kingdom, (7)Child and Adolescent Mental Health Service, Northumbria Healthcare NHS Foundation Trust, North Shields, United Kingdom

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**Background:**

Anxiety is common in autistic children. One key mechanism underlying anxiety is intolerance of uncertainty, a tendency to react negatively on an emotional, cognitive, and behavioural level to uncertain situations. We have worked with clinicians and parents to develop a parent-based programme to assist autistic children to manage uncertain situations more effectively: Coping with Uncertainty in Everyday Situations (CUES<sup>®</sup>). We conducted a pilot randomised controlled trial of this programme.

**Objectives:**

We aimed to ascertain whether CUES<sup>®</sup> helped to increase tolerance to uncertainty. Also, we aimed to determine whether it was feasible and acceptable for families.

**Methods:**

Fifty families were recruited to the study through clinical services. The children were aged 6 – 16 years, had a diagnosis of autism, and were experiencing anxiety related to uncertainty. At baseline, parents were asked to identify two target real-life situations that caused their child significant intolerance of uncertainty. Parents were allocated by chance to either receive CUES<sup>®</sup> or attend a psychoeducation group in a small group setting.

The target uncertain situations at baseline were compared to a 6-month follow up. They were rated on a nine-point scale of improvement/deterioration independently by a panel of experienced clinicians. The top 3 points defines a 'responder'.

Four months after the programme, parents completed a semi-structured interview about their experiences of the intervention. The data from the interviews were then analysed thematically.

**Results:**

Six months post-programme, the CUES<sup>®</sup> group had significant improvement in terms of the impact of the uncertain situation on the child (n = 12 'responders') and family (n = 11 'responders') compared to the group that received psychoeducation (n = 2 'responders' for child and family impact),  $p = .028$  and  $.051$  respectively.

In terms of feasibility, sixty percent of the CUES<sup>®</sup> group attended at least 80% of the sessions, and 86% completed primary outcome data.

Parents reported that taking part in the CUES<sup>®</sup> group was useful: it allowed them to understand their child's anxiety, identify uncertain situations and apply the strategies they learned during the programme. In addition, taking part in the study helped parents to feel less isolated. All parents reported that the programme highlighted the role of uncertainty in their child's anxiety and they felt better equipped to manage it.

**Conclusions:**

Our data support the value of CUES<sup>®</sup> in reducing the impact of uncertainty on the child and family, as well as its acceptability and feasibility. The findings indicate that parents valued a range of aspects of the programme, including the content and pace of the programme, the small group setting which was beneficial for peer support, repetition of concepts to consolidate learning, and the focus on uncertainty, which had face validity for parents. Our pilot trial has established parents were willing to be recruited

and randomised, the format and content of the groups were feasible and acceptable, and the outcome measures were appropriate for use in a future definitive trial.

**410.003 (Poster)** Person-Ability Scores As an Outcome Measure Alternative to Norm-Referenced Scores in ASD Clinical Trials: A Simulation Study

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**Background:** It is well-established that clinical trials in autism spectrum disorder (ASD) suffer from a dearth of adequate outcome measures. Norm-referenced scores, often used as outcomes in clinical trials, represent the comparison of an individual's level of ability to that of their chronological age-peers. However, these scores are often not sensitive to within-person change, and the reliability of norm-referenced scores is compromised at the extremes of the distribution. Item-response theory-based person ability scores are a direct index of ability, and are designed to assess within-person change. However, ability scores are unfamiliar to many users and have unknown distributional properties in the population.

**Objectives:** We used simulation to explore and compare the statistical power and accuracy of norm-referenced and ability scores as outcome measures in ASD clinical trials.

**Methods:** The Vineland Adaptive Behavior Scales, Third Edition provides ability scores (growth scale values, GSV) at the subdomain level, where the norm-referenced scores are called V-scale scores. We focused on the Socialization subscale, which comprises three subdomains: Interpersonal Relationships, Play and Leisure, and Coping Skills. We simulated a series of randomized controlled trials, varying the following factors: subdomain, age range of participants, baseline level of functioning, sample size, and treatment effect size. For each factorial combination of conditions, 2,500 datasets were constructed. The outcomes of interest were the efficiency with which the GSV and V-scale scores recover the true effect size (i.e., normalized root mean square deviation, nRMSD, smaller values are better) and the power of the studies to detect the true effect (i.e., the proportion of simulated studies in which the null hypothesis is rejected at  $p < .05$ , higher values are better when the true effect is non-zero).

**Results:** Selected results for the Interpersonal domain are shown in Table 1. The GSV and V-scales performed similarly when the true effect size was zero. Regardless of sample size, both maintained the Type I error rate around 5%, and the nRMSD was similar between the scores. However, in the presence of a moderate effect on the GSV scale, the GSV outperformed the V-scale scores. The power advantage of the GSV was slight: 65% versus 62% for  $N = 50$ ; 95% versus 94% for  $N = 100$ . However, the nRMSD was much smaller for the GSV, reflecting a more accurate estimate of the true effect size, whereas the V-scale tended to underestimate the effect size. The results from all parameterizations of study conditions will be presented.

**Conclusions:** The results of this simulation study provide initial empirical support for the argument that ability scores may offer statistical and methodological advantages over norm-referenced scores when used as outcomes in clinical trials of ASD. In the next stages of this work, we will explore the extent to which this is true under other sets of conditions commonly encountered in ASD research.

**410.004 (Poster)** Predictors of Treatment Response Using the Brief Observation of Social Communication Change (BOSCC).

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**Background:** The BOSCC is a coding scheme of ASD symptoms that is used as a treatment response measure. The BOSCC coding scheme has been validated in a study of toddlers who participated in early interventions ( $n=56$ ) over the course of about 6 months (Grzadzinski et al., 2016). In this work, the coding scheme was applied to 10-minute videos of parent-child free-play sessions (Standard-BOSCC). Subsequent work validated the coding scheme when applied to standardized segments of ADOS videos (ADOS-BOSCC; Kim, Martinez, Grzadzinski, & Lord, 2019). These works confirmed the utility of the BOSCC as a treatment outcome measure when applied to parent-child and clinician-child interactions. Though these projects used an overlapping sample of children participating in early intervention trials, whether the children who show improvements on the Standard-BOSCC are the same as those that show change on the ADOS-BOSCC is unknown. Further, the impact of child characteristics improvement on the Standard BOSCC vs. ADOS-BOSCC needs to be further explored.

**Objectives:** 1. To provide a data-driven definition of “improvers”, 2. To evaluate the overlap between ADOS-BOSCC and Standard BOSCC groups, and 3. To determine whether there are characteristics that predict group status.

**Methods:** The Standard-BOSCC and ADOS-BOSCC was gathered within three days (range=0-49 days) for toddlers participating in intervention trials (n=49; 39 males; age=25 months  $\pm$ 10 months) over the course of ~9 months ( $\pm$ 5 months). Two domains of the Standard-BOSCC and ADOS-BOSCC were assessed separately: Social Communication (SC) and Restricted, Repetitive Behaviors (RRBs). Children were administered the Mullen Scales of Early Learning (MSEL) to assess verbal and non-verbal developmental level (DL). An alpha value of 0.01 was used to account for multiple comparisons.

**Results:** Latent Growth Trajectory analyses revealed good model fit (Figure 1, Panel a) for a three-class result in SC (high, medium, and low improvers) as well as a three-class result in the RRBs (improving, stable, worsening) across both Standard-BOSCC and ADOS-BOSCC. There was observed consistency across ADOS-BOSCC and Standard-BOSCC class membership (Table 1, with 68% of cases remaining in the high or medium SC improvers group as well as 69% of cases remaining in the improving or stable RRB groups. Child baseline skills (intercept) for Standard-BOSCC SC and ADOS-BOSCC RRB as well as baseline symptom severity (ADOS-CSS-SA) for Standard BOSCC SC were significant predictors of group membership. Verbal and Non-Verbal DL at baseline were significant predictors of group membership for Standard-BOSCC and ADOS-BOSCC SC (Figure 1, panel b).

**Conclusions:** Standard-BOSCC and ADOS-BOSCC were relatively consistent in determining who is improving over the course of an intervention. Higher Verbal and Non-Verbal skills predicted more improvement over a relatively short intervention in SC across both Standard-BOSCC and ADOS-BOSCC. Higher ADOS-CSS-SA (more severe ASD SC symptoms) predicted less improvement in SC skills on the Standard-BOSCC, but not the ADOS-BOSCC. These results highlight that early intervention researchers should consider child verbal and non-verbal skills as well as ASD severity when assessing what a “meaningful” amount of improvement is over short periods of time.

#### **410.005 (Poster) Psychometric Properties of Restricted and Repetitive Behavior (RRB) Scales and Associations between Rrbs and Co-Occurring Symptoms and Behaviors**

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**Background:** Restricted and repetitive behaviors (RRBs) span a broad range of behaviors including repetitive sensory motor behaviors (RSMB), ritualized and rigid behaviors, compulsions, and restricted interests, regrouped as insistence on sameness (IS) behaviors. There is a high need for accurate and reliable assessments of RRBs for the use in clinical practice, basic research and clinical trials. Yet, limited insight into the psychometric properties of existing RRB measures present a major obstacle to better understand underlying mechanism and develop effective treatments. Further, the relationship between RRBs and sensory symptoms, as well as other associated symptoms (anxiety, sleep disturbances) and executive functions is poorly understood, particularly in a longitudinal context.

**Objectives:** First, compare test-retest reliability, convergent validity and ability to detect change of commonly used caregiver-reported (RBS-R, CRI-R, RBQ-2) and self-reported (ARI, RBQ-2A) RRB questionnaire measures. Second, explore the relationships between RRBs and other associated symptoms and behaviors – specifically sensory symptoms, anxiety and sleep problems - within a deeply characterized cohort of individuals with Autism Spectrum Disorder (ASD).

**Methods:** 95 individuals with ASD from children to adults (aged 5-36) and varying levels of intellectual functioning (IQ 50-115) completed a comprehensive battery of assessments at three clinic visits (baseline, week 2, week 12). Test-retest reliability of RRB scales (caregiver-reported: RBS-R, CRI-R, RBQ-2; self-reported: ARI, RBQ-2) was assessed via Intraclass Correlation Coefficients (ICC) using baseline-week 2 data and estimates of the standard error of measurement (SEM) of each scale were derived. Convergent validity, ability to detect change, and the relationship between RRBs and other associated symptoms was assessed via correlational analyses both cross-sectionally and across the 12-week study period.

**Results:** All RRB measures demonstrated good-to-excellent test-retest reliability, being excellent for the RBS-R, CRI-R and ARI (ICCs  $\geq$ .90 for total scores), and good-to-very good for the RBQ-2A (ICC=.78) and RBQ-2 (ICC=.85) respectively. As expected, convergent validity was high for RRB measures completed by the same rater across total scores ( $r>0.8$ ) and subscale scores measuring similar RRB constructs (RSMB:  $r>0.6$ ; IS:  $r>0.7$ ). Change correlations demonstrated a significant moderate degree of

convergence between caregiver-reported measures for total scores ( $r$  range: 0.3-0.4,  $n=68$ ) and IS behaviors ( $r$  range: 0.24-0.46,  $n=68$ ), but less so for RSMB ( $r$  range: 0.09-0.32). Change correlations between self-reported measures (RBQ-2A and ARI) were small and not significantly related ( $r=.18$ ,  $p=.27$   $n=38$ ). Across caregiver-reported measures, more frequent/severe RRBs were associated with greater sensory and anxiety symptoms ( $r>.7$  and  $r>.5$  respectively,  $n=58$ ), as well as sleep problems and executive function deficits (all  $r$ 's  $>.3$ ,  $n=72$ ). More RRBs based on self-report were highly associated with greater anxiety symptoms ( $r>.6$ ,  $n=43$ ) and sleep problems ( $r>.44$ ,  $n=42$ ), but not with executive function deficits ( $r<.1$ ).

**Conclusions:** In this well characterized ASD sample, these results demonstrate the good-to-excellent psychometric properties of caregiver- and self-reported RRB questionnaire measures, including test-retest reliability and convergent validity, and further elucidate the complex relationships of RRBs with other associated symptoms and behaviors. The study design affords to evaluate performance of these scales over a 12-week period under conditions comparable with interventional studies.

**410.006 (Poster)** Social Networks As a Mediator for Transition Success: Building Better Bridges RCT

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Background: Children with autism can experience difficulties navigating school transitions (Nuske et al., 2019). Parent advocacy is considered a key determinant of successful outcomes for children with disabilities (Turnbull & Turnbull, 2001), however under resourced, minoritized families experience formidable challenges advocating in school settings, due to lack of access to resources, little knowledge about their rights, lack of training, negative stereotypes (Burke et al., 2018; Coots, 2007) and social class status and power inequalities (Bourdieu, 2018; Lareau, 2011) leading to distrust and disconnection between home and school (Lareau, 1989). Research suggests that both parents and intervention providers value collaboration (Azad & Mandell, 2016), and preliminary evidence suggests that parent-school collaboration affects treatment quality (Ingersoll & Dvortcsak, 2006) and goal attainment (Ruble, Dalrymple, & McGrew, 2010) for children with ASD. We hypothesize that building parent-school networks during transition could positively impact transition outcomes for under-resourced children with autism.

Objectives: To test this hypothesis, we investigated the mediating role of network strength in a randomized control trial of *Building Better Bridges (BBB)*, a multiple-dimensional intervention for under resourced parents of children on the autism spectrum experiencing school transitions. Parents in the treatment group received a binder of transition resources and coaching support during six training modules, two of which focused on building connections with pre and post transition school teams. Control parents received the transition resource binder only.

Methods: Parent networks of family and school staff (Network Size) were collected at 3 timepoints from four sites, and parents rated their satisfaction with the transition. We used structural equation models to test the mediating effect of social networks on transition satisfaction. Mediation was tested at each step by calculating the indirect, direct, and total effect of the pathways ( $c = c' + a*b$ ).

Results: BBB increased parent-school network size and larger network size was associated with better transition outcomes. Overall, the indirect pathways accounted for 68% of the total effect of treatment. As shown in Table 1, in Model 1a, there was a significant, direct effect of treatment on the outcome. In Model 2, there was a significant direct effect of treatment on the outcome, as well as a significant pathway between Network Size at Time 3 and the outcome. There was also a significant effect of treatment on Network Size at Time 3. In this model, the total indirect effect (the mediation of Network Size) accounted for 18% of the treatment effect. In Model 3 there was a significant direct effect of treatment and Network size at Time 3 on the outcome. The pathway between treatment and Network Size at Time 3 was not statistically significant, but there was a large, positive association between treatment and Network Size at Time 2.

Conclusions: Interventions that target network building for under resourced parents with school staff can impact outcomes of children with autism, suggesting that social network support is a potentially powerful modifiable factor for addressing socioeconomic gaps for under resourced children on the autism spectrum.

**410.007 (Poster)** The SIGN Trials: A Phase III Study of Bumetanide 0.5 Mg Oral Liquid Formulation for Treatment of Children and Adolescents with Autism Spectrum Disorder - Study Design and Patient Baseline Characteristics

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## Background:

Autism spectrum disorder (ASD) is a neurodevelopmental condition, defined by impairments in social communication and the presence of restricted or repetitive behaviors. Today, no pharmacological treatments exist for this disorder. An oral liquid formulation of bumetanide, a NKCC1 chloride-importer inhibitor, is being evaluated as a potential treatment in children and adolescents with ASD. Two identical phase III trials including children 2 to <7 years old (yo) and children and adolescents 7 to <18 yo, respectively (SIGN trials), are ongoing to assess the efficacy and safety of bumetanide in ASD. Here, we report the baseline characteristics of patients included in one of these trials.

Objectives: N/A

## Methods:

This is an international, randomised, double-blind, placebo-controlled, ongoing phase III trial. Children and adolescents aged 7 to <18 yo, with moderate or severe ASD (Childhood Autism Rating Scale 2 (CARS-2)  $\geq 34$ ; Social responsiveness Scale (SRS-2) total score  $\geq 66$  T-Score; Clinical Global Impression (CGI)-S  $\geq 4$ ) were randomised (1:1 ratio) to one of two parallel treatment groups: bumetanide 0.5 mg oral liquid formulation twice daily (BID) or placebo BID, and entered a 6-month double-blind treatment period, followed by a 6-month open-label treatment period and a 6-week discontinuation period after treatment stop. Patient demographic, clinical data and efficacy parameters including CARS-2 (main efficacy criterion), SRS-2, CGI-S, quality of life parameters (PedsQL and WHOQOL) were collected at baseline.

## Results:

211 patients were enrolled in 10 countries (9 European countries and Brazil). Mean (SD) age of patients was 10.4 (3.0) years and 82.5% were male. Mean BMI was 19.5 (4.3) kg/m<sup>2</sup>, mean age at diagnosis was 4.7 (2.5) years, mean time since diagnosis was 6.4 (3.5) years and 68.7% reported at least one previous condition, mainly psychiatric disorders (22.7%). Among 155 patients evaluable for IQ mean IQ score was 71.2 (26.2), with 47.7% of patients scoring  $\geq 70$ . About 3/4 of patients (75.8%) were assessed according to CARS2-ST (for use with individuals < 6yo or with communication difficulties or below-average estimated IQs) and 24.2% according to CARS2-HF ( $\geq 6$  yo and verbally fluent individuals, with IQ scores above 80). Mean CARS-2 total raw score at baseline was 40.1 (4.9) and mean SRS-2 total score was 116.7 (23.4). The majority of patients (50.7%) were categorised as 5 (markedly ill) according CGI-S score. Mean PedsQL total score was 59.55 (14.49); According to WHOQOL, 50% of caregivers/parents reported a 'good' overall quality of life and 32.2 reported 'neither good nor poor'.

## Conclusions:

The profile of patients enrolled is consistent with the population targeted in the protocol. This trial offers a large and representative data set for children and adolescents with moderate to severe ASD. The population appears well characterized considering CARS and SRS baseline scores but also considering age, IQ and time since diagnosis. Study outcomes will inform the benefit and safety of bumetanide and, if positive, could contribute to the first available pharmacological treatment to enhance social reciprocity and adaptive behavior, thereby helping people and families living with ASD to improve their social integration and quality of life.

## PANEL SESSION — COGNITION: ATTENTION, LEARNING, MEMORY

### Panel 202 - Tracking Outside the Box: Moving Beyond Traditional Areas of Interest in ASD Eye Tracking Research

**Panel Chair:** Elena Tenenbaum, *Duke Center for Autism and Brain Development, Durham, NC*

**Discussant:** Frederick Shic, *Center for Child Health, Behavior and Development, Seattle Children's Research Institute, Seattle, WA*

Over the last two decades, eye tracking has become one of the most widely used tools for behavioral research in autism. Many important discoveries have been forged in this paradigm by selecting areas of interest (AOIs) within a scene and calculating the proportion of time an individual focuses their attention on that area. While this approach has been fruitful, it has also glossed over and left unstudied vast amounts of potentially rich data regarding attention allocation in autism. In this panel, we will discuss four ways to move beyond traditional AOIs to deepen our understanding of the importance of eye movements and attention in autism research. Our first speaker will address aspects of eye tracking that are rarely explored intentionally in research but provide their own windows into phenotypic heterogeneity in ASD. The second speaker focuses on the importance of time-course data in eye tracking. Our third speaker introduces a novel method for constructing AOIs for use with photographs, videos, and in wearable eye-tracking research. Our final speaker turns to virtual reality and semantic models to push the boundaries of what eye tracking can tell us about how individuals with and without autism attend to complex information in real-world environments.

#### **202.001 (Panel) Relating Eye-Tracking Data Quality, Data Quantity, and Phenotypic Heterogeneity in ASD**

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#### **Background:**

Eye-tracking (ET) is an objective, easily acquired, and noninvasive measure of visual attention that is appropriate for individuals of any age or level of cognitive ability and widely used in autism research. However, despite the rich data generated by ET experiments, the quantity and quality of data collected can vary substantially among individuals, and it is unclear to what extent these metrics influence experimental findings or index meaningful individual differences.

#### **Objectives:**

We sought to assess: (1) The relationship between metrics of data quality and clinical characteristics; (2) The reliability of data quality metrics within a person over time; and (3) To what extent, different metrics of data quality are interrelated.

#### **Methods:**

Data were collected as part of the Autism Biomarkers Consortium for Clinical Trials (ABC-CT); a multisite, naturalistic study of 6-11 year-old children with ASD (n=280) and typical development (TD, n=119). ET data were collected while participants viewed static and dynamic social and non-social stimuli spanning six experiments. Children participated in three identical visits over six months, allowing assessment of reliability. The primary metrics of data quality included %ValidTrials, the percentage of valid trials obtained from a task; %ValidData, the percentage of eye-tracking data obtained relative to total experimental time; and ET calibration uncertainty/error. Clinical characterization included measures of cognitive ability (Differential Ability Scales — DAS-II), ASD symptomology (Autism Diagnostic Observation Schedule — ADOS-2) and adaptive behavior (Vineland Adaptive Behavior Scales—VABS3).

## Results:

Both groups exhibited high rates of data quality. Although rates were lower in ASD, with %ValidData ranging, across experiments, from 89—93% in ASD to 96—97% in TD (all  $ps < .005$ ). Among children with ASD, %ValidData was correlated with cognitive ability ( $rs$  ranging from .13—.38); ADOS-2 social affect (-.14—-.31); and VABS3 Social and Communication subscales (.14—.3), such that increased symptomology, was associated with reduced %ValidData (all  $ps < .005$ ). Test-retest reliability of %ValidData ranged from .47—.66 but fell to .001—.37 when including data from participants with high calibration error or few trials who would have been otherwise excluded from subsequent analyses, indicating interdependence among data quality metrics.

## Conclusions:

Our results demonstrate: (1) Data quality is associated with symptom heterogeneity above and beyond what is explained by relationships with age or cognitive ability; (2) Data quality metrics exhibited moderate levels of intraindividual stability, indicating that they index features of the participant, not random error; and (3) These metrics exhibited asymmetric interdependence, e.g., data metrics such as calibration error directly influence our ability to measure valid eye-tracking data.

These findings show that data metrics, including those used to establish diagnostic cutoffs or inclusion criteria, are inextricably tied to participant characteristics and must be carefully considered lest experimental designs introduce bias. These metrics may serve as a heretofore untapped tool for understanding heterogeneity in ASD. The ongoing ABC-CT work explores the extent to which these metrics associate with measures of social attention, and inform our understanding of social attention, and considerations for new measures that explicitly model data quantity as a quality unto itself.

**202.002 (Panel)** Distance from Typical Scan Path When Viewing Complex Stimuli in Children with Autism Spectrum Disorder and Its Association with Behavior

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Background: Eye-tracking has been used for decades to distinguish between the gaze patterns of individuals with autism spectrum disorder (ASD) and typically developing (TD) individuals. These studies have identified group differences in patterns of attention and correspondence between gaze patterns and behavioral measures. Many of the studies exploring group differences have relied on proportion of looking time to predefined areas of interest collapsed across the length of the stimuli presented. While overall looking time at specific areas is clearly important, this measure fails to capture one of the key features of the eye-tracking technology: time-course data.

Objectives: Here we capitalize on time-course data (1) to quantify the extent to which gaze paths among children with ASD differ from the scan paths of TD participants and (2) to determine whether symptoms of ASD are related to the distance from the average scan path.

Methods: Using video stimuli in which a woman engages in dyadic bids, sandwich-making, joint attention, and moving toy conditions, we calculated the mean fixations frame-by-frame in a group of TD children ( $n = 40$ ; 23 males, 17 females;  $M$  age = 49.95 months,  $SD = 10.51$ ). We then determined the mean distance from that typical fixation frame-by-frame for 155 children with ASD (122 males, 33 females;  $M$  age = 65.65 months,  $SD = 19.73$ ). This allowed us to identify critical periods in the 3-minute-long stimuli when the two groups were closest to and most divergent from each other. Finally, we used partial correlations (controlling for age and IQ) to assess the correspondence between mean distance from the TD path and symptoms of ASD as measured by Autism Diagnostic Observation Schedule (ADOS-2), Vineland Adaptive Behavior Scales (VABS-3), Pervasive Developmental Disorder Behavior Inventory (PDD-BI) and Aberrant Behavior Checklist (ABC).

Results: Results showed that context (i.e., dyadic bid, joint attention bid, sandwich-making, or moving toy condition) had a significant effect on the mean distance between ASD fixations to the typical scan path (Figure 1). Moments in which the groups were most divergent tended to involve social cues (e.g., dyadic bid, joint attention). Moments in which ASD fixations were closest tended to involve salient movement (e.g., sandwich making; see Figure 2). Significant correlations were identified for mean distance from ASD fixations to the TD scan path on multiple behavioral measures including VABS Communication ( $R^2 = .19, p = .02$ ), ADOS-2 Severity Score ( $R^2 = .20, p = .01$ ), PDD-BI Expressive Social Communication ( $R^2 = -.23, p = .005$ ), and ABC-C Lethargy/Social Withdrawal ( $R^2 = .33, p < .001$ ). In each case, greater distance from the typical scan path was associated with lower communication abilities and/or greater ASD symptomatology.

Conclusions: These results indicate that moment-by-moment changes in stimulus content can have significant effects on what constitutes typical fixation and the extent to which participants with ASD demonstrate divergent gaze patterns. This has important implications for our use of eye-tracking as a measure of atypical attention. Findings also support previous results demonstrating correlations between gaze and ASD symptomatology.

**202.003** (Panel) Automated and Flexible Area-of-Interest Construction for Eye-Tracking Research: With Applications to Autism Research

*R. S. Hessels and I. Hooge, Utrecht University, Utrecht, Netherlands*

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**Background:** Areas of Interest (AOIs) are used to transform an eye-tracker signal that consists of timestamped spatial coordinates into more meaningful entities such as fixations on relevant objects in the world. AOIs have been widely used to characterize looking behavior to faces in Autism Spectrum Disorder (ASD). However, AOI construction can be problematic for researchers. First, AOIs are often constructed manually, which means subjective choices are made about AOI shape or size. As a result, AOIs differ tremendously even between studies using highly similar stimuli. Second, if the stimulus contains moving objects, AOI construction needs to be done manually for each video frame, which is laborious. The recent emphasis on investigating looking behavior in ASD across various social contexts – from observing photos or videos to live interaction – suggests a need for an automated and flexible AOI-construction method.

**Objectives:** To develop and validate an automated AOI-construction method that can be used to investigate looking behavior to human bodies and faces across various social contexts.

**Methods:** We developed an AOI-construction method based on Voronoi tessellation. It allows researchers to manually specify AOI centers, or to use computer-vision techniques to determine relevant AOI centers. AOI shape and size are then automatically determined by the method, optionally constrained in size by a radius-parameter.

Our AOI-construction method was validated in three studies. First, our method was compared against conventional AOI-construction methods in an eye-tracking study of 10-month-old infants (n=40), adults with ASD (n=13) and adult controls (n=16) observing photographs of faces. Second, an automated implementation was built for videos of faces using OpenFace facial landmark detection and validated in an eye-tracking study of video-mediated dyadic interaction (n=96). Third, an implementation using OpenPose body keypoint estimation was used in a wearable eye-tracking study on social encounters during locomotion (n=23).

**Results:** The outcomes of a study depend on the AOI-construction method used: Relevant measures such as total looking time and the time to first fixation of the eyes, nose, and mouth differed between the AOI methods. Crucially, AOI size affected the statistical comparison of looking time to the eyes between individuals with ASD and controls. The AOI-construction method based on Voronoi tessellation involves the least number of subjective choices, is most noise-robust, and is easiest to implement automatically using a computer.

Validation of the automated implementation for videos of faces revealed that total looking times to the eyes, nose, and mouth, were highly similar ( $\leq 2.6\%$  absolute difference) to an implementation where the researcher determined the AOI centers manually. Thus, the automated implementation is at least as good as manual AOI-construction methods. The implementation for eye-tracking glasses is a proof of concept that our AOI-construction method can be used in less constrained settings as well.

**Conclusions:** The AOI-construction method based on Voronoi tessellation is less subjective than the common manual AOI-construction method. It is easy to implement automatically using state-of-the-art computer-vision techniques and can thus be flexibly used across many different social settings relevant to Autism research.

**202.004** (Panel) Measuring Naturalistic Attention in Complex, Real-World Environments in Autism

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Background: Eye-tracking studies provide substantial insight into cognition, revealing stable, heritable differences in patterns of information-seeking that often distinguish individuals with and without autism. Yet, traditional eye-tracking studies lack key features of the real-world environments in which individual differences in attention are most apparent. In traditional paradigms, images are viewed passively on a computer screen and segmented into a small number of discrete areas of interest (AOIs) for statistical analysis. In contrast, real-world environments are immersive and actively explored, containing a high-dimensional

space of semantic information vying for individuals' attention. A crucial next step for leveraging gaze behavior is to better approximate real-world environments in laboratory settings.

**Objectives:** 1) Develop a novel experimental paradigm using eye-tracking + headmounted virtual reality to measure gaze behavior while participants actively explore complex, real-world environments. 2) Characterize patterns of attention in individuals with and without autism using continuous and high-dimensional models of semantic information.

**Methods:** We showed 40 young adults (N = 21 TD; 19 ASC) a set of varied, real-world photospheres specifically curated to contain a balance of engaging social, object, and scene information. While actively exploring each photosphere (i.e., freely moving eyes, head, and body), participants' gaze was measured via in-headset eye-trackers. Each photosphere was decomposed into a set of smaller image tiles, and the content of each tile was verbally described by online participants (N = 3000). Using a computational language processing model, Bidirectional Encoder Representations from Transformers (BERT), we transformed the verbal descriptions of each tile into high-dimensional semantic embeddings. Sentence embeddings were then used to model continuous feature spaces of each photosphere. We validated this approach for modeling semantic features by comparing the computationally-derived and experimenter-derived (i.e., traditional AOIs) models of information in one specific domain: social information.

**Results:** We obtained high-quality eye-tracking data from participants with and without autism: we observed no group differences in the accuracy of pre-trial fixations ( $p = 0.12$ ) and retained over 90 percent of trials for participants in both groups after excluding trials with poor eye-tracking. Furthermore, we observed high correspondence between the continuous semantic maps generated via sentence embeddings ("social maps") and hand-drawn AOIs. Regions of an image labeled by an experimenter as social (i.e., faces) were ranked in the 90th percentile or higher ( $M = 97.25 \pm 1.75$ ) in semantic maps generated computationally. However, unlike AOIs, which represent binary information (e.g., "face", "not face"), social maps successfully capture the continuum of socially-relevant information present in real-world photospheres and explain a greater proportion of attention across all participants ( $p < 0.001$ ).

**Conclusions:** Here we demonstrate two methodological advances for eye-tracking studies: 1) an experimental approach to enable immersive, active viewing in real-world environments using VR, and 2) a computational approach for modeling rich information in real-world stimuli. This novel approach can be used to test classic hypotheses regarding attentional deployment in autism in more naturalistic contexts, and to generate new hypotheses about the semantic dimensions most relevant to attentional differences in autism.

## ORAL SESSION — COGNITION: ATTENTION, LEARNING, MEMORY

### Oral 322 - Behavior, Gaze, and Biomarkers

#### **322.001** (Oral) Altered Locus Coeruleus Activity during Reaction Time Performance in Autism

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**Background:** Arousal mediates our sensitivity to sensory input, amplifies perceptual acuity, and regulates behavioural performance. Atypical arousal regulation may thus explain slower mean reaction time (MRT) in visuospatial task performance in Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) compared to typically developing controls (TD). The Locus Coeruleus – Norepinephrine system (LC-NE) underlies arousal regulation and adapts its activity to the utility of a task. LC-NE tonic and phasic activity are indexed by baseline pupil size (BPS) and stimulus-evoked pupillary response (SEPR).

**Objectives:** Investigate group difference in arousal regulation as index of LC-NE activity during visuospatial task performance of different task utility.

**Methods:** The present study assessed pupillometry in matched children (8-17y) with ASD (n=31), ADHD (n=28), or TD (n=31) during a visuospatial reaction time task. Participants were instructed to respond to the visuospatial location of a target with button

presses (up, down, left, right). The task manipulates arousal by varying task utility between conditions. A high-utility condition with slow event rates versus and a high-utility condition with fast event rates (1s.) that also rewarded intra-individually fast MRT. We estimated linear-mixed models of BPS, SEPR, and MRT in a per-trial analysis. Effect sizes were estimated by marginalized means (M) and coefficients ( $\beta$ ).

**Results:** Across groups, high utility was associated with faster MRT ( $\beta = -1.03$ , 95% CI [-1.09, -0.96]), lower BPS ( $\beta = -0.25$ , 95% CI [-0.33, -0.16]), and higher SEPR ( $\beta = 0.15$ , 95% CI [0.07, 0.24]) indicating manipulation of performance and arousal. In low utility, BPS and SEPR were inversely related ( $r = -.50$ , 95% CI [-.53, -.48]) and additively associated with faster MRT indicating an emphasized neuro-modulatory effect of arousal on performance when task utility is low (see figure A).

Three main group findings were observed: (1) Slower MRT was specific to ASD compared to TD during low utility ( $\Delta M = -0.48$ , 95% CI [-0.68, -0.28]). (2) Higher ASD symptoms across groups (Social Responsiveness Scale [SRS] total score) were associated with higher BPS during low utility ( $\beta = 0.20$ , 95% CI [0.06, 0.34]). (3) Changes in BPS and SEPR from low to high utility were smaller in ASD compared to ADHD and TD (see figure B).

**Conclusions:** We successfully manipulated arousal as indicator of LC-NE activity by task utility variation in a visuospatial task. In line with previous meta-analysis, slower visuospatial task performance in ASD might be specific to conditions of low task utility that lack exogenous salience.

Overall, arousal was associated with task performance and showed altered activity in ASD. Increased BPS during low task utility indicates increased LC-NE tonic activity, which might be applied as transdiagnostic ASD symptom marker in children. Smaller BPS and SEPR changes indicate attenuated LC-NE tonic down- and phasic up-regulation in response to high utility, which suggests reduced exploitative processing that impairs sensory selectivity to target stimuli. In ASD, attenuated visuospatial task performance and atypical arousal regulation are likely associated with attenuated LC-NE activity adaptation, which shall be investigated as biomarker in future research.

### **322.002 (Oral) Attention Allocation during Visual Exploration Tasks in School-Age Children with ASD: Autism Biomarkers Consortium for Clinical Trials**

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#### **Background:**

Between-group differences in visual attention in response to social vs. non-social stimuli may reflect a potential class of biomarkers for ASD. In the Autism Biomarkers Consortium for Clinical Trials (ABC-CT), a visual exploration task was employed within the eye-tracking (ET) battery with children with ASD and typical development (TD). This task examined the detection of and preference for social images (faces) when they were in competition with non-social distractors. Previous studies have found ASD-TD differences in ET measures in visual exploration tasks [1]. However, it is still unclear as to what extent these differences methodologically or conceptually relate to more general attentional issues in ASD.

#### **Objectives:**

Assess (1) ASD-TD between-group differences in attention patterns during a visual exploration task, (2) the effects of controlling for overall data acquisition rates (associated with general attentiveness to presented stimuli) on results.

#### **Methods:**

The sample comprised 399 6-to-11-year-old participants (280 ASD and 119 TD). The task (from [2]) presented an array of five images: one social image (face) and four non-social distractors (e.g. face outlines, technology, birds, cars). Variables analyzed were adapted from [1]: latency for participants to look at the face image; exploration (number of images viewed); perseveration (fixation duration per image viewed); detail orientation (number of fixations per image viewed); and percentage of valid data. ANOVAs with follow-up contrasts were conducted to compare between-group differences with and without control for valid data.

## Results:

As expected, children with ASD had longer latency times to initially view the social image compared to TD children (mean difference=248ms;  $p=0.009$ ). Contrary to prior work, children with ASD showed less perseveration towards social images compared to TD children (mean difference=237ms;  $p=0.039$ ) and lower levels of exploration in non-social images (mean difference=.103 images;  $p=0.001$ ). There were no significant between-group differences in social exploration, non-social perseveration, and detail orientation.

However, there was a difference in percentage of valid data between ASD and TD children, with children with ASD having a lower percentage of valid data than TD (mean difference=5.1%;  $p<0.0001$ ). When the percentage of valid data was controlled for, all significant between-group differences were rendered non-significant, indicating that general attention differences between groups may share substantial variance with indices of social attention.

## Conclusions:

The results suggest that differences exist in visual exploration performance between ASD and TD participants. However, because these differences seem linked to the extent of lost ET data, they may reflect more general attention issues in ASD rather than specific constructs associated with atypical social attention or cognition. Further investigation will be needed to unpack the methodological or conceptual variance associated with atypical general versus exploratory social attentional processes in ASD. Future work should (1) consider methodological sources of variation (number of images in the array, heterogeneity in non-social images, etc.) that may exacerbate general attention issues in ASD and (2) explore possible links between lower percentages of valid data and atypical visual exploration in ASD to ASD and ADHD comorbidity.

[1] Sasson et al., *Autism Research.*, 2008.

[2] Elsabbagh et al., *Behavioral Brain Research*, 2013.

### 322.003 (Oral) Increased Attention to the Mouth at 12 Months Predicts Language Outcomes in Infants at Low-Risk but Not Elevated-Risk for ASD

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Background: Between six and twelve months, infants increase their attention to speakers' mouths, coinciding with their expanding speech production and understanding (Lewkowicz & Hansen-Tift, 2012). Attention to the mouth facilitates access to combined auditory and visual speech cues and is positively associated with later language development (Tenenbaum et al., 2015; Young et al., 2009). Due to familial liability, younger siblings of children with autism spectrum disorder (ASD) often exhibit language delays (Drumm et al., 2015). We prospectively followed 12-month-old infants with (high-risk, HR) and without (low-risk, LR) familial risk for ASD to examine if these delays are linked with limited ability to attend to the face and utilize redundant audiovisual information in speech. Evaluating links between infants' selective attention and language outcomes is fundamental to identifying factors contributing to typical and atypical early language development.

Objectives: Determine (1) whether attention to a speaker's face and mouth at 12 months differs between HR and LR siblings, and (2) whether risk status modulates the relationship between 12-month selective attention to the face and mouth and 18-month language skills.

Methods: Participants included 61 LR and 90 HR infants, none with ASD. At 12 months, infants participated in a free-viewing eye-tracking study depicting a female speaker (Chawarska et al., 2012). Their proportion of time looking at the scene (%Valid-Looking: scene-looking time/experiment duration), face (%Face: face-looking time/scene-looking time), and mouth (Mouth-Eye Index (MEI): mouth-looking time/mouth+eye-looking time) were computed. Expressive language (EL) and receptive language (RL) were evaluated with the Mullen Scales of Early Learning (MSEL) at 12 and 18 months. Two-sample t-tests assessed group differences in %Valid-Looking, %Face, MEI, and MSEL language t-scores. Multiple linear regressions tested the effects of 12-month predictors (%Valid-Looking, %Face, MEI, RL and EL t-scores) on RL and EL t-scores at 18 months in the HR and LR groups.

Results: At 12 months, groups did not significantly differ in %Valid-Looking, %Face, MEI, or MSEL language t-scores. RL at 18 months was significantly lower in HR siblings compared to LR peers (Table 1). Multiple linear regressions indicated that for LR infants, 18-month RL was predicted by MEI ( $p=.025$ ,  $\beta=.25$ ) and %Face ( $p=.022$ ,  $\beta=.27$ ); for HR infants the only predictor was %Valid-Looking ( $p=.047$ ,  $\beta=.20$ ). EL at 18 months was predicted by %Face ( $p=.005$ ,  $\beta=.35$ ) for LR but not HR siblings (Table 2).

Conclusions: At 12 months, LR and HR infants showed comparable language abilities and selective attention patterns, yet risk status modulated links between attention and language outcomes. Unlike LR peers, HR infants' ability to attend to the speaker's face in a complex social scene did not predict increased language understanding and production six months later. Furthermore, greater attention to the speaker's mouth contributed uniquely to RL outcomes for LR siblings only. These findings suggest that HR infants, despite attending to audiovisual social information similarly to LR peers at 12 months, may not process audiovisual information in a way that facilitates language development. It is imperative to develop language learning methods for HR siblings that target their combined attentional and language processing vulnerabilities.

### **322.004** (Oral) Episodic Memory Dysfunction in ASD – Is It Real?

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Background: Episodic memory (EM) is memory for past events in specific spatial-temporal contexts ('what-where-when' memory [WWWhen]) (Tulving, 1972). In typical development, EM emerges around 4-5 years of age (Tulving, 2003, 2005). Existing research suggests that individuals with autism spectrum conditions (ASC) display significantly poorer memory when recalling episodic events, compared to neurotypical controls (NT) - which might derive from diminished autoegetic (self-knowing) consciousness and impaired binding processes. However, often tests of EM use verbal material to be recalled, which can be problematic for young NT children and children with an ASC. Although highly variable, language delays and language impairments are documented in ASCs. Therefore, complying with the demands of traditional EM tasks which rely on the language capacity of the child may underestimate their EM ability. Here, we report the first experiments exploring EM in ASC using a behavioural and nonverbal content-based measure of EM which allows us to identify the integration and binding of different associations within an episodic representation.

Objectives: This study aimed to provide the first insights into EM in ASC using a behavioural and non-verbal measure of memory that allows us to disambiguate events in spatiotemporal context, with information about What happened, Where and in Which occasion.

Methods: We developed a hide-and-seek task combining elements of the "WWWhen" memory test by Holland and Smulders (2011) and the "What-Where-Which" memory test by Eacott and Norman (2004). Nineteen children with ASC (mean age = 8.02 years; SD = 1.38 [16 Male]) and 20 NT children (mean age = 6.15 years; SD = .45 [12 Male]) matched on mental age participated. Children completed two sessions to hide six coloured pens (what) at specific locations (where) in two different contexts (which). At retrieval, children retrieved six pens across two sessions yielding two trials each of What-where, What-Which and What-Where-Which. Cognitive functioning was assessed using the Wechsler Intelligence Scale (WPPSI-IV and WAIS-IV) and was used to match the groups (ASC and NT) on mental age.

Results: A Generalised Estimating Equation (GEE) analysis was performed on repeated measures binary data using accuracy as the dependent variable and group (ASC, NT), trial type (EM, what-where, what-which) and encoding order (first, second) as predictors. Results showed no effect of group on the EM task: Wald  $\chi^2 = 3.428$ ,  $N = 39$ ,  $p = .023$ . Bayes factor (B) calculations returned a BF of .064, suggesting substantial evidence of a genuine absence of a difference. Comparisons to chance revealed that both groups are performing above chance (ASC:  $X^2 = 5.158$ ,  $p = .023$ ,  $BF_{10} = 3.003$ ; NT:  $X^2 = 24.025$ ,  $p < 0.001$ ).

Conclusions: Findings suggest that contrary to existing research reporting poorer episodic skills among children with ASC, these children actually demonstrated a pattern of performance similar to TD children, with no evidence of atypicality. We propose that the absence of impairments found in this study may reflect the nonlinguistic methods used. This work suggests a new way to investigate and understand the memory profile in ASCs.

## POSTER SESSION — COGNITION: ATTENTION, LEARNING, MEMORY

### Poster 411 - Cognition: Attention, Learning, Memory Posters

**411.001** (Poster) A Model for Disruption and Heterogeneity of Attentional Processes in Autism: Role of Prefrontal Cortical and Thalamic Networks

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**Background:** The activity of lateral prefrontal cortices (LPFC) has been associated with a variety of executive functions including working memory, selective attention control, and regulation of emotional responses, processes that are affected in Autism Spectrum Disorders (ASD). LPFC has reciprocal short-range connections with the anterior cingulate cortex (ACC), an area that is involved in learning changing task rules: coordinated neuronal firing, first in ACC and then LPFC, has been shown to correlate with successful task-switching performance, attributed partially to changes in the regulation of attention.

**Objectives:** Attention and task-related performance are disrupted in ASD, with very heterogeneous behavioral outcomes. The mechanisms and processes underlying this disruption are not understood. We hypothesized that an imbalance in excitation/inhibition within LPFC circuits interacting with ACC and thalamic networks may be at the core of ASD pathology.

**Methods:** Our recent neuropathological findings suggest highly variable, increased connectivity in short-range ACC-LPFC networks that disproportionately affects the feedback output of ACC to superficial LPFC layers in ASD. We have also reported a decrease in the density of specialized inhibitory neurons that innervate other inhibitory neurons in the superficial layers of LPFC in ASD. These inhibitory neurons are likely targeted by diffuse thalamic pathways in mammals and are the predominant inhibitory neurons in the human cortex. Based on this evidence we created a computational model to simulate typical LPFC neural network function and its disruption in ASD during simultaneous processing of distinct inputs. We test the variability of cortical response after changes in the balance of excitation and inhibition, based on our neuropathological findings.

**Results:** Our simulations reveal mechanisms that raise base cortical tone in ASD and can spread this disruption widely in the extended cortical attentional network, through thalamocortical pathway involvement. These result in decreased signal to noise ratio and difficulty in the distinction of signals that can adversely affect attention. Variable changes in the balance of excitation/inhibition can also provide clues about compensatory mechanisms and processes underlying the observed ASD heterogeneity, through variability in cortical responses, accuracy, and reaction times in a simulated behavioral task.

**Conclusions:** Overall, our findings highlight the important role of feedback excitatory cortical communication and widespread thalamocortical inputs in attention networks and the imbalance of excitation/inhibition in these networks in ASD.

**411.002** (Poster) Altered Internal Concentration in Autism Spectrum Disorder

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**Background:** Attentional incompetence are widely reported in children with Autism spectrum disorder (ASD). Children with ASD are atypically over-focused to be able to pay attention towards an external stimulus, over their motivational state. This phenomenon is referred as altered attentional modulation in which selection of desired information from infinite number of objects and events that are available in environment for further processing is difficult. We propose that distinct patterns of delta spectral power could be used to distinguish children with ASD from typically developing children (CTRL).

**Objectives:** To compare EEG delta power in children with ASD compared to typically developing children (CTRL) during attention task.

**Methods:** EEG was recorded during attention task i.e. digit span forward task, using 128 channel hydrocel geodesic sensor net in 61 children with ASD diagnosed by DSM 5 criteria and 48 age matched CTRL. Raw EEG was filtered (1-100 Hz band pass,

50Hz notch) followed by segmentation into 5 epochs of 1 second duration from each trial i.e. total of 15 epoch of 1 second duration. Artifacts such as eye movement, eye blink and bad channel were removed using Net-station software. EEGLAB was used to remove ECG and power line noise artifact using independent component analysis. Average re-referencing was computed. After exclusion of files with artifacts or corrupt files at some or preliminary analysis steps, EEG data of 19 children with ASD were analysed. For comparison EEG data of age matched 20 CTRL children were used for analysis. Mean  $\pm$  SD age of children with ASD ( $6.12 \pm 2.4$  years) and CTRL ( $7.24 \pm 2.3$  years) were not significantly different. Individual alpha frequency (IAF) was calculated using "Spectopo" EEGLAB function, with window size of 256 data points and overlapping windows of 50%, to classify the EEG frequency bands i.e. delta bands for spectral power analysis. Further, for spectral power analysis Fast Fourier Transform was performed in MATLAB using a custom made script. For plotting of power results, EEGLAB topoplot function was used.

Results: Delta power changes during digit span forward task was measured and compared between ASD and CTRL. Decreased spectral power ( $p < 0.0005$ ) in delta band was observed in children with ASD compared to CTRL

Conclusions: Reduced delta power during attention task suggests altered internal concentration in ASD children compared to CTRL. Previous studies also reported that resting state activity in delta band is inversely associated with higher cognitive functions such as self-reflection, working memory, and sustained attention. Additionally, EEG studies during arithmetic task showed increases in delta power in control subject. To the best of knowledge this is the first EEG study exploring delta power during attention task in ASD children, therefore further studies could be undertaken to explore the same in tasks involving attention as the predominant cognitive domain.

#### **411.003 (Poster) Assessing Event Knowledge in Relation to Autistic Traits and Social Ability**

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**Background:** Event knowledge, a person's understanding of patterns of activities in the world, is crucial for everyday social interactions. Atypical event knowledge could contribute to the social communication issues prominent in autism spectrum disorder (ASD). Previous research indicates that event knowledge is atypical in autistic individuals, including knowledge of temporal order of event activities. However, research in this area is minimal, particularly concerning the relationship between event knowledge and social abilities.

**Objectives:** We aimed to investigate how event knowledge, measured through ordering of event activities, relates to traits associated with ASD, particularly lower social abilities.

**Methods:** Two studies were conducted. In Study 1, 140 participants ordered activity lists presented with commonplace events, such as "baking a cake". In Study 2, 123 participants listed their own steps for presented commonplace events. Events were categorized based on the level of social interaction (personal interaction, with others, non-social) involved in the event for Study 2 only. All participants completed self-report questionnaires assessing autistic traits, including measures of social abilities and repetitive behaviours: Autism-spectrum Quotient (AQ), Multidimensional Social Competence Scale (MSCS), and Repetitive Behaviour Questionnaire (RBQ-2A). In both studies, average deviation from consensus ordering of event activities (activity ordering deviation) was calculated per participant. In Study 1, correlational analyses were conducted between questionnaire scores and activity ordering deviation. In Study 2, composite scores were calculated for social ability (using applicable AQ and MSCS subscales) and repetitive behaviours (using applicable AQ and RBQ-2A subscales). Participants were categorized as having high or low levels of traits using a median split. ANOVAs were used to analyze differences in activity ordering deviation across the three event categories between high and low trait levels.

**Results:** In Study 1, more atypical activity ordering was associated with higher overall autistic traits ( $r(137)=.21, p=.01$ ). Lower social ability was also related to more atypical activity ordering ( $r(138)=.27, p=.01$ ). More atypical activity ordering was not associated with higher overall repetitive behaviours ( $r(138)=.10, p=.26$ ). In Study 2, a significant interaction between level of social ability and event category was found ( $F(2, 242)=3.82, p=.02$ ). For the low social ability group, activity ordering became more atypical as events became more social in nature (Figure 1). Repetitive behaviours were not found to relate to ordering of event activities.

**Conclusions:** Because event knowledge plays a central role in social interactions, atypical event knowledge may cascade into further issues, including social communication issues in ASD. Results suggest that individuals with higher autistic traits may have difficulties with predictability related to the temporal order of events. As activity ordering became more atypical as events became more social in nature for the low social ability group, social events may be even less predictable, such that it may be more difficult for these individuals to retain representative event knowledge of extremely social events. Future research could

consider investigating the interplay between event knowledge, autistic traits, and related areas such as inferencing ability.

**411.004 (Poster)** Assessing the Impact of Sensory Processing on Academic Achievement and Attention

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**Background:** Atypical sensory processing is widely recognized as a feature of ASD (Tomcheck & Dunn, 2007), and it is hypothesized that difficulty with sensory processing may impact academic achievement (Ashburner et al., 2008). Additionally, it is also hypothesized that difficulty with auditory processing may be linked with attentional difficulties (Moore et al., 2010) which may also impact achievement in ASD. This study was designed to examine both hypotheses.

**Objectives:** To understand the impact of sensory processing difficulties on academic achievement and symptoms of attention deficit/hyperactivity disorder (ADHD) in children and adolescents with ASD without a comorbid intellectual disability (ASD-WoID).

**Methods:** Participants in this study included 81 children with ASD-WoID (FIQ > 74; M = 11.29 years, SD = 2.13). Parents completed the Sensory Profile 2 (SP2) to provide a measure of sensory processing and Conners-3 to provide a measure of their child's ADHD symptoms. An objective measure of children's auditory processing was obtained using the SCAN. Math ability was measured with Numerical Operations and Problem Solving measures from the WIAT-III and reading ability was measured with Reading Comprehension and Reading Fluency measures from GORT5. WASI2 was used to provide a measure of full-scale IQ (FIQ).

**Results:** Pearson correlations conducted between the academic, attention, and sensory variables are reported in Table 1. Parent and objective measures of auditory processing were not correlated, and there was little evidence of relations between ADHD symptoms and sensory measures. Regression analyses indicated that SP2 Auditory Processing predicted GORT Reading Fluency scores ( $b = -.11, p < .05$ ) above FIQ ( $b = 0.07, p < .01$ ), age and gender ( $ps > .05$ ),  $F(4, 50) = 6.85, p < .05, R^2 = .35$ . SP2 Auditory Processing also predicted reported Conners-3 Learning Problems ( $b = 0.61, p < .05$ ), above FIQ ( $b = -0.25, p < .05$ ), age ( $p > .05$ ), and gender ( $b = -8.24, p < .05$ ),  $F(4, 49) = 5.08, p < .01, R^2 = 0.29$ . SP2 Visual Processing significantly predicted Problem Solving scores ( $b = -0.80, p < .05$ ) above FIQ ( $b = 0.92, p < .001$ ), age and gender ( $ps > .05$ ),  $F(4, 50) = 13.73, p < .001, R^2 = 0.52$ . The SCAN, but not SP2 measures, was related to FIQ. The Scan also correlated with GORT Comprehension and WIAT Problem Solving, but regressions indicated these relations did not hold when FIQ was included in the model. All other models did not reach statistical significance.

**Conclusions:** The findings indicate that measures sensory processing may relate to some aspects of academic achievement and learning ability. However, this did not appear to be due to sensory associations with ADHD symptoms. The results also indicated that parent report and objective measures of sensory processing may measure different processes. While the former was related to academic achievement, the later appear to be related to domain general cognitive development. Additional studies are needed on the mechanisms by which sensory processing and cognitive development are related, academic achievement in ASD, and measurement issues in sensory processing research.

**411.005 (Poster)** Atypical Exogenous and Endogenous Orienting in People with ASD

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**Background:**

Attention orienting determines where we focus our concentration and is an essential contributor to all cognitive processes. It involves endogenous (goal-directed) and exogenous (stimulus-driven) systems. A deficit in attention orienting may be one of the earliest features in individuals with Autism Spectrum Disorder (ASD), but previous investigations into attention orienting in ASD have presented inconsistent results. Possible explanations are that the atypical attention orienting in individuals with ASD is related to abnormal alerting levels or appear during specific developmental periods. To date, it remains unclear what factors contribute to atypical attention orienting found in some individuals with ASD.

**Objectives:**

We aimed to examine whether individuals with ASD showed atypical attention orienting and whether the provision of an alerting tone and age affected attention orienting differently between the ASD and typically developing (TD) groups. Given limited

research on gender differences in ASD on attention, we also investigated whether males and females with ASD showed different patterns of attention orienting.

#### Methods:

Twenty-seven people with ASD (14 males; mean age = 21 years, SD = 9.21) and 22 TD people (13 males; mean age = 23 years, SD = 9.77) completed both the exogenous and endogenous Posner tasks. Participants were required to respond to a target on either the left or right side of the computer screen after presentation of a visual cue. The cues either validly or invalidly indicated the location of the target or they were non-informative neutral cues. An alerting tone was present before the visual cue in 50% of trials. Attention orienting was measured through the orienting effect (invalid trials RT – valid trials RT), benefit of valid cue effect (neutral trials RT – valid trials RT), and cost of invalid cue effect (invalid trials RT – neutral trials RT).

#### Results:

In the exogenous task, the ASD group showed a larger orienting effect and benefit effect compared to the TD group. No group difference was found in the cost effect. The alerting tone, age, and sex did not affect the outcome measures. In the endogenous task, the ASD group showed a larger cost effect compared to the TD group. No group difference was found in the orienting or benefit effect. The cost effect reduced with age in the ASD group but was stable across age in the TD group. The alerting tone and sex did not affect any outcome measures.

#### Conclusions:

The participants with ASD performed the Posner task with atypical exogenous and endogenous orienting. They were more efficient at orienting to valid exogenous cues but showed difficulties in disengaging from invalid endogenous cues. The provision of an alerting tone did not affect attention orienting for either group. Although attention orienting appeared to be stable after adolescence in the TD group, endogenous orienting continued to develop until middle adulthood in people with ASD.

#### **411.007** (Poster) Executive Function and Emotion Regulation As Predictors of Academic and Social Outcomes in Kindergarteners with ASD

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**Background:** Executive function (EF) and emotion regulation (ER) are critical for academic and social development in typically developing (TD) children (e.g., McClelland et al., 2007). However, EF and ER vary in young children with ASD (Konstantareas et al., 2006; Venter, Lord, & Schopler, 1992). Thus, more in-depth examinations of how school-entry EF and ER predict academic and social outcomes have strong implications for early interventions for young children with ASD.

**Objectives:** To examine how kindergarten-entry EF and ER predict concurrent and kindergarten-exit academic and social outcomes while controlling for age, gender, autism symptom severity, and cognitive levels.

**Methods:** Participants included 64 cognitively-able children with ASD (13 females) assessed at kindergarten-entry (M=63.8 months; SD=5.1) and -exit (M=72.3 months; SD=4.4). EF was assessed based on innovative, tablet-based tasks, “EF-Touch”, targeting inhibitory control (“Spatial Conflict Arrows”; SCA), working memory (“Pick the Picture”; PTP), and attention shifting (“Something’s the Same”; STS; all % correct rates). ER was measured by caregiver report using the Child Behavior Checklist-Dysregulation Profile (CBCL-DP; sum of three Syndrome Scale T-scores: Attention Problems, Anxious/Depressed, Aggressive Behavior). The Woodcock-Johnson III tests of achievement (WJ) was used to measure academic achievement in reading (Passage Comprehension [PC]) and math (Applied Problems [AP]). Social outcomes in the areas of Peer Interaction (PInteract), Peer Disruption (PDisrupt), and Peer Disconnection (PDisconnect) were assessed using the Penn Interactive Peer Play Scale (PIPPS). Kindergarten-entry ASD symptom severity and cognitive skills (Full Scale IQ) were assessed with the Autism Diagnostic Observation Schedule-2 calibrated severity scores (ADOS-2 CSS) and the Differential Ability Scale (DAS). Regression analyses were conducted to examine whether EF and ER significantly predicted concurrent and future academic and social outcomes while controlling for age, gender, ADOS CSS, and FSIQ. Two separate sets of analyses were conducted with EF Touch scores first and then with CBCL-DP.

**Results:** For concurrent predictions with EF, kindergarten-entry attention shifting (STS) predicted math performance (WJ AP; B=44.670, p=0.004). For ER, kindergarten-entry dysregulation levels predicted math performance (WJ AP, B=0.268, p=0.003) and peer play (PIPPS PDisrupt, B=0.291, p<0.001; PDisconnect, B=0.261, p=0.016; PInteract, B=-0.184, p=0.024). For the

predictions of kindergarten-exit outcomes with EF, kindergarten-entry attention shifting (STS) predicted math performance (AP;  $B=57.196$ ,  $p=0.003$ ). For ER, kindergarten-entry dysregulation levels also predicted kindergarten-exit math performance (WJ AP,  $B=0.260$ ,  $p=0.02$ ) and peer play (PIPPS PDisrupt,  $B=0.321$ ,  $p<0.001$ ; PDisconnect,  $B=0.199$ ,  $p=0.005$ ; PInteract,  $B=-0.156$ ,  $p=0.039$ ). All predictors were significant after controlling for age, gender, FSIQ, and symptom severity.

**Conclusions:** Kindergarten-entry EF and ER may play a critical role in concurrent and future academic and social development at kindergarten-exit in children with ASD. Impairments in attention shifting and emotion dysregulation predicted poor math outcomes. Emotion dysregulation also predicted higher levels of peer play disruption and disconnection and lower levels of peer interaction. Results highlight the importance of targeting EF and ER even before school-entry to maximize academic and social outcomes in children with ASD (Jones et al., 2017).

**411.008 (Poster)** Inhibitory Difficulties in Autism Spectrum Condition: A Nuanced View on an Ongoing Debate  
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**Background:** Difficulties in prepotent response inhibition (PRI) have been argued to explain the repetitive behavior, and social difficulties in autism spectrum conditions (ASC). However, the evidence in autistic adults is rather mixed. As PRI is a complex executive feature, we hypothesized that these mixed findings could be explained by the involvement of other executive features.

**Objectives:** We aimed to replicate the PRI difficulties of autistic individuals observed in previous research in a large adult sample. Furthermore, we investigated whether context monitoring and adaptation, two features hypothesized to be involved in PRI, were associated with these PRI difficulties.

**Methods:** We used a 3-stimulus Go-NoGo-task and a complementary 3-stimulus Oddball-task in a sample of 246 adults between 19 and 79 years (106 ASC and 146 non-ASC). Our pre-registered analysis plan ([osf.io/ayn7e](https://osf.io/ayn7e)) consists of three steps. 1) Group differences were analyzed on mean reaction time, standard deviation of reaction time, (c)omission errors, and post error slowing. 2) We investigated associations with age, and group\*age interactions on these measures. 3) We tested whether PRI (commission errors Go-NoGo) could be predicted by context monitoring (omission errors Oddball) and adaptation (post error slowing (PES) Go-NoGo) and their interactions with group, and age.

**Results:** Preliminary results showed 1) no significant group differences on any of the measures. 2) On the Go-NoGo task more (c)omission errors, more variable and slower responses, and more PES were associated with older age. On the Oddball task, older age was only related to slower responses, and more omission errors. No group\*age interactions were observed. 3) Commission errors were significantly associated with PES, but not with omission errors. No interactions with group, or age were observed.

**Conclusions:** We found no evidence for PRI difficulties in autistic adults. Also, no differences between groups in context monitoring and adaptation were observed. Nearly all measures showed a significant relation with age, highlighting the importance of age in explaining previous contrasting findings. Also, remarkably large standard deviations demonstrated the heterogeneous performance on these measures, and the caveats of using group-based statistics. Nonetheless, we carefully conclude that difficulties in PRI do not seem (dominantly) present in ASC.

**411.009 (Poster)** Investigating Executive Functioning in Preschool Children with Autism Spectrum Disorder  
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**Background:** Impairments in executive functions (EF), a group of complex inter-related cognitive processes that are essential for deliberate and goal-directed behaviour, have been reported in school-age children with Autism Spectrum Disorder (ASD). The results from studies on EF performance among preschool children with ASD are highly inconsistent and it therefore remains to be seen whether EF difficulties in preschool ASD children are linked to the disorder itself or other factors, including the nonverbal age (NVA).

**Objectives:** Compare the performance between ASD and typically developed (TD) preschool children on EF tasks and to investigate whether potential performance differences are independent of nonverbal age.

**Methods:** Fourteen children ( $M = 51.71$  months,  $SD = 6.32$ , range = 40 – 59, 85.7 % boys) with a confirmed ICD – 10 diagnosis of ASD and thirty-three TD children ( $M = 48.64$  months,  $SD = 6.92$ , range = 37 – 59, 57.6 % boys) performed two non-digital behavioral tasks, namely the Block Sorting Task (BST), consisting of 12 pre-switch and 12 post-switch trials, and the

Dimensional Card Sorting Task (DCST), consisting of 5 pre-switch and 5 post-switch trials. Both tasks are purported to measure cognitive flexibility and inhibitory control. Children's performance was video recorded and then coded. For each participant, the dependent variable was the composite score computed by adding the number of correctly sorted post-switch trials from both tasks. The composite score ranged from 0 to 17, with the latter indicating ceiling performance. The children were also assessed with the Mullen Scales of Early Learning from which the NVA was derived. At the day of this writing the process of participant recruitment is ongoing.

**Results:** There was a significant difference in performance ( $t(45) = -2.08, p = .043, 95\% \text{ CI} [-6.07 - -.10], \text{Hedges' } g = 0.67$ ) with ASD children performing worse ( $M = 9.21, SD = 5.19$ ) than TD children ( $M = 12.30, SD = 4.41$ ) on the sorting tasks. NVA was significantly different ( $t(45) = -5.89, p < 0.001, 95\% \text{ CI} [-22.66 - -11.11], \text{Hedges' } g = 1.87$ ) between the ASD ( $M = 32.25, SD = 8.38$ ) and TD groups ( $M = 49.13, SD = 9.22$ ). A multiple linear regression was conducted with group and NVA as predictor variables and composite scores as outcome. The results indicated that the model explained 22.8% of the variance of the composite scores ( $F(2,44) = 6.49, p = .003$ ). While NVA contributed significantly to the model ( $B = .202, p = .007$ ), the group variable did not ( $B = -.328, p = .859$ ).

**Conclusions:** The results suggest that factors other than ASD, in this case NVA, may be responsible for the difference in performance on the executive functioning task. It may be the case that factors that are not exclusive to ASD but highly associated with the disorder may be contributing to the impairment in EF in young children.

**411.010 (Poster) Long-Term Melodic and Pitch Memory in Children with Autism Spectrum Disorder.**

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**Background:** Short and long-term memory for individual tones and melody are enhanced among some musically untrained persons with autism spectrum disorder (ASD) (Bonnell et al., 2003; Stanutz, Wapnick, & Burack, 2014). Particularly, absolute pitch (AP), the ability to identify pitch of a tone without a reference pitch, is enhanced among musical savants with autism (Hermelin, 2001). As the abilities to identify and distinguish pitches are not as outstanding in typically developing (TD) children (Cooper, 1995; Fancourt, Dick & Stewart, 2013), AP may offer a potential framework for understanding the musical memory strengths of persons with ASD.

As visual-spatial skills have been linked to musical learning among both TD persons (Rauscher & Zupane, 2000) and musical savants with ASD (Heaton 2012), they may be a potential mechanism for the enhanced musical memory among persons with ASD.

**Objectives:** Investigate the potential roles of pitch memory and visual-spatial skills in performance on a melodic memory task among high functioning children with ASD.

**Methods:** High functioning children with ASD aged 8-12 years and TD children matched on chronological (and mental) age learned 4 melodies and completed a melodic memory task one week later. In the first session, the participants learned melodies in a specific key that were each matched to a specific animal. One week later, the participants were presented each of the four melodies in the original key and two other transposed keys. They were then asked to identify 1) the key in which they originally learned each melody; and 2) the animal with which each melody was paired. The Wechsler Abbreviated Scale of Intelligence, 2<sup>nd</sup> edition (WASI-II), Digit Span of the Wechsler Intelligence Scale for Children, 5<sup>th</sup> edition (WISC-V, DS), Salk and McGill Music Inventory (SAMMI, Levitin et al. 2004), and Music Training and Experience Questionnaire (MTEQ, Quintin et al., 2011) were administered to account for intelligence and musical experience. The children with ASD were assessed with the Autism Diagnostic Observation Schedule, 2<sup>nd</sup> edition (ADOS-2) to confirm their diagnosis. One parent of each child completed the Social Responsiveness Scale, 2<sup>nd</sup> edition (SRS-2) and the Social Communications Questionnaire Lifetime version (SCQ-L) to ascertain autism symptomatology among the participants with ASD and to ensure that the TD children did not present with signs of ASD.

**Results:** In preliminary analyses, 7 children with ASD showed more accurate long-term melodic memory ( $p < .05$ ) than 16 TD children after accounting for intelligence and auditory working memory (measured with WISC-V, DS), but no group difference were found in distinguishing the target melody from the transposed version of the melody ( $p > .05$ ) (Figure 1). Correlational analyses revealed a positive relationship between accuracy in pitch memory task and all of the cognitive measures among the participants with ASD, but not among the TD participants (Table 1).

**Conclusions:** These tentative findings suggest that previously documented strengths in musical memory among children with ASD are attributable to melodic memory rather than pitch memory. They also suggest the potential cognitive overlap between visuo-spatial skills and pitch memory within children with ASD.

**411.011 (Poster)** Measuring the Impact of Bilingualism on Inhibitory Control Abilities in Autistic Children.

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**Background:** There is a dearth of empirical literature addressing how bilingualism might impact upon those with autism. The limited literature that currently exists suggests that bilingual exposure is unlikely to lead to poorer development in children with ASD and could provide an advantage across a number of cognitive domains. However, many parents remain concerned about the potentially harmful effects of bilingualism on cognitive development.

**Objectives:** The overall aim of this research is to explore the impact of bilingualism on cognitive development in autistic children. Here we advance understanding of the relationship between bilingualism and inhibitory control; an area in which autistic people frequently exhibit difficulties.

**Methods:** Eighty-eight (43 autistic, 45 non-autistic) children aged 5-12 years were included in the analysis. In order to understand the potential cumulative effects of bilingualism, exposure was analysed as a continuous variable, with participants reporting varying levels of bilingual exposure. Participants completed two widely used measures of inhibitory control; The Psychomotor vigilance task (PVT) and the Flanker Task. In addition, IQ, expressive language and demographic information was collected.

**Results:** For each measure of inhibitory control, we fit a linear mixed effects models with fixed effects of Group (autistic / non-autistic), Bilingual Exposure, Age and IQ. For the PVT, a two-way interaction term between bilingualism and group was included, with Number of False Starts at the outcome variable. For the Flanker, Trial Type (congruent/ incongruent), and a three-way interaction between Group, Bilingualism and Trial Type were included, with Reaction Time as the outcome variable. The number of variables were reduced using a backwards stepwise selection procedure.

*PVT:*

Number of False Starts (error rate) was significantly associated with Bilingual Exposure across all participants (Odds Ratio = 0.19, CI = [0.11 – 0.34],  $p = 0.001$ ), when accounting for Age (Odds Ratio = 0.41, CI = [0.20 – 0.83],  $p = 0.014$ ) and IQ (Odds Ratio = 2.46, CI = [1.22 – 4.99],  $p = 0.012$ ). Model fit using conditional  $R^2 = 0.663$ . Higher levels of Bilingual Exposure were associated with fewer False Starts.

*Flanker:*

Reaction Time of correct responses was predicted by Age (Estimate = -0.08, CI = [-0.15 – 0.00],  $p = 0.040$ ), IQ (Estimate = -0.16, CI = [-0.24 – 0.09],  $p = <0.001$ ), and Bilingual Exposure (Estimate = 0.06, CI = [-0.00 – 0.12],  $p = 0.051$ ) across all participants. Although Bilingual Exposure did not reach significance as a predictor, it contributed significantly to the fit of the model,  $R^2 = 0.603$ .

**Conclusions:** The results provide preliminary evidence that increased bilingual exposure could positively impact on aspects of inhibitory control. This is the first study to analyse bilingual exposure as a continuous variable, showing the possible cumulative positive effects from greater exposure. The study proposes the possibility that bilingualism could provide a naturalistic opportunity to further develop specific executive function skills, and importantly, demonstrates that bilingualism is not harmful for these skills in autistic children. The work makes important contributions to an evidence base for parents to make an informed decision about bilingualism.

**411.012 (Poster)** Memory for Actions and Reality Monitoring in Adults with Autism Spectrum Disorder

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**Background:**

People with autism spectrum disorder (ASD) often have repetition errors. Previous studies in typically developing people (TD) have reported that reality monitoring errors are associated with repetition errors. Reality monitoring is defined as distinguishing between internally generated information sources, such as images, from externally generated information sources, such as perceived or performed actions. The results of previous studies on reality monitoring in people with ASD have been inconsistent,

and there are no studies that have used performance, including imagined or performed actions. Moreover, previous studies on reality monitoring in ASD have assessed memory performance. People with ASD are known to have reduced self-related memory. Therefore, we assessed the memory performance of people with ASD.

#### Objectives:

The purpose of this study was twofold: (1) to investigate reality monitoring regarding actions in people with ASD, and (2) to investigate the memory for actions and memory for action images in people with ASD.

#### Methods:

Twenty adults with ASD (18 men and 2 women) and twenty neurotypical adults (6 men and 14 women) participated in the study. Participants in the ASD group had received formal diagnoses of ASD, according to the criteria of the DSM-IV and ICD-10. The ASD group was recruited from a Career Transition Support Office in Hyogo Prefecture. All participants were fully informed about the study, and they gave their written consent for participation. The ethics committee of the author's institution approved the study protocol. All study procedures were conducted in accordance with the Helsinki Declaration.

Participants memorized action sentences, such as "wear a hat," under three conditions. In the imagined condition, participants imagined the action and memorized the sentences read by the experimenter. In the pantomime condition, the experimenter read each sentence aloud, and the participants memorized the sentences by performing them. In the enactment condition, after the experimenter read each sentence aloud, the participants performed the action using objects and memorized the sentences. After that, free recall, yes/no recognition, and reality monitoring tests were conducted immediately and one week later.

#### Results:

The results indicated that there was no difference between the ASD and TD groups in reality monitoring (Fig.1). The free recall performance of the ASD group was lower than that of the TD group, and both were ranked in the order of Enacted, Pantomime, and Imaged conditions (Fig.2). Moreover, there was no significant difference in recognition between the groups.

#### Conclusions:

People with ASD have intact reality monitoring. Reality monitoring does not affect repetition errors in people with ASD. However, free recall performance of those with ASD was lower than TD. It is possible that a decline in self-related memory is associated with repetitive errors in ASD.

#### **411.013 (Poster)** Mind the Gap: Does Executive Functioning Predict the Discrepancy between IQ and Adaptive Functioning in Children with ASD without ID?

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**Background:** Autism spectrum disorder (ASD) is associated with poor adaptive functioning (AF), even in the absence of intellectual disability (ID). AF decreases with age relative to non-ASD peers, whereas the gap between IQ and age-expected AF increases with age (Pugliese et al., 2015). Executive functioning (EF) and AF are correlated in ASD (Pugliese et al., 2015; Pugliese et al., 2016), although results are mixed regarding which aspects of EF and AF are linked. No study has examined the association between EF and the gap between IQ and AF in children with ASD without ID.

**Objectives:** We aim to evaluate whether: (a) AF decreases with age relative to same-age peers, (b) the gap between IQ and AF increases with age, and (c) EF is associated with AF. We will also explore (d) which components of EF are associated with the gap between IQ and AF.

**Methods:** Parents of children with ASD without ID (N = 101, 89% boys) ages 84 - 144 months completed the Vineland Adaptive Behavior Scales (VABS) and the Behavior Rating Inventory of Executive Functioning (BRIEF). Multiple regressions examined whether age predicted (a) VABS domain scores beyond IQ, income, and parental education, and (b) the gap between IQ and VABS domain scores beyond income and parental education. Hierarchical regressions examined whether BRIEF Behavioral Regulation Index (BRI) or Metacognition Index (MCI) predicted (c) VABS domain scores beyond age and IQ and (d) the gap between IQ and VABS domain scores beyond age and income. When BRIEF index scores were significant, subsequent analyses explored which subscales predicted each outcome.

Results: Age negatively related to VABS Communication ( $\beta = -.380, p < .001$ ), Daily Living Skills ( $\beta = -.325, p = .001$ ) and Socialization ( $\beta = -.377, p < .001$ ). Age positively related to the gap between IQ and VABS Communication ( $\beta = .324, p = .001$ ), Daily Living Skills ( $\beta = .259, p = .01$ ), and Socialization ( $\beta = .280, p = .006$ ). MCI significantly predicted Communication ( $\beta = -.353, p = .002$ )—specifically Working Memory ( $\beta = -.375, p = .004$ ). Neither MCI ( $\beta = -.199, p = .10$ ) nor BRI ( $\beta = .082, p = .52$ ) predicted Daily Living Skills. BRI significantly predicted Socialization ( $\beta = -.316, p = .006$ )—particularly Emotional Control ( $\beta = -.299, p = .016$ ). Neither MCI nor BRI predicted the gaps between IQ and Communication or Daily Living Skills. Only BRI predicted the gap between IQ and Socialization ( $\beta = .435, p < .001$ )—particularly Emotional Control ( $\beta = .263, p = .04$ ).

Conclusions: Children with ASD without ID decline in AF compared to same-age peers and the gap between IQ and AF increases with age. Greater working memory deficits predicted lower communication skills and greater emotional control deficits predicted lower socialization skills. EF did not predict the gap between IQ and communication or daily living skills. However, greater emotional control deficits predicted a larger gap between IQ and socialization. These findings demonstrate the potential importance of EF interventions for this population.

**411.016 (Poster) Rhythm Perception: A Preserved Musical Ability of Children with Autism Spectrum Disorder**  
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Background: There is growing evidence showing musical ability as a strength of people with autism spectrum disorder (ASD). Many studies demonstrate intact or superior musical pitch, melody, and memory perception in ASD (Heaton, 2009), but only a few studies explore musical rhythm perception abilities. The preliminary research on rhythm perception suggests that people with ASD can process and produce simple and complex rhythms and that these musical skills are positively linked to cognitive visuospatial skills in adolescence (DePape et al., 2012). Therefore, it is possible that rhythmic patterns in music can be used as temporal cues for synchronizing social interactions and facilitating impulse control in children and adolescents with ASD (Pellitteri, 2000). However, more research on the developmental trajectory of rhythm perception and its association with cognitive skills is necessary for future intervention planning.

Objectives: The purpose of this research is to 1) compare rhythm perception in typically developing (TD) children and children with ASD, as well as 2) compare rhythm perception and 3) its association with cognitive skills in younger and older children with ASD.

Methods: Eighteen TD children and 29 children with ASD (6-12 years of age) were recruited to examine objective #1. Nineteen older children with ASD (13-17 years of age) were also recruited to examine objective #2-3. All the participants completed a cognitive test (WISC-V/ WASI) and a rhythm perception task, which was an adapted version of the Beat Alignment Test (Iverson & Patel, 2008). The participants listened to short musical excerpts with overlaid beeps (on or off the musical beat) and identified whether the beeps matched the musical beat.

Results: One-sample t-tests revealed that TD children and children with ASD performed above chance level (two choices: 50%) on the rhythm perception task ( $p < .05$ ); however, further inspection revealed that children with ASD with cognitive difficulties (full scale IQ < 70) could not complete the task above chance level, ( $p > .05$ ) and thus, were removed from the sample ( $n = 8$ ). An independent t-test revealed no group differences in task performance ( $p > .05$ ). #2: There was also no difference in task performance between younger and older children with ASD ( $p < .05$ ). Pearson correlations was used to confirm that there was no significant relationship between task performance and the age of participants ( $p > .05$ ). #3: There was a strong positive correlation between visual-spatial abilities and rhythmic perception in older children with ASD ( $r = .52, p < .05$ ) but not in younger children with ASD ( $p > .05$ ).

Conclusions: Findings are consistent with previous research showing preserved rhythm perception for children with ASD across development, though this may not extend to children with ASD with cognitive difficulties. In harmony with the literature, we also found that rhythmic perception abilities are associated with visual-spatial abilities in adolescence. Findings could help guide the development of musical training programs that leverage preserved rhythm perception in ASD by using rhythmic patterns in music to facilitate behavioural (social skills, impulse control) and cognitive (visual-spatial abilities) functioning.

**411.017 (Poster)** Sensorimotor Flexibility in Autism Spectrum Disorders: The Contextual Interference Effect Facilitates the Retention and Transfer of Newly Acquired Sensorimotor Skills

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**Background:** Acquiring sensorimotor skills via random practice (i.e., performing different actions) often facilitates retention and transfer compared to blocked practice (i.e., performing the same action). Random practice facilitates learning by inducing effortful and elaborative cognitive processing known as the contextual interference (CI) effect (Shea & Morgan, 1979). Although autistic individuals acquire sensorimotor skills via blocked (Foster et al., 2020) and random practice (Hayes et al., 2016), these studies did not measure performance in retention or transfer. Therefore, whilst these findings indicate sensorimotor adaptation across practice, it is unclear whether these processing effects underpin the CI effect in autistic individuals.

**Objectives:** (1) to examine CI in autistic children.

**Methods:** Thirty autistic (mean age: 11.3 (1.8) years.months; 6 female) and thirty matched neurotypical (mean age: 10.9 (1.6) years.months; 6 female) children volunteered for the study, which was approved by the local ethics committee. Children practised three different 3-segment motor sequences during an acquisition phase via blocked (low CI), or random (high CI), practice. Children then performed the practised sequences in two retention tests (random and blocked structures) and two transfer tests (novel 3-segment and 4-segment sequences). We quantified *reaction time (RT)*, *movement time (MT)* and *total time (TT)* from all children across the three phases. To examine the CI effect, a *retention/transfer index* [last 5 trials of acquisition – first 5 trials of test] was calculated for *RT/MT/TT* from the retention, and transfer, tests. Retention scores for *RT/MT/TT* were analysed using separate 2 *diagnosis* (autism, neurotypical) x 2 *practice* (blocked, random) x 2 *test* (blocked, random) mixed design ANOVAs. Transfer test scores were analysed using separate 2 *diagnosis* (autism, neurotypical) x 2 *practice* (blocked, random) mixed design ANOVAs.

**Results:** There were no diagnosis effects in retention ( $ps > 0.05$ ). *RT* and *TT* scores were superior ( $ps < 0.05$ ) in the retention test following random, compared to blocked, practice. Blocked practice specifically led to poorer ( $p < 0.05$ ) *MT* and *TT* scores in the random retention test. Transfer scores for *RT* and *TT* in the 3-segment transfer test were superior following random practice ( $ps < 0.05$ ), but autistic children had poorer *RT* scores ( $p < 0.05$ ). There was no effect of practice ( $p > 0.05$ ) between transfer scores in the 4-segment transfer test ( $p > 0.05$ ), but compared to the neurotypical children, the autistic children showed poorer *RT* and *TT* scores ( $ps < 0.05$ ).

**Conclusions:** Autistic and neurotypical children that learned via random practice showed superior *RT* and *TT* scores in retention, and transfer (novel 3-segment sequence). Whilst sensorimotor planning problems have often been reported (Rinehart et al., 2001) in autism, the present CI effect suggests that domain general elaborative cognitive planning processes are operational. Importantly by designing interventions and/or tasks that effectively engage these processes (i.e., via random practice) they can better support the development of internal action models that support sensorimotor flexibility to different task demands.

**411.018 (Poster)** The Relationship between Performance on a Musical Working Memory Task and Parent Reports of Working Memory: A Comparison between Typically Developing Children and Children with ASD.

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Background:

Autism Spectrum Disorder (ASD) is often associated with strengths in music perception, which requires auditory working memory, although parent reports often suggest difficulty with working memory in daily life.

Objectives:

We thus aim to **1**) compare the performance of typically developing (TD) children and children with ASD on a musical working memory task and **2**) investigate the relationship between the performance on a musical working memory task and (non-musical) day-to-day working memory skills.

## Methods:

Eighteen children with ASD (age= 6-12) and eighteen TD children (age= 7-11) participated in this study. To assess musical working memory, sequences of 3, 4, and 5 pitches were presented in pairs and participants were asked to identify whether sequence-pairs were similar or different. The 4 and 5 pitch sequences included two conditions: 1) the different sequence-pairs introduced a new pitch, or 2) the different sequence-pairs used already introduced pitch but inverted their position in the sequence. The goal of creating these two conditions (e.g., 4 pitch vs. 4 pitch with inversion) was to increase the task's complexity. Total performance was calculated as Hits minus False Alarms. The Working Memory Scale of the Behavior Rating Inventory of Executive Functions-2 (BRIEF-2) parent questionnaire was used as a potential correlate of the participants' task performance.

## Results:

1) Independent sample t-tests revealed that total performance on the musical working memory task did not differ between the ASD and TD groups, nor did it differ on the 3- 4- 5-pitch and 4- 5-pitch with inversion conditions (all  $p$ -values  $>.05$ ). However, when comparing the performance within groups, the TD group performed significantly lower on the 4-pitch with inversion vs. the 4-pitch condition ( $p=.001$ ), while the ASD group's performance did not differ between conditions ( $p=.110$ ). Both ASD and TD groups performed significantly lower on the 5-pitch with inversion vs 5-pitch condition ( $p=.01$ ) 2) Independent sample t-test revealed that there was significantly lower BRIEF-2 working memory skills in the ASD compared to TD group ( $p=.01$ ). However, BRIEF-2 working memory skills were not related to musical working memory task performance for either group.

## Conclusions:

Our findings reveal that children with ASD performed equally well on the musical working memory task in comparison to TD children. While the 5-pitch sequences were more difficult for both groups, the ASD group's performance on the 4-pitch sequences with and without inversion revealed that they were not as impacted by the complexity and difficulty of the task in comparison to TD children. This finding is in line with documented strengths of people with ASD in musical perception. Furthermore, parent reports of working memory were not related to task performance for either group. Results provide preliminary evidence for the use of music as a strength-based modality to assess the working memory abilities of children with ASD to complement traditional tests and questionnaires.

### 411.019 (Poster) Visual Perception in Autism: Autistic Adults Are More Accurate at Identifying Subtle Differences between Stimuli.

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**Background:** Autism is associated with superior attention to detail (Shah & Frith, 1983), heightened drive to “systemize” (i.e. to identify if-and-then rules in a system) (Baron-Cohen et al., 2003; 2009), and enhanced perceptual function (Motttron et al., 2006). Evidence of distinct autistic perception has been derived from decades of historical reports, first-hand accounts, and behavioural research. For example, autistic individuals have consistently shown superior performance on tasks related to visual search and identifying hidden figures in complex scenes.

**Objectives:** To examine visual perception in autistic vs non-autistic adults by means of web-based cognitive tasks.

**Methods:** 140 autistic (82 females) and 147 non-autistic (118 females) adults aged 18-60 years participated in this study. Participants completed a battery of cognitive tasks probing working memory and visual perception via *Cambridge Brain Sciences*, a web-based platform for cognitive assessments. Participants whose working memory performance fell below 2 standard deviations from each group mean were excluded from further analysis. The following 2 visual perception tasks were employed:

1. *Polygons:* A pair of overlapping polygons is displayed on one side of the screen. Participants indicate whether a polygon displayed on the other side of the screen is identical (“match”) or not identical (“mismatch”) to one of the interlocking polygons.
2. *Feature Match:* Two grids are displayed on the screen, each containing an array of abstract shapes. In half of the trials the grids differ by just one shape. Participants indicate whether or not the grid's contents are identical (“match”) or not identical (“mismatch”).

To investigate group differences in the visual perception tasks, we conducted a 2x2 Factorial ANOVA on accuracy rates with group (autistic vs non-autistic) and task condition (“match” vs “mismatch”) as factors. To account for the unbalanced sex ratio, an exploratory analysis was then conducted on the female only subgroups to ensure that the sex did not affect the direction of the results.

**Results:** Autistic individuals had higher mean accuracy rates in the “mismatch” condition of the *Polygons* task (Fig1a). The 2x2 ANOVA on *Polygons* accuracy rates showed a significant group-by-task condition interaction ( $F_{1,16}=7.0852, p=0.008013^*$ ) (Fig 1c). Meanwhile, *Feature Match* accuracy rates were high across both groups, with autistic individuals showing more ceiling effects on the “mismatch” condition (Fig1b). The 2x2 ANOVA on *Feature Match* accuracy rates revealed a significant group-by-task condition interaction ( $F_{1,16}=6.6305, p=0.0103^*$ ) (Fig 1d).

**Conclusions:** On average, autistic individuals, when compared to non-autistic controls, made significantly more correct responses in the “mismatch” conditions of visual perception tasks, i.e., autistic individuals were found to be better at identifying subtle differences between stimuli. These findings lend support to a large body of evidence of distinct autistic perception.

## POSTER SESSION — COGNITIVE NEUROSCIENCE

### Poster 412 - Cognitive Neuroscience Posters

**412.001** (Poster) Associative Learning Under Uncertainty in ASD: Intact Learning of Cue-Outcome Contingencies but Slower Updating of Predictions after a Change in Contingency

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Background: Autism Spectrum Disorder (ASD) is characterized by heterogeneous social and non-social symptoms. Recent predictive coding theories have attempted to account for this heterogeneity in an integrated theory by suggesting that atypical perceptual learning could play a central role in ASD. Specifically, priors, which capture the underlying statistical regularities of the environment, may be atypically learnt in ASD.

Objectives: We aimed to investigate whether adults with ASD can learn and adjust their prior in a very uncertain environment.

Methods: Participants were 29 neurotypical (NT) adults (13 males,  $M = 23.5$  years old) and 25 adults with ASD (13 males,  $M = 27.2$  years old). In an associative learning task (384 trials), based on a study by Weinhhammer and colleagues (2018), participants heard a high or a low tone, then predicted the rotation direction of two dots (prediction response), perceived the actual rotation and reported their percept (perception response). The tone and rotation were congruent in 62.5% of the trials and incongruent in 25% of the trials to allow participants to learn the main contingency (total of 87.5% of unambiguous trials). In another 12.5% of the trials, the dot pair did not rotate (ambiguous trial) but could be perceived as rotating if priors biased percepts. Associative learning could be explicitly assessed with the prediction response, and more implicitly assessed with the perception response in ambiguous trials. The tone-rotation association changed every 16, 24 or 32 trials. Hierarchical Gaussian Modelling was used to characterize learning in this task.

Results: On average, NT and ASD participants had  $61\% \pm 7$  and  $58\% \pm 6$  of correct prediction responses. In order to assess how the prior about the cue-outcome association was updated after a change in contingency, we performed an ANOVA with the factor group and part (beginning vs. end, i.e., 8 first trials after a change vs. 8 last trials before a change). There was an interaction between group and part ( $p < .0005$ ), as the percentage of correct predictions significantly increased in the NT group (beginning:  $55\% \pm 5$ , end:  $64\% \pm 8$ ,  $p < .0001$ ), whereas there was no improvement in the ASD group (beginning:  $58\% \pm 6$ , end:  $58\% \pm 7$ ,  $p = .98$ ) (Figure 1). The percentage of ambiguous trials perceived according to the current contingency was above chance level in NT ( $61\% \pm 9$ ,  $p < .0001$ ) and ASD ( $56\% \pm 6$ ,  $p < .0001$ ), but this prior bias was smaller ASD ( $p < .05$ ). Computational models showed that the influence of associative learning was stronger in the NT than ASD group, while the learning rates did not differ.

Conclusions: Adults with ASD can learn priors in uncertain contexts but are less flexible to update their prior after a change in contingency. This is consistent with predictive coding theories suggesting more inflexibility in ASD. Using the same paradigm, we recently conducted an fMRI experiment to identify the neural correlates of prediction learning in ASD.

**412.002** (Poster) Atypical Temporal Distraction in Processing Visual Temporal Order in Individuals with Autism Spectrum Disorders.

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Background:

Atypical sensory processing has been getting attention in researches for autism spectrum disorders (ASD). Individuals with ASD often show enhanced perceptual function, such as in efficiently finding a visual target from distractors (Motttron et al., 2006), implying a relationship between sensory dysfunction in their daily life and the atypical attention towards incoming sensory stimuli.

## Objectives:

We examined the potential linkage between sensory hyperresponsiveness and temporal processing in ASD by focusing on stimulus simultaneity and temporal order. A previous literature reported that temporal resolution of two distinct asynchronous stimuli in temporal order judgment (TOJ) was worsened by temporally distributed distractors in typically developed (TD) participants (Vatakis et al., 2007). In that experiment, temporal resolution for those asynchronous stimuli at the second and third serial positions of four successive sets was impaired. We hypothesized that magnitude of the distractive effect on temporal resolution may relate to sensory hyperresponsiveness in ASD.

## Methods:

Thirty-one Japanese participants (15 ASDs and 16 TDs) observed four successive sets of the left and right white gaussian blobs (Fig 1. left top). One out of the four sets were formed by two asynchronous blobs (Target) while the others involved synchronous blobs (Distractors); participants were required to report whether the two blobs perceived as simultaneous in all the sets (simultaneity judgment: SJ), and which blob was presented latter (TOJ). The asynchronous blobs were temporally separated by various gaps (stimulus onset asynchrony: SOA), and the serial position presented the target set was randomly changed in every trial. We also evaluated individual sensory hyperresponsiveness by using the Adolescent/Adult Sensory Profile (Brown et al., 2001).

## Results:

As demonstrated in the previous report, TD participants showed poorer temporal resolution in the serial positions surrounded by the sets with task-irrelevant synchronous stimuli (thus, the second and third positions) in the TOJ (comparisons with the first set using Wilcoxon signed rank test,  $ps < 0.05$ ). The temporal resolution of TOJ in the position 2 and 4 were worsened in ASD ( $ps < 0.05$ ), suggesting quicker return to the neutral temporal resolution from the distraction by preceding task-irrelevant stimulus set, than the TD group. None of the position-dependent differences in SJ was observed in either group. In the ASD group, the effect of distraction in the serial positions following the first set estimated by the difference between the mean temporal resolution in worsened sets (i.e., 2 and 4) and the one in intact set (i.e., 3) correlated with individual sensory hyperreactivity score (sum of Sensory sensitivity and Sensation avoiding) ( $r = -0.59$ , permutation-based correlation analysis,  $p = 0.02$ ). This relationship was not observed in the TD group.

## Conclusions:

Previous studies reported that individuals with ASD have difficulty in detecting the visual target among sequentially presented distractors because of continuous temporal attention (Keehn et al., 2016, 2017). Our results suggest that temporal attention towards stimuli during higher-order temporal processing (i.e., TOJ; Jaśkowski, 1991) is linked to sensory hyperresponsiveness, and its underlying mechanism may depend on shortened inhibition of temporal processing for incoming stimuli.

## **412.003 (Poster)** Autism Spectrum Disorder, Learning What to Ignore: Deficits in Psychological Priors over Attribute Informativeness

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## Background:

There is an acute need for well-justified behavioral assays that enable detection and stratification of psychiatric disease. Autism spectrum disorder (ASD) in particular benefits from early detection and therapeutic intervention. Those with ASD have long been described as having issues with generalization and filtering of irrelevant information (1). Probands often display high precision in sensory representation and amazing attention to detail, along with pathologically rigid behavior (2). To investigate these phenomena, recent studies have examined how those with ASD use attribute information when inferring underlying latent states in the environment (3,4). They found that performance differences between those with ASD and neurotypicals are primarily driven by an altered way in which those with ASD assign informativeness to latent state attributes.

## Objectives:

We lack the kind of theoretical foundation for these behaviors that can provide insight into the etiology of ASD. Such tools can facilitate the design of tasks that are easily administered in clinical and online settings, advancing our ability both to study ASD, as well as produce behavioral markers that improve detection.

## Methods:

The emerging field of Computational Psychiatry aim to bridge the gap between a mechanistic understanding of brain function and the signs observed in disease. Two of the more successful frameworks that have enriched understanding a wide variety of psychiatric phenomenon are reinforcement learning and Bayesian inference. Reinforcement learning posits that by utilizing reward prediction errors (involving dopamine), we can develop an accurate value to assign to stimuli or actions. Bayesian inference is a statistical framework through which incoming information is integrated with prior assumptions. In this study, we utilized a latent-state reinforcement learning model to characterize the use of psychological priors over attribute informativeness.

## Results:

We find that generalization is primarily impacted by priors over attributes informative for distinguishing between latent states (rather than priors over defining latent states). Furthermore, we find in a behavioral experiment that human subjects perform as predicted by the model.

## Conclusions:

We propose that the over-attention to detail and difficulty in generalization observed in subjects with ASD results from a disruption in the formation of priors over attributes informative for distinguishing between latent states. We also present a specific, validated task for testing these predictions.

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### 412.004 (Poster) Brain Imaging Investigation of the Hippocampal and Amygdala Structural Changes in Autism throughout Development

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**Background:** Autism spectrum disorder (ASD) is typically characterized by deficits in social communication and by restrictive and repetitive patterns in behaviour. Individuals with ASD have also been found to have impaired episodic memory which involves recalling one’s own experiences. Two important brain regions, namely the hippocampus and amygdala, have been linked to these episodic memory deficits in ASD. However, the structural changes occurring in the hippocampus and amygdala in ASD throughout development are poorly understood. In addition, previous studies have focused on whole hippocampal and whole amygdala volume and have not investigated the subfields of the hippocampus or nuclei of the amygdala in ASD. Given the differences in histological characteristics and function between hippocampal subfields and amygdala nuclei, it’s important to study these individual subfields/nuclei in order to have a comprehensive understanding of the structural changes occurring in these brain regions in ASD.

**Objectives:** Our aim was therefore to investigate the volumetric changes of hippocampal subfields and amygdala nuclei in ASD at various ages (5-21), allowing us to better understand the development of episodic memory deficits in ASD.

**Methods:** Magnetic Resonance Imaging (MRI) data from autistic (n = 195, mean age = 10.91, 33 females) and neurotypical (n = 109, mean age = 9.79, 48 females) participants aged 5 to 21 from the Healthy Brain Network, a large-scale open-source dataset, was used for this study. Participant’s T1-weighted MRI scans were analyzed using FreeSurfer. The “Segmentation of Hippocampal Subfields and Nuclei of the Amygdala (cross-sectional and longitudinal)” module of FreeSurfer (Iglesias *et al.*, 2015; Saygin *et al.*, 2017) was used to segment the amygdala into 9 nuclei and the hippocampus into 12 individual subfields and

3 merged subfields (ie. hippocampal head, body and tail). Volumetric measurements for these subfields and nuclei were then extracted for each participant and compared between groups.

**Results:** After correcting for age and sex, we found no significant differences in amygdala nuclei volumes between the ASD and neurotypical groups. The volume of the left hemisphere hippocampal cornu ammonis 1 (CA1) body subfield showed a significant difference between the groups. The left CA1 body volume was enlarged in the ASD group (t-value = 3.34, p-value = 0.0009) and increased with age ( $r^2 = 0.03$  and p-value = 0.02). No differences in volume were observed for the other hippocampal subfields.

**Conclusions:** This exploratory study provides evidence that the left hippocampal CA1 body is structurally abnormal in ASD. It also suggests that hippocampal volumetric differences exist between children and adolescents with ASD. These findings may help us better understand the pathophysiology and the neuroanatomical underpinnings of ASD. Given the critical role of the human hippocampal CA1 in autobiographical memory retrieval and for re-experiencing detailed episodic memories (Bartsch *et al.*, 2011), future work will examine how episodic memory deficits in ASD is linked with hippocampal subfield abnormalities.

**412.005 (Poster)** Cortico-Striatal Functional Connectivity Predict Higher Rates of Camouflaging and Better Cognitive Control in Females but Not Males with Autism Spectrum Disorder

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**Background:** Research shows that females with autism spectrum disorder (ASD) engage in more camouflaging behavior than males with ASD and neurotypical (NT) groups. Higher rates of camouflaging in ASD have been linked to better cognitive control. However, little is known about sex differences in the neurocircuitry underlying increased camouflaging observed in females with ASD. Characterizing brain circuits underlying compensatory behaviors in ASD may inform future research investigating prognosis and sex-specific treatment development.

**Objectives:** This study aimed to characterize functional connectivity (FC) patterns supporting higher rates of camouflaging in females with ASD relative to males with ASD and NT groups as well as associations with cognitive control.

**Methods:** The sample comprised 71 non-intellectually disabled adults, including 18 females with ASD (ASDF; mean age: 38.6 [13.7, 19-60]), 18 NT females (NT-F; mean age: 41.6 [15.9, 18-65]), 19 males with ASD (ASD-M; mean age: 43.3 [11.2, 26-64]), and 16 NT males (NT-M; mean age: 44.6 [10.5, 26-62]). Camouflaging was measured via the Camouflaging Autistic Traits Questionnaire (CAT-Q) Compensation, Masking, and Assimilation subscales. Participants completed a six-minute, eyes-closed, resting-state fMRI scan. Resting-state data was preprocessed using SPM12. The CONN Toolbox was used for denoising (aCompCor, scrubbing, 12 realignment parameters) and group analysis. Group-MVPA identified clusters expressing sex-by-diagnosis differences in camouflaging-FC associations for the three CAT-Q subscales ( $p < .01$ , FDR-corrected, cluster-level, age/IQ covariates). Post-hoc seed-to-voxel analysis identified which MVPA clusters that expressed the interaction contrast of interest (ASD-F > ASD-M, NT-F < NT-M for camouflaging-FC associations;  $p < .01$ , FDR-corrected, cluster-level). Post-hoc analysis tested associations between identified FC patterns and cognitive control (Wisconsin Card Sorting Task Perseverative Errors;  $p < .05$ , uncorrected, age covariate).

**Results:** Behavioral results showed a significant sex-by-diagnosis interaction for the CAT-Q Compensation subscale (but not Masking or Assimilation), such that adults with ASD showed more camouflaging than NT adults with a greater magnitude of difference in females. Group-MVPA revealed no sex-by-diagnosis interactions for FC associations with CAT-Q Masking/Assimilation subscales. However, five clusters showed sex-by-diagnosis interactions for CAT-Q Compensation-FC associations (brainstem, left occipital pole, right pre-central gyrus, and left putamen/white matter). Post-hoc seed-to-voxel analysis revealed that only FC patterns with the left putamen cluster reflected the interaction contrast of interest (ASD-F > ASD-M, NT-F < NT-M for camouflaging-FC associations). Specifically, left putamen FC with two clusters associated with the salience network (right inferior frontal gyrus [IFG] and right supramarginal gyrus [SMG]) showed stronger positive associations with compensatory camouflaging for ASD-F and NT-M but not for ASD-M or NT-F. Post-hoc associations with cognitive control revealed significant FC-by-sex-by-diagnosis interactions, such that higher left putamen-right IFG/SMG FC uniquely predicted better cognitive control in ASD-F but not in ASD-M or NT-F/NT-M.

**Conclusions:** Cortico-striatal connectivity has been implicated in cognitive control in NT groups. In particular, the right IFG may play a role in error detection and punishment sensitivity, which may apply more broadly to social processes. Given the small sample with a broad age range, validation in a larger sample is needed as well as a detailed characterization of circuits supporting camouflaging in males with ASD.

**412.006 (Poster)** Creating Psychophysical Touch-Screen Paradigms to Test Sensory Processing in Young Children with and without Autism

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### **Background:**

In the latest revision of the DSM, sensory atypicalities have been added as a core feature of autism. An increasing body of work suggests that alterations in lower-level sensory processing during early development may contribute to difficulties in higher-level processes that are characteristic of autism, such as altered social and cognitive development, language delay or restrictive and repetitive behaviours. Despite the need to understand trajectories of *early* sensory functioning in autism, we still lack sensitive experimental measures that allow for reliable, objective, and fast assessment of sensory processing across different sensory domains in young autistic children. Psychophysical approaches allow for differentiation of physiological function (e.g. detection, discrimination). While these approaches have long been used to objectively and reliably assess sensory perception, few studies have successfully applied psychophysics in young children.

### **Objectives:**

Our objective was to develop and validate appropriate psychophysical tasks in young children (particularly in children with autism) that can be used to remotely assess individual differences in low-level sensory processes using touch-screen appliances.

### **Methods:**

We developed auditory and tactile discrimination tasks. Both tasks were based on existing two-alternative force choice (2AFC) psychophysical paradigms, which had previously been successfully applied in older cohorts (Puts et al., 2017). The tasks were developed in Unity, a mobile app development platform. A full description of the tasks can be seen in the figure caption of Fig. 1A and 1B. The tasks were delivered remotely on touch-screen devices and were either parent or tester mediated. Additional questions were also provided to parents and caregivers to gauge inattention and comprehension (see Figure 1D). So far, data has been collected from 4 children with ASD and 15 TD children age between the ages of 18 months and 5 years.

### **Results:**

Figure 1C displays a typical example of staircase tracking in a single 2.5-year-old individual, showing that we can capture psychophysical properties in this young population. 75% of pre-schoolers with autism, as well as 86% of TD pre-schoolers successfully completed the tasks. The average frequency discrimination thresholds were 92.1 Hz for the TD group and 48.3Hz for the ASD group. Two participants completed the task more than once. Although preliminary, we then calculated the test-retest reliability for these participants by using a two-way mixed effect model. The computed intra-class correlation coefficient (ICC) of the frequency discrimination threshold was 0.64, showing moderate test-retest reliability of our paradigm.

### **Conclusions:**

We show that we were able to measure sensory thresholds using psychophysical tasks in pre-school children with and without autism, and that these can be performed remotely. Our preliminary evidence shows that these tasks are moderately reliable and comparable to lab-based reliability. Our conservative estimate is to recruit >100 participants in the coming months, through our existing pre-school studies (Preschool Brain Imaging Project, One of a Kind Project). After establishing reliability of a conservative 70% and an acquisition rate in autism of 70%, we hope to validate the tasks against questionnaire measures and create normative ranges.

**412.007 (Poster)** Enhanced Pseudoword Reading in Autism Is Supported By Differences in Ventral Visual Stream Activation  
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#### Background:

Reading words is accomplished through a combination of applying learned letter to sound consistencies (i.e. orthography to phonology mappings) and applying knowledge of word meaning (i.e. semantics). For example, orthography-phonology mappings are sufficient to read consistent words like, “hash” and “cash”; however, semantics is useful for reading inconsistent words like “wash”. In contrast, for pseudowords (pronounceable but meaningless nonwords, like “fash”), readers only have the resource of orthography-phonology mappings to pronounce the novel letter strings. Thus, readers are at a disadvantage reading pseudowords compared to words. Prior studies suggest individuals with autism spectrum disorders (ASD) can be particularly proficient in applying orthography-phonology mappings, which may contribute to the incidence of hyperlexia in this population. This strength may also allow this population to overcome the disadvantage of novelty when reading pseudowords. Neurally, reading involves a generally left-lateralized network of brain regions, including those along the ventral visual stream, such as the visual word form area (VWFA), which plays a role in mapping orthography to phonology. Therefore, we predict that proficiency in applying orthography to phonology mappings in the ASD group will manifest as superior performance pronouncing pseudowords compared to neurotypical (NT) readers. Neurally, this advantage may be underpinned by the participants with autism recruiting additional neural resources, in the ventral visual stream, to support applying orthography-phonology mappings.

#### Objectives:

We examined the cognitive and neural processes of reading in autism by comparing behavioral performance and neural activation between neurotypical controls and participants with autism in a reading-aloud task with words and pseudowords.

#### Methods:

Age, PIQ, VIQ, and gender-matched ( $ps > .14$ ) English speaking undergraduates with ( $N = 19$ ) and without ( $N = 21$ ) autism read 110 monosyllabic words and 110 pseudowords aloud during an fMRI scan. Verbal responses were recorded and analyzed to determine trial-level pronunciation accuracies and response times. We tested for effects of group (ASD, NT) and item type (words, pseudowords) on pronunciation accuracy and response time. Finally, we contrasted brain activation between groups for responses to words and pseudowords.

#### Results:

Words were read more accurately than pseudowords,  $F(1, 39) = 62.024, p < .001$ . The ASD group trended towards greater overall accuracy than the NT group,  $F(1, 39) = 2.005, p = 0.165$ , driven by a trend towards greater accuracy reading pseudowords,  $t(39) = 1.59, p = 0.12$  (Figure 1A). Neurally, the NT group showed the expected pattern of left-lateralized activity for reading, while the ASD group showed comparatively greater activation in the right-hemisphere homologue of the VWFA for reading words and pseudowords ( $p < .005$ , uncorrected, Figure 1B).

#### Conclusions:

The ASD group’s superior task performance overall may be underpinned by recruiting both left and right ventral visual regions. Notably, right inferotemporal cortex is typically more responsive to social stimuli, such as faces, suggesting that altered organization of this region may contribute to both strengths and weaknesses in this population. Crucially, the ASD group’s enhanced reading performance was driven by the pseudowords, suggesting that extending VWFA activation by recruiting its right-hemisphere homologue may enhance use of orthography-phonology mappings.

**412.008** (Poster) Hidden Literacy in Minimally Verbal ASD Revealed By Eye Gaze: Reduced Pupil Dilation Hint at a Deficit in Recruiting Arousal That Impact Voluntary Behavior

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**Background:** Minimally verbal individuals with ASD (MV-ASD), estimated as 30% of the spectrum, who have little or no spoken language, typically fail the conventional tests for cognitive abilities. However, it is yet unclear whether these failures reflect a true cognitive impairment or, alternatively, a severe deficit in behavioral expressions of cognitive skills. Here we suggest that the main barrier for communication in this group is a severe deficit in the initiation and control of reliable voluntary actions, which calls for using involuntary or effortless measures such as small eye gaze lateralization. Preliminary results from our study of hidden literacy in MV-ASD were reported in INSAR 2019. Here we report a novel finding related to a possible cause for the deficit, which we explored by analyzing the transient pupil dilation during the task.

**Objectives:** Assess basic reading and lexical-semantic knowledge in young adults with MV-ASD using eye-movement measures in comparison to pointing performance and investigate transient pupillary responses as measures for Locus Coeruleus norepinephrine (LC-NE) activation.

**Methods:** Young adults with MV-ASD (N=25, ages 15-24, <30 communicative words) and 25 age-matched controls were tested on a novel "cued looking" paradigm watching a sequence of stimuli while their eyes were tracked. In each trial, a text word was presented at fixation (1s), followed by a pair of side-by-side pictures of familiar objects (1s), with next trial following after 800ms. There were 4 short (~1min) runs repeated 3-6 times with breaks. In additional experiments, the written words were replaced by recorded words, and both paradigms were repeated with pointing on cards. We analyzed the lateralization of the eye-gaze according to target side, the time course of correct gaze lateralization, and the transient pupil dilation associated with the gaze.

**Results:** 21 of the 25 MV participants showed a significant effect of reading as reflected by correct lateralization estimates of 72-100% (average 87%), with similar results obtained for vocal words. They made smaller lateral eye movements than controls but were as fast in terms of movement onset. In a striking contrast, most of the MVs who showed significant reading with the eyes were at or near chance level in pointing (40-65%) making their reading skills "hidden" to standard testing. To investigate the cause for this anomaly, we analyzed the transient pupil dilation associated with the eye gaze. We found a reduced pupil dilation in the MV-ASD group compared to controls, and a significant correlation (MV-ASD group) between the dilation and the eye gaze performance in reading ( $R=0.64, p=0.001$ ), and listening ( $R=0.57, p=0.01$ ).

**Conclusions:** These results provide the first systematic evidence for reading ability in individuals typically assumed to be severely language and cognition impaired. The results also demonstrate a striking anomalous gap between pointing performance and gaze, which opens the way for uncovering unknown cognitive abilities in MV-ASD. Our results of reduced pupil dilation provide a first hint at the possible cause of the anomaly in terms of reduced transient activation of the LC-NE system that reflects the recruitment of arousal subserving many cortical circuits that drive behavior.

**412.009** (Poster) Increased Context Adjustment with Higher Sensory Sensitivities Indexed By Auditory Mismatch Negativity

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**Background:**

Bayesian models of autism suggest that disruptions in context-sensitive sensory weighting may underpin sensory perceptual alterations, such as hypersensitivities. Mismatch negativity (MMN), an electroencephalographic (EEG) response to pattern violations in sensory stimuli, is an excellent measure to understand sensory learning in autism.

**Objectives:**

We aimed to identify if context adjustment as indexed by delta-MMN amplitudes (i.e., difference in MMN between contexts) differed between autistic and neurotypical groups. Furthermore, we investigated whether delta-MMN amplitude was associated with autistic traits and sensory sensitivities when all participants are aligned on a continuum.

## Methods:

We recruited autistic adults (AS group; N=29, *M* age = 25.57, 16 females and 13 males) and age and gender matched neurotypical adults (NT group; N=30). Participants underwent EEG recordings while listening to a stochastic auditory oddball paradigm. Participants listened to a stream of tones with frequencies drawn from two contexts of either high (200Hz to 4000Hz) or low (200Hz to 2000Hz) uncertainty, where the outlier sounds were of 2000Hz. MMN amplitude was measured at the Fz electrode between 125ms and 175ms. Participants completed the Autism Quotient (AQ; Baron-Cohen et al. 2001), which measures autistic traits, and the Sensory Processing Quotient (SPQ; Tavassoli et al 2014), which measures sensory sensitivities.

## Results:

We found no significant difference in delta-MMN between groups suggesting sensory context updating is intact in autism. However, group differences arose in the typical P300 time window, where the AS group showed a more negative difference in amplitude compared to the NT group. We also undertook a dimensional approach which revealed a positive correlation between delta-MMN and sensory sensitivities, but not with autistic traits.

## Conclusions:

Group findings suggests that while AS has greater reorienting for outlier sounds, context updating is intact. However this may be due to the AS group and NT group showing no significant differences in auditory SPQ scores. A dimensional analysis revealed finer context adjustment in people with higher sensory sensitivities. We suggest that autism MMN studies may benefit from accounting for sensory sensitivities in group comparisons.

### **412.010** (Poster) Intersecting Intention Encoding and Readout in Autism

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**Background:** The ability to infer the intentions of others from subtle changes in the way they move is crucial to interpret and anticipate their behavior (Becchio et al., 2018). Children with autism spectrum conditions (ASC) show delays in the development of this ability, with knock-on consequences on social interaction across lifespan (Forbes and Hamilton, 2018). However, the exact nature of ASC difficulties in intention reading remains unknown. Here we report on a study combining motion tracking, psychophysics and computational modelling to compare how intention information encoded in single-trial kinematics is read out by typically developing (TD) children and children with ASC.

**Objectives:** To analyze how intention encoding – the mapping of intention to movement kinematics during action execution – and intention readout – the mapping of visual kinematics to intention during action observation – intersect at a single-trial level in TD children and children with ASC.

**Methods:** Eight- to thirteen-year-old TD children (n=37) and children with ASC without accompanying intellectual impairment (n=35) watched a hand reaching for and grasping a bottle, either to pour or to place, and judged on the intention of the observed grasp. In a within-subjects counterbalanced order, participants observed videos of grasping acts performed by TD children or children with ASC (see Fig. 1a). We devised a simple time-dependent model based on logistic regression to examine how intention encoding and readout intersect in TD and ASC observers. Adapting methods developed in Patri et al. (2020), we first determined the set of kinematic features that encode intention information in TD and ASC single movement kinematics. We then developed a readout model to examine how (and how well) TD and ASC observers read out such information. We finally computed how encoding and readout intersect at the single-trial level to inform intention choice in each group.

**Results:** In both ASC and TD observers, intention readout was sensitive to variations in the kinematics of the observed actions. However, the proportion of readers – individuals whose readout was sensitive to variations in single-trial kinematics – was lower in the ASC group than in the TD group ( $p < .01$ ; Fig. 1b). In the TD group, a significant proportion of readers was able to link informative kinematic features to the correct intention, particularly when observing TD actions (ASC actions:  $p < .01$ ; TD actions:  $p < .001$ ). In the ASC group, readers failed to map kinematics to intention. This failure was observed regardless of whether ASC readers observed TD or ASC actions.

Conclusions: Observers with ASC are less proficient intention readers not because they are blind to subtle variations in visual kinematics, but rather because they are unable to link these variations to the correct intention. These findings have implications for clinical assessment and intervention in ASC.

**412.011** (Poster) Investigating Timing Processes in Autistic Adults

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Background:

It has been theorised that there are problems with timing in autism (Allman, 2011), impacting multiple domains encompassing the precision of duration perception, relative timing of sensory information and temporal cognition. To date, empirical findings regarding problems with timing are mixed, with differences likely to be dependent on the cognitive mechanisms and stimuli involved in specific timing tasks (Casassus et al, 2019).

Objectives:

We aimed to better characterise timing processes in autistic adults by measuring performance across multiple timing domains using scalar expectancy theory (SET; Gibbon, Church & Meck, 1984) as a theoretical framework. SET suggests an internal clock that accumulates pulses emitted by a centralised neural pacemaker controls timing of duration. We used tasks believed to target individual components of the timing system as understood within this framework.

Methods:

In this pre-registered study (<https://osf.io/pcahj/>), 58 autistic and 91 neurotypical adults completed a battery of visual and auditory temporal psychophysics tasks. The relative timing of brief stimuli was assessed using temporal order judgements. The perception of sub-second durations was assessed using tasks measuring basic discrimination (temporal difference thresholds), direct estimates of perceived duration (verbal estimation tasks) and involving memory and decision processes (temporal generalisation tasks). Participants also completed retrospective estimates involving judgements about durations of several minutes. Questionnaires were used to measure behaviours relating to time in daily life.

Results:

Differences between the groups were observed on questionnaire measures but, overall, measures of timing precision from experimental tasks were similar between the groups.

Conclusions:

The present study suggests that duration and relative timing precision is comparable between autistic and neurotypical adults. Differences on questionnaire measures indicate that behaviours relating to time in daily life may be impacted. In future work it would be valuable to consider the interaction between higher-order cognitive processes involved in everyday behaviour relating to time in autism.

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Gibbon, J., Church, M., & Meck, W. (1984) Scalar Timing in Memory. In J. Gibbon & L. Allan (Eds), *Annals of the New York Academy of Science: Vol. 423. Timing and Time Perception* (pp52- 77). New York Academy of Science: New York

**412.012 (Poster)** Longitudinal Functional Connectivity of Cognitive Brain Networks in Older Men with Autism  
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**Background:** The first person diagnosed with autism spectrum disorder (ASD) is now entering advanced aging. Projections indicate that the number of older adults with ASD will increase dramatically over the next decades. Emerging cross-sectional cognitive aging research in ASD has shown mixed findings, with some evidence suggesting poorer cognitive and brain aging trajectories. Brain functional connectivity may reveal early biomarkers of cognitive aging.

**Objectives:** In our prior cross-sectional work, we showed age-group differences suggesting exacerbated reductions in functional connectivity (FC) affecting the fronto-parietal network (FPN) in adults with ASD (Walsh et al., 2019). This current, preliminary study extends these findings by longitudinally examining changes in FC of cognitive brain networks over a two-year follow-up period in a sample of mid-to-older adults with and without ASD and associations with cognitive control.

**Methods:** Participants included men ages 40-64 years at the start of the study (mean: 50.7[7.1]) of average intellectual ability (IQ>80) with and without ASD (ASD:  $n=13$ ; NT:  $n=18$ ). There were no significant differences between ASD/NT groups in terms of age at the start of the study. Follow-up intervals were two years on average. Participants completed a six-minute, eyes-closed, resting-state fMRI scan. Resting-state data was preprocessed using SPM12 (slice time correction, realignment, co-registration to anatomical image, and normalization via DARTEL with 8mm FWHM smoothing). Confound regression was conducted using aCompCor, scrubbing, and 12 realignment parameters. FC was calculated via independent component analysis using the CONN Toolbox and the FPN, dorsal attention (DAN), default mode (DMN), and salience networks (SN) were selected. Main effects of time and group-by-time interactions were modeled at the whole-brain level with FDR-correction ( $p<.05$ , cluster-level) with age as a covariate. Baseline and follow-up performance on the Wisconsin Card Sorting Task (WCST; Total Errors) was used to examine associations with cognitive control for participants with ASD.

**Results:** For the right lateralized FPN, a significant time-by-diagnosis interaction was observed, such that adults with ASD showed declines in FC between the left inferior frontal gyrus (IFG; pars triangularis portion) and the rest of the FPN that were not observed in NT participants ( $p=.018$ , FDR-corrected, cluster level). No other main effects of time or group-by-time interactions were observed for the right lateralized FPN or other networks investigated (left FPN, DMN, DAN, or SN). No significant effects of time or group-by-time interactions were found for the Wisconsin Card Sorting Task. However, poorer baseline ( $r_9=0.579$ ,  $p=0.062$ ) and follow-up ( $r_9=0.621$ ,  $p=0.042$ ) WCST performance was marginally and significantly associated, respectively, with larger decreases in FPN-IFG connectivity over time for participants with ASD.

**Conclusions:** FPN-prefrontal connectivity decreases with age in mid-to-older adults with ASD, but not NT adults, and this decreasing connectivity predicts poorer follow-up performance on a cognitive control task. Despite the small sample included in this preliminary analysis, these findings suggest a trend toward worse brain aging in ASD, which may predict poorer cognitive outcomes. Validation of these findings in a larger sample with a longer follow-up duration and utilizing structural and task-based neuroimaging methodology is warranted.

### **412.013 (Poster)** Measuring the Prediction of Observed Actions Using an Occlusion Paradigm: Comparing Autistic and Non-Autistic Adults

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**Background:**

Action prediction involves observing and predicting the actions of others and plays an important role in social cognition, interacting with others as well as in many types of sports. It is thought to involve simulation, where the observer uses their own motor system, such as premotor cortex, to predict the observed actions. As many autistic individuals have motor coordination difficulties, it is possible that simulation ability is altered, leading to action prediction deficits and contributing to difficulties understanding the actions of others.

## Objectives:

To compare action prediction between autistic and non-autistic adults and investigate any relationship between prediction and motor coordination.

## Methods:

Twenty autistic and 21 non-autistic adults matched on age, gender and IQ watched 8 different videos of a female actor carrying out everyday actions (e.g. watering a plant). During each video, the action was transiently occluded 2-6 times by a grey rectangle for 1000ms. During occlusions, the video was allowed to continue as normal or was fast forwarded (i.e. appearing to continue too far ahead) or slowed down (i.e. appearing to continue too far behind). Participants were asked to indicate whether the action continued with correct timing or too far ahead/behind by pressing keyboard buttons. Motor ability was assessed using the adult Developmental Coordination Disorder (DCD) checklist.

## Results:

The autistic group reported significantly worse motor coordination skills as assessed with the DCD checklist. For prediction accuracy, autistic individuals were less accurate than non-autistic individuals, particularly when the video was slowed down during the occlusion time (i.e. actions appeared too far behind). Both groups selected a higher number of “correct timing” responses for the normal compared to fast forwarded videos. However, only the autistic group showed no difference in correct timing responses between the normal and slowed down videos, suggesting that they confused these two video continuations. There were no correlations between overall prediction accuracy and DCD checklist scores in either group.

## Conclusions:

Autistic adults were less accurate at predicting whether videos of everyday actions occurred at the correct speed, confusing actions that had been played too slow during the occlusion with those that occurred at the normal speed. While this finding needs to be replicated, these results potentially indicate that autistic individuals were slower to switch from action perception to internal simulation or had slower simulation processes (Prinz and Rapinett, 2008; Sparenberg, Springer and Prinz, 2012). While the autistic group had poorer motor coordination, this ability did not correlate with prediction accuracy.

## References

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**412.014 (Poster)** Neural Measures of Social Attention As an Indicator of Communication and Social Development in Infants at-Risk for Autism Spectrum Disorder

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**Background:** Over the past decade, studies of infants at risk for developing autism by virtue of having an older sibling with autism have made extensive use of event related potentials (ERPs), an EEG-based measure. Specifically, the negative central (Nc) ERP component has been associated with attention in response to visual stimuli such as faces or objects. Further, our lab has observed differences in the Nc responses to mother versus stranger faces between low- and high-familial-risk infants. However, whether the Nc response is related to clinical symptoms of ASD remains to be determined. Here, we present the results from an ERP study focused on infant siblings, the goal of which was to compare infants with high familial risk who develop ASD (HR-ASD), high risk infants who do not develop autism (HR-NoASD), and low risk controls (LRC).

**Objectives:** This study aims to characterize the neural correlates of face recognition in 12-months-old infants; specifically, we seek to determine (1) whether there are differences in the Nc response to faces between HR-ASD, HR-NoASD, and LRC infants and (2) how the Nc correlates with communication and social development.

**Methods:** Infants at 12 months participated in the Mother/Stranger visual paradigm (LRC  $n = 42$ ; HR-NoASD  $n = 40$ ; HR-ASD  $n = 20$ ), where EEG data was collected as infants looked at pictures of their mother and a similarly looking stranger. Communication measures at 12 months included: MacArthur Bates Communicative Development Inventory (CDI), deictic gestures counted during parent-child interactions, and Mullen Scales of Early Learning (MSEL) scores. Social measures at 18 months included: Autism Diagnostic Observation Schedule (ADOS) Social Affect Score, and Communication and Symbolic Behavior Scales (CSBS) Social Composite Score. Multiple linear regressions were conducted with maternal education and outcome groups as covariates.

**Results:** The difference in Nc amplitude in response to mother versus stranger (Mother/Stranger-Nc) was statistically similar across the three groups studied ( $F(2,41) = 0.16$ ,  $p = 0.85$ ). A larger Mother/Stranger-Nc was associated with higher raw scores on CDI Early Gestures only for the HR-ASD group ( $R^2\text{-adj} = 0.222$ ,  $B = 0.7277$ ,  $p = 0.050$ ), and higher MSEL Expressive Language standard scores, across all groups ( $R^2\text{-adj} = 0.111$ ,  $B = 0.9037$ ,  $p = 0.002$ ). Additionally, increased Nc difference in the HR-ASD group was associated with better social skills at 18 months as measured on the CSBS (Social Composite; Pearson  $r = 0.69$ ,  $p = 0.04$ ) with a similar trend on the ADOS (Social Score; Pearson  $r = -0.39$ ;  $p = 0.17$ ).

**Conclusions:** These data show the potential use of ERPs providing estimates in communication and social development. These data confirm that, while accounting for maternal education and regardless of diagnosis groups, there is a positive relationship between preferential attentional resources given towards mother and expressive language development. Additionally, specific to HR-ASD infants, more attentional resources towards mother at 12 months was associated with better social development at 18 months.

**412.015 (Poster) Reduced Early Habituation to Repeated Sounds in Autism: An EEG Study**

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**Background:** Predictive coding accounts of autism spectrum disorder (henceforth ‘autism’) state that both social and non-social symptoms of autism can be accounted for by increased bottom-up sensory processing, which should result in decreased habituation to repeated stimulation. While there is indeed some support for reduced habituation to faces in ASD (Kleinhans et al., 2009), according to predictive coding accounts, this should also be the case for non-social stimuli such as repeated meaningless sounds. Previous studies that used a paired-click paradigm reported mixed results with both reduced and normal habituation in children and adolescents with autism (Chien et al., 2019; Kemner et al., 2002; Madsen et al., 2015; Oranje et al., 2013; Orekhova et al., 2008). In this paradigm, habituation is measured (and limited) by comparing the neural responses to two subsequent short tones. In the current study we applied an arguably more sensitive paradigm to investigate habituation, namely an auditory oddball paradigm, which allows to investigate responses to multiple repeated standard sounds. Indeed, there is evidence for reduced habituation using multiple repeated sounds in infants at high-risk for autism and adults with Fragile X syndrome (Ethridge et al., 2016, 2019; Guiraud et al., 2011). Surprisingly however, research using this paradigm to compare habituation between adults with and without a diagnosis of autism is still lacking.

**Objectives:** In the current study, we aimed to investigate whether autism is characterized by reduced habituation of neural responses to multiple standard tones in an auditory oddball task.

**Methods:** We investigated habituation of ERP responses in a sample of adults with autism ( $n = 38$ ) and control participants ( $n = 32$ ) matched on age, gender, handedness and IQ.

**Results:** Results show habituation in the P2 component in this task, and a reduced P2 habituation in the autism group only at the beginning of the experiment. Over time, habituation seems to normalize in the autism group.

**Conclusions:** Results are in line with predictive coding accounts that predict attenuated habituation and hence increased bottom-up sensory processing in autism. However, this deviation in autism may be more nuanced than was initially proposed, as habituation normalized over time.

**412.016 (Poster)** The Cerebellum's Role in Prediction across Cognitive and Motor Domains in Autism

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**Background:**

It has been proposed that a predictive processing deficit might underpin core social, language, and sensorimotor behaviors in autism, although the neural bases of these challenges remain unclear. The cerebellum is one candidate: cerebellar circuits are engaged during autism-relevant tasks, and cerebellar structural and functional differences in right VII are well-documented in autism. The cerebellum supports prediction and learning through building and honing internal models of behavior. We hypothesized that cerebellar dysfunction in autism may disrupt predictive processing, and that cerebellar neuromodulation would alter performance on predictive tasks.

**Objectives:**

We used cerebellar transcranial direct current stimulation (tDCS) to investigate the impact of cerebellar neuromodulation on motor learning, language prediction, and social learning.

**Methods:**

Neurotypical adults (NT; n=12, 22.5 ± 2.5 yrs) and adults with autism (AG; n=10, 24.5 ± 9.0 yrs) performed three tasks: serial reaction time task (SRT, motor learning), sentence completion (language prediction), and Cyberball (social learning). Excitatory (anodal), inhibitory (cathodal), or sham tDCS (20 min, 1.5 mA) targeting cerebellar right lobule VII was administered to participants prior to the tasks. Each participant received all three tDCS conditions separated by one week. Prediction scores were calculated as the difference in accuracy and response times (RTs) between predictive and nonpredictive trials. Behavioral measures were assessed within subjects, between groups, and as a function of autism quotient (AQ) score using linear mixed effects models.

**Results:**

**Motor Learning:** At baseline, there were no significant group differences in accuracy, although accuracy and AQ scores were negatively correlated (p=0.05). AG baseline RTs were faster than NT (p=0.05), and RTs were negatively correlated with AQ score (p=0.01). Active tDCS reversed these trends selectively in the AG: anodal tDCS impaired accuracy (p=0.001), while anodal (p=0.02) and cathodal (p=0.0001) tDCS resulted in positively correlated RT and AQ score (p=8.8e-6, p=1.7e-5).

**Language Prediction:** At baseline, there were no significant group differences in task performance and no significant correlations between task performance and AQ scores. tDCS did not alter response times in either group. Anodal tDCS selectively improved accuracy in AG (p=0.029). Cathodal tDCS trended toward impairing AG accuracy (p=0.2), and accuracy was negatively correlated with AQ score (p=0.048) after cathodal tDCS.

**Social Learning:** At baseline, there were no significant group differences, although learning scores were negatively correlated with AQ scores in both groups (NT R = -0.33, AG R = -0.37). Anodal tDCS disrupted social learning in both groups (p=0.037), while cathodal tDCS improved social learning selectively in AG (p=0.006).

**Conclusions:**

Cerebellar tDCS altered prediction and learning across three separate task domains. On tasks with a specific learning component (social, motor), AQ scores negatively correlated with performance, indicating poorer learning in individuals with higher AQ scores. Following cerebellar tDCS, social learning and language prediction improved selectively in the AG. These results provide evidence for the cerebellum's involvement in prediction and autism, and demonstrate that cerebellar tDCS targeting right lobule VII selectively improves performance on cognitive predictive tasks in the AG.

**412.017 (Poster)** The Similarity and Differences in Aberrant Task-Induced Functional Connectivity Patterns Observed in ASD and ADHD: A Meta-Analysis Approach  
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**Background:** Autism spectrum disorders (ASD) and Attention deficit/hyperactivity disorder (ADHD) are traditionally considered as categorically different disorders related to aberrant brain connectivity during various cognitive tasks. However, recent research studies have shown that there is a high degree of comorbidity between the two disorders (15%~70%), but little is known about the similarity and differences in their functional connectivity patterns. Therefore, a comprehensive comparison of aberrant task-induced connectivities in ASD and ADHD could provide critical insights into the neurobiological basis for comorbid symptoms.

**Objectives:** Using a meta-analysis approach, we aim to examine existing studies of task-induced functional connectivity abnormalities in ASD and ADHD, in order to develop a model about the neurobiological basis of comorbid conditions. Specifically, we first examined the overlaps of reported seed regions of interest (ROIs) in ASD and ADHD studies, and then examined the similarities and differences in the observed abnormal connectivity patterns in both groups.

**Methods:** We conducted a literature search on PubMed and EBSCO databases using combinations of search terms including “ASD”, “ADHD”, “Autism”, “functional connectivity”, and “task”. After initial screening based on titles and abstracts, 64 papers were selected according to the following inclusion criteria: (a) published between 2010-2020; (b) reported data from either an ASD or ADHD group; (c) reported functional connectivity analysis; and (d) included a cognitive task. These 64 papers were further reviewed in-detail based on the following inclusion criteria: (a) presented task-based functional connectivity in fMRI; (b) used a seed-based approach to examine the functional connectivity; (c) included at least the qualitative data (region labels) for both seed and target ROIs; and (d) included a comparison between the patient group and a healthy control group. As a result, a total of 32 studies (13 ASD and 19 ADHD) were included in this preliminary meta-analysis.

**Results:** Although existing studies used different cognitive tasks in ASD and ADHD, we still found a set of common seed ROIs that were examined in both disorders, such as anterior cingulate cortex (ACC), dorsolateral PFC (dlPFC), inferior frontal gyrus (IFG), inferior parietal cortex (IPC), amygdala, and striatum. This suggests a common frontoparietal network with subcortical structures may underlie the cortical dysfunctions in both disorders during cognitive tasks. From these commonly-examined seed ROIs, the abnormal functional connectivities between frontal regions (ACC, dlPFC, IFG, etc.) and from right subcortical (amygdala and striatum) to left frontal regions were found overlapping in both ASD and ADHD (see Figure 1). Additionally, the left amygdala and striatum showed abnormal connectivity with various regions across different lobes in ASD, but the left frontal regions showed distributed connectivity abnormalities in ADHD.

**Conclusions:** Our meta-analysis revealed that the connectivity abnormalities in frontal executive control networks may underlie the common cognitive deficits in ASD and ADHD, suggesting a neurobiological basis for the comorbid conditions. By contrast, left amygdala and striatum for affective and motivational processing serve as specific hubs with abnormal connectivity in ASD, whereas the left frontal regions (e.g., dlPFC and IFG) for executive control serve as specific hubs with abnormal connectivity in ADHD.

**412.018 (Poster)** Variability in Movement and Visual Attention during a Behaviorally Adaptive Eye-Tracking and EEG Paradigm with Children with ASD  
*E. Cummings<sup>1</sup>, A. Naples<sup>1</sup>, J. M. Wolf<sup>1</sup>, C. C. Cukar-Capizzi<sup>1</sup>, G. T. Han<sup>2</sup> and J. McPartland<sup>1</sup>, (1)Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Vanderbilt University, Nashville, TN, TN*

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**Background:** Much neuroscience research requires participants to remain extremely still, maintain fixed visual attention, and comply with complex instructions. This approach limits the scope of research by excluding participants who have difficulty following verbal directives, such as minimally verbal children with ASD. This problem could be addressed by interactive paradigms that shape behavior and encourage compliance without the need for verbal instructions. The present study applies a novel eye-tracking (ET) and electroencephalography (EEG) data acquisition approach designed to monitor and respond to participant movement to shape behavior in real-time.

**Objectives:** To quantify change in the behavior of children with cognitive impairment and ASD during an ET and EEG paradigm designed to adapt to participant behavior in real time to improve data acquisition success.

Methods: Five children with ASD (7-11 years,  $M=9.2$ ,  $SD=2.0$ ) completed a co-registered ET-EEG paradigm with simultaneous eye and head movement tracking; data collection is ongoing. Progression of the paradigm was compliance-dependent, such that off-screen eye gaze or excessive movement (i.e., head movement exceeding baseline threshold determined during participant's initial viewing of a preferred video) paused experimental administration. For this participant-specific behavioral analysis, derived variables included timing of breaks and pauses, pause triggers (i.e., excessive movement or off-screen eye gaze), and two-dimensional head movement (i.e., front-to-back, side-to-side) derived from head position recorded at 2000Hz. ASD symptom severity was measured by the *Autism Diagnostic Observation Schedule-2* (ADOS-2) comparison score (CS), which ranged from 6 to 10 ( $M=8.8$ ,  $SD=1.6$ ). Cognitive ability was measured by the *Differential Ability Scales-II* (DAS-II) or *Mullen Scales of Early Learning*. FSIQs ranged from 22 to 73 ( $M=43.4$ ,  $SD=21.4$ ), verbal IQs ranged from 19 to 57 ( $M=35.6$ ,  $SD=15.5$ ), and nonverbal IQs ranged from 23 to 81 ( $M=47.6$ ,  $SD=24.2$ ).

Results: Overall, EEG session length ranged from 13.5 to 54.7 minutes ( $M=25.3$ ,  $SD=17.2$ ). Behavior-dependent pauses ranged from .01 to 208.83 seconds long ( $M=4.56$ ,  $SD=14.74$ ), with eye-gaze pauses ( $M=7.23$ ,  $SD=20.06$ ) being significantly longer than movement pauses ( $M=2.55$ ,  $SD=7.57$ ;  $t(519.18)=4.34$ ,  $p<.001$ ). Variation between participants emerged in the number of pauses during the session, ranging from 45 to 446 ( $M=187.60$ ,  $SD=159.21$ ). In particular, the number of eye-gaze pauses ranged from 34 to 176 ( $M=84.40$ ,  $SD=62.25$ ) and movement pauses ranged from 11 to 324 ( $M=103.20$ ,  $SD=127.12$ ). Frequency of eye-gaze and movement pauses remained stable over the course of the session. There was more movement during breaks than trials for four participants (all  $ps<.001$ ) and for the other participant, movement was greater during the trials than breaks ( $p<.001$ ). As the session progressed, movement increased for two participants ( $r_s=-.04$ ,  $r_s=-.14$ ;  $ps<.001$ ) and decreased for three participants ( $r_s=.15$ ,  $r_s=.02$ ,  $r_s=.06$ ;  $ps<.001$ ). Outcome measures for each participant are represented visually (e.g., Figure 1) and in summary statistics (e.g., Table 1).

Conclusions: Variability in individual behavioral responses highlights the potential benefit of adaptive experimental paradigms. Decreased movement across the EEG session demonstrated by most participants suggests that automated behavior modification can effectively be integrated with data acquisition to increase compliance without verbal instruction. These results hold promise for increasing representation of minimally verbal populations in neuroscience research.

## Communication and Language

### PANEL SESSION — COMMUNICATION AND LANGUAGE

#### Panel 224 - Vocal Development in Infants and Children with ASD and at Risk for ASD

**Panel Chair:** D. Kimbrough Oller, *School of Communication Sciences and Disorders, University of Memphis, Memphis, TN*

**Discussant:** Daniel S. Messinger, *University of Miami, Coral Gables, FL*

We focus on both the vocalizations of infants and children at risk for ASD and on parental responses to those vocalizations. The goals are 1) to help designate anomalies in very early vocal development associated with risk or diagnosis of ASD, 2) to characterize features of vocal development held in common early in life between infants at risk and not at risk for ASD, and 3) to address parental vocal responsivity patterns that may be special to the infant or child with or at risk for ASD and that may inform future approaches to intervention. The work involves both laboratory and home recordings, many of them all-day recordings, automated multitaper harmonic analysis to determine fundamental frequencies, functional data analysis with dynamic time warping to evaluate developmental trajectories, evo-devo inspired human coding of vocalizations in a multidimensional audio-video software environment, and comparisons across infants and children both at risk and not at risk for ASD along with additional infants and children with an ASD diagnosis. Infants were also racially and ethnically diverse. The speakers represent four nationalities as well as Asian, middle Eastern, and European ancestries. There are four universities represented, and speakers range from tenured to just completing the Ph.D.

**224.001 (Panel)** Developmental Cascades Linking Infant-Directed Speech, Infant Vocal Behavior and Social Contingency in Typical Development and ASD

**G. Ramsay<sup>1</sup>, M. Edwards<sup>2</sup>, J. Bailey<sup>3</sup> and S. Ghai<sup>4</sup>,** (1)Department of Pediatrics, Emory University, Atlanta, GA, (2)Emory University, Atlanta, GA, (3)University of Miami, Miami, FL, (4)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA

*Background:* Adults habitually adopt a special vocal register when talking to children, exaggerating prosodic properties that are attractive to, and elicit responses from, typically developing infants. Children with ASD show early differences in social responding, and have specific impairments producing and perceiving prosodic contrasts, which may explain differences in infant-directed speech as well as infant vocal behavior observed in autism. The acoustic properties characterizing infant-directed speech change over the course of development, in response to changes in infant vocal behavior, but it is not yet known what drives those changes, either in autism or typical development.

*Objectives:* The goal of this study is to examine developmental progressions in infant-directed speech over the first two years of life, in typical development and autism, and to determine the origin of these changes in infant vocal signaling and response.

*Methods:* As part of an NIH Autism Center of Excellence (NIH P50 MH100029), we tracked vocal development among 45 high-risk infants with a family history of ASD and 35 low-risk controls. Each child wore a LENA recorder one day every month from 0-24 months to provide audio recordings of their vocal behavior and environment. Using speech recognition technology, we identified the number of vocalizations per hour for infant and caregiver, and calculated the rate of contingent interactions based on timing statistics. We also took random samples of infant vocalizations and infant-directed vocalizations throughout each day, and used multitaper harmonic analysis to calculate the mean, standard deviation and range of fundamental frequency contours. Using Functional Data Analysis, we determined developmental trajectories of these measures for each child and mean trajectories for each risk group. Using the transfer entropy, an information-theoretic metric of statistical causality between the past history of one stochastic process and the future of another, we calculated the graph of information flow between all profiles.

*Results:* Using permutation tests to identify significant differences ( $p < 0.05$ ) between trajectories, we found deviations between high-risk and low-risk groups in all measures. Declines in high-risk infant-caregiver interaction starting at 12 months, caregiver volubility at 15 months, and infant volubility at 18 months provide evidence that deficits in social contingency impact vocal responsivity in caregiver then infant. By the end of the first year, high-risk infants departed from the natural downtrend in fundamental frequency over time expected in low-risk controls, continuing to exhibit elevated and more variable pitch through the second year. Over the same period, high-risk caregivers either persisted later in infant-directed speech, or switched earlier into adult-directed register relative to the natural transition seen in low-risk controls. Examining the transfer entropy matrix, developmental changes in infant-directed fundamental frequency appear to be driven mainly by vocal contingency, which is impaired in high-risk infants.

*Conclusions:* These results provide further evidence for a developmental cascade whereby processes of early socialization shape adaptive mechanisms of infant-caregiver vocal signaling in typical development, but are serially disrupted in autism.

**224.002 (Panel)** Social and Endogenous Motivations of Canonical Babbling Development in Infants at Low and High Risk for Autism

**H. L. Long<sup>1</sup>**, G. Ramsay<sup>2,3</sup>, D. Bowman<sup>4,5</sup>, M. Burkhardt-Reed<sup>1</sup> and D. K. Oller<sup>1,5,6</sup>, (1)School of Communication Sciences and Disorders, University of Memphis, Memphis, TN, (2)Department of Pediatrics, Emory University, Atlanta, GA, (3)Marcus Autism Center, Atlanta, GA, (4)Department of Mathematics, University of Memphis, Memphis, TN, (5)Institute for Intelligent Systems, Memphis, TN, (6)Konrad Lorenz Institute for Evolution and Cognition Research, Klosterneuburg, Austria

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**Background:** There is a growing body of research emphasizing the role of intrinsic motivation and endogenous activity to support the development of cognitive systems alongside the well-established role of social interaction. The present study longitudinally evaluated canonical babbling during social and non-social contexts across the second-half year of life, when canonical babbling becomes well-established. Canonical babbling (examples, baba, dada...) is recognized as forming a critical foundation for language because words are overwhelmingly composed of canonical syllables.

**Objectives:** We compared recorded segments that had been rated as having high vs low levels of turn taking (as a measure of social vocal activity) and high vs low levels independent vocal play (as a measure of nonsocial vocal activity) for infants at low and high risk for autism spectrum disorder. We predicted low-risk infants would produce higher canonical babbling ratios (CBRs, the number of canonical syllables divided by the total number of syllables in the sample) during segments rated as having vocal high turn taking compared to high-risk infants due to a greater intrinsic social motivation in low-risk infants. We also predicted high-risk infants would produce higher CBRs during segments rated as having high vocal play compared to low-risk infants as a potential early indicator of vocal self-stimulatory activity as a restricted and repetitive behavior.

**Methods:** Eight, five-minute segments were extracted from an average of five all-day home audio recordings of 98 infants to observe canonical babbling development between 6.5 and 13 months of age. CBRs were determined based on blinded human coding in real-time of each five-minute segment for canonical and noncanonical syllables followed by Likert-scale ratings on the level of turn taking and vocal play in each segment.

**Results:** More than 80% of the five-minute segments included at least some vocal play, while less than 20% included vocal turn-taking in these all-day recordings. The CBRs of infants at high and low risk for ASD were similar, contradicting our expectation. CBRs increased significantly across age in both groups. There were significant differences showing higher CBRs for both risk groups during segments with high vocal play, suggesting that endogenous vocal activity is associated with relatively advanced vocalization. High vs low levels of turn taking yielded a weaker effect on CBR, also suggesting more advanced vocalization during turn taking. There were also interactions of CBR with age, risk, and amount of vocal play or turn taking.

**Conclusions:** We conclude that social and endogenous/exploratory motivations may drive both high- and low-risk infant tendencies to produce their most speech-like vocalizations.

**224.003 (Panel)** Phonatory Control in Typically Developing Infants and Infants at Risk for Autism

**H. Yoo<sup>1</sup>**, G. Ramsay<sup>2</sup> and D. K. Oller<sup>3</sup>, (1)Communicative Disorders, The University of Alabama, Tuscaloosa, AL, (2)Marcus Autism Center, Children's Healthcare of Atlanta, and Emory University School of Medicine, Atlanta, GA, (3)School of Communication Sciences and Disorders, University of Memphis, Memphis, TN

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**Background:** Human infants spontaneously explore different categories of speech-like vocalizations (i.e., protophones) from the beginning of life. These categories include squeals, growls and vowel-like sounds (vocants), reflecting different phonatory characteristics (different prosody and vibratory regimes). Phonatory control occurs before infants master supra-glottal movements (i.e., articulation). However, despite the importance of phonatory development, most research has been directed to articulatory development in both typically developing infants and infants at risk for autism. To our knowledge, this is the first empirical study investigating clustering patterns of phonatory categories in infants at risk and infants not at risk for autism. These clustering patterns, showing repetition of particular vocal types, may suggest practice and exploration on the part of infants; we propose there might be differences between the extent of such repetitive activity in infants at risk or not at risk for autism.

**Objectives:** If infants attempt to learn/explore a certain category (e.g., squeal or growl), they may tend to produce the same sound in clusters rather than at random. This exploratory pattern may be observed differently from session to session. The purposes of the study are (1) to investigate whether there are differences in clustering between infants at risk and not at risk for autism and (2) to investigate age effects whereby infants may change with regard to these clustering patterns across the first year.

**Methods:** 11 infants at risk for autism because they had an older sibling with an autism diagnosis and 11 infants not at risk for autism participated in ~ 8 all-day recordings in their homes as part of a longitudinal study across the first year of life. 21 five-minute segments were extracted at random from each recording (205 recordings, 4305 segments). Each vocalization was coded as squeal, vocant (vowel-like sound), growl, cry, whimper, laugh, or other. In the analysis, we compared segments for the proportions of squeals and growls, seeking to determine if they were randomly distributed across segments as opposed to clustered preferentially in some of them. Squeals and growls were selected because they occur fairly frequently and when they do occur they have been proposed to be an aspect of vocal play with prosodic categories having high (squeal) or low (growl) pitch.

**Results:** Consistent with our hypothesis of a practice-like serial-repetition pattern, infants produced significantly different proportions of squeals and growls across randomly-selected 5-min samples from the all-day recordings, and the extent to which this was true was different at different ages. According to chi-square tests 51% of recordings showed significant clustering patterns in infants not at risk while 74% of recordings were significant in infants at risk for autism.

**Conclusions:** Infants indeed seemed to practice different phonatory categories by showing clustering patterns of the vocalization types, squeal and growl. While both groups showed practice-like behaviors, the results suggest there may be differences between these groups regarding the extent of significant clustering or patterns of clustering.

**224.004 (Panel) Maternal Input Differences within Infant-Directed Speech and Volubility in Preschool Children with ASD**  
**L. K. Farran<sup>1</sup> and D. K. Oller<sup>2</sup>,** (1)Communication Sciences and Disorders, University of West Georgia, Carrollton, GA,  
(2)School of Communication Sciences and Disorders, University of Memphis, Memphis, TN

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**Background:** Infant-directed speech (IDS), also known as "motherese", "baby talk", and baby register (IDS-BR), is a special way of communicating with infants and young children, characterized by salient features such as variable pitch, smooth intonation contours, and simple, short utterances, and thought to facilitate positive language and socioemotional outcomes in typically developing children. IDS in adult register (IDS-AR) is used much more frequently with older infants and presumably with more language competent children. While recent research suggests positive associations among IDS, various registers within IDS, and language development in typically developing children, little is known about this relationship in children with autism spectrum disorders (ASD), a developmental disorder diagnosed reliably by age 3 and marked by social deficits and high risk for speech and language disorders. Compared to typically developing children, children with ASD tend to demonstrate a (1) diminished preference for maternal speech, particularly IDS-BR; and a (2) limited ability to tune in to their mothers' language input. However, the extent to which mothers tailor their input to suit the language and communicative abilities of their children with ASD remains an open research question, particularly around the age of ASD diagnosis.

**Objectives:** The purpose of this study is to examine the association between maternal differential use of IDS registers (IDS-BR versus IDS-AR), volubility (frequency of vocalizations), and language ability in children with autism. We hypothesize that mothers tend to use less IDS-BR compared to IDS-AR when addressing their preschool children with ASD.

**Methods:** Participants are nine mothers and their three- to six-year-old children with ASD who participated in a longitudinal study that examines vocal development in preschool children. Ten minutes of free-play interactions were recorded in the participants' homes with two cameras simultaneously. In order to capture naturalistic interaction, mothers were instructed to communicate with their children as they usually do during these 10-minute recorded segments. *Measures:* The Mullen Scales of Early Learning. *Audio- and video-recordings* were coded in real-time using AACT, a speech analysis software. Maternal IDS and child utterances were classified as mutually exclusive, acoustically-based categories as defined in prior research from our laboratories. Total counts and proportions of maternal IDS (IDS-BR and IDS-AR) and child utterances were computed.

**Results:** The results showed a strong tendency ( $r = -.89$ ) for higher child volubility (the sum of all speech and speech-like vocalizations such as laughter and cry) to predict lower use of IDS-BR, and conversely higher use of the more adult-like speech register, IDS-AR. This result is surprising given that other aspects of the child vocalizations such as the number of real speech utterances ( $r = -.09$ ) or the number of speech-like utterances ( $r = .15$ ), showed much lower associations with maternal speech register.

**Conclusions:** The results suggest that mothers of preschool children with autism may adjust their speech register to include more adult-like characteristics of prosody (IDS-AR) as a function of the amount of infant vocalizations, irrespective of the nature of those vocalizations (i.e., speech or speech-like).

## POSTER SESSION — COMMUNICATION AND LANGUAGE

### Poster 413 - Communication and Language Posters

**413.001** (Poster) A Cross-Cultural Analysis of Narrative and Visual Attention in Autism Spectrum Disorder  
**J. Xing<sup>1</sup>**, **K. Nayar<sup>2</sup>**, **E. Landau<sup>2</sup>**, **X. Kang<sup>3</sup>**, **J. C. Lau<sup>4</sup>**, **G. E. Martin<sup>5</sup>**, **P. Wong<sup>3</sup>** and **M. Losh<sup>6</sup>**, (1)Communication Sciences and Disorder, Northwestern University, Evanston, IL, (2)Feinberg School of Medicine, Department of Psychiatry and Behavioral Sciences, Northwestern University, Evanston, IL, (3)The Chinese University of Hong Kong, Ma Liu Shui, Hong Kong, (4)Department of Communication Sciences and Disorder, Northwestern University, Evanston, IL, (5)Communication Sciences and Disorders, St. John's University, Staten Island, NY, (6)Communication Sciences and Disorders, Northwestern University, Evanston, IL

Background: Narrative (i.e., storytelling) is a primary form of communication that plays an essential role in social-communicative interactions. Narrative is impaired in individuals with autism spectrum disorder (ASD) (e.g., Loveland et al., 1993; Tager-Flusberg et al., 1995; Capps et al., 2000) compared to individuals with typical development (TD). Some evidence suggests that narrative atypicalities may be rooted in underlying visual attentional differences—e.g., attention towards protagonists versus background scenery may impact the content and quality of the narrative (Lee et al., 2019). Importantly, cultural and language differences are known to shape both narrative (e.g., Domino et al., 1987; Stein, 2004) and attentional biases (e.g., Blais et al., 2008; Chua et al., 2005), which may in turn influence narrative profiles in ASD. To examine this question, this study assessed narrative competence and visual attention profiles across English- and Cantonese-speaking individuals with ASD versus respective control groups.

Objectives: To explore the influence of culture and language on narrative and associated visual attention patterns in ASD.

Methods: Participants included age- and IQ- similar groups from the US (n=59 ASD; n=49 TD) and Hong Kong (HK) (n=25 ASD; n=52 TD). Participants narrated the wordless picture book *Frog, Where Are You?* (Mayer, 1969), which was presented on a Tobii eye-tracker. Narratives were coded for descriptions of characters' cognition and affect, causal explanations of story events, and narrative structure (e.g., inclusion of key story elements, establishing the theme). Gaze variables included percentage of looking time towards social and nonsocial information to examine social and non-social attention, respectively. Age and IQ were covaried for analysis.

Results: Individuals with ASD in both cultures produced narratives with fewer causal inferences ( $p = .002$ ) and missed more key story components ( $p = .001$ ) compared to TD controls. Interaction effects revealed that the US-ASD group included fewer descriptions of cognition and affect than the US-TD group ( $p < .001$ ), whereas the HK-ASD and HK-TD groups performed comparably. Both HK groups generated fewer descriptions of cognition and affect than their US counterparts ( $p < .001$ ), but were more likely to allocate descriptions of cognition and affect within causal frameworks ( $p < .001$ ). For narrative evaluation specifically, increased social attention and decreased non-social attention were correlated with increased descriptions of cognition and affect across diagnostic and cultural groups.

Conclusions: Results demonstrated unique patterns of narrative performance across diagnostic and cultural groups. Diagnostic effects were found in causal inferences and inclusion of key story components across both cultures, which might point to specific narrative deficits that express robustly across different cultures in ASD. Interaction effects further suggested that descriptions of cognition and affect may be more malleable to environmental influence in ASD, and may therefore be a possible target for intervention. Associations between gaze and narrative abilities revealed comparable gaze-narrative coordination among both ASD and controls across cultures, highlighting their interdependence and may implicate attentional profiles as importantly related to narrative and other social communicative impairments in ASD.

**413.002** (Poster) A Novel Method of Introducing Emotional Content in Synthesized Speech Via Facial Expression and Vocal Prosody  
**L. J. Brady**, *iTherapy, LLC, Martinez, CA*

Background: Autism Spectrum Disorder (ASD) is one of the leading causes of communication disorders. Acquiring functional language abilities can be difficult depending on the severity of the disorder. Some individuals are verbal and have stronger functional language abilities whereas others are minimally verbal or nonverbal, experiencing difficulties with speech production. Those who are minimally to non-verbal face great challenges when participating in daily communication. Effective communication relies not only on words but on tone of voice and facial expressions. The ability to express emotion through one's tone of voice, or prosody, clarifies the communicative intent behind a spoken message. While there are augmentative and assistive communication (AAC) systems that allow a person to communicate using digitally synthesized speech, these voices are

monotone and can be readily identified as computer generated. To be more effective, AAC products must convey emotions through prosody and have the ability to video-model a user's facial expressions to convey happiness, sadness, or anger.

**Objectives:** This research sought to identify and implement a set of a unique para-linguistic features that most realistically conveyed the emotions of happy, sad and angry. which can be critical for ASD individuals. A working prototype that synthesized emotional communication through speech and facial animation software designed for Apple iOS.

**Methods:** We administered a prototype with a diverse population of 14 adult male and female subjects aged 18-75 and recorded their ability to correctly label the emotions presented in each of the three VO, FO, and C groups. Subjects were given a combined total of 64 presentations for each stimulus. We conducted a one-way analysis of variance (ANOVA) to compare the three groups' mean identification scores (the mean number of correctly labeled emotions in each medium) with a P-value set at 0.05. The ANOVA allowed us to examine variations within each medium (such as subjects' variations between trials) along with variations among the three mediums, or whether the number of correctly identified emotions is the same for all three approaches.

**Results:** Analysis of the data produced an F-statistic of 10.0735, with two degrees of freedom, arriving at a P-value of 0.0001, which was statistically significant to reject our null hypothesis. In conclusion, given three different mediums — voice only (VO), facial expression only (FO), and combined voice and facial expression (C) — subjects most accurately categorized emotions that were conveyed through the combination of animated facial expressions with synthesized emotional speech (C). Along with the ANOVA, the responses in each medium were broken down into three categories: Total Recognized, Percent Recognized, and Label Substitutions.

**Conclusions:** We arrived at a statistically significant conclusion: individuals tended to improve their ability to identify synthesized human emotions when shown a combination of facial expressions and speech. This conclusion has a potentially high value proposition for current and future customer segments.

**413.003 (Poster)** A Systematic Literature Review of Autism Research on Caregiver Talk

**K. Bottema-Beutel<sup>1</sup>** and **S. Y. Kim<sup>2</sup>**, (1)*Lynch School of Education, Boston College, Chestnut Hill, MA*, (2)*Duksung Women's University, Seoul, Korea, Republic of (South)*

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**Background:** Caregiver talk influences children's language acquisition, and may be a particularly important resource for autistic children. Caregiver talk also structures interactions that impact developmental milestones, including social-communication (Bottema-Beutel et al., 2018; Siller & Sigman, 2002; Yoder et al., 2015). Given that autistic children can exhibit language delays, and some do not go on to develop flexible language in any modality (Tager-Flusberg & Kasari, 2013), the features of caregiver talk that influence autistic children's language and social-communication development are of interest to discern. Describing the features of caregiver talk, and how it may differ between caregivers of autistic children and other populations is also of interest, because autistic children's caregivers may modify their talk in particular ways as a response to their children's social and language profiles (Nadig & Bang, 2017). However, there have not yet been attempts to systematically review the myriad ways caregiver talk variables have been conceptualized and measured.

**Objectives:** In this systematic literature review, we examine 294 caregiver talk variables extracted from 65 studies, provide a narrative overview of research findings, and link measurement approaches to various theories of language development.

**Methods:** We conducted a systematic search and selection process to gather studies that examined talk from caregivers of autistic children. Inclusion criteria were that articles must be peer-reviewed, group-design studies published in English between 1980 - present, and measure some aspect of talk in caregivers of autistic children. Caregiver talk variables were coded to identify how they were operationalized; see Table 1 for codes and definitions.

**Results:** See Table 2 for the number of reports and variables coded for each caregiver talk feature. Notably, the majority of variables included only talk directed to children and specified the speech act being performed. More than one-third of variables measured talk that was responsive to children's attention, activities, or communication (i.e., 'follow-in' talk), and slightly less than a third measured variables that elicited children's communication or engagement. We found strong support that talk related to children's attention is implicated in autistic children's language development, but this construct has varied in terms of semantic, structural, and functional features. There is also evidence that caregivers of autistic children modify their talk to accommodate their autistic children's needs, and for bi-directional relationships between caregiver's talk and autistic children's development on a variety of semantic and structural variables. Experimental evidence regarding the influence of caregiver talk interventions on autistic children's development is weak. Theoretical paradigms used by researchers included information processing, transactional, and speech act approaches.

**Conclusions:** We found inconsistencies in how researchers measured caregiver’s talk, but also uncovered promising leads with strong empirical support. We encourage researchers to reach consensus on how to operationalize variables such as follow-in talk, and to be clear about how conceptualizations of caregiver talk relate to theories of language and language acquisition. Further, researchers should consider supplementing caregiver talk research with interactional approaches that consider language-as-action, and do not restrict coding to the utterance level. These adjustments could provide foundational research for improving caregiver-talk related interventions.

**413.004 (Poster)** Acoustic-Perceptual Analysis of Oral Narratives in Individuals with Autism

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**Background:** Acoustic differences in the speech, voice and prosody of individuals with autism include increased pitch variability, atypical/shallow vocal quality, fast or slow rate, exaggerated/decreased pitch, and inappropriate phrasing, stress and resonance. Research supports that human listeners can perceive speech differences under controlled conditions that distinguish children with ASD from typically developing (TD) peers. For example, human listeners distinguished children with autism from TD controls as sounding significantly “different” on the basis of story sequencing, articulation, fluency, and emotional language (Andrianopoulos et al., 2015); using more words per utterance during elicited story telling tasks (Dahlgren, 2018); and speech intelligibility (Redford et al., 2018). There is limited consensus regarding which acoustic features contribute to the perception of prosodic differences in autism. The clinical usefulness of perceptual ratings of prosody remains limited. Continued empirical research investigating the ability of trained listeners to identify individuals with autism on the basis of speech, voice and prosody could contribute to the development of an objective definitions of “atypical prosody” to be used across clinical, diagnostic, and research settings.

**Objectives:** The following research questions were addressed: Do individuals with autism have acoustic differences in their speech, voice, and prosody during oral narrative productions compared to controls?; Are speakers with autism described by trained human listeners as sounding “different” with respect to perceptual correlates of prosody; Are speakers with autism identified by trained human listeners based on their speech, voice, and prosody?

**Methods:** A between-group study was conducted to investigate acoustic-perceptual features of the voice during an oral narrative re-telling task in individuals with autism (n=15; 12 males, 3 females) compared to TD controls (n=15;) matched for age, gender and language. Participants were monolingual speakers of English, between 7;10 to 15;1 years of age. Testing took place in a 1:1 setting in a sound-treated, double-walled chamber with an ambient noise level of 25 dBA. Participants’ produced an oral narrative using controlled picture stimuli, which was audio recorded for analysis. The duration of each story (seconds), average fundamental frequency (f0), f0 range, standard deviation of f0, rate, and intensity was measured per participant using the Multi-Dimensional Voice Program and compared between groups. Trained listeners used a novel perceptual rating tool consisting of Likert scales to describe the oral narratives with respect to pitch, intonation, rate, fluency, timbre, loudness, and group membership (ASD vs. TD).

**Results:** The acoustic-perceptual analysis of 18 participants’ oral narratives has been completed. The group means for duration and fundamental frequency during an elicited storytelling task are presented in Table 1. Data collection and analysis will be complete by December 2019. Planned statistical analysis includes one-way analysis of variance, t-tests, Fisher’s Exact, Cohen’s d, and Cohen’s kappa for intra- and inter-rater reliability of perceptual judgments.

**Conclusions:** Published empirical research findings are contradictory. The results of this study support differences in duration during elicited spontaneous storytelling tasks (Dahlgren et al., 2018; Redford et al., 2018). Clinical implications and directions for future research require reliable operational metrics to assess prosody in autism.

**413.005 (Poster)** Are Children with Autism More Likely to Retain Object Names When Learning from Colour Photographs or Black-and-White Cartoons?

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Background:

Many children with autism spectrum disorder (ASD) have difficulty learning words. Despite widespread use of picture-based communication interventions to facilitate their word learning, previous research indicates that some children with ASD have difficulty understanding pictorial symbols. Moreover, there are currently no data-grounded guidelines regarding which kinds of

pictures should be employed by interventions. Here, we examine how ASD impacts children's ability to learn words from pictures that vary on the dimension of iconicity – the extent to which a symbol resembles its intended referent.

#### Objectives:

This study investigated whether children with ASD and delayed language development map and retain novel object names more accurately when learning from colour photographs or black-and-white cartoons. We expected to observe superior retention when children learned from highly-iconic colour photographs, as high levels of visual detail may facilitate children's mapping of picture-object relationships and scaffold the formation of more robust representations of meaning.

#### Methods:

Children with ASD ( $n = 20$ ;  $M$  age = 80.35 months) and TD controls ( $n = 20$ ;  $M$  age = 41.55 months) matched on receptive language (ASD  $M$  age equivalent = 43.60 months; TD  $M$  age equivalent = 44.75 months) mapped novel word-picture relationships in a mutual exclusivity referent selection task. They completed two versions of this task on different days; in one condition the pictures were colour photographs and in the other the pictures were black-and-white cartoons (words and objects differed across versions - see Figure 1 for an illustration of each trial type). During eight referent selection trials, participants actively learned four novel words for pictures of unfamiliar objects. After a 5-min delay, we tested children's retention of the newly-learned words by asking them to identify their corresponding 3-D referents.

#### Results:

Both groups used mutual exclusivity to accurately map novel word-picture relationships, achieving ceiling level accuracy in both iconicity conditions (93-100%), but demonstrated substantially reduced retention accuracy. When learning from black-and-white cartoons, retention trial accuracy of TD children (37.5%) and children with ASD (32%) did not significantly differ ( $p = .39$ ). However, when learning from colour photographs, children with ASD achieved significantly greater accuracy on retention trials (47%) than TD children (33.3%;  $t = 2.55$ ,  $p = .013$ ). Children with ASD achieved significantly greater retention accuracy when learning words from photographs (47%) than cartoons (32%;  $t = 2.20$ ,  $p = .04$ ).

#### Conclusions:

Discrepancies between referent selection accuracy and subsequent retention accuracy suggest that these word learning processes are subserved by distinct mechanisms. The superior retention accuracy achieved by children with ASD in the photograph condition could be attributed to enhanced perceptual functioning which may afford an advantage over TD children when learning object names from highly-iconic colour photographs. TD children may not have benefitted from increased iconicity because of their propensity to focus on shape, at the expense of other details (e.g. colour), when learning new object names. From an applied perspective, our results provide a data-grounded rationale for using colour photographs in clinical and educational contexts.

**413.006 (Poster)** Assessing Vocabulary Differences in Infants with an Elevated Likelihood of ASD Using the n-CDI  
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**Background:** Infants with an elevated likelihood (EL) of autism diagnosis are shown to have smaller receptive and expressive vocabularies at various timepoints, when compared to their lower likelihood (LL) peers. Group differences in vocabulary size derive from a wide range of internal (e.g., infant behaviour, genetics) and external factors (e.g., environment). Such factors may also lead to differences in the *content* of the vocabularies of EL versus LL infants. In typically developing infants, for example, it has been shown that the language(s) to which an infant is exposed impact the timepoint at which the infant begins to learn different syntactical categories (e.g., nouns, verbs). Similarly, we may expect that the atypical internal and external factors of EL infants may also impact the words that make up their vocabulary (i.e., content) in such a way that it is distinguishable from their LL peers.

**Objectives:** We assess whether there are group differences in the vocabularies between EL versus LL infants at 14 and 24 months, examining both vocabulary size and content. This is an explorative study and the first step to subsequently complement

our findings via a pre-registered report with a larger data set from an international consortium covering more languages. To our knowledge, this is the first study assessing EL infants' vocabulary in this age group.

**Methods:** Fifty-nine infants (36 EL) were assessed using the Dutch version of MacArthur-Bates Communicative Developmental Inventory (N-CDI). Vocabulary size was assessed through infants' raw scores on the questionnaire. Vocabulary content was examined in two ways. First, a syntactic analysis focused on the word classes (i.e., nouns, predicates, function words, other). Second, a semantic analysis focused on the kind of words (i.e., more versus less social words).

**Results:** Although at 14 months there was no significant group differences for neither vocabulary size nor vocabulary content, results revealed clear differences in both at 24 months. EL infants had smaller receptive,  $U = 245.00$ ,  $p = .009$  and expressive,  $U = 187.00$ ,  $p < .001$  vocabularies than their LL peers. They also had lower proportions of 'predicates' (i.e., verbs and adjectives),  $U = 288.00$ ,  $p = .030$  and higher proportions of 'other' words (such as 'animal sounds'),  $U = 294.00$ ,  $p = .037$  in their total vocabularies compared to their LL peers (see Figure 1). The groups did not differ significantly in the proportions of 'more social' and 'less social' categories in their vocabularies.

**Conclusions:** While groups initially did not differ, differences in size and content became visible by 24 months: compared to their peers, EL produced fewer words, and the type of words they produced were relatively simpler: fewer 'predicates' but more 'other' words (e.g. 'animal sounds'). Arguably, predicates are more complex words because they describe the relationship between multiple entities, making them more abstract (e.g., verbs revolve around varying persons). At the same time 'animal sounds' are relatively concrete. Further research is required to see whether this pattern holds for more languages and to observe whether these differences in contents arise from the reported smaller vocabularies.

**413.007 (Poster)** Atypical Neural Representation of Phonological Working Memory in Children with Autism

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**Background:** Despite the removal of language impairments from the diagnostic criteria of autism spectrum disorder (ASD) in 2013, a majority of children with ASD show borderline or impaired language (Kjelgaard & Tager-Flusberg, 2001). It is unknown whether the language impairments (LI) in ASD share the underlying neural bases of LI in neurotypical (NT) individuals. Nonword repetition (NWR) is a standard clinical measure for phonological working memory (PWM) with high sensitivity and specificity for developmental language disorders (Weismer et al., 2000). NWR involves three language processes: speech perception, PWM, and speech production. Research has suggested behavioral and neural differences in children with ASD for each of these processes (Tryfon et al., 2018; Habib et al., 2019; Williams et al., 2013; Pang et al., 2015). Comparing the precision of neural representations of PWM in children with ASD to those in NT controls would provide novel insight into the neural bases of LI in ASD.

**Objectives:** Our objective is to assess whether children with ASD and NT engage similar neural substrates of PWM as measured by decoding accuracy from a multivariate pattern analysis (MVPA) during NWR, and whether decoding varies by phonological skill (stronger vs. weaker).

**Methods:** Nineteen participants with ASD were matched with 19 NT peers by age, gender, NWR behavior, and IQ (Table 1). Each group was divided by in-scanner NWR performance (stronger (SP) and weaker performers (WP)) using an age-based median split. fMRI data were collected via sparse sampling. Participants repeated nonwords distributed across four NWR loads (2 to 5-syllables).

We used MVPA to decode the neural activation during challenging NWR tasks (5-syllable) from easier NWR tasks (2-syllable) within the NWR networks of interest: speech perception, verbal working memory, and speech production (Figure 1). Meta-analysis maps from Neurosynth.org were used as the network masks. We also performed decoding analyses on the combination and conjunction ROIs to determine if particular regions were driving accuracy across maps.

**Results:** A two-way ANCOVA revealed a main effect of diagnosis in the speech production network (greater decoding accuracy in NT than ASD), after correcting for IQ ( $F(1, 33) = 4.35$ ,  $p = 0.043$ ). There were no other main effects or interactions for the other networks. Because we found a main effect of diagnosis, but not phonological skill, we collapsed the data within each diagnosis and compared decoding to chance for each network. The NT group demonstrated above-chance decoding for the speech perception ( $p = 0.007$ ), speech production ( $p = 0.001$ ), and combination networks ( $p = 0.04$ ), while the ASD group did not

show above-chance decoding for any of the networks (Figure 1). Neither group performed above chance for the verbal working memory or conjunction ROIs.

Conclusions: Children with ASD showed reduced precision of neural representation in speech perception and speech production networks. The specificity of group differences in speech production was highlighted by the lack of significant decoding in the conjunction map. These results may implicate compensatory networks that support PWM in the ASD groups. Future analyses will use searchlight MVPA to verify this possibility.

#### **413.008 (Poster)** Audiovisual Integration of Speech and Gesture in Autism

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##### Background:

Autistic people often find it difficult to integrate verbal and non-verbal cues effectively in communication, and show atypical prosody and use of gestures in conversations. Differences in multisensory integration, motor coordination, and temporal processing suggest that atypical speech/gesture delays could characterize the coordination and integration of audiovisual communication cues in autism. Perceptually, gestures have been found to facilitate comprehension to a lesser extent for autistic individuals than it does for their typically developing (TD) peers (Silverman et al., 2010). Prior research also found longer delays between gesture and speech production in autistic speakers (de Marchena and Eigsti, 2010); it remains unknown whether autistic listeners show similar differences in integrating perceived audiovisual communication.

##### Objectives:

This study investigated the preferred delay for audiovisual integration of speech and gesture in autistic and TD adults. To determine whether any differences observed pertained to all audiovisual stimuli or only to specific stimulus types (complex or linguistic stimuli), we measured participants' preferred delay using speech and gesture, dance and music, and the movement of abstract shapes to distorted speech (noise).

##### Methods:

26 adults ( $N_{ASD} = 14$ ,  $N_{TD} = 12$ ) viewed pairs of videos presented side-by-side and were tasked with deciding which video fitted an accompanying audio track more naturally. Each trial featured the original clip and a temporally-shifted version of the same clip, modified in relation to the original audio by one of eight delays ranging from  $\pm 240$  ms to  $\pm 2000$  ms. Trials were divided into three blocks based on stimulus type.

##### Results:

Results indicated that all participants showed an asymmetrical preference for video-lead compared to video-lag trials ( $F[1, 24] = 42.87$ ,  $p < .001$ ,  $\eta_p^2 = .641$ ), suggesting that participants tolerated (and sometimes preferred) delays between audio and video when video was leading, but less so when video was lagging. Our data also indicates a main effect of condition ( $F[2, 48] = 12.56$ ,  $p < .001$ ,  $\eta_p^2 = .344$ ); participants showed a stronger preference for the original clip in the speech condition compared to the dance ( $t = 4.80$ ,  $p < .001$ ) and abstract ( $t = -4.02$ ,  $p < .001$ ) conditions, however, participants did not differ in preference between the dance and abstract conditions ( $t = -0.27$ ,  $p = .79$ ). The data also indicated a significant interaction between group and delay; compared to the ASD group, TD participants showed a stronger shift in preference between video-lag and video-lead trials ( $F[1, 24] = 8.47$ ,  $p = .008$ ,  $\eta_p^2 = .261$ ).

##### Conclusions:

In line with prior research, findings indicated an asymmetrical preference for occurrences where gesture preceded the corresponding audio in naturalistic speech in both autistic and non-autistic participants. This preference extended to dance and abstract stimuli, suggesting it is not specific to complex or linguistic stimuli. Similar to the TD group, the preferred delay for the autistic group was around 240-480 ms. However, autistic participants exhibited a subtler shift in preference between delays, suggesting that the audiovisual integration process differs for simple and complex stimuli in autism.

#### **413.009 (Poster)** Characterizing Language Atypicality in ASD and ADHD

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**Background:** Pragmatic differences are prevalent in neurodevelopmental disorders, including Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). Indeed, communication differences are a common impetus for assessment, and differential diagnosis between ASD and ADHD is sometimes difficult. Traditional assessment captures salient details regarding language form and content; however, challenges remain in formally assessing language *use* (i.e., pragmatics). There is a need to better understand differences in language profiles among clinical groups and review parent-reporting as a critical component of the diagnostic processes.

**Objectives:** With careful measurement, it is possible to examine discrete pragmatic differences and linguistic atypicality that can differentiate typical development (TD), ASD, and ADHD. While ADHD in isolation is not considered a communication disorder, symptoms of the disorder can interfere with communication and mimic the symptoms of ASD. Our primary aim is to describe how evaluation using a questionnaire with pragmatic subscales can be a robust indicator of group membership and differentiation between children with ASD, ADHD, and TD.

**Methods:** 174 children were involved in a study on functional magnetic resonance imaging: 101 with ASD (mean age: 11.3 years; 85 males), 28 with TD (mean age: 11.6 years; 12 males), and 45 with ADHD (mean age 11.5 years; 31 males). There were no significant group differences for age or race. Subjects participated in psychometric testing using the Autism Diagnostic Observation Schedule, Social Responsiveness Scale, the Wechsler Intelligence Scale for Children and the Children's Communication Checklist, 2nd Edition (CCC-2). Cognitive scores were significantly lower for the ASD group compared to TD and ADHD groups (98.8 vs 113.4 and 111.6,  $p < .001$ ). Language profiles were explored with the CCC-2, with subscales for linguistic and social communication features. Parents completed the CCC-2 to yield total, structural, and pragmatic scores for each child participant. Analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used to compare clinical groups.

**Results:** Nine ANOVA models revealed significant ( $p < .001$ ) between-groups differences. Games-Howell post-hoc tests revealed that children with ASD scored significantly lower on all CCC-2 scales than children with ADHD and TD. Effects sizes were larger for pragmatic ( $\eta^2$ : .56 - .65) than structural ( $\eta^2$ : .20 - .47) scaled scores. With the exception of two structural scales (Speech and Syntax), the ADHD group scored significantly lower than TD and their scores fell between the ASD and TD groups. Covarying Full Scale Intelligence Quotient scores (FSIQ) reduced the size of CCC-2 differences across groups only minimally. When structural scaled scores were covaried alongside FSIQ, pragmatic scaled scores remained different across diagnostic groups, with a very large effect size for the composite score ( $\eta^2$ : .49).

**Conclusions:** We compared specific linguistic and pragmatic aspects of language in children with ASD, TD, and ADHD. Using a validated parent-report questionnaire, we analyzed responses to explore language profiles among these groups. Results suggest that differences in pragmatic language are robust predictors of ADHD and ASD diagnoses even after accounting for cognitive and structural linguistic differences.

**413.010 (Poster)** Construct Validity of the Autism Classification System of Functioning: Social Communication (ACSF:SC) across Development

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**Background:** During typical development, children learn to communicate through social processes. Many children with autism struggle with social skills, which are associated with social communication difficulties. Categorization based on children's social communication abilities may be informative for clinical decisions such as what therapy modifications or support recommendations may help maximize therapeutic change. The Autism Classification System of Functioning: Social Communication – Integrated (ACSF:SC–I), describes a range of social communication abilities from Level I (most functional) to Level V (least functional) of children with autism 2-19 years of age. ACSF:SC–I ratings are reliable (intra- and inter-rater) for both parents and professionals to categorize children and youth on their 'Capacity' (what children do at their best) and 'Performance' (everyday function).

**Objectives:** To examine the construct validity of the ACSF:SC–I.

**Methods:** Participants included 95 children with autism (2-19 years). We present two effect size estimates (correlation coefficient & eta-squared) to quantify construct validity. The construct validity of ACSF:SC-I was examined by providing indices of its degree of convergent and discriminant validity. We used Social Responsiveness Scale 2<sup>nd</sup> edition (SRS-2) subscales and Behavior Assessment System for Children, third Edition – Parent Rating Scales (BASC-3 PRS) as comparison measures to examine construct validity. We used  $\alpha=.05$  for Spearman's Rho ( $r$ ) correlation analysis and defined Eta-squared ( $\eta^2$ ) < .06 as small,  $\eta^2 = .06$  to .14 as moderate, and  $\eta^2 > .14$  as larger effect sizes. To establish convergent construct validity of ACSF:SC-I, a priori hypotheses anticipated that parent ratings of Capacity and Performance scores would be significantly correlated with the Social Communication and Interaction (SCI; SRS-2), Functional Communication (BASC-3), and Social Skills (BASC-3) subscales. To determine discriminant construct validity of ACSF:SC-I, Capacity and Performance scores were expected to weakly correlate with the Attention Problems and Externalizing Problems (BASC-3) as these are distinct constructs independent from social communication.

**Results:** We found significant correlations between ACSF:SC-I and the SCI (Performance:  $r=.39$ ,  $p<.001$ ; Capacity:  $r=.39$ ,  $p<.001$ ), Functional Communication (Performance:  $r=-.37$ ,  $p<.001$ ; Capacity:  $r=-.44$ ,  $p<.001$ ), and Social Skills (Performance:  $r=-.25$ ,  $p=.02$ ; Capacity:  $r=-.39$ ,  $p<.001$ ) T-scores. The effect size of these convergent associations ranged from moderate to large for ACSF:SC-I Performance ( $\eta^2=.11$  to .19) and large for Capacity ( $\eta^2=.18$  to .21). Discriminant analyses showed weaker correlations between ACSF:SC-I ratings and comparison measures of Externalizing Problems (Performance:  $r=-.04$ ,  $p=.70$ ; Capacity:  $r=.01$ ,  $p=.93$ ) and Attention Problems (Performance:  $r=-.01$ ,  $p=.96$ ; Capacity:  $r=.06$ ,  $p=.57$ ) T-scores. The effect size of these discriminant associations was small for Performance ( $\eta^2=.04$  to .05) and small for Capacity ( $\eta^2=.004$  to .01).

**Conclusions:** The results provided support for construct validity of ACSF:SC-I with significant correlations in the predicted directions for convergent validity and weak correlations in the expected direction for discriminant validity. Findings also indicated stronger associations for Capacity than everyday Performance, suggesting that these may be distinct constructs within the social communication domain. This finding has implications for clinical practice and research such as whether interventions and research are targeting Capacity or everyday Performance and the predictive power of each for treatment outcomes (e.g., social isolation).

**413.011 (Poster)** Development of Conversation Abilities in Chinese-Speaking Preschoolers with Autism: The Contributing Role of Parents

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**Background:** Children with autism are found to have deficits in conversation. Yet, the development of conversation abilities is understudied. A few studies reported that there are significant improvements in the ability to maintain a topic of discourse and in the length and frequency of communication interchanges. Additionally, findings of the role of parental inputs in shaping conversational abilities in these children are inconclusive. Abundant research has examined the relation between parental inputs and vocabularies, and shown that parental inputs have been shown to predict later vocabularies of children with autism. Yet, very little research studied the relation between parental inputs and conversational abilities. Besides, these studies focused on English-speaking children with autism. None of them has examined conversation abilities in Chinese-speaking children with autism, whose autism prevalence has been increasing.

**Objectives:** This study aimed to document the growth of conversational abilities in Chinese-speaking preschool children with autism and to investigate how parental inputs influenced these abilities.

**Methods:** Participants in the current study were taken from the larger intervention project for Chinese-speaking individuals with autism. A subset of these participants ( $N=37$ ; 32 males; Mean age: 5;6,  $SD=10.46$  months) contributed their language samples at four time points over a nine-month intervention. Children were administered Autism Diagnostic Observation Schedule (Second Edition), Kaufman Brief Intelligence Test (Second Edition), and Mullen Scales of Early Learning. They interacted with their caregivers at four time points, with each time lasting for 20 minutes playing a standard set of toys in a treatment room. Each session was video-recorded. We first identified the conversation topic for each utterance and who initiated the conversation. We also counted the numbers of conversation turns. Finally, for each utterance produced by the respondent during the conversation, we considered whether the respondent responded, and if so, whether the response was appropriate.

**Results:** Overall, there were 8817 conversation topics ( $M=60.39$ ;  $SD=19.31$ ) and 914.54 conversation turns ( $M=6.18$ ;  $SD=2.04$ ) across four time points. Separate Hierarchical Linear Modeling analyses were conducted to model the growth curve trajectories for different conversation abilities. Number of conversation turns and the proportion of children-initiated conversation (but not the proportion of children's appropriate responses) grew over the course of nine months ( $\beta=.15$ ,  $SE=.05$ ;  $\beta=.04$ ,  $SE=.01$ ). In separate random intercept models, after controlling for time, ADOS and Express Language age equivalent scores, we found that parents' appropriate responses positively predicted children's appropriate responses ( $\beta=.25$ ,  $SE=.07$ ). Parents' inappropriate

responses negatively predicted children's appropriate responses ( $\beta = -.51$ ,  $SE = .11$ ) and the number of conversation turns ( $\beta = -3.58$ ,  $SE = .95$ ). Interestingly, parent-initiated conversation negatively predicted the proportion of children's appropriate responses ( $\beta = -.28$ ,  $SE = .05$ ) and the number of conversation turns ( $\beta = -2.83$ ,  $SE = .45$ ). Absence of parent responses positively predicted children-initiated conversation ( $\beta = .71$ ,  $SE = .10$ ).

Conclusions: Some aspects of conversation abilities may grow over time in Chinese-speaking children with autism. Contingent and appropriate parent responses help children with autism to learn to formulate appropriate responses to maintain a conversation. Nevertheless, parent-initiated conversation might impose challenges for children to respond appropriately and even discourage these children from initiating conversations themselves.

**413.012 (Poster)** Differences in Conversational Prosodic Entrainment between Youth with and without ASD As a Function of Conversational Duration

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Background: Differences in speech prosody between those with and without ASD have been well-attested. However, the exact nature of these differences is as of yet not completely understood. A relatively new area of prosodic investigation in the speech of those with ASD is prosodic entrainment - the alignment of conversation partners in acoustic-prosodic features over the course of a conversation (Wynn et al., 2018; Lehnert-LeHouillier et al., 2020). Generally speaking, more entrainment in prosodic features is associated with positive interactions whereas a lack of entrainment as well as dis-entrainment – the divergence of conversation partners – is typically associated with negative relational attributes (i.e. Pickering & Garrod, 2004; Soliz & Giles, 2014). The current study furthers our understanding of differences in conversational prosody between individuals with and without ASD.

Objectives: This study set out to investigate the relationship between acoustic-prosodic entrainment in mean f0 and the length of the conversation in which speakers were engaged. It was hypothesized that longer conversations will exhibit more prosodic entrainment, which, in turn, may be reflective of better rapport between conversation partners.

Methods: Twenty-seven children and adolescents between the ages of 9 and 15 years participated in the current study; 14 (11 boys, 3 girls) participants had previously been diagnosed with ASD and 13 (10 boys, 3 girls) participants were neurotypical peers matched in age, gender, and nonverbal IQ. All participants completed IQ (K-Bit 2) and language (CELF-5) testing, and the participants in the ASD group were also administered the ADOS-2 to confirm the ASD diagnosis. Participants engaged in a goal-oriented conversation using the Diapix task (Baker & Hazan, 2011). All conversations were recorded and acoustically analyzed to derive measures of global prosodic entrainment in mean f0 as well as the duration of each conversation. The results were analyzed using linear regression modelling.

Results: The regression model included mean f0 entrainment as outcome variable and duration of the conversation, conversational effectiveness (measured as the number of differences found per minute), and overall language ability (measured by the CELF Core Language score) as predictor variables. The results suggest that no relationship between f0 entrainment and conversational effectiveness exists in our data set. We found a significant effect of overall language ability on mean f0 entrainment ( $b = -0.31$ ,  $SE = 0.11$ ,  $p < 0.01$ ) such that those participants with better language ability tended to show less mean f0 entrainment compared to those with lower CELF scores. This was true of participants with and without ASD alike. However, a significant interaction between participant group and duration of the conversation was found ( $b = 0.1$ ,  $SE = 0.04$ ,  $p = 0.01$ ). The participants in the neurotypical group that were engaged in longer conversations also exhibited more f0 entrainment, while participants in the ASD group who conversed for a longer time not only showed less mean f0 entrainment but actually dis-entrained from their conversation partners over the course of the conversation.

Conclusions: Conversation length is correlated with prosodic entrainment in neurotypical peers but not in youth with ASD.

**413.013 (Poster)** Difficulties with Personal Pronouns for School-Aged Children with ASD and ADHD in a Virtual Reality Task  
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**Background:** Early in development, children with Autism Spectrum Disorder (ASD) show difficulties with producing personal pronouns, particularly non-first-person pronouns (Kelty-Stephen et al., 2020; Song et al., 2020). Furthermore, most of the research on pronoun production among school-aged children with ASD, and some on children with Attention Deficit/Hyperactivity Disorder (ADHD), primarily focuses on ambiguity/unclear uses (e.g. Kuijper et al., 2015; Novogrodsky & Edelson, 2016), without distinguishing these by personhood and sheer base rates of production. This current study examines personal pronoun production in a conversational context, where both first- and third-person pronoun usage is afforded.

**Objectives:** 1) To determine if and how pronoun challenges might persist in older, school-aged children with ASD. 2) To test whether a conversational context, which affords more discussion of others (i.e. family, friends, pets, etc.), expands children with ASD's pronoun type production.

**Methods:** Participants included 21 highly verbal children with ASD (HFA;  $M_{\text{age}} = 11.6$ ,  $SD = 2.2$ ), 24 children with ADHD ( $M_{\text{age}} = 11.9$ ,  $SD = 2.5$ ), 31 children with comorbid symptoms of both ASD and ADHD ( $M_{\text{age}} = 12.0$ ,  $SD = 2.3$ ), and 22 typically-developing (TD) children. Children were all within the normal range of Non-Verbal IQ. Language samples were collected during a virtual reality paradigm where children viewed a virtual classroom through a head-mounted display while they answered questions posed by a research assistant in a conversational format. Sample questions include: "Describe your family and who lives with you", "Talk about any pets you have now or had when you were younger", and "Talk about a favorite vacation you have had". Their responses were recorded and transcribed using CLAN (MacWhinney, 2000). CLAN algorithms were used to extract average mean length of utterances (MLU) and personal pronoun types and tokens.

**Results:** All groups produced significantly fewer third-person personal pronouns than first-person personal pronouns ( $ps < 0.001$ ), with no significant group differences in first-person pronoun production ( $p = 0.310$ ). However, significant group differences emerged in third-person pronoun frequency,  $F(3, 94) = 2.517$ ,  $p = 0.043$ ,  $\eta^2 = 0.174$ . A post hoc comparison using the Tukey HSD test revealed that the HFA ( $p = 0.018$ ) and Comorbid ( $p = 0.002$ ) groups produced significantly fewer third-person pronouns than the TD group (Figure 1).

**Conclusions:** Overall, third-person pronoun challenges still exist in school-aged children with ASD, including those with comorbid symptoms of ADHD. Although the children with ASD did not show difficulties with producing first-person pronouns, corroborating existing findings, children with ASD produced significantly fewer third-person pronouns in their responses, despite the fact that the conversational context probes for the use of third-person pronouns. For example, responding to the pet question, one TD child said: "So I used to have a pet named Goldie. She was really amazing actually." Responding to the same question, one child with ASD, matched on age and average MLU, said: "My dog Sky is brown. Sparky is like white and gray with curly fur." Despite the question affording the use of third-person pronouns, the child with ASD only used full noun phrases.

#### 413.014 (Poster) Distinctive Features of Pragmatic Expression in Adults with ASD

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Background: Autism spectrum disorder (ASD) is characterized by impaired pragmatic expression, which can lead to challenges establishing relationships, maintaining employment, and achieving independence. Although pragmatic language in children with ASD is well studied, there has been little research on pragmatics in the discourse of adults with ASD and their interlocutors.

Objectives: We investigate the degree of politeness, uncertainty, and informativeness of utterances in conversation between adults with ASD or with typical development (TD) and a neurotypical conversational partner while completing a collaborative task. The joint goals of this work are to identify distinctive pragmatic features of ASD and to determine how interlocutors adapt their own pragmatic expression in response to varied discourse input.

Methods: Twenty-two adult experimental participants (EP, ASD  $n=14$ ; TD  $n=8$ ) engaged in a collaborative navigation task with a neurotypical conversational partner (CP,  $n=11$ ). In addition to the general eligibility criteria (PIQ $\geq 80$ ; VIQ $\geq 80$ ; age $>18$ y; no history of speech, language, or auditory disorder, or hearing difficulty), participants with ASD met criteria for diagnosis on the ADOS. Each experimental participant (EP) completed a map navigation task with a conversational partner (CP), in which each person was provided with a map of the same area containing slight differences in landmarks, labels, and obstacles. The EP provided verbal directions to the CP to lead the CP from their indicated location to the EP's indicated location on the map. Three trials were carried out with three different maps. Using coding guidelines from previous work (Danesco-Niculescu-Mizil, 2013; Vincze, 2015; Pavlick and Tetrault, 2016), two annotators independently rated each utterance on 3-point ordinal scale for politeness (Krippendorff's  $\alpha=0.57$ ), uncertainty ( $\alpha=0.75$ ), and information content ( $\alpha=0.90$ ), and the ratings were averaged.

Results: Utterances produced by EPs with ASD were significantly more polite (ASD=2.01, TD=1.95,  $t=4.358$ ,  $p=0.00001$ , Cohen's  $d=0.17$ ) and less informative (ASD=1.61, TD=1.72,  $t=-3.846$ ,  $p=0.00012$ ,  $d=0.15$ ) than those produced by EPs with TD. Utterances produced by CPs of EPs with ASD were significantly more uncertain (CP:ASD=1.41, CP:TD=1.21,  $t=4.812$ ,  $p=0.0000016$ ,  $d=0.20$ ) and more informative (CP:ASD=1.65, CP:TD=1.56,  $t=2.510$ ,  $p=0.012$ ,  $d=0.11$ ) than those produced by conversational partners of EPs with TD. Group difference at the participant level followed similar trends but did not reach significance due to limited sample size. Correlations between the pragmatic features and time required for task completion were

calculated, revealing a negative correlation between experimental participant informativeness and time to complete the task (Pearson's  $r = -0.318$ ).

Conclusions: Adults with ASD exhibited pragmatic language patterns distinct from those of their TD peers when engaging in a collaborative task with a neurotypical conversational partner, which influenced both the pragmatic expression of their conversational partners and extrinsic measures of task success. In particular, we note that conversational partners' language increased in uncertainty in response to the less informative utterances of their ASD interlocutors. These results provide insight into the ways in which language differences observed in children with ASD might manifest in adulthood, which in turn may prove useful for clinicians developing interventions to improve personal and professional outcomes for adults with ASD.

**413.016 (Poster)** Do Preferred Interests Support Vocabulary Learning in Preschoolers with ASD? a Pilot Study

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Background:

While the intense, focused, preferred interests associated with ASD are sometimes viewed as restrictive (e.g., Dichter et al., 2010; Stocco, Thompson, & Rodriguez, 2011), many researchers argue that they should be considered strengths. Some studies find that incorporating preferred interests into intervention can support children's development of social skills (e.g., Gunn & Delafield-Butt, 2016; Vismara & Lyons, 2007). However, the role of preferred interests has not yet been studied in language learning. Approximately 90% of children with ASD have language delays and require language intervention (e.g., Pickles, Anderson, & Lord, 2014). Incorporating preferred interests may make this intervention more effective.

Objectives:

In this pilot study, we ask whether children demonstrate better learning of a new word when the learning situation involves their preferred interest as compared to a more neutral situation.

Methods:

Children with ASD ( $N = 5$ ) and typically developing children ( $N = 5$ ) have participated thus far in two trials (order counterbalanced). On each trial, children saw a video of a character or object performing an action (e.g., spinning) and heard a novel word (e.g., "Look, he is semming!").

On one of the trials, the character/object was the child's preferred interest, as reported by their parent (e.g., Mickey Mouse). On the other trial, it was not the preferred interest, and the parent rated it as neutral (neither hated nor particularly well liked). The child was then tested on whether they had learned the word: They saw the trained action (e.g., spinning) and a new action (e.g., bouncing) side-by-side, being performed by the same character/object as well as a new character/object to test generalization. See Table 1. Children's eye gaze was tracked. Their attention to the correct scene when prompted to, e.g., "find semming" was taken as an indicator of whether they learned the word.

Results:

A mixed-effects linear model with proportion of looking to the correct scene as the dependent variable, participant as random factor, and condition (preferred interest vs. neutral) as a fixed factor revealed a significant main effect of condition ( $\beta = 1.48$ ,  $t = 5.17$ ,  $p < .01$ ). This result indicated that children looked to the correct scene more in the preferred interest condition than the neutral condition. See Figure 1. Although we lack statistical power to look for differences between children with and without ASD, the majority of individual children in both groups showed this pattern.

Conclusions:

This pilot study suggests that children with and without ASD may more successfully learn vocabulary when the learning situation incorporates their preferred interest. This is true even though the word's meaning was not inherently about that interest—that is, although we might imagine that incorporating a preferred interest in dinosaurs would facilitate learning dinosaur-related vocabulary, our results further indicate that preferred interests can be helpful for vocabulary learning more generally. With additional data, we will look for differences between children with and without ASD, relations to ASD symptom severity, and

differences between the two test phases (preferred interest vs. generalization) to see how well learning generalizes.

**413.017** (Poster) Does a Naturalistic Coding Measure of Social Communication Predict Pragmatic Ability As Measured By the CCC-2?

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Background:

Previous work has used real-time coded natural language samples to derive general measures of spoken communication (utterances and conversational turns) for children and adolescents with ASD. Findings revealed high construct validity with the coding measures and caregiver report measures assessed at the same timepoint (Barokova et al., 2020). However, these studies did not examine the predictive role of language sample-derived measures to later language ability and did not include a naturalistic real-time coding measure of social communication. Social communication difficulties are a key characteristic of individuals with ASD (Young et al., 2005). In this study, we used our naturalistic real-time coding measure of social communication to assess whether it will predict pragmatic behaviors, as measured by caregiver report, 8-months later.

Objectives:

In a sample of verbally fluent kindergarteners with ASD, we aimed to examine how our naturalistic measure of social communication predicts pragmatic communication behaviors as measured by caregiver report over an 8-month period.

Methods:

Twenty-six kindergarteners with ASD (4 female;  $n=26$  ADOS mod. 3), ages 56-79 months, completed assessments at the start and end of kindergarten (8 months apart; Table 1). Assessments included the Differential Ability Scales (DAS-II; Elliott, 2007) to measure cognitive abilities, the Brief Observation of Social Communication Change (BOSCC; Lord et al., 2018), a 12-minute examiner-child interaction comprised of play and conversation, and the Children's Communication Checklist (CCC-2; Bishop, 2003), a caregiver report measure to assess children's communication skills, including pragmatics. Speech utterances from the BOSCC were segmented into communication units (Loban, 1976) in ELAN (Lausberg & Sloetjes, 2008). Each child utterance was then coded according to whether it was socially communicative or not. Socially communicative utterances (SCU) included intent to request, share, and/or redirect. Total SCU was converted to SCU per minute (FreqSCU).

Results:

All analyses involved linear regression and controlled for DAS full-scale IQ (FSIQ) scores measured at time 1. FreqSCU at time 1 predicted CCC-2 frequency of pragmatic communication behaviors at time 2 ( $\beta=.45$ ,  $t=2.15$ ,  $p=.042$ ; Figure A). CCC-2 pragmatic communication behaviors at time 2 and FSIQ explained 17.20% of the variability in FreqSCU at time 1. FreqSCU at time 1 also predicted CCC-2 frequency of nonverbal pragmatic communication behaviors at time 2 ( $\beta=.43$ ,  $t=2.55$ ,  $p=.018$ ; Figure B). CCC-2 frequency of nonverbal pragmatic communication behaviors at time 2 and FSIQ explained 22.51% of the variability in FreqSCU at time 1.

Conclusions: Our measure of social communication derived from the BOSCC protocol predicted pragmatic behaviors, including nonverbal communication (e.g., gestures) 8 months later as measured by caregiver report. Findings support the utility of our naturalistic real-time coding measure to capture broader and more nuanced pragmatic communication skills in young children with ASD. Future work should examine how our coding measure captures changes over time in the context of ASD interventions targeting social communication skills.

**413.018** (Poster) Early Expressive Language in Young Children with Autism Spectrum Disorder: The Importance of the Context  
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Background: From research on children with typical development, we know that a) caregivers' child-directed speech have strong impact on early language development and b) objects, animals and persons in the child's environment define much of the semantic content of the child-directed speech of the caregivers. As most children with autism spectrum disorder attend preschool, they will encounter similar but also different objects, persons and places compared to home. The differences will affect words used by parents and preschool teachers and might subsequently affect words used by the child.

Objectives: This exploratory study aims to investigate how the expressive language of young children with ASD might be different across the home and preschool contexts. We compare the amount of words said by children with ASD at home and in preschool across 10 categories listing various types of objects, places, animals and persons that we assume to be typical for one or the other context. We also investigate the degree of overlap between the words reported to be used by the children at home and in preschool.

Methods: Fifty-eight 2-4 years-old children [ $M=48.8$  months ( $SD = 8,0$ ), 81% boys] with a confirmed ICD-10 diagnosis of childhood autism and their parents and preschool teachers participated in this study. Parent and preschool teacher separate ratings of the words said by the children on the 10 noun categories of MacArthur-Bates Communication Development Inventory (CDI) were used to study expressive language across the home and preschool context.

Results: There was no significant difference in the total number of words the children said at home or in preschool ( $M_{\text{home}} = 78.1$ ,  $SD = 78.4$ ;  $M_{\text{preschool}} = 70.5$ ,  $SD = 75.9$ ,  $p = .07$ ), but the children said significantly more words in the noun categories "Furniture and rooms" ( $M_{\text{home}} = 7.4$ ,  $SD = 8.8$ ;  $M_{\text{preschool}} = 5.4$ ,  $SD = 7.4$ ,  $p = .00$ ) and "People" ( $M_{\text{home}} = 6.0$ ,  $SD = 5.5$ ;  $M_{\text{preschool}} = 5.0$ ,  $SD = 5.8$ ,  $p = .04$ ) at home. Only one third (38%) of the words the children said were said both at home and in the preschool, while the other two thirds were said only at home or only in the preschool. The highest percentage of words said across both contexts was within the categories "Vehicles (real or toy)" (47%) and "Food and drinks" (44%), while the lowest percentage was in the categories "Furniture and rooms" (26%) and "Small things in the household" (27%).

Conclusions: The results suggest that although young children with ASD use similar amount of words at home and in preschool, their vocabulary is highly context-dependent, similarly to that of younger children with TD. The results also suggest that their early expressive vocabulary might be larger when these two contexts are taken into account. This novel study highlights the importance of investigating the early language in children with ASD in multiple contexts in order to better evaluate their vocabulary and to design appropriate language interventions.

#### **413.019** (Poster) Evaluating Atypical Language in Autism Using Automated Discourse Measures

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Background: Structural and pragmatic language deficits are core symptoms of Autism Spectrum Disorder (ASD) and predict long-term outcomes. Although language proficiency is a treatment target in early intensive behavioral interventions, measurement is cumbersome and costly. Better language outcome measures are needed. By analyzing language transcripts, our study generated Automated Discourse Measures (ADMs) that we tested for their convergent and discriminant validity across clinical groups.

Objectives: 1. examine language differences between three clinical groups (ASD, ADHD, and TD); 2. analyze the convergent validity of these measures by calculating correlations between the ADMs and standardized language measures; 3. investigate the accuracy of each individual ADM in predicting ASD status; and 4. examine if gains in accuracy would be obtained by combining all ADMs together in predicting ASD status.

Methods: 169 participants (96 ASD, 28 Typically Developing (TD), 45 Attention Deficit Hyperactivity Disorder (ADHD)) ages 7 to 17 were evaluated with the Autism Diagnostic Observation Schedule (ADOS-2), module 3. ADOS tasks were transcribed following SALT guidelines. Transcripts of one task were automatically analyzed with novel software to generate seven ADMs for each participant: Mean Length of Utterance in Morphemes (MLUM), Number of Different Word Roots (NDWR), um proportion, content proportion, unintelligible proportion, c-units per minute (CPM), and repetition proportion.

Results: With the exception of repetition proportion ( $p = .07$ ), nonparametric ANOVAs (Kruskal-Wallis) showed significant group differences ( $p < .01$ ). The TD and ADHD groups did not differ from each other in post-hoc analyses for the seven ADMs. The ASD group showed significantly lower language skills. The highest effects sizes were found for content proportion and CPM. The ADMs were correlated with standardized clinical evaluations of ASD, which provided support for their convergent

validity. In logistic regression analyses adjusted on age and IQ, four ADMs were found to significantly predict ASD versus non-ASD status with accurate classification ranging from 67.9% to 75.5%. When combined together in one model, an overall correct classification rate of 82.4% was achieved. We estimated ROC curves using the class prediction probabilities drawn from the logistic regression models. The combined model using all seven ADMs had the highest AUC of 0.9223, followed by the individual model for content proportion with an AUC of 0.8149.

Conclusions: All seven ADMs show an improved accuracy of ASD prediction over a baseline model using only age and IQ; a combined model achieves a highly improved prediction model for ASD diagnosis using easily classifiable language measurements. These ADMs offer a promising approach for generating novel outcome measures.

**413.020 (Poster)** Examining the Impact of Electronic Toys on Social Interactions between Young Children with Autism Spectrum Disorder and Their Parents

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Background: In recent years, ‘traditional’ toys have, in large part, been replaced by electronic toys with colorful flashing lights, talking voices, and musical tunes. Though electronic toys are often marketed as being beneficial for children’s development, numerous studies suggest that the opposite may be true. For example, electronic toy play has been shown to elicit fewer adult words, fewer parent-child conversational turns, and lower rates of maternal responsiveness than traditional toy play. Though most studies on electronic toys have focused on children with typical development, the effects of electronic toy play may be even more important to consider in the case of children with autism spectrum disorder (ASD), who are at heightened risk for language delays.

Objectives: The goal of this study was to determine how electronic toy play impacted the quality of parent language input, compared to traditional toy play.

Methods: Participants were 10 children with ASD (2-4 years old) and one of their parents. Most children showed severe delays in language and cognitive skills. Data collection is ongoing; additional data will be included in the presentation. Each parent-child dyad took part in two 10-minute play samples—one on each day of their two-day research visit. Parents were instructed to play with their child like they normally would at home. Dyads received the traditional toy set on one day and the electronic toy set on the other day (counterbalanced across participants). Each toy set included a barn with animals, a shape sorter, spiky sensory balls, three vehicles, a puzzle, and a pull toy dog (see Figure). Videos of the samples were transcribed by trained research assistants using Systematic Analysis of Language Transcripts (SALT) software.

Results: Given the limited sample size, Wilcoxon signed-rank tests were used to compare the quality of parent language input between toy types. Parent lexical diversity (number of different words per minute) was significantly higher during traditional toy play than during electronic toy play ( $p = .027$ ). Parent mean length of utterance did not significantly differ between toy types ( $p = .700$ ). The number of parent utterances per minute also did not significantly differ between toy types ( $p = .110$ ), though traditional toy play elicited more parent utterances than electronic toy play in an absolute sense. Parents paused between utterances significantly more often during electronic toy play than during traditional toy play ( $p = .010$ ).

Conclusions: Though preliminary, the findings of the current study suggest that electronic toy play may elicit lower quality language input from parents of children with ASD than traditional toy play. These findings mirror the results of experimental studies focused on children with typical development. Given the importance of providing high-quality language input to children with ASD, the potential impact of toy type should be considered in both clinical and research settings. Findings from this and future studies will help clinical professionals make informed recommendations to parents—particularly those taking part in parent-mediated interventions designed to facilitate children’s language and communication skills.

**413.021 (Poster)** Facing Your Fears: Collaborating with Autistic Young Adults to Adapt an Evidence-Based Anxiety Intervention

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Background: While research on evidence-based interventions for children and adolescents with co-occurring autism and anxiety is available, a dearth of research exists on how autistic young adults experience anxiety and how interventions can support these challenges. Previous research on intervention design and implementation has largely neglected to account for the preferences and

self-reported needs of autistic students. Allowing students with autism to have a voice in how interventions for them are created or adapted can improve the validity and efficacy of a newly proposed intervention. Thus, in planning to adapt a current evidence-based anxiety intervention to meet the needs of autistic college students, critical feedback from autistic college students was gathered through focus group and online survey formats.

Objectives: This study sought to answer the following questions:

- How do autistic college students experience anxiety in the college setting?
- Given an evidence-based anxiety intervention for autistic adolescents, what recommendations do autistic college students have for adapting the curriculum to the college setting?

Methods: Students registered at the disability office at the University of Delaware who identified as autistic were recruited for participation in the focus group via email invitations. Five students attended the focus group. The focus group was held virtually over a 1.5-hour Zoom session. Following the focus group, twelve other students who expressed interest in study participation were sent a Qualtrics survey with the focus group questions. This data is currently being collected (and not included in the results below). The focus group data was coded using the Rigorous and Accelerated Data Reduction (RaDaR) technique (Watkins, 2017).

Results: According to initial analyses of the focus group, participants commonly experienced anxiety due to sensory overstimulation, presence in social spaces and situations, and academic- or career-related stressors. Descriptions of students' anxiety experiences varied from displaying anxiety-related behaviors to struggling to eat or feeling physical pain. Similarly, students found that their anxiety impacted them in many different circumstances, and they reported using a variety of coping strategies to manage their anxiety. Participants voiced that receiving social support from a peer or mentor, learning how to identify their anxiety symptoms, and promoting autistic students' independence by offering a treatment that limits parental involvement would be both helpful and appropriate goals for the adapted intervention.

Conclusions: Autistic college students experience anxiety in many ways that are similar to neurotypical students' experiences of anxiety. In terms of recommendations for adapting the *Facing Your Fears* intervention, participants' clear preference for excluding parents from involvement presents a challenge and opportunity, given the current use of parents as coaches in other versions of the intervention. Participants' viewpoints on parental involvement, as well as their expressed desires to learn about their anxiety and related coping strategies, can inform the further adaptation of interventions for young adults on the spectrum.

**413.022 (Poster)** Figurative Language Comprehension in Hong Kong Children with Autism Spectrum Disorders: The Role of Theory of Mind and Conventionality

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Background:

While deficit in comprehending figurative language is regarded as a defining characteristic of individuals with autism spectrum disorders (ASD), the role of theory of mind (ToM) is controversial. Happé (1993) found that first- and second-order ToM understanding were needed for metaphor and irony comprehension, respectively, in English speakers with ASD. In contrast, Huang et al. (2015) showed that first-order ToM understanding was needed for Taiwanese autistic children's comprehension of metaphor and irony. However, Japanese autistic children lacking first-order ToM understanding were found to comprehend metaphors as well as their typically developing (TD) peers (Adachi et al., 2006). In sum, previous findings suggest that the relation between figurative language comprehension and ToM understanding is subject to cross-cultural variation (Huang et al., 2015), and the conventionality of the figurative language might play a role (Oi et al., 2013).

Objectives:

This study examined the comprehension of four types of figurative language (metaphor, irony, indirect request, and indirect reproach) in Hong Kong autistic children and their TD peers to investigate (i) the relation between children's figurative language comprehension and ToM understanding; and (ii) the role of conventionality in figurative language comprehension.

Methods:

37 Hong Kong Cantonese-speaking children with ASD (mean age = 8.64,  $SD = 1.33$ ) and 37 TD children (mean age = 7.94,  $SD = 0.78$ ) participated. To measure figurative language comprehension, 32 scenarios were described, each ending with a figurative utterance. Participants indicated the intended meaning of the figurative utterance by selecting among five choices. First- and second-order ToM understanding were assessed using the Sally-Anne test and the Ice-Cream Van test, respectively. Standardized tests measured language ability and nonverbal intelligence (Raven, 1989; T'sou et al., 2006). 52 Hong Kong adults rated the conventionality of each figurative utterance.

#### Results:

Regression analyses showed that for the ASD group, after controlling for the effects of age, language ability, and nonverbal intelligence, first-order ToM understanding predicted comprehension of metaphor and irony, while neither first- nor second-order ToM understanding predicted comprehension of indirect request and indirect reproach. For the TD group, after controlling for the same effects, neither first- nor second-order ToM understanding predicted comprehension of any type of figurative language. The results of pairwise comparison after Bonferroni adjustment showed that metaphor and irony were both rated as less conventional than indirect request and indirect reproach, while no significant difference was found between metaphor and irony, or between indirect request and indirect reproach.

#### Conclusions:

Our finding regarding autistic children's comprehension of metaphor is consistent with Happé's (1993) and Huang et al.'s (2015) findings, but differs from Adachi et al.'s (2006), thus providing additional evidence that the relation between figurative language comprehension and ToM understanding is subject to cross-cultural influence. Our finding also showed that metaphor and irony were considered less conventional compared to indirect request and indirect reproach, suggesting that autistic children's comprehension of less conventional figurative languages might rely more heavily on ToM understanding.

**413.023** (Poster) Frequency, Form, and Function: Question-Asking in Young Children with Autism Spectrum Disorder  
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Background: Questioning is a social and linguistic tool allowing children to learn from the people in their worlds. Early questions vary in form; typically-developing (TD) children develop *Yes/No* questions by 24 months and use linguistically-complex *Wh*-questions by 30 months. Questions also vary in function, serving information-seeking (e.g., *What's that?*), conversational initiation and maintenance (e.g., *What?*), and directive (e.g., *Can you help me?*) purposes. While TD preschoolers use questions that vary in form and function, less is known about question-asking in preschoolers with autism spectrum disorder (ASD). Children with ASD produce fewer questions overall, but little research has documented question form or function in this population, nor whether the various question forms and functions are reduced to the same extent.

Objectives: We investigated the (1) frequency, (2) form, and (3) pragmatic functions of questions in preschoolers with ASD and TD preschoolers.

Methods: A detailed coding scheme captured question form (i.e., *Yes/No* [e.g., *Is that a dino?*], *Wh*- [e.g., *Where the kitty?*], *Intonation* [e.g., *Blocks?*]) and function (i.e., *Information-seeking* [e.g., *You hungry?*], *Initiation & Maintenance* [e.g., *Huh?*], *Directive* [e.g., *Can I have a turn?*]). Two independent raters coded four 30-minute play interactions, at four-month intervals, for each of 12 mother-child dyads (6 ASD; 6 TD), a subset of an existing longitudinal dataset. All child questions were coded; discrepancies were brought to consensus.

The groups were matched at the initial visit by child gender (five males and one female in each group) and language level. At the initial visit, the average mean length of utterance (MLU) for each group (i.e.,  $>2.0$ ) corresponded with a developmental period in which question-asking would be present (Table 1). Given the small sample size, these exploratory analyses are qualitative in nature.

#### Results:

*Frequency:* At each time point, children in the ASD group asked roughly half as many questions as their TD counterparts, confirming previous evidence of reduced question-asking among children with ASD (Figure 1).

*Form:* The ASD group relied disproportionately more than the TD group on *Yes/No* questions (see Figure 1).

*Function:* The groups were similar to one another in their proportional reliance on *Information-seeking* questions, with a substantial minority of *Directive* and *Initiation & Maintenance* questions. However, the TD group tended to ask disproportionately more *Initiation & Maintenance* questions than the ASD group, while the ASD group relied disproportionately more on *Directive* questions than their TD counterparts. See Figure 1.

*Conclusions:* Of note was the disproportionate reliance on *Yes/No* questions observed in the ASD group, a finding consistent with their delayed acquisition of *Wh-* questions. Despite these differences, children with ASD showed diverse question-asking capabilities, comprised of a flexible range of forms and functions. Questioning offers children the opportunity to practice their pragmatic skills and enhance their world knowledge. A reduction in question-asking frequency suggests that children with ASD may be missing out on important opportunities to learn from their social partners. Results support interventions targeting frequency of question-production in young children with ASD.

**413.024** (Poster) *Gesture Variability during Narrative Production in 5-7-Year-Olds: A Comparison of Children with ASD or TD*  
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*Background:* Gesture use is frequently described as atypical in ASD. For example, early in development, both HR-ASD infants and preschoolers with ASD are reported to show slower rates of gesture development (Iverson et al., 2017), produce fewer gestures overall (LeBarton & Iverson, 2016), and specifically use fewer deictic gestures, than their TD and HR-noASD peers (LeBarton & Iverson 2016, Ozcaliskan et al. 2015). However, by adolescence, high verbal individuals with ASD have been found to use the same number and same types of gestures as language- and age-matched TD peers, with differences observed at more subtle levels, such as speech-gesture synchrony (deMarchena & Eigsti 2010). Investigations of the use of gesture in children between infancy and adolescence are rare, so it is unknown when in development children with ASD may ‘catch-up’ in their gesture usage.

*Objectives:* The current study investigates gesture usage during narrative production in children 5- to 7-years of age, who are either TD or diagnosed with ASD.

*Methods:* Participants included 14 children either TD (N=7, M=5.52 years) or diagnosed with ASD (N=7, M=6.38 years), who were participating in a longitudinal study on language development. At the longitudinal study’s onset, the children were language-matched; however, at this visit, the TD children’s TACL scores were significantly higher than those of the ASD group ( $M_{ASD}=83.71, M_{TD}=116.9, p=.009$ ). As part of their participation in the ADOS, each child narrated one story from a book (*Tuesday* or *Frog, Where Are You?*) and two from cartoons (monkey, fisherman) in which they were asked to retell the story from memory. All tasks were transcribed and coded for the type of gesture (deictic and iconic), the number of body parts used per gesture (1 hand, 2 hands, or full body), and whether the gesture included movement.

*Results:* Between-group comparisons of the children’s number of utterances ( $M_{ASD}=37.0, SD=9.29; M_{TD}=44.57, SD=8.36$ ) and total gestures ( $M_{ASD}=10.57, SD=8.65; M_{TD}=11.14, SD=8.36$ ) were not significant ( $p > .10$ ). Mann-Whitney U-tests also revealed no significant group differences for any gesture subtype (see Figure 1; Mann-Whitney  $U_s > 15, p_s > 0.25$ ). Enormous within-group variability in gesture use was observed, with every pattern of gesturing observed in the TD group also manifested by at least one child with ASD. For example, two children with ASD and one TD child each produced a high (>20) number of 1-handed deictic gestures; one TD child and one child with ASD both produced predominantly iconic two-handed or full-body gestures, and one child with ASD and two TD children each produced fewer than 5 gestures total.

*Conclusions:* All coded types of gesture were attested at similar frequencies in both groups. Overall, 6-year-old children with ASD appear to have caught up to the gesture usage of their TD peers. At this age, the children differed widely within groups, with some gesturing rarely, others primarily with points, and still others primarily with 2-handed or body movements. Future analyses will include at least 5 more children in each group and will investigate the developmental precursors to this variability in gesture use.

**413.025** (Poster) *Hierarchical Acoustic Structure during Parent-Child Interactions of Toddlers with Typical Development and Autism Spectrum Disorder*  
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**Background:** Timing is essential for successful social interactions, as exemplified by interactional variables like interpersonal synchrony and parental responsiveness, which support the development of communication and language skills in children with and without ASD (Siller & Sigman, 2002; Hudry et al., 2013). The importance of timing is also evident in caregivers' vocalizations to young children: compared to adult-directed speech, the prosodic variation of infant-directed speech exhibits greater hierarchical temporal structure, or clustering of acoustic events across multiple linguistic timescales (e.g., syllables nested within phrases nested within utterances), which likely supports children's attention to the speech signal and their developing communication skills (Falk & Kello, 2017). However, hierarchical temporal structure has not yet been examined across a dyadic interaction, with both parent and child contributing to the acoustic signal, and has not been applied to a clinical population.

**Objectives:** In consideration of the transactional nature of parent-child interactions, we examined acoustic temporal clustering of parent-child interactions in dyads of toddlers with and without ASD.

**Methods:** 50 parent-child dyads (15 ASD; 36 TD (22 nonverbal MA-matched, 13 verbal MA-matched)) were audio-recorded during a 10-minute parent-child free play activity. Peak amplitude events in audio recordings were used to compute Allan Factor variances, which reflects event clustering at multiple time scales (from a 0.0146 second scale to a 30 second scale) Quadratic slopes were fit across each dyad's Allan Factor functions to quantify acoustic clustering patterns across timescales. Slopes of nonverbal MA-matched, verbal MA-matched TD dyads, and ASD dyads were compared using Welch two-sample t-tests.

**Results:** Overall, the slopes derived from Allan Factor analysis of dyadic interactions were significantly lower in the TD nonverbal MA-matched cohort ( $M = 0.68$ ,  $SD = 0.086$ ) than the ASD cohort ( $M = 0.75$ ,  $SD = 0.082$ ),  $t(28.7) = -2.76$ ,  $p = 0.01$ . However, the slopes were comparable in the ASD and verbal MA-matched cohort ( $M = 0.75$ ,  $SD = 0.074$ ),  $t(25.9) = 0.093$ ,  $p = 0.93$ . The magnitude of slopes indicates greater hierarchical clustering (steeper Allan Factor functions) of the acoustic signal in the dyads with children with ASD versus nonverbal MA-matched children with TD, particularly in longer timescales corresponding to phrase-level speech, but similar levels of hierarchical clustering when compared to the verbal MA-matched dyads.

**Conclusions:** This is the first study to examine multi-scale acoustic temporal structure across both partners in a dyadic interaction, as well as in a clinical population of toddlers with ASD. Results add to evidence that temporal clustering is impacted by social communicative factors with greater hierarchical temporal structure in parent-child dyads of toddlers with ASD versus TD nonverbal MA-matched toddlers. Accordingly, the similar degree of acoustic clustering between the ASD and verbal MA-matched sample indicate that higher slopes in the ASD cohort may be related to adaptations in interpersonal vocal dynamics based on the vocal skill of the communication partner. Future analyses will investigate characteristics, such as turn-taking and vocal durations, that may impact acoustic temporal clustering.

#### **413.026 (Poster) How Do Bulgarian- and English-Speaking Parents Refer to Their Children with ASD?**

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**Background:**

Almost every description of language ability in ASD contains a mention of pronoun difficulty (e.g., Lord & Luyster, 2009; Kanner, 1946; Rutter, 1979; Tager-Flusberg et al., 2005). In addition, parents of high-risk infants use their child's name more than parents of low-risk infants (He et al., 2018), and how parents use person-reference correlates with the way their children do (Barokova & Tager-Flusberg, 2019). However, all of these studies were done with English-speaking participants. The present study compares English and Bulgarian as a substantially different language (Gordon et al., 2005). Specifically, it is a pro-drop language (personal pronouns are optional), and it has a very rich diminutive system that allows common and proper nouns to be changed (e.g., slynce -> slunchice; Sasho -> Sashko -> Sashence). Furthermore, it is a common practice for parents to use kinship terms (mommy, daddy) to refer to their child.

**Objectives:**

To compare how Bulgarian- and English-speaking parents refer to their children with ASD (**Table 1**).

**Methods:**

37 (7F) Bulgarian-speaking children between 2;7 and 9;10 years ( $M = 70.62$ ) with a community diagnosis of ASD or PDD based on ICD-10, and confirmed on the ADOS-2 participated in this study. Parents completed a demographic questionnaire and played with their child with developmentally appropriate toys. These parent-child interactions were transcribed in SALT following

standard procedures (Miller et al., 2011), and coded for how the parent referred to and addressed their child and themselves (**Table 1**).

Transcripts of 37 (7F) English-speaking children with ASD between 1;8 and 4;9 years ( $M = 37.97$ ) (from Carter et al., 2007) were matched to the Bulgarian-speaking children on the Number of Different Words (NDW) they produced per minute during the parent-child interaction. The English transcripts were also coded for person-reference. Coding reliability ( $ICC > 90\%$ ) on 20% of the transcripts was achieved in both languages.

#### Results:

Parental input across languages was compared with independent-samples t-test and Mann-Whitney U tests, where appropriate, and the Bonferroni multiple-comparison correction was applied. Bulgarian parents used fewer personal pronouns (you, your;  $M = 34.86$ ,  $SD = 21.61$ ) than English-speaking parents ( $M = 71.66$ ,  $SD = 13.84$ ;  $t(72) = -8.956$ ,  $p < .001$ ), but used their child's name (John, Johnny) and kinship terms (ma, mommy, mom) significantly more (**Table 2**). In addition, Bulgarian parents had a significantly higher child reference type/token ratio (Mann-Whitney  $U = 107$ ,  $p < .001$ ).

#### Conclusions:

Bulgarian parents used significantly fewer personal pronouns, which could be attributed to the pro-drop nature of the language. Furthermore, they used more different ways to address their child (type/token ratio), which could be explained by the widely used diminutive forms of nouns. Interestingly, 20% of Bulgarian parents' person-reference was made up of kinship terms, which has not been reported in the ASD literature. Imagine a child being called Jonathan, John, Johnny, honey, sweetie, ma, mom, mommy in a single interaction, and how that could be associated with the child's ability to track the referent and language skills overall. Future studies should examine whether and how parent and child person-reference are associated.

**413.027 (Poster)** Investigating IQ, Sex, Attention, and Anxiety As Determinants of Social Communication Difficulties: Data from the Pond Network

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#### Background:

Social communication difficulties are a core diagnostic domain of autism spectrum disorder (ASD), a multi-faceted neurodevelopmental disorder. They can affect academic, friendship and peer acceptance outcomes as social communication skills are required for everyday interactions.

Despite social communication difficulties being universally pervasive in ASD, the etiology is not well understood. In addition to proposed neurobiological mechanisms, other factors such as IQ, sex, attention, and anxiety have been found to affect social communication in ASD.

#### Objectives:

To determine the differential contribution of IQ, attention, and anxiety to social communication abilities across diagnoses (ASD, attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD)) and typical development (TD).

#### Methods:

In the study, we included 565 participants from the Province of Ontario Neurodevelopmental Disorders (POND) network, a multi-centre research network that studies neurodevelopmental disorders. Participants included 310 with ASD (age =  $12.6 \pm 2.9$ ; 241 males), 121 ADHD (age =  $10.8 \pm 2.4$ ; 91 males), 80 OCD (age =  $12.9 \pm 2.5$ ; 43 males) and 54 TD (age =  $12.1 \pm 2.7$ ; 30 males).

27 items from the Social Communication Questionnaire - Lifetime (SCQ; Rutter et al., 2003), assessing social communication, reciprocal interaction, and reciprocal conversation, were used as the measure of social communication difficulties. The Wechsler Abbreviated Scale of Intelligence—Second Edition (Wechsler, 2011), Child Behavior Checklist (Achenbach & Edelbrock, 1983), and Revised Children's Anxiety and Depression Scales (Chorpita et al., 2014) were used to measure IQ, attention, and anxiety, respectively.

Multiple linear regression analysis was used to quantify the marginal effects of each determinant, controlling for the effects of diagnosis and age. For each of the 27 items, we conducted multiple logistic regression, controlling for diagnosis and age as well as applying Bonferroni correction for multiple comparisons.

### Results:

The results of the regression indicated that the linear model explained 54.2% of the variance and that the model was a significant predictor of social communication difficulties,  $F(8, 565) = 84.6$ , corrected  $p < 0.0001$ . While IQ ( $\beta = -0.081$ , corrected  $p < 0.0001$ ) and sex ( $\beta = 1.98$ , corrected  $p < 0.0001$ ) each contributed significantly to the model, with attention having a marginal effect ( $\beta = 0.068$ , corrected  $p = 0.071$ ). The effect of anxiety was not significant ( $\beta = 0.015$ , corrected  $p = 1.0$ ).

There were also significant item-level findings (Table 1). Anxiety was a significant predictor of neologisms. Attention was a significant predictor of stereotyped utterances, inappropriate questions, and neologisms. Male sex was a significant predictor of four items: imitative social play, imaginative play, interest in children, group play. IQ was significantly predictive of 18 out of 27 items, the top three items being pronoun reversal, conversation, and showing and directing attention.

### Conclusions:

Consistent with previous literature, we found a significant effect of IQ and sex on social communication difficulties, with male sex having the most pronounced association. We were unable to replicate a significant association between anxiety and anxiety with social communication. Our findings are a preliminary step toward determining potentially personalized supports.

#### 413.028 (Poster) Investigation on Examiner "Um" and "Uh" Usage in ADOS-2 Sessions

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Background: Studies have found that children with Autism Spectrum Disorder (ASD) use the filler "um" at a significantly lower rate than children with Typical Development (TD), with no difference in "uh" usage. Examiners' filler usage in similar conversational language samples has not been studied. We investigated whether differences in "um" and "uh" usage between ASD and TD children also characterize the speech of their conversational partners: the examiners.

Objectives: (1) Compare examiner usage rates of "um" and "uh" when conversing with ASD vs. TD participants; (2) Investigate whether within-group differences in examiner filler usage vary by participant age, intellectual ability, expressive language ability, or autism symptom severity.

Methods: Participants were recruited for an fMRI study. They were 7 to 17 years old, spoke native English, had full-scale IQ  $\geq 70$ , and consisted of 83 children with ASD (68 male) and 28 with TD (12 male). Language samples consisted of transcribed Autism Diagnostic Observation Schedule (ADOS-2) Module 3 sessions. Transcription was completed by trained transcribers who were blind to the participants' diagnostic status and intellectual abilities in accordance with the Systematic Analysis of Language Transcripts (SALT) guidelines. Four ADOS-2 tasks were chosen for analysis: *Emotions; Social Difficulties and Annoyance; Friends, Relationships, and Marriage; Loneliness*.

We computed three measures of filler usage:  $um\text{-rate} = total\ um / total\ words$ ;  $uh\text{-rate} = total\ uh / total\ words$ ;  $um\text{-ratio} = total\ um / (total\ um + total\ uh)$ . Examiner filler usage rates between diagnostic groups were compared using Wilcoxon-Mann-Whitney tests, with effect sizes calculated using Glass rank biserial correlation coefficients. Associations between examiner *um-rate* and participant-level measures were measured with Kendall rank correlation coefficients, with  $p$ -values adjusted using the Benjamini-Hochberg procedure to reduce false discovery rate.

Results: There was a significant difference in examiner *um-rate* between ASD and TD ( $U = 763.0, p = .007; ASD < TD$ ), with a medium effect size ( $r_{pb} = -.343$ ; Table 1). There was no significant difference in examiner *uh-rate* between ASD and TD ( $U = 1,038.0, p = .399$ ) or in examiner *um-ratio* ( $U = 1,017.5, p = .369$ ).

Examiner *um-rate* was significantly positively correlated with both participants' age ( $\tau_b = .280, p_{adj.} = .002$ ) and mean length of utterance in morphemes (MLUM) ( $\tau_b = .220, p_{adj.} = .018$ ; Table 2). There was no significant correlation between examiner *um-rate* and any of the following participant-level measures: full-scale IQ; number of distinct word roots; Children's Communication Checklist (CCC-2) General Communication Composite, structural language score, pragmatic language score; ADOS-2 Social Affect total, Comparison Score.

Conclusions: Examiners use the filler "um" significantly less with children with ASD than children with TD, which mirrors previous results on "um" usage in ASD and TD. We also found that examiner "um" usage is positively associated with participant age and MLUM but not with more strenuous participant-level measures of expressive language ability and autism symptom severity. Because analyses did not control individual differences between examiners, these results should be interpreted with caution. Further analyses that account for examiner-level measures are needed.

**413.029 (Poster)** Language Profiles of Russian Primary-School-Aged Children with Autism Spectrum Disorder  
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Background: Language impairments are usually co-occurred in children with Autism Spectrum Disorder (ASD) and affects all linguistic levels, from phonology to discourse (e.g., Jarrold et al., 1997; Kjelgaard & Tager-Flusberg, 2001). However, there is a high variability of language skills in ASD due to the high heterogeneity of autistic groups as well as criteria for including children into studies, e.g., age or non-verbal IQ.

Objectives: The goal of the present study is to investigate the language abilities of primary-school-aged Russian children with ASD at all linguistic levels (phonology, vocabulary, morphosyntax, and discourse) and to clarify which non-language factors, such as age, non-verbal IQ, and the severity of autistic traits, predict better the language functioning.

Methods: 107 children participated in the study: 82 children with ASD (17 girls,  $M_{age} = 9.11, SD = 11.5$ ), varying in non-verbal IQ (range 40 – 125), and a control group of 25 typically developing children, TD (11 girls,  $M_{age} = 9.1, SD = 1.0$ ). All children with ASD had a clinical diagnosis within the autism spectrum (F84.0, F84.1 or F84.5) according to ICD-10 and 67 out of 82 children with ASD were assessed by licensed psychiatrist with Autism Diagnosis Observation Schedule-2 (Lord et al., 2012).

Language abilities were measured with the Russian Child Language Assessment Battery (Lopukhina et al., 2019), consisted of 13 tests assessing all linguistic levels in production and comprehension (see detailed information on each test, <https://osf.io/h9jzbz/>). Non-verbal IQ of ASD children was screened with the Kaufman Assessment Battery for Children, K-ABC II (Kaufman and Kaufman, 2004), and Wechsler Intelligence Scale for Children – Third Edition, WISC-III (1991), only the non-verbal scale, where possible; non-verbal IQ of TD children with screened with the Raven's Colored Progressive Matrices (Raven 2000, 2004). The severity of autistic traits were measured with the Russian version of the Autism Spectrum Quotient: Children's Version, AQ (Auyeung et al. 2008) for both groups of children.

Results: We showed that children with ASD had lower scores in all language tests we used compared with TD children, excluding simplest *Word repetition* test (see tables with the model outcomes, <https://osf.io/275vq/>). Importantly, age and the severity of autistic traits did not predict language functioning in all tests in comparison to non-verbal IQ (Figure 1). Additionally, the results demonstrated that linguistic levels accounted for the general language abilities of children: according to more complex morphosyntax and discourse tests, fewer children with ASD were within the normal range unlike the results in simpler phonological and lexical tests.

Conclusions: Similarly to the previous studies, we showed a high variability of language skills in children with ASD and also that impairments appeared at all linguistic levels (Kjelgaard & Tager-Flusberg, 2001). Crucially, our results demonstrated that the severity of autistic traits and age did not predict language functioning whereas non-verbal IQ accounted for language abilities.

**413.030 (Poster)** Language Regression As a Predictor of Outcomes in Children with ASD through the Preschool Years

Background:

While Autism spectrum disorder (ASD) is characterized by difficulties in social/pragmatic communication, there is considerable variability in structural language outcomes. One early developmental factor that has been considered in explaining some of this variability is the early loss of previously attained skills, which is known as regression. Currently, evidence for differences in language outcomes between children with ASD with and without a history of regression is conflicting, due in part to inconsistencies in the operationalization of regression. By employing multiple definitions of regression, measuring outcomes with standardized language assessments at multiple time points, and distinguishing receptive and expressive language skills, the present study aimed to address several gaps in the current body of literature and provide needed clarification on language outcomes among children with ASD and regression.

Objectives:

This study sought to answer two primary research questions: 1) Do children with ASD and a history of language/communication regression demonstrate different language outcomes across the preschool years from children with ASD without a history of language/communication regression? 2) Among children with ASD with a history of language/communication regression, does number of words used before loss predict language outcomes across the preschool years?

Methods:

One hundred twenty-nine children with confirmed ASD diagnoses were followed through the preschool years (30-66 months) for a total of four visits. All participants met DSM-IV-TR criteria for ASD (the standard at the time of data collection) based on the Autism Diagnostic Observation Schedule (ADOS) Toddler Module, the Autism Diagnostic Interview – Revised (ADI-R), and clinician best estimate. At each visit, participants were administered a battery of assessments. ADI-R data from visit 1 (30 months) were used to define regression by three incrementally less strict criteria (see Table 1) and characterize pre-loss language skills. Language outcomes were measured by Preschool Language Scales 4<sup>th</sup> Edition (PLS-4) Expressive Communication (EC) and Auditory Comprehension (AC) raw scores from visit 2 (44 months) and visit 4 (66 months). Nonverbal cognition was measured by Mullen Scales of Early Learning (MSEL) nonverbal ratio IQ scores. Our analytic approach involved use of nonverbal cognition and age as covariates in analyses of covariance (ANCOVA) to examine group differences in language outcomes in question 1 and multiple regression models for predicting outcomes from words used before loss in question 2.

Results:

Children with a history of regression demonstrated lower receptive language skills and a greater discrepancy between expressive and receptive language skills (see Fig. 1) at 44 months, but not at 66 months. Among children with history of loss of any communication skill, number of words used before regression onset was predictive of receptive and expressive language skills at 44 months but not 66 months.

Conclusions:

Results indicated that regression in ASD may impair language development in the year following loss, but any negative impacts on language outcomes are transient and small in magnitude, disappearing by the time of school entry (66 months). These findings do not suggest that regression leads to a distinct language phenotype in ASD or requires a different approach to speech-language intervention.

**413.031 (Poster)** Lexical and Morphosyntactic Complexity of Echolalic Utterances in Low and Minimally Verbal Individuals with ASD

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Background:

Echolalia is frequent in the speech of low verbal and minimally verbal (LV/MV) individuals with ASD, but it is often excluded from language sample analyses despite the communicative functions it serves (Prizant & Duchan, 1981; Roberts, 2014; Sterponi & Shankey, 2014). While evidence suggests that echolalic imitation does not affect the acquisition of grammar in children with ASD (Tager-Flusberg & Calkins, 1990), we do not know how it affects lexical development or its role in language use in LV/MV individuals with ASD (Tager-Flusberg & Kasari, 2013). In this study, we analyzed the lexical and morphosyntactic complexity of echolalic (versus nonecholalic) utterances in LV/MV individuals using recommended natural language sampling (Barokova & Tager-Flusberg, 2020).

#### Objectives:

1. How does the lexical complexity of echolalic utterances relate to the lexical complexity of nonecholalic utterances as measured by the number of different words (NDW)?
2. How does the morphosyntactic complexity of echolalic utterances relate to the morphosyntactic complexity of nonecholalic utterances as measured by mean length of utterance in morphemes (MLUm)?
3. How does the frequency of use of echolalic speech by MV/LV individuals relate to lexical and morphosyntactic complexity of nonecholalic utterances?

#### Methods:

We analyzed ADOS language samples from 49 individuals who had at least one intelligible nonechoed spoken word (MV: 34 (Module 1); LV: 16 (Module 2); age: 6-21,  $M=12.52$ ,  $SD=4.12$ ). Participant standardized assessment means are: ADOS overall CSS 7.46 (1.37), ADOS SA CSS 7.04 (1.42), ADOS RRB CSS 8.34 (1.55), nonverbal IQ 67.98 (20.72), PPVT raw score 55.96 (34.73). We used the Systematic Analysis of Language Transcripts software (SALT; Miller & Iglesias, 2015) to analyze lexical complexity (number of different words (NDW)) and morphosyntactic complexity (mean length of utterance in morphemes (MLUm)). Utterances were considered echolalic if they were repeated within the previous five examiner or examinee utterances. We included scripted recitation in echolalic utterances. Nonspeech and unintelligible utterances were excluded.

#### Results:

Analyses involved linear regression controlling for age, sex, nonverbal IQ and receptive vocabulary. For lexical complexity, echolalic NDW significantly predicted receptive vocabulary ( $\beta=.87$ ,  $t=2.74$ ,  $p<.01$ ) but not nonecholalic NDW (Figure 1). For morphosyntactic complexity, echolalic MLUm significantly predicted nonecholalic MLUm ( $\beta=.57$ ,  $t=3.26$ ,  $p<.01$ ). This result suggests LV/MV individuals with higher echolalic MLUm also have higher nonecholalic MLUm (Figure 2). For frequency of echolalia, the proportion of echolalic utterances predicted an interaction between nonecholalic NDW and receptive vocabulary ( $\beta=.00$ ,  $t=2.41$ ,  $p<.01$ ) (Figure 3). As the proportion of echolalic utterances decreased, nonecholalic NDW and receptive vocabulary increased.

#### Conclusions:

Morphosyntactic complexity in echolalic utterances predicted morphosyntactic complexity in nonecholalic utterances. This suggests that echolalia does not interfere with morphosyntactic development and aligns with previous findings that echolalia, in the form of imitation, does not affect the acquisition of grammar (Tager-Flusberg & Calkins, 1990). In terms of lexical development, however, we found echolalia in MV individuals with low nonecholalic NDW is more lexically complex and associated with lower receptive vocabulary. While echolalia does not affect morphosyntactic development, it interacts with lexical development. Future studies can further elucidate this relationship between echolalia and expressive/receptive vocabulary.

**413.032** (Poster) Making Autistic Children's Behavior Accountable: A Conversation Analytic Study of Classroom Interactions  
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Background: Autistic children experience differences in social-communication, which impacts peer interactions. Within general education classrooms, paraprofessionals often guide autistic students through social interactions, under the assumption that paraprofessional support will foster social relationships (Giangreco, 2010). Few studies document how paraprofessional involvement influences autistic children's social interactions. In this qualitative, observational study, we micro-analyzed classroom interactions that included a paraprofessional, an autistic student, and at least one non-autistic student.

We focused on interactions in which participants provided an *account*. Accounts address unanticipated behavior (Scott & Lyman, 1968). Rejections, departures from routines, or violations of expectations, are often preceded or followed by accounts, which can be negotiated by participants until mutual understanding is reached (Firth, 1995; Raevaara, 2011).

Objectives: The purpose of this study is to use Conversation Analysis (CA) to explore: 1) how accounts are made relevant to interactions, and 2) who provides accounts, and whose conduct is construed as accountable.

Methods: Teachers and students from three elementary school classrooms in a school district participated. Each classroom had at least one autistic student who received special education services, and was assigned a paraprofessional. Classrooms were video-recorded three times, for thirty minutes each session. Following data collection, participants' talk was transcribed using detailed (CA) conventions (Jefferson, 2004). We then selected transcripts derived from video-recordings of small group activities that included the autistic student and paraprofessional. CA involves a period of 'unmotivated looking', whereby the research team examines transcripts to inductively identify phenomena related to the sequence organization of interaction (Schegloff, 2007). We selected *accounts* as a phenomena of interest.

Results: We found that autistic student's conduct was often construed as *accountable*, made evident when classmates, paraprofessionals, and sometimes autistic students themselves provided accounts for their words and actions. We identified 19 instances of accounts in our dataset. Interestingly, paraprofessionals provided accounts for mundane interactional moves made by autistic students. For example, Figure one provides a transcript of a paraprofessional providing an account for an autistic student who answers the question "when did you first lose a tooth" with the date she lost it ("January 23rd"). Thirty-seven percent of accounts addressed autistic students' talk and behavior and were provided by others, and only 21% were provided by the autistic student. In CA literature, accounts are almost always 'self-accounts'; they are provided by individuals accounting for their own behavior. 'Other-accounts', provided by someone other than who produced the behavior, are notable because they are often provided to a third party. This changes the participation framework so that the person whose behavior is deemed accountable becomes the subject of the talk, rather than a participant in talk (Goffman, 1981).

Conclusions: Because autistic children's behavior is often construed as departing from normative standards, accounts are an informative interactional phenomena for understanding how interactions with autistic children proceed. 'Other-accounts' provided by paraprofessionals addressed autistic children's mundane behavior that did not appear to be a threat to intersubjectivity. Additionally, these accounts have the unintended consequence of positioning autistic children as the 'talked about' rather than the 'talked to'.

#### **413.033** (Poster) Measurement of Pragmatic Language in ASD: Clinical Adaptations to the Pragmatic Rating Scale, School-Age (PRS-SA)

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Background: Pragmatic (i.e., social) language impairments are a core deficit among individuals with autism spectrum disorders (ASD). Available measures of pragmatic language, such as the Pragmatic Rating Scale for School-Age Children (PRS-SA; Landa, 2011) provide nuanced analyses of skills required in social interactions. The PRS-SA has been used extensively in research to evaluate pragmatic language during semi-naturalistic language samples in children with ASD (e.g., Klusek et al., 2014; Greenslade et al., 2018). However, it relies on long language samples (i.e., 45 minutes or more), and highly specialized and intensive training procedures, making it difficult for clinicians and researchers to easily implement in clinical contexts (Young et al., 2005). Thus, there remains a need for rapid assessment of pragmatics during naturalistic interactions.

Objectives: To evaluate preliminary reliability and validity of the PRS-SA on an abbreviated language sample to support assessment of pragmatic communication in clinical trials.

Methods: Preliminary data consisted of 13 children randomly selected from a larger participant sample of 40 children enrolled in an NIH-sponsored clinical trial targeting social behavior and social cognition (NCT02918864). The final sample will include all eligible and enrolled children. Children enrolled met criteria for ASD, were between the ages of 8 and 11, and had IQ scores greater than 80. The PRS-SA includes 34-operationally-defined items assessing discrete pragmatic language features. Items are scored using a three-point scale (0-2) indicating presence and degree of impairment for each item. The PRS-SA was coded by trained, reliable coders from video-recorded ADOS-2 samples in two ways: using the entire ADOS-2 assessment and using an abbreviated sample, i.e., first 15-minutes. Item-level reliability was examined to compare within participant scores between the two samples.

Results: The average percent of agreement between the two language samples was 53%. When items were collapsed (scores of 2 converted to 1) to indicate presence/absence of an item (regardless of severity), the average reliability was 66%. Items that occurred less frequently (e.g., overly formal language) and/or were dependent on quantifying the specific number of occurrences were less reliable than those items that were more global in nature and coding criteria (e.g., overall quality of reciprocal conversation).

Conclusions: Results from preliminary analyses highlight limitations of using an abbreviated language sample to capture pragmatic impairments. Given that many scores on the PRS-SA are based on counts of observed behaviors, the abbreviated sample may not provide enough opportunity to detect less frequent pragmatic features in children with less severe symptoms. However, more global rating items (e.g., reciprocal conversation; elaboration; eye contact) that do not depend on specific counts of observation but rather capture quality and appropriateness were significantly more reliable, particularly when using a two-point scale. Overall, preliminary findings suggest the need for continued investigation into adaptations of objective rating scales such as the PRS-SA to support clinicians and researchers in measuring this critical impairment. Future directions may include identification of the best types of abbreviated language samples for different language levels (e.g. conversation tasks) and reducing or adapting pragmatic language domains used in an abbreviated measure.

**413.034** (Poster) Moderators of Social Communication Growth during a Parent-Mediated Intervention.  
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Background:

Recent research has demonstrated differences in developmental growth trajectories among children whose caregivers receive parent-mediated interventions. One study found that a parent responsiveness intervention showed effects for children with fewer baseline language skills (Siller, Hutman & Sigman, 2013). Another study of a parent-mediated naturalistic developmental behavioral intervention (NDBI) with infant siblings of a child with autism found that only children with the fewest cumulative risk factors demonstrated significant treatment effects (Yoder, Stone & Edmunds, 2020).

Objectives:

The goal of this study was to examine moderators of social communication growth in a heterogeneous sample of children on the autism spectrum.

Methods:

Participants were 68 children and their caregivers who participated in two research studies evaluating the efficacy of a low-dose parent-mediated NDBI delivered via telehealth. All caregivers in this sample received some study intervention, either self-directed or with the support of a coach, and most were enrolled in additional services in the community. Caregiver-child interactions of a play routine and a snack routine were filmed in family homes at three time-points (pre- and post-intervention, and a 3-month follow-up) and rated for child social communication using the Brief Observation of Social Communication Change (BOSCC). We evaluated moderators of social communication growth using multilevel linear growth models with child as the upper-level unit and trial as the lower-level unit. Specifically, we were interested in the effects of baseline age, autism symptom severity, and verbal developmental quotient on social communication growth over time. Our model included fixed main effects and interaction terms (with time) for each of our predictors of interest. We expected that children who were younger, with a higher verbal developmental quotient, and with lower autism symptom severity would demonstrate greater social communication growth.

Results:

We found significant main effects of time ( $p = .004$ ), baseline age ( $p = .006$ ), and verbal developmental quotient ( $p < .001$ ), but not autism symptom severity ( $p = .085$ ). The only significant interaction term was the time\*age interaction ( $p = .049$ ), such that children whose age was 1 standard deviation below the mean demonstrated significant improvement in BOSCC score over time ( $b = -1.00$ ,  $p = .009$ ), while children whose age was 1 standard deviation above the mean did not ( $b = .094$ ,  $p = .795$ ). The interaction between time and autism symptom severity ( $p = .172$ ) and between time and verbal developmental quotient ( $p = .898$ ) were not significant.

Conclusions:

Our study found that age significantly predicted subsequent social communication growth, while autism symptom severity and baseline verbal developmental quotient did not. Specifically, we found that younger children's social communication scores improved more over the course of the intervention period, consistent with the field's understanding of neuroplasticity and clinical recommendations for beginning social communication intervention early. Understanding for whom parent-mediated intervention are most efficacious has implications for treatment matching and the ideal timing of early social communication intervention.

**413.035 (Poster)** Multi-Talker Speech Perception Thresholds in Young Adults with Autism Spectrum Disorder

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**Background:** When multiple people are talking at the same time, referred to as multi-talker situations, listeners must segregate competing voices into distinct auditory streams. Acoustic cues such as pitch and loudness as well as binaural cues stemming from differences between the two ears can aid segregation. Prior research suggests neurotypical listeners can use acoustic and binaural cues to selectively attend to the desired talker even when competing voices are louder. Auditory processing differences, including difficulty listening under noisy conditions, have been reported in individuals with autism spectrum disorder (ASD). Despite these reported challenges, few studies have investigated multi-talker speech perception in individuals with ASD.

**Objectives:** This study investigates differences in multi-talker speech perception thresholds in young adults with ASD and age- and sex-matched controls. We hypothesize that the ASD group will show greater difficulty attending to a single talker in the presence of competing talkers compared to the control group.

**Methods:** Twenty-four participants aged 21-23 years (n=12 ASD; n=12 Control) participated in this study. ASD participants were recruited from a larger longitudinal study conducted at the University of Washington Autism Center. All participants passed an audiometric screen ( $\leq 20$ dB hearing level at octave frequencies between 250 and 8000 Hz) to ensure clinically normal hearing thresholds. Auditory stimuli were sentences from the Coordinate Response Measure (CRM) corpus. Listeners were presented with three simultaneous CRM sentences: the target talker to be attended ( $0^\circ$  azimuth) and two spatially separated ( $\pm 45^\circ$  azimuth) competing talkers. Speech perception thresholds in terms of signal-to-noise ratios (SNRs), were estimated as the level difference (dB) between the target and the two competing talkers, where a positive SNR indicated that the target talker had to be louder than the competing talkers, and a negative SNR indicated that the target talker could be quieter than the competing talkers.

**Results:** Overall, all participants were able to perform this multi-talker speech perception task. This suggests that both ASD and control participants were able to utilize the available acoustic and binaural cues to segregate simultaneous speech streams (i.e., selectively attend to one talker when three people were talking at once). Preliminary analyses show a trend towards worse speech perception thresholds in the ASD group compared to the control group (two-tailed t-test;  $t=1.81$ ,  $p=.08$ ). As a group, most individuals with ASD required the target speaker to be louder than the two competing talkers ( $M=2.69$ ,  $SD=4.15$ ). In comparison, individuals in the control group were able to selectively attend to the target talker even when competing talkers were louder ( $M=-0.67$ ,  $SD=4.90$ ).

**Conclusions:** These results suggest young adults with ASD have the ability to use acoustic and binaural cues to listen successfully when multiple people are talking at the same time. However, as a group, adults with ASD in this sample required the person they were attending to be louder than competing voices. Understanding auditory processing differences in ASD may reveal new information about contributors to social and communication challenges.

**413.036 (Poster)** Narrative Abilities in Teens with Autism Spectrum Disorder across Two Contexts

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**Background:** Narrative macrostructure impairments are common among individuals with Autism Spectrum Disorder (ASD; Baixauli et al., 2016); however, differences between ASD and typically developing (TD) individuals on structural language measures (e.g., mean length of utterances (MLU), word types and tokens) while narrating from a storybook are rarely reported (Tager-Flusberg, 1995). Narratives can also be drawn from personal experiences, though. Losh and Capps (2003) found that school-aged TD children and children with ASD differed in complex syntax while telling personal narratives, but not storybook narratives. The current study compares TD adolescents and adolescents with ASD in both of these contexts to see how they may highlight different strengths and weaknesses in structural language abilities.

**Objectives:** To extend this storybook-personal narrative comparison by (a) assessing adolescents with a wider range of language abilities and (b) including pronouns, which have been shown to vary by group in different contexts (Song et al., 2020; Suh et al., 2014; Kelty-Stephen et al., 2020).

Methods: Participants included five teens with ASD ( $M_{\text{age}} = 16.60$ ,  $SD = 3.50$ ) and five TD children ( $M_{\text{age}} = 14.40$ ,  $SD = 3.14$ ). With this small sample, raw CELF vocabulary scores differed, with the TD group ( $M=37.0$ ,  $SD=2.19$ ) having significantly higher scores than the ASD group ( $M=28.6$ ,  $SD=4.80$ ),  $p < .05$ . Storybook narratives were elicited using the *Tuesday* wordless picture book. Personal narratives were elicited with the investigator prompting the teen to narrate specific events (e.g. “Can you tell me about a time you got jabbed by something?”). Participant videos were transcribed and CLAN algorithms were used to extract MLU, utterance count, and noun, verb, and pronoun types and tokens (MacWhinney, 2000).

Results: Qualitative patterns are reported, due to small sample sizes. As expected, TD teens ( $M_{\text{storybook}} = 11.72$ ,  $SD=5.01$ ;  $M_{\text{personal}} = 9.85$ ,  $SD=3.38$ ) produced longer MLUs than teens with ASD ( $M_{\text{storybook}} = 6.77$ ,  $SD=3.96$ ;  $M_{\text{personal}} = 6.69$ ,  $SD=5.78$ ), in both contexts. Interestingly, teens with ASD ( $M = 41.8$ ,  $SD=20.41$ ) produced more utterances than TD teens ( $M = 30.8$ ,  $SD=14.69$ ) in the storybook context, but not in the personal context ( $M_{\text{ASD}} = 10.0$ ,  $SD=5.1$ ;  $M_{\text{TD}} = 16.2$ ,  $SD 10.92$ ). We re-calculated noun, verb, and pronoun tokens as a function of number of utterances (see Figures 1 & 2). Both groups produced more nouns/utterance in the storybook context and more pronouns/utterance in the personal context. Teens with ASD also produced more verbs/utterance in the personal context, while the TD teens were equivocal. Finally, while both groups used varied pronouns in the storybook context, only the TD group used varied pronouns in the personal context; the ASD group only used “I” in this context.

Conclusions: Whereas storybook narratives illustrated some expected differences between groups, the personal narratives revealed both strengths and weaknesses in the teens with ASD’s pronoun use. In particular, teens with ASD consistently used pronouns self-referentially but not in reference to others. These preliminary findings support the idea that language varies by narrative context. Data collection, suspended due to COVID-19, has recently recommenced. Future analyses will examine pronoun usage in closer detail.

#### **413.037 (Poster) Narrative Production and Comprehension in Greek-Speaking Children with Autism Spectrum Disorders: Associations with Theory of Mind**

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Background: Narrative abilities are consistently reported as problematic for children with autism spectrum disorder (ASD) [1,2]. While difficulties in narrative production are well-documented (mostly in English-speaking children with ASD), relatively less is known about narrative comprehension in these children [3,4,5]. Furthermore, the difficulties in narrative performance of individuals with ASD are often associated with impairments in theory of mind (ToM)[6,7].

Objectives: The present study aims to add to our knowledge by examining narrative production and comprehension of Greek-speaking children with ASD as compared to a control group of typically developing (TD) peers. In addition, we examine the links between different aspects of narrative production (microstructure, macrostructure, Internal State Language (ISL)) and narrative comprehension with cognitive and affective aspects of ToM.

Methods: Participants. A total of 48 Greek-speaking children participated: 24 children with ASD (Mean age: 9;66) and 24 age-, gender-, and language-matched typically developing controls (Mean age: 9;75). Materials. A wordless picture book was used to test children’s re-tellings of the story told to them by the Experimenter followed by comprehension questions that were immediately asked after the child had completed their retelling. Children’s narrations were analyzed for both microstructural (i.e., narrative length, lexical diversity, syntactic complexity and syntactic diversity) and macrostructural (narrative coherence and ISL) properties. Narrative comprehension was assessed by coding five general memory, factual and inferential questions. Children’s ToM abilities were evaluated using a battery of 14 cognitive and affective ToM tasks at two levels of complexity (first- and second-order) that tapped mental state reasoning across the domains of beliefs, perceptions, desires and emotions.

Results: Children with ASD produced shorter ( $p = 0.007$ ), less coherent ( $p = 0.003$ ) stories, and experienced difficulties with narrative comprehension ( $p = 0.021$ ) as compared to their TD peers. However, in terms of lexical diversity, syntactic complexity, and diversity of ISL children with ASD did not differ from their TD controls (see Table 1). Regression analyses showed that a total ToM (cognitive and affective) score uniquely predicted narrative coherence, while affective ToM (emotion recognition and understanding) predicted the use of IST in children’s narratives. However, ToM was not predictive of children’s narrative comprehension performance.

Conclusions: Our findings showed that children with ASD demonstrate some challenges with narrative production and comprehension compared to TD children. With regard to narrative productivity, results support previous research [3,8,9,10] suggesting that these areas of narrative language are problematic for children with ASD. It is possible that children with ASD are

facing difficulties in their ability to build a mental model of the story in order to retell a coherent and informative story. Additionally, difficulty with narrative comprehension supports previous findings, which have shown that children with ASD are experiencing difficulties that require the understanding of implied or inferential meaning [3,11,5]. Finally, our results support the assertion that ToM understanding can affect children's ability to retell a comprehensive story including more ISL in their stories. The overall findings reveal both strengths and weaknesses in the ASD group's narrative performance.

**413.038** (Poster) Naturalistic Joint Attention and Theory of Mind in Children with ASD and TD Peers  
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Background:

Individuals with autism spectrum disorder (ASD) often show differences in theory of mind (ToM; the ability to take the perspective of another person), an integral skill for interpersonal interactions. Joint attention (JA) or the ability to coordinate with a person during communication has also been found to be a meaningful precursor to ToM ability in both children with ASD (Mundy et al., 1986) and typically developing (TD) peers (Charman et al., 2000; Nelson et al., 2008) as understanding of attentional state may underlie an understanding of mental state (Baron-Cohen, 1989). Research on JA to date has primarily focused on testing specific skills in constrained situations designed specifically to elicit JA and testing ToM in younger children.

Objectives:

Here we examine how parent-toddler engagement in JA during free-play, which captures how child and caregiver purposefully switch attention between each other and an object in more natural situations, relates to ToM performance 3 years later.

Methods:

Forty-two parent-toddler dyads (ASD: $n=20$ ; TD: $n=22$ ) participated in three, thirty-minute, semi-structured play sessions separated by four months as part of a longitudinal study of early language. The groups were matched on receptive language ( $t(40)=.03, p=.97$ ) at visit 1 ( $Mage\ ASD=32\ months; Mage\ TD=20\ months$ ). Sessions were recorded and coded for joint attention type (IJA, in which the child initiates; RJA, in which the child responds to the parent's initiation; and passive attention (PA) in which parent and child are focused on the same object but the engagement lacks referential looks at each other). ToM was assessed approximately 3 years later ( $Mage\ ASD=6.4\ years; Mage\ TD=5.5\ years$ ); children were given both an unexpected change of contents and unexpected change of location task, which were summed for one composite score.

Results:

The TD group's (89% correct) performance was significantly higher on ToM than the ASD group (48% correct) ( $t(40)=4.42, p<.001$ ). When controlling for cognitive ability at Visit 1, JA performance at the initial visit did not relate to later ToM. RJA at Visit 2 was positively related to ToM for the ASD group ( $r=.484, p=.036$ ) and just missed significance for the TD ( $r=.449, p=.054$ ). IJA engagement at visit 3 was related to subsequent ToM for both groups (ASD:  $r=.504, p=.028$ ; TD:  $r=.546, p=.016$ ). When the entire sample was included in a regression of ToM performance on early IQ, early receptive language, visit 2 RJA, Visit 3 IJA and group, early IQ did not predict a significant amount of variance (.2%), early language predicted 14 % of variance, RJA 18%, IJA an additional 15%, and group an additional 9% of variance.

Conclusions:

When more naturalistic parent child encounters are analyzed, early JA performance relates to later ToM in both children with ASD and TD peers, indicating that JA is equally important for both groups in ToM development. Measuring ToM at this age left less variability in the TD group, while the older ASD group included many children with floor performance. Joint attention skills add important understanding to ToM above and beyond individual language ability.

**413.039** (Poster) Often Encountered but Rarely Reported - Challenges in Selecting Language(s) for Intervention in Bi/Multilingual Children with Autism Spectrum Disorder

**Background:** India is home to 22 official languages. Most often individuals grow up exposed to more than one language. Apart from exposure to native and community languages, there is a growing preference for English as the language of formal education and employment. Studies indicate that bilingual children with Autism Spectrum Disorder (ASD) develop language similar to their monolingual non-verbal IQ matched peers (Lund et al 2017). Yet, we see professionals working with bi/multilingual children with ASD advise families to limit exposure to a monolingual environment, often to English or the native language. Hence, there is an evident mismatch between literature and clinical practice.

**Objectives:** To provide insight on factors that influence the selection of language(s) for intervention in children with ASD in bi/multilingual environments.

**Methods:** We present a case series of four children with ASD, exposed to monolingual (n=1), bilingual (n=1) and multilingual environments (n=2). All four children had a primary diagnosis of ASD (mild to moderate) with varying comorbidities. Developmental and behavioral assessments, and detailed speech-language evaluation were conducted. In-depth information on home and school language environments, advice received for language choice for home conversations and intervention, and parental preferences for choice of language(s) were collected. Children were assessed at one time point only. A team of speech-language pathologists (SLPs) discussed each case scenario and helped parents arrive at a decision regarding choice of language(s) for intervention.

**Results:** Mean (SD) age of the four children (N=3 males) in the study was 38.75 (7.8) months; range 29-48 months. Children belonged to semi-urban/urban backgrounds. Three children were enrolled for education/intervention in non-native and one in native language. Parents of three children preferred bilingual and one a multilingual approach. Parents of all children expressed a preference for use of non-native language (English). Details of home language environment, medium of instruction in school are presented in table 1. Professionals other than SLPs recommended a monolingual approach for all children. Based on (A) language environment of the child, (B) parent/caregiver perspectives, and (C) medium of education and availability of services, SLPs recommended monolingual approach for two children and bilingual approach for the other two. Final decision after discussing with parents resulted in supporting bilingual approach for three children. Decision around choice of language became more complex with an increase in number of languages the child was exposed to (Figure-1). Factors such as occupation of parents (transferable jobs) and family structure (joint versus nuclear) influenced decision making.

**Conclusions:** Choosing language(s) for intervention in bi/multilingual environments is complex. The key is to involve families in this decision-making process and address their concerns around bi/multilingualism. This study reflects the urgent need to sensitize fellow professionals to existing literature, create a larger evidence base and formulate guidelines to assist the decision-making process for selecting language(s) for intervention/exposure in children with ASD growing up in bi/multilingual environments. In addition to limited sample size, a major limitation of the case series is lack of follow-up data which prevents us from critically evaluating children's language development across languages.

#### **413.040 (Poster) Otitis Media and Language Delays in Autistic Youth**

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**Background:** Acute Otitis Media (AOM) and Otitis Media with Effusion (OME) are types of ear infections commonly diagnosed in the first five years of life, with prevalence rates of 10.85% (Monasta et al., 2012). Chronic AOM/OME, while less common (4.76%), can contribute to hearing impairments and delayed language acquisition. In typically-developing toddlers, expressive language deficits are seen as early as 12 months in infants with AOM/OME (Wallace et al., 1988). In autistic youth, OME infections are diagnosed significantly earlier (Adams et al., 2016), and rates of AOM/OME are significantly higher than in typically-developing children (23.5%; Rosenhall et al., 1999). Despite the increase in AOM/OME frequency, no work has investigated the impact of AOM/OME on language in autistic youth. Given the high comorbidity between language delay and ASD, investigating the impact of ear infections on language acquisition is of high importance.

**Objectives:** The current presentation seeks to evaluate the relationship(s) between AOM/OME and expressive language delays in autistic youth.

**Methods:** Medical reports and language data from 2758 youth in the Simon Simplex Collection (SSC) were analyzed. Participants were ages 4-18 years ( $M = 9.02$  years,  $SD = 3.56$ ; 83.5% male) and identified as predominantly white (76%). Parents reported whether their child had been diagnosed with an ear infection (yes/no), and the number of discrete infections. Dependent

variables included the Expressive and Receptive Language T-scores from the Vineland Adaptive Behavior Scales, age of first words and age of first phrases from the Autism Diagnostic Interview-Revised (ADI-R), and dichotomous variables of a word delay and phrase delay derived from the clinician score on the ADI-R.

Results: Seventy-five percent of the sample reported having at least one ear infection in their lives; 70% reported having more than 2 infections ( $M = 4.84$  infections,  $SD = 2.85$ ). Children with AOM/OME were not significantly more likely to have a word delay or phrase delay compared to children without AOM/OME ( $\chi^2 = 2.432, 4.646$  respectively,  $ps > .122$ ). After accounting for age and sex, linear regression analyses indicated AOM/OME frequency did not account for significant variance in expressive language,  $B = -.024, p = .281$ , receptive language,  $B = -.028, p = .208$ , age of first words,  $B = -.023, p = .307$ , or age of first phrases,  $B = .00, p = .987$ . The results held when considering only youth 5 years and younger ( $n = 351$ ).

Conclusions: Results suggest a majority of autistic youth had at least one ear infection, with frequency rates being higher than previous reports in typically-developing youth (75% vs. 10.85%) and autistic youth (75% vs. 24%), which could be due to the parent-report modality. Despite high prevalence rates, the frequency of infection did not negatively impact language acquisition or contribute to a language delay. Although the sample was AOM/OME saturated, the sample's language skills were evenly distributed; thus, relationships should have been evident if present. These findings suggest other factors apart from OME are contributing to language acquisition in autistic youth such as intellect, parenting practices, or ASD severity.

**413.041 (Poster)** Parent Nonverbal Initiations and Child Responses during Free-Play Interactions between Young Children with Autism Spectrum Disorder (ASD) and Their Parents

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Background:

Early joint attention learning often takes place in unstructured circumstances where parents provide an interactive context wherein children are assisted through mediated learning. Young children with ASD tend to be more responsive towards parent nonverbal initiations because they are developmentally closer to the child's current level of capabilities. While research supports such parental initiations and their overall effects on joint attention development, there is more to be learned about parent's contributions, more specifically to break down parents' nonverbal initiation bids and determine any differences in the type and frequency of such initiations separately and their overall effects, that is, which behaviors are most effective at eliciting responses in young children with ASD.

Objectives:

The purpose of the present study was to better understand the impact of parents' behaviors on children's responses by investigating type and frequency of (a) parents' non-verbal initiating bids during play with their child with ASD and (b) children's verbal and nonverbal responses to parents' bids.

Methods:

A total of 50 children ( $M = 65.9$  months,  $SD = 6.7$ , range = 48-79, 82% boys) diagnosed with ASD and one of their parents (45 mothers/5 fathers) participated in the study. Video recordings of 10-min of free-play with a standard set of toys between parents and children from a previous study were re-coded. During the first stream we coded non-verbal initiations (i.e. pointing, showing, and giving) by the parents. During the second stream we coded a) whether the child responded or not to the parent's non-verbal initiations, and b) type of response (i.e. verbal response or non-verbal response defined as following point, reaching or taking toy, alternating gaze).

Results:

During the 10 min play parents on average displayed 12.8 ( $SD = 7.0$ ) nonverbal initiations towards their child. The most frequent was pointing towards a toy or object ( $M = 4.7, SD = 3.9$ ), followed by showing ( $M = 4.4, SD = 4.6$ ), and giving ( $M = 3.7, SD = 3.4$ ). The children responded to 72% of the parents' nonverbal initiations. Child nonverbal responses (74%) were more frequent compared to verbal responses (26%). There was a significant strong association between total parent initiations and total child nonverbal responses ( $r_s = 0.80, p < 0.001$ ), but not between total parent initiations and total child verbal responses ( $r_s = 0.26, p > 0.069$ ). Regression analysis revealed that parents' showing was the strongest predictor of total children's response ( $B = 0.748, p < 0.001$ ).

## Conclusions:

Parents play an integral role in facilitating joint attention with their child with ASD by adjusting their behaviors and providing effective initiatives. The current study results suggest parents' nonverbal initiations, especially showing of toys seems to be effective in eliciting a response in preschoolers with ASD. Thus, it is imperative that we help parents to be proactive, and use nonverbal initiatives, such as showing to effectively support their children.

**413.042** (Poster) Parent-Education Via Telehealth during the COVID-19 Lockdown in Beijing, China

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## Background:

The COVID-19 pandemic forced an extended lockdown in China that lasted 10 weeks. Children with autism spectrum disorders (ASD) stayed home and did not attend school for several months. Children with ASD often show a protracted period of language development that can be stressful on families. Mothers play a crucial role in supporting their children's language and social development by using child focused activities, reciprocity, early-literacy and extended conversations. This study measured the effectiveness of parent-education on language development and social interactions in ten children with ASD (30-52 months) and their mothers' stress levels during the COVID-19 lockdown in Beijing.

## Objectives:

1. To improve children's expressive language (words spoken) during shared-reading and play, use of gestures and imitation of actions.
2. To improve reciprocal interactions between the children and their mothers.
3. To reduce the mothers' stress levels.
4. To compare a longer parent intervention (LPI) (10-weeks) and a shorter parent intervention (SPI) (5-weeks).

## Methods:

We observed children's use of language, gestures and imitation during shared-reading/play and home-based activities with their mothers. We used an AB design, baseline (4 observations) and intervention (5 and 10 observations). We measured the Improvement Rate Difference (IRD) for the LPI (10 observations) and for the SPI (5 observations). The LPI cohort included 6 children and the SPI 4.

Mothers received one weekly interactive picture-book with visual support for paired actions with toys and pretend play activities (i.e., bouncing a ball, cooking, shopping). Each topic was extended through complementary home-based activities (i.e., washing rice, sorting clothes, wiping toys). Mothers learned language-stimulation strategies (modeling, recasting, expansions) and a child-focused approach via telephone video-conferencing with a specialized teacher.

To monitor the children's progress, mothers sent three weekly five-minute videos. These videos were scored by two clinicians to measure the children's use of words, gestures, and imitation of actions. In addition, mothers reported progress on reciprocal interactions with their children and on their own stress levels, by completing a pre- and post-intervention checklist (Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO) and the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983).

## Results:

Both cohorts made IRD gains in their use of words (LPI 73%, CI 82-94.6; and SPI 80%, CI 78.6-81.4). However, IRD gains were below chance levels for gestures (LPI 48% and SPI 15%) and slightly above chance for imitation of actions (LPI 60% and SPI 55%). See Figures 1-10 for LPI and SPI scores. Mothers across cohorts reported improved reciprocal interactions with their children, dependent t-test  $p < .001$ ,  $d = 3.8$ , and reduced stress levels,  $p < .02$ ,  $d = 1.05$ .

## Conclusions:

This intervention was effective in improving children's expressive language, but not for improving children's use of gestures and imitation. The use of gestures and imitation proved to be more challenging than acquiring words. Such differences may be related

to the caregivers' direct teaching approach and may require additional specialized parent instruction. In spite of these differences, all mothers reported improved reciprocal interactions with their children and reduced stress levels. Our sample size was small and results cannot be generalized.

**413.043 (Poster) Parental Concerns of Children with ASD By Age: A Qualitative Analysis**

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**Background:** Eliciting parents' concerns about their children is an important initial step in the ASD diagnostic process. This information is often collected through forced-choice questionnaires utilizing professional terminology and may limit the potential concerns that can be reported. Studies examining parents' concerns to date have largely used deductive qualitative methods with only one age group of children. To capture a more thorough understanding of parental concerns without clinical interpretation, an open-ended form of questioning using an inductive method of qualitative analysis is needed. The advantage of this type of analysis is gaining direct information from parents without imposing preconceived categories, or professional terminology, onto their responses. This allows for the creation of a more holistic, parent-centered, understanding of parental concerns by permitting all types of concerns to be captured. No inductive qualitative studies to our knowledge have been conducted to investigate parents' concerns across age groups using a single coding scheme. Such research is important to better understand the specific language parents use to describe their concerns about children of different ages.

**Objectives:** The purpose of this study was to understand parents' concerns about their children with ASD, at the child's first ASD diagnostic evaluation. Using an inductive approach, we sought to identify: a) all parents' concerns about their children across age groups (toddler, preschool, middle childhood), b) concerns that were shared across age groups, and c) concerns that differed across age groups.

**Methods:** An inductive qualitative analysis process was employed to analyze concerns reported by parents of children ages 1-11 years on intake forms ( $n = 455$ ) at an urban outpatient ASD specialty clinic. Analyses were based on three age groups (toddler, preschooler, middle childhood).

**Results:** Using conventional content analysis, 12 categories of concerns emerged from parents' responses: communication, social, behavioral/emotional, cognition, life skills, atypical behaviors, sensory, academic, health, seeking diagnostic clarity or resources, developmental, and motor skills. We found that parents reported the same concerns about their children across age groups in six of the 12 categories. The biggest difference in reported concerns across age groups was that parents of children in the preschooler and middle childhood groups reported a greater number of concerns related to mental health than parents of toddlers.

**Conclusions:** While structured or forced-choice parent questionnaires have utility for eliciting parental concerns, parents should also have a way to report their concerns in an open-ended format, allowing researchers and clinicians to capture parents' concerns in their own words. The current study confirms previous research reporting the complex phenotype of ASD within child age groups and adds to it by capturing detailed information about this complexity. Our analysis yields specific information about similarities and differences in parents' concerns depending on their child's age. By eliciting detailed parental concerns before the evaluation, burden on both parents and providers may be reduced by identifying the necessary professionals and assessments needed ahead of time to ensure both timely diagnosis and identification of appropriate, comprehensive treatments.

**413.044 (Poster) Parents' Declarative Deictic Gesture Use Predicts Vocabulary Development in Infants at High and Low Risk for Autism Spectrum Disorder**

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Background:

We can identify factors associated with atypical language development in children with autism spectrum disorder (ASD) by studying the linguistic environment of infants at high familial risk for the disorder. Given the important role parents play in shaping their children's language development, analyses of parent-child interactions are of particular interest. Although previous studies have investigated various features of parent-child interactions, they have not examined if parents of high- and low-risk

infants differ on the communicative intentions behind their gestures. Also, while recent evidence suggests that parent's varying pointing intentions may be differentially related to language development of typically developing children, the question of whether the association between parental gesture intentions and children's vocabulary development is also found in high-risk infants remains unanswered.

#### Objectives:

This work aims to (1) examine deictic gesture intentions in parents of high-risk infants later diagnosed with ASD (HRA+), high-risk infants who were not diagnosed with ASD (HRA-), and low-risk comparison (LRC) infants at 12 months and (2) assess whether expressing declarative vs. imperative intentions via deictic gestures differentially predicts child vocabulary scores at 36 months.

#### Methods:

Participants included 70 parent-child dyads where infants were classified as high or low familial risk for ASD (HRA+:  $n = 17$ ; HRA-:  $n = 25$ ; LRC:  $n = 28$ ). At the infants' 12-month in-lab study visit, parents were asked to play with their child as they normally would during a 10-minute free play interaction. We later transcribed the videotaped interaction and coded parental deictic gestures at the level of communicative intention as declarative or imperative. Declarative gestures were defined as those intended to share interests with their infants or convey information about objects, persons, or events in the environment. Imperative gestures were defined as those utilized to direct or elicit a specific action from the child. Infants' vocabulary scores were measured at 36 months using the MacArthur-Bates Communicative Development Inventory (MB-CDI-III; Fenson et al., 1994). To determine infants' ASD outcomes, the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) was administered at 18, 24, and 36 months and used in conjunction with a clinical judgment estimate.

#### Results:

(1) Using ANOVAs and/or nonparametric tests (based on the distributions of data), we found that parents in the three groups produced similar numbers of declarative and imperative deictic gestures when interacting with their 12-month-old infants ( $\chi^2 = 4.58, p = .10; F(2, 67) = 1.64, p = .20$ ).

(2) Using regression analyses, we found that across groups, 12-month parental declarative, but not imperative, use of deictic gestures was significantly, positively associated with children's 36-month vocabulary scores (Figure 1), even when controlling for levels of parental education, parental speech, child sex, and previous child language skills ( $b = 1.11, SE = 0.43, t = 2.59, p = .02$ ).

#### Conclusions:

These results suggest that parents who have a child with ASD provide gestural input of similar quality to parents who have a typically developing child. Encouraging parental use of declarative gestures with infants could have important implications for language development.

#### 413.045 (Poster) Patterns of Interactional Prosody in Youth with and without Autism

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**Background:** Difficulties in social interaction and communication are defining features of autism, with prosodic differences often implicated. However, investigations of prosody in those with ASD have focused mostly on aspects relating to emotional and linguistic functions (Marchi et al, 2018), and the ways in which autistic people differ in the interactional aspects of prosody remain poorly understood.

Recent work in prosody modeling has developed the notion of "prosodic construction": a temporal configuration of multiple acoustic-prosodic features --- pitch, intensity, lengthening, reduction, voicing properties, and others --- that serves a specific function or family of functions (Ogden 2010, Niebuhr et al 2013). In English, prosodic constructions serve many functions relating to turn taking, topic management, information structure, speech acts, and the expression of stance (Ward 2019). Computational methods have been developed, notably including the application of Principal Component Analysis (PCA) to multiple robustly computed features over a corpus, for the automatic identification of common dimensions of variation. These

generally correspond to meaningful prosodic constructions, and support analysis of differences in construction form and frequency of use across subpopulations (Ward & Gallardo, 2017).

**Objectives:** In this exploratory study, we aim to identify ways in which interactional prosody differs between youth with ASD and their neurotypical peers.

**Methods:** From the NMSU corpus of autistic and neurotypical dialogs (Lenhert-LeHouillier et al, 2020), we selected 10 dialogs from each, totaling 83 and 72 minutes, respectively, whose recording conditions supported automatic analysis. In these dialogs, confederates engaged children and adolescents between the ages of 9 and 15 years (ASD mean = 12.66, NT mean = 12.57) in dialogs seeking to find differences in a pair of pictures. Applying PCA to 212 features computed across 400,000+ overlapping samples from each group's data, we examined the top 8 dimensions derived for each group, accounting for 44% and 33% of the variance, respectively. We noted differences between the constructions found and differences in the detailed forms.

**Results:** Contrary to our expectation, the youth with ASD generally exhibited prosodic patterns marking many of the same functions as the NT youth, including those used to mark contrast and correction, factual versus affective or personal stance, and topic keeping versus topic transitions. However there were often salient differences in the realization of these patterns. For contrast and corrections, for example, these included atypically strong use of high pitch and lengthening, marking with atypical features such as high harmonicity, and marking on only the content word rather than using the usual wider pattern. We also noted tendencies to not always use the typical prosody appropriate for the context, meaning that at such times the speaker's intent was often unclear. Further, we noted many cases of apparently non-functional and possibly uncontrolled occurrences of prosodic features, including wide pitch range, lengthening, and loudness.

**Conclusions:** The youth with ASD exhibited use of many of the prosodic patterns involved in pragmatic and interactional functions, but in many cases they were realized differently.

#### 413.046 (Poster) Perceptions of Conversational Responses in Adolescents with and without ASD

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Background: Successful conversation requires that both partners: A) respond to one another; B) produce responses that are interpretable. Existing evidence shows that individuals with ASD produce non-verbal conversational behaviors that are more difficult to interpret and less indicative of their partner's preceding behavior. (Sheppard et. al., 2016; Alkhaldi et. al., 2019), which could lead to misinterpretations and communicative breakdowns.

Objectives: The aim of this study was to determine whether naïve observers can interpret the non-verbal behaviors of NT and ASD adolescents as signaling surprise in response to an off-topic questions by an unseen conversation partner.

Methods: Stimuli were extracted from videos of ASD and NT adolescents in conversation with two adult research assistants (RAs). During the conversation, the RAs produced one on-topic and one off-topic question. We selected 2-5 second-long video clips for each adolescent showing their initial response to each question type. Video clips only showed the adolescents' face and body; the two RAs were not visible, and the clips did not include sound to avoid verbal clues about the preceding question type.

We presented 44 pseudo-randomized video clips from 22 adolescents (11 ASD: 11 NT, ASD verified via ADOS-2) in an online survey via MTurk. 158 NT adults completed the survey and used ungraduated slider bars (anchors: "not at all" to "very much") to respond to questions about the adolescents' reactions: "How surprised do you think the person was by what their conversation partner said?" and "How responsive do you think the person was to their conversation partner?"

Results: We conducted a 2 (adolescent diagnosis: NT or ASD) by 2 (question-type: on-topic or off-topic) repeated-measures ANOVA for each question and found significant main effects for question-type, with both groups perceived as more surprised ( $F(1,158) = 35.62, p < 0.001$ ) and more responsive ( $F(1,158) = 96.02, p < 0.001$ ) following off-topic than on-topic questions. NT adolescents were perceived as more responsive than their ASD peers ( $F(1,158) = 135.64, p < 0.001$ ) but not more surprised ( $F(1,158) = 2.00, p = 0.159$ ). Significant group-by-question-type interactions showed that the NT group had a greater increase in perceived responsiveness ( $F(1,158) = 8.25, p < 0.01$ ) and surprise ( $F(1,158) = 57.53, p < 0.001$ ) to the off-topic vs on-topic questions than the ASD group. Follow-up Tukey HSD tests revealed significantly higher perceived responsiveness ( $p < 0.01$ ) and surprise ( $p < 0.001$ ) for the NT adolescents following off-topic than on-topic questions. Adolescents with ASD are also perceived as significantly more responsive to off-topic questions ( $p < 0.001$ ) but not more surprised ( $p = 1.00$ ).

Conclusions: Both NT and ASD adolescents are perceived as more responsive to off-topic questions; however, only the NT group is perceived as conveying more *surprise*, which is the expected reaction to an off-topic question. This suggests that adolescents with ASD differentially react to off-topic vs on-topic questions, but that their nonverbal reactions are less specifically readable as displaying surprise. This could lead to communicative breakdown when conversation partners are not aware that their message was not understood.

**413.047 (Poster)** Phonological Awareness and Visual Spatial Abilities in School-Age Children with Autism

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**Background:** Phonological awareness is an essential precursor to reading acquisition and refers to the awareness of sound structures in language and the ability to manipulate (i.e., blend, segment, and delete) sounds at both the syllable and individual phoneme levels. Phonological awareness development may be vulnerable in children with autism spectrum disorder (ASD) given that many children with ASD demonstrate delays in language and communication. The current literature yields mixed findings showing that preschool children with ASD demonstrate difficulties with phonological awareness, while some studies indicate phonological awareness as a relative strength within this population. Children with ASD present with heterogenous language and cognitive profiles, yet, an important overlap between oral language skills and nonverbal cognitive abilities has been identified.

**Objectives:** The current study aimed to investigate the phonological awareness skills of school-age children with ASD compared to children with typical development (TD), while exploring the role of individual differences in IQ and ASD symptom severity on phonological awareness abilities.

**Methods:** Eighteen children with ASD (age= 6-12,  $M=9$ ,  $SD=1.71$ , male  $n=16$ ) and seventeen TD children (age= 6-11,  $M=9$ ,  $SD=1.53$ , male  $n=8$ ) participated in this study. Phonological awareness was measured using the *NEPSY-II Phonological Processing* subtest, ASD symptomology using the Social Responsiveness Scale-2 (SRS-2), and cognitive abilities, including verbal and visual spatial abilities, were measured using the Wechsler Abbreviated Scale of Intelligence - 2<sup>nd</sup> Edition (WASI-II).

**Results:** MANOVAs revealed that the ASD and TD groups did not differ in their score on the NEPSY-II Phonological processing subtest ( $p > .05$ ) and the WASI-II ( $p > .05$ ), demonstrating similar phonological awareness and cognitive abilities. Within the ASD group, a regression analysis revealed that visual spatial, but not verbal cognitive abilities, predicted phonological awareness scores ( $p < .05$ ) and that autism symptoms did not predict scores in phonological awareness skills ( $p > .05$ ). Regression coefficients indicated that within the ASD group, participants with a higher visual spatial score obtained a higher score in phonological awareness skills compared to those with a lower visual spatial score. Within the TD group, a regression analysis showed that visual spatial abilities, verbal abilities, and autism symptoms did not predict scores in phonological awareness skills ( $p > .05$ ).

**Conclusions:** Results contribute to the literature in examining phonological awareness skills in school-age children with ASD, demonstrating that it is a relative strength within this population and is not related to autism symptom severity. Additionally, our findings support previous research showing a relationship between phonological awareness skills and nonverbal cognitive abilities in children with ASD. Given the increase in attention to the academic achievements within this population, findings add to our understanding of phonological awareness skills of children with ASD compared to aged-matched peers and can help inform instructional interventions aiming to increase reading success.

**413.048 (Poster)** Pragmatic Language Difficulties during Scripted Narratives in Autistic Adults and Significance to Clinical Diagnosis of Autism Spectrum Disorder

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**Background:** Pragmatic language difficulties have been observed in children and adults with ASD through analysis of their fictional narratives (e.g., Barnes & Baron-Cohen, 2012; Suh, et al., 2014). While studies have also analyzed children's scripted narratives (e.g., Volden, 2002), no studies have taken this approach to evaluate pragmatic difficulties in adults with ASD. Despite growing numbers of adults being referred for diagnostic evaluation and evidence that existing diagnostic tools may have reduced sensitivity in adult diagnostic referrals (deBildt et al., 2016; Langmann et al., 2017), relatively little research has been devoted to understanding the autism phenotype in adulthood. More information regarding pragmatic difficulties may provide insights into diagnostic markers for adults and inform development of diagnostic tools to improve adult diagnostic practices.

**Objectives:** 1) Delineate the pragmatic language features observable in autistic adults during a scripted narrative task. 2) Determine if verbal pragmatic language difficulties are mitigated by use of nonverbal communicative behaviors. 3) Examine associations between pragmatic language features and clinician diagnostic certainty ratings to identify potential diagnostic markers.

**Methods:** Participants ( $n = 45$ ) were recruited for studies aimed at improving diagnostic instruments and characterizing ASD in adulthood. The majority (82.2%) were male, had an ASD diagnosis (91.1%), and age ranged from 15-61 years old ( $M = 22.13$ ,  $SD = 7.22$ ). Mean verbal IQ was 99.38 ( $SD = 25.18$ ). The ADOS Demonstration Task was used as a scripted narrative task. Verbal descriptions were transcribed and then coded for five pragmatic language features: 1) number and coherence of events (e.g., turns on tap), 2) type and quality of details (e.g., water temperature), 3) use of filler words, 4) inclusion of tangential or task-irrelevant information, and 5) inclusion of personal details. Each category included broad summary codes to capture different aspects of abnormality (e.g., excessive detail, level of inappropriateness) and frequencies of category features (e.g., specific events, types of detail). Next, videos were coded using the same summary codes, as well as codes for body language, facial expression, tone, and gestures. Finally, clinicians experienced in ASD diagnosis used videos to rate their diagnostic certainty and explain behaviors influencing their certainty.

**Results:** Participants used an average of nine events ( $M = 9.90$ ,  $SD = 4.20$ ; range = 0-18) and an average of five details ( $M = 5.45$ ,  $SD = 5.15$ ; range 0-18) in their toothbrushing narratives. Females ( $M = 13.80$ ,  $SD = 3.70$ ) used more events than males ( $M = 9.08$ ,  $3.88$ ) [ $t(27) = 2.49$ ,  $p = 0.019$ ], but did not differ in number of details [ $t(27) = 0.45$ ,  $p = 0.658$ ]. Many participants included tangential or task-irrelevant information (58.6%). Preliminary analyses suggest higher overlap in summary code scores between transcript and video coding for cohesion (71.4%) and irrelevant information (71.4%), but lower overlap in domains of excessive detail (57.1%) and tangential information (57.1%).

**Conclusions:** Low overlap in excessive detail and tangential information coded from video vs. transcriptions of spoken language suggest the importance of integrating both verbal and nonverbal behaviors when considering pragmatic language. Further analyses are underway to explore associations between pragmatic features and clinician certainty.

#### **413.049 (Poster) Pragmatic Language and Aggressive Behavior in ASD: The ACE Gendaar Network**

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**Background:** Impaired pragmatic language (i.e., language use for social interaction) is a hallmark feature of Autism Spectrum Disorder (ASD); a neurodevelopmental disorder characterized by social, behavioral, and communication impairments. Aggressive behavior is an unfortunate comorbidity of ASD with nearly 22% of autistic youth demonstrating clinically significant levels of aggression (Hartley, Sikora, & McCoy, 2008). Past research indicates that higher levels of externalizing behaviors are associated with weaker expressive language skills and pragmatic language, however, these associations have not been uniformly observed specifically with pragmatic language and aggression (Boonen et al., 2014; Neuhaus et al. in press). To address the hypothesized connection between pragmatic language ability and aggressive behavior in individuals with ASD and to expand this work to include female youth, we analyzed data from the GENDAAR study, which focused on understanding sex-based differences in youth with ASD.

**Objectives:** To explore the relationship between pragmatic language ability and aggressive behavior in male and female youth with ASD.

**Methods:** In a one-site subsample from GENDAAR, 37 youth (19 females, 18 males) with ASD ages 8 to 18 years had data available for this project. All ASD youth had a community clinical diagnosis, confirmed via the ADOS, ADI-R, and DSM-IV criteria. All participants completed the DAS-II and had an IQ >70. Aggressive behavior was identified using the parent report Child Behavior Checklist (CBCL) aggression scale. Pragmatic language was coded using 20-minute language samples recorded during the ADOS. Two raters, unaware of diagnostic group, independently watched and rated videos using the Pragmatic Rating Scale – Modified, which includes emotional, communicative, overtalk, and general language scales.

**Results:** Preliminary analysis of group differences in pragmatic language between sexes showed that male youth with ASD had significantly lower pragmatic language ability ( $M = 8.6$ ,  $SD = 3$ ) than female youth with ASD ( $M = 11.6$ ,  $SD = 3.3$ ),  $t(35) = -2.7$ ,  $p = .01$ . However, no sex differences were found for aggressive behavior. Correlations were run to explore the relationships between pragmatic language and aggressive behavior. No associations were found for males ( $r(13) = -.06$ ,  $p > .05$ ), females ( $r(15) = -.02$ ,  $p > .05$ ), or the total ASD sample ( $r(30) = -.1$ ,  $p > .05$ ).

**Conclusions:** In this preliminary analysis, our results do not support a relationship between pragmatic language and aggressive behavior in youth with ASD. Sex differences were only observed for pragmatic language ability, suggesting that female youth had better pragmatic language ability than male youth. Previous work by our group (in the full GENDAAR sample) suggests that more severe aggression, specifically in males, was associated with difficulties in communication skills. Thus, we may be currently underpowered to identify this relationship. Further research will examine the relation between pragmatic language, age and other language measures.

**413.050 (Poster)** Predicting Language in Children with ASD Using Spontaneous Language Samples and Standardized Language Measures

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**Background:** Previous research has indicated that standardized measures of language are often not sensitive to the heterogeneity of language abilities in children with Autism Spectrum Disorder (ASD) (Kasari et al., 2013). One suggestion has been the use of spontaneous language samples to capture a wider range of grammatical abilities in children with ASD that are not always apparent on standardized instruments (Wittke et al., 2017).

**Objectives:** The current project examines the degree to which standardized measures and natural language samples predict change in language skills in a longitudinal sample of children with ASD.

**Methods:** A subset of participants from the *Autism Phenome Project* (APP;  $N=54$ ; 41 males) were selected for the current study. The APP is a longitudinal study intending to define clinically meaningful ASD subtypes based on behavioral and biological data. Participants were selected based on availability of video recordings of the *Communication and Symbolic Behavior Scales* (CSBS; Wetherby & Prizant, 2002) at initial visit (T1) and the *Autism Diagnostic Observation Schedule* (ADOS; Lord, Rutter, Dilavore, & Risi, 1999) three years later (T3). Coding of spontaneous language samples from CSBS and ADOS testing was used to calculate mean length of utterance (MLU) and total word types (TWT) at both T1 and T3. Mean age of participants at T1 was 33.9 months ( $SD=5.5$ ) and 67.2 months ( $SD=10.2$ ) at T3. In addition to MLU and TWT, formal testing at T1 from the Mullen Scales of Early Learning Expressive Language Raw Scores (MSEL-EL) as well as ADOS Social Affect (SA) and Restricted and Repetitive Behaviors (RRB) Total Scores were included as variables of interest.

**Results:** Two stepwise regression models evaluated predictors of language skills at T3; one for MLU and the other for TWT. T1 MSEL-EL ( $R^2_{adjusted} = .438$ ,  $F(1,52) = 42.327$ ,  $p<.001$ ) and T1 MLU ( $\Delta R^2 = .050$ ,  $F(2,51) = 25.343$ ,  $p=.029$ ,) separately accounted for significant amounts of variance in T3 MLU. In contrast, T1 MSEL-EL ( $R^2_{adjusted} = .533$ ,  $F(1,52) = 61.567$ ,  $p<.001$ ), T1 ADOS-SA ( $\Delta R^2 = .034$ ,  $F(4,49) = 19.298$ ,  $p=.043$ ), and T1 ADOS-RRB ( $\Delta R^2 = .040$ ,  $F(5,48) = 17.926$ ,  $p=.024$ ), each separately accounted for significant proportions of variance in T3 TWT.

**Conclusions:** Both standardized language and autism testing, and spontaneous language samples were unique predictors of later language skills in this heterogeneous sample of children with ASD. MLU at T1 accounted for a unique proportion of the variance in later MLU at T3, whereas ADOS SA and RRB accounted for variance in later TWT at T3. Thus, early grammatical language use significantly predicts later grammatical language use (T1 and T3 MLU, respectively) over and above standardized MSEL-EL scores. Moreover, higher levels of autism symptomatology negatively impacted later vocabulary skills (indicated by lower TWT scores). One potential explanation is that social interaction skills facilitate the acquisition of new words, although not (apparently) grammatical skills. These results suggest that valuable predictive information can be obtained from both standardized measures and natural language samples in children with ASD; especially, spontaneous language scores should be considered when predicting longitudinal change in how children with ASD use language.

**413.051 (Poster)** Predictors of Augmentative and Alternative Communication System Use in an Inpatient Sample of Youth with ASD

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**Background:**

Approximately 30% of children with autism spectrum disorder (ASD) are nonverbal or minimally verbal. Augmentative and alternative communication (AAC) systems, such as picture exchange communication systems (PECS) and voice output devices (VODs), are often recommended for this population. However, little is known about the factors that are associated with AAC use.

Previous research has suggested that child level factors, such as language level and ASD symptom severity, predict response to AAC systems. However, little research has examined family- or system-level predictors of AAC use.

#### Objectives:

The current study aims to 1) Describe the frequency of AAC use in an inpatient sample of youth with ASD and 2) identify child and family characteristics that are associated with AAC use.

#### Methods:

The current study uses data from the Autism Inpatient Collection, a large sample of children with ASD in inpatient hospital settings. A subset ( $n=132$ ) of the sample received a survey about communication system use, which inquired about what types of communication systems children utilized. First, descriptive statistics were used to determine the frequency of AAC use in the sample. Then, bivariate correlations examined the association between AAC use and child and family factors. Finally, logistic regression analysis was used to investigate interaction effects between child and family factors that may predict AAC use.

#### Results:

41.7% of parents in the sample reported that their child uses some type of communication system (including PECS, VODs, sign language, written/text communication, and other systems). Bivariate correlations found that child nonverbal IQ, verbal expression, and receptive language were negatively associated with communication system use. Child ASD symptom severity and most demographic factors were not associated with AAC use at the bivariate level. (See Table 1 for all correlations). Logistic regression analyses examined predictors of AAC use, revealing an interaction effect between expressive vocabulary and maternal education ( $p=.006$ ), as well as between child IQ and maternal education ( $p=.022$ ). The association between IQ and verbal ability with the likelihood of AAC use was stronger for children of parents with lower levels of education. At higher levels of IQ and verbal ability, children of parents with higher education levels were more likely to use an AAC.

#### Conclusions:

These findings suggest that a substantial portion of children with ASD in inpatient settings may use AAC systems to communicate. While language and IQ were negatively associated with AAC use, ASD symptom severity and child behavior problems were not related, which highlights the need to consider how communication systems may be utilized for a range of children. Given the frequency of their use, it is critical to consider how AAC systems can be better integrated into inpatient treatment plans. Parent education moderated the association between IQ and verbal ability and AAC use, suggesting that indicators of family socio-economic status may impact which children are likely to use a communication system. Future research should continue to investigate factors associated with AAC use, as well as consider how training and education may impact the usefulness of these systems in an inpatient setting.

**413.052** (Poster) Predictors of Discourse and Pragmatic Language Use in Preschoolers with Autism Spectrum Disorder  
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#### Background:

Several studies have found that social communication skills, including initiation of and response to joint attention (IJA and RJA), play, and imitation, predict concurrent language abilities (Kasari et al., 2008; Luyster et al., 2008; Toth et al., 2006; Van der Paelt et al., 2014) and growth in language overtime (Thurm et al., 2007; Yoder et al., 2015) in young children with Autism Spectrum Disorder (ASD). These studies measured language using standardized assessments (e.g., Mullen Scales of Early Learning), which may be less effective at capturing “clinically-meaningful” change in discourse and pragmatic language abilities (Barokova & Tager-Flusberg, 2018). Natural language sampling, in contrast, is more sensitive to variations in language as it is used during everyday social interactions (Casenhiser et al., 2013).

#### Objectives:

In a sample of preschool-aged children with ASD, we aimed to 1) investigate the concurrent relations among social communication skills (IJA, RJA, play, imitation), discourse, and pragmatic language use, and 2) determine which of these social communication skills predict growth in discourse and pragmatic language use overtime.

### Methods:

A sample of  $N=24$  (4 females) children with ASD, ages 21-55 months, completed assessments at two visits that were approximately 4 months apart (range: 2-6 months). Assessments included the Early Social Communication Scales (ESCS; Mundy et al., 2003), Structured Play Assessment (SPA; Kasari et al., 2006), Elicited Imitation Battery (EIB—manual and object oriented imitations only; Rogers et al., 2003), and a 10-minute parent-child interaction (PCI). Speech utterances during the PCI were segmented into communication units (c-units; Lovan, 1976) to obtain the rate of conversational turns (CTs) per minute. Child utterances were also coded according to communicative function (e.g., share, request, redirect) to obtain the rate of Social Communicative Utterances (SCUs) per minute; non-communicative utterances (e.g., scripting, rote speech) were excluded from analyses. Change scores were calculated by subtracting CT/min and SCU/min rates at the second visit (time 2) from CT/min and SCU/min rates at the first visit (time 1).

### Results:

Controlling for chronological age and Mullen NVDQ scores measured at time 1, imitation scores were significantly correlated with concurrent CT/min ( $r_s(18)=-.536, p=.015$ ) and SCU/min ( $r_s(18)=-.791, p<.001$ ), and IJA was significantly correlated with SCU/min ( $r_s(18)=-.547, p=.013$ ). All other concurrent correlations between social communication skills and language were non-significant (Table 1). Controlling for chronological age and Mullen NVDQ and VDQ scores measured at time 1, as well as the number of months between visits, imitation was significantly correlated with change in CT/min ( $r_s(16)=-.840, p<.001$ ) and change in SCU/min ( $r_s(16)=-.737, p<.001$ ). All other longitudinal correlations between social communication skills and change in language were non-significant (Table 2). Controlling for time between visits, change in imitation scores were significantly correlated with change in CT/min ( $r_s(20)=-.506, p=.016$ ) and SCU/min ( $r_s(20)=-.501, p=.017$ ).

### Conclusions:

Imitation is a significant concurrent and longitudinal predictor of discourse and pragmatic language use in preschoolers with ASD. Findings suggest that the predictors of language abilities may vary depending on the method used to assess language (e.g., natural language sampling). Future work should explore how targeting imitation in ASD intervention can lead to direct improvements in discourse and pragmatic language use.

#### 413.053 (Poster) Production of Complex *Ba* and *Bei* Sentences in Mandarin-Speaking Children with ASD: A Corpus-Based Study

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**Background:** Children with Autism Spectrum Disorder (ASD) demonstrated strengths in simple grammar, but limited research has investigated their development of complex grammar (Naigles & Chin, 2015). In Mandarin Chinese, *Ba* sentences (active sentences in subject-*Ba*-object-verb order) and *Bei* sentences (passive voice in object-*Bei*-subject-verb order) are complex structures involving noncanonical word orders. Zhou et al. (2017) was the first to report difficulties in comprehending *Bei* sentences among Mandarin-speaking 4-5-year-olds with High-Functioning Autism (HFA).

**Objectives:** Beyond comprehension, this study aims to investigate the production of *Ba* and *Bei* sentences in Mandarin-speaking preschoolers with HFA and their age and MLU-matched TD counterparts, to deepen our knowledge of their development of complex grammar.

**Methods:** We examined the spontaneous speech of TD children and children with HFA matched on age and MLU from Shanghai corpus (ASD) and Zhou2 corpus (TD) in the Child Language Data Exchange System (MacWhinney, 2000). The 60-month group includes seven children with HFA and twenty TD children (MLU: 2.82±.70 vs. 3.20±.46), while the 66-month group includes five children with HFA and twenty TD children (MLU: 3.10±.59 vs. 3.05±.54) ( $ps > .05$ ). Fourteen types of *Ba* and *Bei* sentences were coded (Table 1).

**Results:** Table 2 showed that the production of *Ba* sentences didn't differ between 60-month-olds and 66-month-olds for either the TD or ASD group ( $ps > .05$ ); moreover, the age-matched TD and ASD groups didn't differ in production ( $ps > .05$ ). The

mean percentage of *Bei* sentences was extremely low in ASD group (0.05% in 60-month-olds and 0.28% in 66-month-olds), while TD group didn't utter any *Bei* sentences. Again, the production of *Bei* sentences didn't differ in TD and ASD groups at two age groups ( $ps > .05$ ). In both groups, most frequently occurring types of *Ba* sentences are those followed by the directional and resultative complement. However, the *Ba* sentence with resultative complements increased significantly between 60-month-olds and 66-month-olds in TD children,  $t(30) = 2.18$ ,  $p < .05$ , but there was no significant development of any types in ASD group ( $ps > .05$ ).

**Conclusions:** Production of complex *Ba* and *Bei* sentences appears challenging for both ASD and TD groups, with the *Bei* sentences being more difficult to acquire, possibly due to children's greater reliance on word order than morphological cues. Specifically, the reanalysis of *Bei* sentences against the surface word order posits difficulties for children with ASD with deficits in executive function (Zhou et al., 2017). Children with ASD are similar to TD children in producing resultative and directional complements for the *Ba* sentences, because of the high percentage of these types in the input (Deng et al., 2018) and the fundamental "action-result" model of cognition (Zhang, 2008). However, TD group, but not ASD group, showed significant development of resultative complements of the *Ba* sentence (indicating the completion of an event, frequently co-occurring with the perfective aspect marker *le*), which may be influenced by children with ASD's difficulties in analyzing and representing the temporal components of event structure (Boucher, 2000).

**413.054 (Poster) Profiles and Predictors of Reading Abilities in Chinese Children with Autism Spectrum Disorder**  
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**Background:** Reading is an important approach for us to obtain information and good reading ability is the foundation for success in study and life. However, for people with Autism Spectrum Disorder (ASD), acquiring good reading skill is not easy. Most children with ASD have some deficits in their reading development. Previous studies mainly explored the development of reading ability of autistic children in the context of alphabetic language, but rarely referred to the reading development of Chinese autistic children. The writing system of Chinese is a kind of morphemic language, which is essentially different from the alphabetic language. Therefore, it is particularly important to explore the development and influencing factors of Chinese reading ability of autistic children in the Chinese language environment.

**Objectives:** In order to understand the uniqueness of the reading development of Chinese autistic children and to explore the influencing factors of their reading abilities, this study measured the Chinese reading ability and reading-related language and cognitive skills of 20 autistic children aged 4-14 years.

**Methods:** Chinese reading ability were assessed by Chinese word decoding, oral vocabulary and sentence listening comprehension, and reading related skills include phonological awareness, morphological awareness, orthographic awareness, rapid naming ability, verbal working memory and general cognitive ability.

**Results:** Results showed that there were 4 different Chinese reading profiles in children with ASD: subtype 1 showed both good word decoding and comprehension skill, subtype 2 showed good word decoding ability but weaker comprehension skill, subtype 3 presented with average word decoding but weaker comprehension skill, subtype 4 showed both weak word decoding and comprehension skill. Overall, the Chinese reading ability of autistic children is significantly related to sentence-level language comprehension ability, phonological awareness, rapid naming, morphological awareness, orthographic awareness, vocabulary skill, general cognitive ability, and verbal working memory. The results tentatively indicate that there are around 20% of Chinese autistic children show high word decoding paired with low language comprehension ability. Phonological awareness, morphological awareness, and vocabulary are significant predictors of reading abilities in Chinese children with ASD.

**Conclusions:** The findings highlight the necessity to pinpoint the profile of ASD children's reading ability and the need for additional investigation of early predictors of reading development across different profiles.

**413.055 (Poster) Pronoun Reversals in Mandarin-Speaking Preschool Children with Autism Spectrum Disorder**  
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**Background:**

Pronoun reversals—using first person pronoun (English 'I' or Mandarin 'wo3') for second person pronoun (English 'you' or Mandarin 'ni3') and/or second person pronoun for first person pronoun — have been claimed to be prevalent in children with Autism Spectrum Disorder (ASD) (e.g., Kanner, 1943, Tager-Flusberg, 1994). However, more recent studies among English-

speaking children with ASD have addressed their relatively rare reversals of pronouns in language development (Barokova & Tager-Flusberg, 2020; Naigles et al., 2016). These conflicting results invite further research involved children with ASD speaking typologically different languages.

#### Objectives:

The present study aims to explore pronoun reversals in Mandarin-speaking preschool children with ASD, to further investigate the prevalence and origins of pronoun reversal in children with ASD learning languages typologically distinct from English.

#### Methods:

The spontaneous speech of 6 Mandarin-speaking high-functioning children with ASD aged 4-6 years across 12 visits was analyzed. The spontaneous speech data were drawn from the Mandarin ASD (Shanghai) corpus in the Child Language Data Exchange System (MacWhinney, 2000). We coded the utterances with first person and second person singular pronouns. Following Naigles et al. (2016), pronouns were coded as “correct” and “reversed”; for “reversed” pronouns, the discourse context was further coded as “imitative” and “non-imitative” (i.e., first person reversal-imitative; first person reversal non-imitative; second person reversal imitative; second person reversal non-imitative).

#### Results:

For Mandarin-speaking children with ASD, the percentages of producing first and second person pronouns out of the total utterances were 2.66% (1334/48890) and 0.6% (317/48890) respectively. And a total percentage of 3.05% (50/1651) was detected for reversed pronouns out of the total production of first and second person pronouns, amongst which the mean percent was significantly higher for second person pronoun reversals than first person pronoun reversals,  $13.8\% \pm 7.0\%$  vs.  $1.47\% \pm 0.9\%$ ,  $t(5) = 4.267$ ,  $p = 0.008$ ,  $d = 0.89$ . Moreover, the mean percent of reversals children with ASD produced was significantly more in imitative than in non-imitative context for second person pronouns,  $11.3\% \pm 5.68\%$  vs.  $2.50\% \pm 3.18\%$ ,  $t(5) = 3.605$ ,  $p = 0.015$ ,  $d = 0.85$ . Besides, a negative correlation emerged between the percent of second person pronoun reversals and MLU scores in children with ASD,  $r = -0.847$ ,  $p = 0.033$  (Fig. 1).

#### Conclusions:

This paper found that pronoun reversals in Mandarin-speaking preschoolers with ASD were very rare, with first and second person pronouns reversed for only 3.05% of the total utterances. The lack of pronoun reversals among Mandarin-speaking children with ASD is consistent with recent findings among English-speaking children with ASD (Naigles et al., 2016, Barokova & Tager-Flusberg, 2020), suggesting that pronoun reversals probably should not be referred to as “prevalent” for children with ASD across languages. Moreover, higher percentages of reversals in the second person pronouns than in the first person pronouns may be attributed to the combination of more parental child-directed speech referring to the child than to the parent and the cognitive egocentrism of young children with ASD (Evans & Demuth, 2012). However, pronoun reversals in children with ASD appear more in the imitative context of parental utterances and are negatively associated with their development of syntactic complexity (Naigles et al., 2016).

#### 413.056 (Poster) Relating Metalinguistic Abilities and Social Communication Skills in Autism

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**Background:** Recent research suggests that autistic individuals exhibit differences in metalinguistic ability, or the ability to understand language outside the concrete meaning of words, relative to their typically-developing peers. Metalinguistic ability has an important role in social communication, including making inferences and understanding figurative language, leading to the possibility that differences in metalinguistic abilities may contribute to the differences in social communication observed in autism. To date, however, this relationship between metalinguistic abilities and social communication skills in autism has not been thoroughly explored.

**Objectives:** Our first objective is to assess group differences in metalinguistic abilities and social communication skills between autistic and non-autistic children. Our second objective is to analyze the relationship between metalinguistic abilities and autistic traits, specifically social communication difficulties, on a spectrum, ignoring diagnostic groups.

**Methods:** Data were extracted from 118 participants from the Healthy Brain Network, including 30 autistic children and adolescents, and 88 individuals without an autistic diagnosis. Measures included the CELF-5 Metalinguistics assessment

(Metasemantic, Metapragmatic, and Total Metalinguistic Indexes), Autism Spectrum Screening Questionnaire, Social Aptitudes Scales, Social Communication Questionnaire, and Social Responsiveness Scale. Student's or Welch's (*t<sub>w</sub>*) t-tests were used to determine potential differences between autistic and non-autistic groups in social communication skills and metalinguistic abilities. Additionally, Pearson's correlations were used to assess the relationship between metalinguistic ability and autistic traits, specifically social communication skills, for all measures. However, participants' metalinguistic ability ranged between very low to average according to standardized scores.

**Results:** Significant differences between the autistic and non-autistic groups were seen within questionnaire and metalinguistic ability scores. Autistic youth had significantly higher autistic traits ( $t_{w(38)}=-5.91, p<.001$ ), lower social aptitude ( $t(94)=4.182, p<.001$ ), lower social communication ( $t(114)=-5.92, p<.001$ ) and lower social responsiveness ( $t(112)=-5.187, p<.001$ ). Furthermore, autistic individuals presented significantly lower metalinguistic abilities compared to non-autistic individuals (Metasemantic Index:  $t_{w(35)}=2.029, p=.05$ ; Metapragmatic Index:  $t(112)=2.262, p=.026$ ; and Total Metalinguistic Index:  $t_{w(33)}=2.218, p=.034$ ). Additionally, Pearson's correlations revealed no significant associations between metalinguistic abilities and autistic traits, specifically social communication skills, for all measures. However, participants' metalinguistic ability ranged between very low to average according to standardized scores.

**Conclusions:** Autistic youth are more likely to have metalinguistic difficulties compared to non-autistic youth, highlighting the importance of further understanding metalinguistic abilities in autism. These group differences included both metapragmatic and metasemantic abilities. Contrary to our hypothesis, no relationships were observed between metalinguistic and social communication abilities. This may be due to the non-autistic population in the Healthy Brain Network presenting with a high rate of non-autism diagnoses, reflected by their relatively constrained distribution of metalinguistic abilities. It is unclear whether a different pattern would result with the inclusion of participants with higher metalinguistic abilities. Further analyses would benefit from a broader range of metalinguistic abilities, and could consider possible moderating factors, such as age or cognitive ability.

#### 413.057 (Poster) Relations between Mental Terms and Theory-of-Mind Understanding in Cantonese-Speaking Autistic and Typically Developing Children

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**Background:** Previous studies have shown that children's understanding of first- and second-order theory of mind (ToM) correlates with their knowledge of the factivity semantics of mental terms. Specifically, Hong Kong typically developing (TD) children's comprehension of strong nonfactive verbs was found to predict their first-order ToM understanding (Cheung et al., 2009), while mainland Chinese TD children's comprehension of factive mental terms was found to predict both first- and second-order ToM understanding (Li & Leung, 2020). Although numerous studies have found that children with autism spectrum disorders (ASD) show deficits in mental term comprehension (Yi et al., 2013) and ToM understanding (Baron-Cohen et al., 1985), the relation between autistic children's ToM abilities and their understanding of the factivity semantics of mental terms remains understudied.

**Objectives:** This study examined whether comprehension of factive mental terms (*zidou6* 'know', *ng4gei3dak1* 'forget', and *hou2hoi1sam1* 'happy') and nonfactive mental terms (*ng6wui6* 'mistakenly think', *ji5wai4* 'falsely think', and *waan6soeng2* 'imagine') predicts first- and second-order ToM understanding in Hong Kong Cantonese-speaking children with ASD and their TD peers.

**Methods:** 40 Hong Kong Cantonese-speaking children with ASD (mean age = 6.92, *SD* = 1.47) and 63 TD children (mean age = 6.20, *SD* = 0.92) participated in this study. The ASD group and the TD group were matched on language ability, and participants in the ASD group were significantly older than those in the TD group. Knowledge of the factivity semantics of mental terms was tested using a sentence comprehension test modeled after Cheung et al. (2009), in which children judged the truth or falsity of the complement clause following the factive or strong nonfactive mental terms. Participants' first- and second-order ToM understanding was assessed using the Content False Belief task (Wellman & Liu, 2004) and the Ice Cream Van test (Perner & Wimmer, 1985), respectively. Participants' language ability and nonverbal intelligence were assessed using the Test of Hong Kong Cantonese Grammar of The Hong Kong Cantonese Oral Language Assessment Scale (T'sou et al., 2006) and the Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2008), respectively.

**Results:** Children with ASD performed significantly worse than TD children on both ToM and mental terms tests. The results of multiple linear regressions showed that after controlling for the effects of chronological age, language ability, and nonverbal intelligence, autistic children's comprehension of the three strong nonfactive mental terms ('falsely think', 'mistakenly think',

and ‘imagine’) significantly predicted their first-order ToM understanding. As for TD children, none of the mental terms significantly predicted their first- or second-order ToM understanding.

Conclusions: This study found that only strong nonfactive mental terms significantly predicted first-order ToM understanding in Cantonese-speaking autistic children. This provides new evidence that knowledge of strong nonfactive mental terms is crucial for autistic children’s understanding of first-order ToM. Our finding that neither factive nor strong nonfactive mental terms predicted first- or second-order ToM understanding in TD children could be attributed to their mastery of the factivity semantics of factive and nonfactive mental terms as well as to their first- and second-order ToM understanding.

**413.058** (Poster) Say That Again: Quantifying Patterns of Grammatical Production for Children with ASD Using Recurrence Analysis

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Background:

Immense heterogeneity of grammatical abilities exists among children with ASD (e.g., Kjelgaard & Tager-Flusberg, 2001; Roberts et al., 2004; Wittke et al., 2017). Previous research has demonstrated that these individuals vary on broader measures (e.g., standardized tests, MLU); however, more detailed analyses are needed to investigate why some children habitually produce short/telegraphic utterances. Categorical recurrence quantification analysis (RQA) offers a novel approach to understand the nature of these production difficulties by quantifying the structure within sequences of categories. Previous applications often quantified grammatical alignment between two speakers (e.g., Dale & Spivey, 2005, 2006), but we evaluate changes within individual children at the level of grammatical form classes.

Objectives:

We perform RQA on noun phrases from 5-year-olds’ language samples, as this grammatical form class develops earliest.

Methods:

The present study uses a subset of the Autism Phenome Project dataset ( $n = 31$ ,  $M_{age} = 72.71$  months, 10 females,  $M_{NVIQ} = 95.32$ ,  $SD = 19.39$ ;  $M_{TOTALADOS} = 12.19$ ,  $SD = 4.86$ ). Language sample transcriptions were parsed for MLU and percent ungrammatical utterances (%UU), annotated for form classes (see Table 1) and analyzed via RQA. RQA measures instances of pairs of repeated units over time by creating recurrence plots (RP) and subsequently quantifying them through recurrence rate (RR) and determinism (DET). RR calculates the percentage of the RP containing filled-in points; high RR indicates frequent reuse of form classes. DET measures the structure of repeated sequences, which is visible on the RP as larger box structures rather than single dots. High DET indicates that children repeat form class combinations. Analyses differentiated between noun phrase (NP) and all other form classes (see Table 1) and investigated the extent to which RR and DET related to MLU and %UU.

Results:

Figure 1 shows four example RPs, highlighting the variability within our sample. Child A repeats many unit combinations verbatim (poor production), whereas B repeats less (good production; e.g., ‘adjective noun’ and ‘determiner possessive noun’). C repeats words often, testing few new words across many new sequences (moderately poor production; e.g., ‘determiner noun’ and ‘determiner adjective noun’), whereas D keeps using new units in new combinations without revisiting prior ones (moderately good production; e.g., ‘noun’ versus ‘adjective demonstrative pronoun’). Preliminary analyses revealed a negative association between RR [ $M = 5.38$ , Range = 3.54 10.47] and MLU [ $M = 4.64$ , Range = 1.90 9.14;  $r(29) = -.54$ ,  $p < .01$ ]; children who repeated NP-related *elements* more often had shorter MLUs. Moreover, a positive association emerged between DET [ $M = 21.77$ , Range = 7.26 37.37] and MLU [ $r(29) = .51$ ,  $p < .01$ ], in that children who repeated longer NP-related *sequences* had longer MLUs. Interestingly, neither RR nor DET were associated with %UU ( $p$ ’s  $> .09$ ). These persisted even after controlling for NVIQ and total ADOS score.

Conclusions:

These data illustrate that higher syntax levels may indicate adding new form classes to previously used sequences. Findings underscore the value of using RQA metrics as more fine-grained measures of grammatical production for extricating variability

among children with ASD.

**413.059** (Poster) School-Entry Language Skills As Predictors of Academic and Social Outcomes in Kindergarteners with ASD  
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Background: Language ability varies widely for children with ASD (Tager-Flusberg, Paul, & Lord, 2005). Among verbal children with ASD, the social use of language (pragmatics) may be still impacted even when syntactic or semantic skills are intact (Gorman et al., 2016). Language problems could also affect children's academic achievement and the development of peer relationships (Gibson et al., 2013; Helland & Helland, 2017). Therefore, exploration of how school-entry language skills predict academic and social outcomes can help to inform early interventions.

Objectives: (1) Compare language profiles of children with ASD and typically developing (TD) children at kindergarten-entry using the Children's Communication Checklist-2 (CCC-2). (2) Determine whether CCC-2 scores at kindergarten entry are predictive of academic achievement and peer interactions across the kindergarten year.

Methods: Participants included 97 children including 62 cognitively-able children with ASD and 35 TD children. Language abilities were assessed via caregiver report using the CCC-2 (Bishop, 1998). A syntactic/semantic domain was created by averaging scaled scores from the domains related to mechanics of language (speech, syntax, semantics, and coherence), and a pragmatics domain by averaging scaled scores for the initiation, scripted language, context, and nonverbal communication subtests. Subtests of the Woodcock Johnson III Tests of Achievement (WJ; Woodcock et al., 2001) were used to measure children's reading and math skills. Children's peer play interactions were assessed via caregiver report on the Penn Interactive Peer Play Scale (PIPPS; Fantuzzo & McWayne, 2002). Language scores of children with and without ASD were compared using linear regressions while controlling for age, gender, and NVIQ. Within the ASD group, linear regressions were conducted to evaluate the effects of kindergarten-entry language abilities as predictors of academic achievement and social functioning at kindergarten-entry and -exit while controlling for gender, age, NVIQ, and autism symptom severity (ADOS-2 Calibrated Severity Scores).

Results: Children with ASD showed significantly more impairments on all domains of CCC-2 at kindergarten-entry compared to TD children even after accounting for the effects of age, gender, and NVIQ. For the prediction of academic skills, when syntactical and pragmatic domains were entered into the same model, kindergarten-entry pragmatic skills significantly predicted concurrent WJ Applied Problems (math;  $B=-.287, p=.035$ ) and Letter Word Identification ( $B=-.352, p=.017$ ). Both syntactic and pragmatic language skills at kindergarten-entry significantly predicted future performance on WJ Letter Word Identification ( $B=.362, p=.012$ ;  $B=-.425, p=.004$ , respectively) and Passage Comprehension ( $B=.272, p=.047$ ;  $B=-.370, p=.008$ , respectively) at kindergarten-exit; pragmatic skills significantly predicted future performance on WJ Math Fluency ( $B=-.321, p=.024$ ). For the prediction of social outcomes, kindergarten-entry pragmatic language skills significantly predicted Play Disruption and Play Disconnection as measured by the PIPPS at kindergarten-entry ( $B=-.355, p=.016$ ;  $B=-.596, p<.001$ , respectively) and kindergarten-exit ( $B=-.506, p=.001$ ;  $B=-.294, p=.041$ , respectively).

Conclusions: Kindergarten-entry language skills in children with ASD predicted concurrent and year-end academic achievement as well as peer play skills, indicating the importance of language ability for kindergarten success. Specifically targeting pragmatic language prior to school-entry may promote better academic and social outcomes for cognitively-able children with ASD.

**413.060** (Poster) Social Language Use and Behavioral and Social Engagement in Inclusive Classrooms for Preschoolers with and without ASD  
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Background: Defined by disturbances in social communication and interactions, autism spectrum disorder (ASD) frequently involves delayed language and self-regulation skills. A common feature of children with ASD is deficits in social language with peers, defined here as talking with a peer while in close proximity and mutually oriented. Here we investigate talking with peers as our primary measure of social language. One key measure of self-regulation is behavioral engagement, or children's ability to stay on task and be self-reliant in the classroom.

**Objectives:** Here, we use innovative, automated measures and expert observations to examine whether differences in language abilities, particularly social use of language, in children with and without ASD relate to classroom behavioral and social engagement.

**Methods:** Participants included 84 preschoolers (36 female) enrolled in eight inclusive classrooms (27 with ASD, 26 with developmental delays [DD], and 31 typically developing [TD]). During monthly observations, children wore lightweight vests equipped with Language ENvironment Analysis (LENA) to measure vocalizations and two Ubisense tags to measure location. Ubisense measures of proximity/orientation were used to determine social contact, and synchronized to LENA data to assess each child's social language use (output) with peers. Children's end-of-year language abilities were assessed with the Preschool Language Scales (PLS-5). Researchers also observed each child using the INdividualized CLassroom Assessment Scoring System (inCLASS), which consists of four domains relating to children's social engagement with teachers and peers (e.g. eye contact), their behavior (or task) engagement (e.g. staying focused on an assigned task), and negative engagement (e.g., yelling). During each inCLASS assessment, a trained researcher observed one child at a time, scoring the child on each of the four domains; each domain had a possible range of 2-21 per observation. Each child was observed for four 10-minute periods over the course of one day. These scores were averaged across all four periods to create a composite score for each child in each domain. Here, we examine behavioral engagement and positive social engagement with peers in the classroom.

**Results:** Preliminary analyses from three classrooms indicated differences in social language use and behavioral and social engagement. TD children had higher behavioral engagement ( $M=8.61$ ), social engagement ( $M=9.52$ ), ( $M=.93$ ), and total PLS-5 scores ( $M=119.29$ ) than their DD/ASD peers (behavioral engagement  $M=6.09$ ; social engagement  $M=4.87$ ; social language use  $M=.62$ ; PLS-5 scores  $M=80.33$ ;  $ps<.05$ ). Linear regression indicated that social language use was associated with behavior engagement ( $p=.040$ ; Figure 1) and social engagement with peers ( $p=.048$ ; Figure 2), such that increases in social language use were associated with higher appropriate classroom behavior and positive peer interactions, regardless of diagnosis.

**Conclusions:** Overall, we found that children with ASD and DD had lower levels of language ability, social language use, and classroom behavioral and social engagement than TD children, but social language use predicted behavioral and social engagement for all groups of children. Thus, although children with ASD and DD may have particular difficulty with the behavioral skills needed for classroom engagement, their developing language skills can support the development of self-regulation.

#### **413.061 (Poster) Social Skills in Multilingual Children with Autism**

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**Background:**

Parents of children with autism spectrum disorder (ASD) are often advised to use only one language to simplify language acquisition for their child. However, monolingualism is especially difficult to implement in the more and more multicultural world and especially challenging in minority-language families, as the recommendation orients towards the geographically predominant language. Scientific research suggests that multilingualism is not related to language skills and other child development factors, and that using exclusively foreign languages may even impede social interaction between family members.

**Objectives:**

The present study investigated whether the choice of language in the upbringing of children with ASD is related to the children's social skills and to parents' ability to feel comfortable, authentic, and free to express themselves when interacting with their child.

**Methods:**

This study was offered as a quantitative online survey and was shared in countries all over the world. Children's and parents' sociodemographic data, language use and proficiencies, and parents' feelings regarding their choice of language use were assessed using questionnaires formulated for the purposes of this study. Children's social skills were assessed using the Social Responsiveness Scale™, Second Edition (SRS-2; Constantino & Gruber, 2012) and children's diagnosis was controlled using the Autism Spectrum Quotient – Children's version test (AQ-Child; Auyeung et al., 2008).

**Results:**

Data of 68 families with children with ASD from 25 different nationalities showed that the choice of language was not significantly related to social skills in children. However, parents using only their mother tongue felt significantly more comfortable [ $H(3) = 18.18, p < .01, r = .39$ ] than parents using exclusively a foreign language when addressing their child (see Figure 1). Also, parents using only their mother tongue felt significantly more authentic than parents using exclusively a foreign language [ $H(3) = 21.21, p < .01, r = .42$ ] and parents using multiple foreign languages [ $H(3) = 23.97, p < .05, r = .38$ ] (see Figure 2). In addition, parents using their mother tongue, either only their mother tongue or in combination with other languages reported feeling significantly more comfortable ( $U = 384.00, z = -2.37, p < .05, r = -.29$ ) and more authentic ( $U = 273.50, z = -3.74, p < .001, r = -.45$ ) than parents using exclusively foreign languages, either one or many. There were no significant differences between monolingual and multilingual families regarding all parents' feelings about their choice of language use.

#### Conclusions:

Our findings suggest that advising parents to discard their mother tongue and use only the culturally predominant language cannot be supported scientifically in terms of consequences for children's social skills and may have negative consequences for the parents. Our findings may encourage specialists to consider multilingualism more often and consult with parents whether monolingualism is worth risking the negative outcomes we have found. Advising parents to raise their child multilingually may facilitate access to therapeutic treatment, childcare, and social interaction in the multicultural society and family and thus improve support and orientation for families with a child with ASD.

**413.062** (Poster) Statistical Learning and Its Relation to Language in Young Children with Autism: An Eye-Tracking Study  
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**Background:** Research has consistently documented language difficulties in autism spectrum disorder (ASD). One plausible yet untested factor contributing to these difficulties is a deficit in statistical learning abilities. Previous research has shown that statistical learning, the ability to extract statistical regularities, is critical to language development in typical children. Its role in young children with ASD has not been studied due to methodological limitations. To address this gap in research, we created a novel eye-tracking task testing statistical learning.

**Objectives:** To test the hypothesis that performance in the statistical learning task contributes to variance in verbal language abilities of young children with ASD.

**Methods:** A group of 32 children with an ASD diagnosis, ages 25-35 months, was administered an eye-tracking task designed to test statistical learning. Statistical learning was indexed by participants' anticipatory gaze in response to the observation of patterns of events in two conditions. In the deterministic condition, a video-animation showed a sequence of events whereby a ball is descending down a waterfall, is occluded behind a bridge, and then descends down to three stream options, going down the same stream for four trials. In the probabilistic condition, the same scenario was presented, but the ball descended down the same waterfall in three of the four trials, while in one trial it descends down the opposite stream. Anticipatory gaze was computed as the duration of attention to the waterfall stream where the ball descended all the time (deterministic condition) or most of the time (probabilistic condition) before the ball was seen falling down stream. We examined the association between statistical learning in the two conditions (as indexed by the increase in anticipatory gaze over trials) and verbal ability as indexed by the communication subscales of the Mullen Scales for Early Learning (MSEL) and Vineland Adaptive Behavior Scales (VABS).

**Results:** In the deterministic condition, after observing that the ball was consistently descending down the left waterfall in the first two trials, children with ASD were showing anticipatory gaze towards the left waterfall in the following trials ( $p < .001$ ), thus demonstrating the ability to extract patterns, such as the direction of the ball's path, and anticipate future events. In the probabilistic condition there was no evidence of anticipatory gaze in the direction where the ball was falling in most trials ( $p = .27$ ). Statistical learning in the deterministic condition, but not in the probabilistic condition, was associated with verbal ability across standardized scores in the MSEL ( $p = .01$ ) and VABS ( $p < .05$ ).

**Conclusions:** Young children with ASD in this task showed evidence of statistical learning in the deterministic condition, but not in the probabilistic condition. This suggests that children with ASD might be able to learn "what is going to happen next" after observing repetitions of the same event in a deterministic but not in a probabilistic scenario. Children with better performance in the statistical learning task had better language skills, consistent with the prediction that statistical learning contributes to language development in this population.

**413.063** (Poster) The Association between Language Impairments and Behaviours of Concern in Autism Spectrum Disorder: A Systematic Narrative Review

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**Background:** Behaviours associated with risks to the individual and others are commonly observed in autism spectrum disorder (ASD) and collectively referred to as behaviours of concern (BoC). Other than potential direct harm, BoC impair social interactions and relationships, limit education and work engagement and reduce care and living options. BoC could, in part, be associated with language impairments.

**Objectives:** To systematically review existing evidence to assess if there is an association between language impairments and BoC in ASD.

**Methods:** We searched EMBASE, MEDLINE, PsycINFO and CINAHL to retrieve original published research. We also checked reference lists of all included studies and relevant reviews. Studies in English were included if the sample size was greater than ten participants with ASD, if there was a measure of language impairment and behaviour amongst the participants, and analysis of an association between these two factors. We included self-injurious behaviour (SIB), aggression, externalising behaviour, tantrums and disruptive behavior as BoCs. Language measures included those that predominantly focused on the structure of language (i.e. content and/or form) as compared with the social use of language. No limitations were placed on age of participants or date of study publication. Risk of bias was assessed. Results were presented using narrative synthesis.

**Results:** The titles and abstracts of 2,669 records were reviewed, with 109 selected for full text assessment. Eighty-six of these were excluded, resulting in 22 included studies (of 23 records). These studies included 7,937 participants, with studies conducted predominantly in the United States (N=15). Of the included studies, 19 collected data cross sectionally, while the remaining 3 were prospective cohort studies. Age of participants ranged from 1.25 to 52 years, with a mean age of 9.1 years. Male to female ratio was 5.3 to 1.

No significant associations were found between expressive language and tantrums, composite measures of language and externalising behaviour, receptive language and SIB, and adaptive language and SIB. There may be a negative association between expressive language and SIB, and expressive language and challenging behaviour. Only 10 of 22 studies adjusted for covariates in their analysis.

There was substantial heterogeneity in the definitions and measurement of language impairment and behaviour. There was a mixture of language domains studied, including expressive language, receptive language, composite measures or a combination of adaptive expressive and receptive language. Most authors that studied expressive language presented a parent-report language scale (e.g. no words, less than 5 words, or functional speech). Behaviour was also defined and measured in different ways.

**Conclusions:** There is no clear, strong consensus on the association between the various constructs of language and BoC. Different domains of language appear to have differential associations with BoC. The most consistent association was between expressive language and challenging and self-injurious behaviour. There is large variation in characterisation of both language and challenging behaviour, including the use of non-validated tools. These findings emphasise the importance of a detailed communication assessment when considering factors associated with BoC and when planning intervention for managing BoC in individuals with ASD.

**413.064 (Poster)** The Emotional Valences of Passive Sentences in Japanese By Adolescents with ASD Tendencies  
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Background: Lartseva, et al. (2015) point out that "...individuals with ASD are able to correctly identify words, sentences or stories as emotionally positive or negative". However, it is not yet clear whether individuals with ASD can accurately classify them into positive or negative in a Japanese cultural context. Direct passive sentences in Japanese almost always convey either a positive or negative meaning, with the exception of passive sentences with inanimate subjects which are usually interpreted as having no benefit or damage connotations. Such passive sentences with inanimate subjects have an objective meaning and are uncommon in Japanese everyday life.

**Objectives:** The purpose of this study is to clarify how individuals with ASD tendency perceive passive sentences with inanimate subjects, compared with more common passive sentences with animate subjects. We measured the emotional values that people with a tendency towards ASD feel about direct passive sentences with positive, negative, or neutral meanings, in order to explore possible difficulties they experience in daily communication.

**Methods:** We measured the emotional values two subject groups placed upon three types of direct passive sentences (16 sentences respectively for damage, benefit, and neutral meanings) in 12 adolescents who had a tendency towards ASD and a control group consisting of 106 university students. They were asked to mark the strength of their feelings concerning each sentence on a straight line ranging from negative to positive (The visual analog scale: VAS). Emotional values were measured by the distance in millimeters from the center point (neutral) of the straight line to the mark the participants had made.

**Results:** As a result of comparing the two groups' reactions for each of the three types of direct passive sentences, a significant difference was observed only in the sentence with an inanimate subject and a neutral meaning ( $t(11.463) = 2.653, p = 0.022, d = 1.51$ ). Furthermore, a chi-square test was performed by dividing the emotional values the subjects put upon the direct passive sentences with inanimate subjects into three groups: negative: ( $\leq -5$  mm), neutral: ( $4 \text{ mm} \leq 5$  mm), positive: ( $> 6$  mm). The result revealed that most participants in the control group showed neutral emotional values, but the ASD tendency group tended to evaluate the sentences more positively ( $\chi^2(2) = 76.338, p < .01$ ).

**Conclusions:** One possible explanation for the outcome is that the subjects on the autism spectrum perceived objects and people as equivalent, so they may have undifferentiated psychological distances toward objects and people. Another possibility is that the two groups viewed the premise that sentences with inanimate subjects which have an objective meaning and are uncommon in Japanese everyday life differently. The cognitive background behind the different perceptions held by people with a tendency towards ASD regarding the emotional values they placed on passive sentences with inanimate subjects in Japanese could be clarified by performing the same study in English-speaking countries, which could provide indicators to help develop a support method for people with ASD concerning daily communication.

**413.067 (Poster)** "I Could Not Quite Figure out What It Was about. They Never Say It Directly" – Contextually Relevant Inferencing and Narration By Young Adults with and without an Autism Spectrum Disorder Diagnosis

**K. Dindar<sup>1</sup>, S. Loukusa<sup>1</sup>, E. Leinonen<sup>2</sup>, L. Mäkinen<sup>1</sup>, L. Mämmelä<sup>1</sup>, M. L. Mattila<sup>3</sup>, H. E. Ebeling<sup>3</sup> and T. Hurtig<sup>4</sup>,** (1)Research Unit of Logopedics, University of Oulu, Oulu, Finland, (2)Office of the Vice Chancellor, Murdoch University, Perth, Australia, (3)Clinic of Child Psychiatry and PEDEGO Research Unit, Oulu University Hospital and University of Oulu, Oulu, Finland, (4)Research Unit of Clinical Neuroscience, Clinic of Child Psychiatry and PEDEGO Research Unit, University of Oulu and Oulu University Hospital, Oulu, Finland

**Background:**

Interpreting and using language in a *contextually relevant* manner is considered challenging for many individuals diagnosed with autism spectrum disorder (ASD). Studies have shown that adults diagnosed with ASD can have challenges in responding to inference questions about others' mental states when viewing pragmatically complex social scenes (e.g. Heavey et al., 2000; Lönnqvist et al., 2017). Studies have also shown that compared to neurotypical individuals, adults diagnosed with ASD spontaneously tell more detail-focused narratives about the complex scenes viewed, with less engagement in inferencing the broader meaning of events (Barnes & Baron-Cohen, 2012). However, in spontaneous situations, little is known about the extent to which inferencing and narration by individuals diagnosed with ASD can be considered contextually relevant for the scenes viewed.

**Objectives:**

To explore whether young adults with and without an ASD diagnosis differ in terms of the contextual relevancy of 1) the inferences and 2) the narratives they spontaneously produce about pragmatically complex social scenes.

**Methods:**

Participants included Finnish young adults with a diagnosis of ASD (25 males, 7 females) and control participants without an ASD diagnosis (24 males, 10 females). The groups did not differ by age ( $Mdn_{ASD} = 22.9$  years;  $Mdn_{CONTROL} = 22.5$  years;  $U = 624.5, p = 0.302$ ) or Wechsler Adult Intelligence Scale IV Verbal Comprehension Index score ( $M_{ASD} = 108.3$ ;  $M_{CONTROL} = 106.9$ ;  $t(64) = 0.344, p = 0.732$ ). The participants were shown seven short video clips. The video clips involved pragmatically complex social interactions, such as deception, requiring the contextual inference of meaning. After viewing each clip, the participants

were asked to spontaneously narrate what they thought had happened in the clip. The narratives were analysed for the pragmatic elements presented in Table 1. Depending on the data distributions, a *t*-test or Mann-Whitney *U*-tests were used for statistical analysis. The analyses were corrected for multiple testing by controlling the false discovery rate (Benjamini-Hochberg procedure) with  $\alpha$  0.05. All the *p*-values reported as statistically significant remained significant after the correction.

#### Results:

The control group scored higher than the ASD group in inferring the pragmatic key elements of the scenes ( $t(64) = 2.720, p = 0.008$ ; see Table 2). The narratives of the control group included less meaning-related misunderstandings ( $U = 756.0, p = 0.005$ ), less focus drift ( $U = 629.0, p = 0.017$ ) and less extraneous details ( $U = 681.0, p = 0.009$ ). The groups did not differ in the number of narratives involving setting-related misunderstandings ( $U = 505.5, p = 0.531$ ), gap fill-in ( $U = 496.0, p = 0.529$ ), personal commenting ( $U = 604.0, p = 0.378$ ) or stimulus-related commenting ( $U = 586.0, p = 0.542$ ).

#### Conclusions:

Whilst the groups' narratives shared multiple elements, they also differed in key aspects, specifically in regard to using context to infer meaning. Narratives about pragmatically complex social scenes give insight into the groups' differences in interpreting social situations as well as into the challenges that individuals diagnosed with ASD might face when navigating social interactions.

# Diagnostic, Behavioral, Sensory and Intellectual Screening and Assessment

## PANEL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT

### Panel 203 - Autism in Children with Hearing or Visual Impairment: Early Risk Signs, Atypical Profiles and Modified Diagnostic Assessment Approaches

**Panel Chair: Naomi Dale**, *Neurodisability Service, Great Ormond Street Hospital NHS Foundation Trust, London, United Kingdom, Clinical Neurosciences, UCL Great Ormond Street Institute of Child Health, London, United Kingdom, Neurodisability Service, Great Ormond Street Hospital NHS Foundation Trust, London, United Kingdom, Clinical Neurosciences, UCL Great Ormond Street Institute of Child Health, London, United Kingdom*

**Discussant: Cory Shulman**, *The School of Social Work, The Hebrew University of Jerusalem, Jerusalem, Israel*

Children with severe hearing or visual impairment are at additional risk of social communicative difficulties and autism spectrum disorder; meta-analysis shows a thirty one times higher risk in children with visual impairment compared to the typically sighted population. For clinical preventative and interventionist reasons and for greater scientific understanding of the early risks and atypical profiles and potential aetiologies, robust validated measures are required for assessing and diagnosing autism spectrum disorder in the context of hearing or visual impairment. This has raised high clinical and scientific challenges as existing validated instruments are dependent on functional auditory or visual abilities. To address this important clinical and scientific need, three paediatric centres, who have been leading in clinical experience and research in this area, bring together new research methodologies, insights and modified diagnostic assessment approaches to underpin the clinical practice and scientific research of the future with these populations. The topics covered are comparison of social communicative skills of young children with vision impairments and those with typical sight and autism spectrum disorder, modified assessment methods for diagnosing autism in children with hearing impairment and vision impairment and early social communicative risks predicting diagnostic profiles of autism in children with vision impairment.

**203.001 (Panel)** A Comparison of Social Skills of Children with Vision Impairments and Those with Autism Spectrum Disorders

**Z. Nir**, *The School of Social Work, The Hebrew University of Jerusalem, Jerusalem, Israel*

Background:

Vision impairment (VI) is a sensory disability that affects many areas of child development (Vann et al., 2015; Hobson, 2005). Research reveals an overlap of the social-communication challenges that children with VI face with those challenges that children with autism spectrum disorder (ASD) experience, but this overlap is not well understood (Hobson & Lee, 2010; Absoud, Parr, Salt & Dale, 2011; Do et al, 2017).

**Objectives:** The purpose of this research was to characterize and compare social, language and behavior profiles of preschool children with VI and with ASD. This study is a part of a wider research program investigating social skills of preschool children with VI and those with ASD.

**Methods:** Forty preschool children with congenital VI and forty preschool children with ASD, matched on gender, and chronological and mental ages participated in this research. The children's vision level, in the VI group, was divided into moderate (n=25) and severe to blind (n=15) according to an ophthalmologist assessment using the Snellen scale for vision acuity and ICD-10 criteria (Salt et al., 2007; WHO, 2016). Parents in both VI and ASD groups were interviewed by the Autism Diagnostic Interview (ADI-R) and all children were observed by the Autism Diagnostic Observational Schedule (ADOS-2). Both tools were modified for the VI group by omitting visual depended items.

**Results:** An item by item analysis of the data from the ADI-R and ADOS2, which accounted for VI severity level, revealed similar deficits in overall level of language, immediate echolalia and hand and finger mannerisms. Differences emerged, with the children with ASD revealing more repetitive and restrictive behaviors and less social initiation than the children with VI. Responsivity, conversation and unusual sensory interest had variations between parental report and direct observation. For

instance, parents in both group reported similar levels of deficits in responsivity in social interaction whereas on direct observation the ASD displayed higher level of deficits in responsivity in comparison to the VI group.

Conclusions: The findings from this study suggest a similar level of deficits in children from both groups in language development and excessive sensory interest. However, children with VI displayed better social skills, including social initiation and responsivity than children with ASD. Our conclusion is that, although there are similar challenges in the development of VI and ASD children, there is apparently a different course of development of social skills. These findings help to distinguish between children with VI and ASD and can further our ability to understand the similarities and differences among them. Further research will help clarify these issues.

**203.002 (Panel)** Modified Assessment Methods for Diagnosing Autism Spectrum Disorder in Children with Severe Hearing Impairment

**B. Wright**, *Child Oriented Mental health Intervention Centre, University of York, York, United Kingdom*

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Background:

Deaf children and young people face a range of challenges that lead to poorer educational and life outcomes than their peers. This includes an increased chance of language deprivation and social emotional developmental delay in early life. These issues and profiles make assessment for autism spectrum disorders (ASD) very challenging.

Objectives:

To present the results of a large sample 5 year Medical Research Council study to adapt ASD assessment tools for use in deaf children and young people. The study has been undertaken by the Child Oriented Mental health Intervention Centre (COMIC) in conjunction with specialist National Deaf Child and Adolescent Mental Health Services (NDCAMHS) in England including deaf mental health practitioners, psychiatrists, speech and language therapists and psychologists who are expert in the psychological and developmental needs of children who are deaf working closely with people with lived experience.

Methods:

A large national sample was recruited through the National Deaf CAMHS (England) services. Children were assessed with the Autism Diagnostic Observation Schedule (ADOS-2) adapted for use with deaf people (using Modules appropriate to their developmental stage) with assessors working in sign language when the child's main language was sign. Parents filled in the Social Responsiveness Scale Deaf adaptation (SRS-2- DA) and were interviewed using the Autism Diagnostic Interview Deaf adaptation (ADI-R- DA). Members of the team independently assessed the children for ASD with gold standard blinded assessment.

Results:

We report the validation of these tools including deaf adaptations of the SRS-2, ADOS-2 and ADI-R. Results show good sensitivity and specificity scores from the modified assessments to the clinician formulations showing concurrent validity and that they are fit for purpose.

Some differences in presentation between deaf and hearing children with ASD are discussed.

Conclusions:

The ADOS-2 Deaf Adaptation has been used successfully for children who are deaf and administered with signing assessors, leading to reliability and 'fit for purpose' for future clinical usage by trained expert teams. This will permit the possibility of accurate diagnoses and future research opportunities to understand more about the different aetiologies and trajectories of deaf and hearing children who develop ASD.

**203.003 (Panel)** Modified Assessment Methods for Diagnosing Autism Spectrum Disorder in Young Children with Severe Visual Impairment

*N. J. Dale, Neurodisability Service, Great Ormond Street Hospital NHS Foundation Trust, London, United Kingdom*

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**Background:**

Children with severe visual impairment (VI) are at high risk of developing autism spectrum disorder (ASD), but reliable validated clinical tools for identification and diagnosis have been lacking. The DAiSY project focused on development and validation of a modified version of the Autism Diagnostic Observational Schedule (ADOS-2®) with 4-7 year olds with VI, which is possibly the earliest age for more reliable diagnosis of *persistent* social-communicative and repetitive and restricted behaviour problems.

**Objectives:**

To design and validate the modified ADOS-2 ® (Module 3) for children with VI and to compare against independent paediatrician formulation and for concurrent validity with the parent-report questionnaires of Social Responsiveness Scale (SRS-2) and Children's Communication Checklist (CCC2).

**Methods:**

A representative national cohort of one hundred four-to-seven-years-olds (M=5.4 years), with congenital disorders of the anterior visual system and profound-severe VI (M=.98 logMAR) participated. 85 children had fluent language and engaged in social interaction and play using modified standard 'presses' of ADOS-2 (Module 3), with some additions. The modified ADOS-2 had no items or scoring ratings dependent on functional vision abilities. Assessors were trained in behavioural assessment methods using auditory and touch cues to help the child participate. The ADOS ratings were compared against independent paediatrician formulation (with expertise in VI and ASD) of Non-Spectrum, Autism Spectrum Disorder (ASD – below full ASD threshold, but ASD symptoms) and Autism (AUT) using DSM-V classification.

**Results:**

The modified ADOS-2 showed high internal consistency and inter-rater reliability. A ROC analysis revealed excellent predictive discriminant validity with high sensitivity and specificity against paediatrician ratings and identified a new diagnostic algorithm (according to Gotham et al 2007) and diagnostic thresholds for ASD and AUT. Concurrent validity showed significant large effect size differences on the SRS-Total, Social Communication and Repetitive Behaviour Subscales according to above or below diagnostic threshold (Non-Spectrum versus AUT). Significant differences were found on the CCC-2 Social Interaction Deviance Composite but not on the CCC-2 General Communication Composite where both groups had lower pragmatic skills.

**Conclusions:** The ADOS-2 (Module 3) can be modified successfully for children with VI, leading to strong internal coherence, construct validity, inter-rater reliability and predictive discriminant validity with high sensitivity and specificity against clinician formulation. The new diagnostic algorithm highlights similarities and differences between the population with VI and those who are sighted (Gotham et al 2007) and these are discussed further. The assessment and scoring methods therefore appear reliable and 'fit for purpose' for future feasibility trial in the clinic context. The parent questionnaires also appear valuable as an additional supplement but pragmatic communication deficits were widespread across the whole sample.

**203.004 (Panel)** Early Social Communicative Risks Predicting Diagnostic Thresholds of Autism in Children with Congenital Visual Impairment

*E. Sakkalou, UCL Great Ormond Street Institute of Child Health, London, United Kingdom*

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**Background:**

Children with congenital profound-severe visual impairment (VI) are at high risk of ASD (prevalence rates ~30%, Do et al., 2017). Early differentiation of social communication risk is important for interventionist reasons; however the task is challenged by the impact of VI on general developmental processes (delays and atypical processes) and the lack of reliable validated measures of social communication/ ASD. Existing measures are validated for children with vision and involve visual approaches.

**Objectives:**

To investigate longitudinally whether the new Social Communication Schedule (SCS-VI) at 2 years old (Time 1 – T1) predicts later outcomes, including new diagnostic thresholds, on the modified ADOS-2 for children with VI (Time 2 – T2).

**Methods:**

Fifty four children with congenital disorders of the anterior visual system and severe-profound vision impairment at Time 1 (mean age 25 months, SD 2 months) were video'd and rated whilst engaging in social and independent play tasks and rated for positive abilities on the Social Communication Schedule - SCS (OPTIMUM study). Forty seven were followed through in the DAiSY project, leading to 37 in the verbal fluent stage participating in video'd play based observational assessment using a modified ADOS-2 (T2). Parents also filled in the SRS-2 and CCC-2. Validation was undertaken against independent clinician formulations (DSM-V). The children's vision was measured by logMAR resolution acuities. The SCS and modified ADOS-2 had no items or scoring ratings dependent on functional vision abilities. Assessors were trained in behavioural assessment methods using auditory and touch cues to help the child participate.

**Results:**

Clinician formulation divided the group into those with Non-Spectrum, Autism Spectrum Disorder – ASD (Autism features but not full threshold) and Autism- AUT (Autism features of full threshold) – T2. Ratings on the modified ADOS-2 led to new diagnostic thresholds against clinician formulation (see Dale et al). A logistic regression analysis with Non-Spectrum vs ASD and AUT clinician classification as outcome (T2) and predictor of SCS scores at T1 (controlling for age and logMAR vision level at T2) revealed a significant negative relation ( $p<0.05$ ). The same analysis with the classifications of Non-spectrum and ASD vs Autism using the diagnostic thresholds of the modified ADOS-2 (T2) was also negatively related ( $p<0.05$ ).

**Conclusions:**

Children with severe-profound VI with lower measurable social communicative abilities at 2 years old were significantly more likely to reach a clinician formulation or diagnostic threshold for ASD and AUT on the modified ADOS-2 at 4-7 years. This suggests that it is feasible to differentiate social communicative risk in the early years and provides the case for screening of social communicative risk even though visual impairment impacts adversely on all developmental processes. The evidence also suggests that early risk has longer term continuity even in the context of emerging language abilities to fluent level language in many cases of the children at school entry age, raising a strong case for social communicative/ ASD as an independent neurodevelopmental risk. The results convey further construct validity to the new SCS measure and the modified ADOS-2 diagnostic thresholds.

**PANEL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT**

**Panel 210 - Innovations in the Use of Telehealth for Evaluating and Treating Autism Spectrum Disorder**

**Panel Chair:** Charles Albright, *Nationwide Children's Hospital, Westerville, OH*

**Discussant:** Jeffrey Hine, *Vanderbilt University Medical Center, Nashville, TN*

Create and validating comprehensive telehealth service models to assess and treat Autism Spectrum Disorder (ASD) would aid in overcoming disparities in access to services caused by factors such as poor access to transportation and long distances from major healthcare systems, as well as make healthcare systems more agile in times of crisis, such as the current pandemic. This panel presents work being done to establish multiple ways telehealth could be used for service delivery of initial ASD screening, toddler evaluation, child and adolescent evaluation, and intervention. These presentations establish the utility of telehealth models across these domains, as well as highlight lessons learned while creating and establishing these services. Strengths across these models include the opportunity to highlight and benefit from strong partnerships with parents, as well as the ability to provide flexible and responsive models of care for all families. Limitations highlighted include technology needs and environmental and intrapersonal factors of families and children to consider when assessing fit for telehealth practice. This panel will also discuss the opportunities that telehealth options provide for extending care to families who would otherwise have difficulty accessing specialized Autism services, creating greater healthcare equity.

**210.001** (Panel) Utilising a Mobile Application for the Early Detection of Autism in Infants and Toddlers: Asdetect  
**J. Barbaro, N. Sadka, E. Beattie and C. Dissanayake, Olga Tennison Autism Research Centre, La Trobe University, Melbourne, VIC, Australia**

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Background: Early detection of autism is critical as it provides access to early intervention, improving children's developmental outcomes and quality of life, and decreasing family stress. Over the past 15 years, two large-scale community-based studies for the early detection of autism have been conducted with Maternal and Child Health (MCH) nurses in Australia, using Social Attention and Communication Surveillance; SACS (Barbaro & Dissanayake, 2010; 2013; Mozolic-Staunton et al., 2020). Monitoring over 30,000 children, the SACS is the most accurate and sensitive developmental surveillance tool for autism in community-based samples, with 81-83% positive predictive value (PPV), 99% Negative Predictive Value (NPV), sensitivity of 82-84%, and specificity of 99-99.8%.

To make this research accessible to the world's population, including those in rural/regional/remote communities, low-resourced setting, and low and middle-income countries, a free mobile application was developed for parents based on the SACS tool. ASDetect (asdetect.org) is designed for the very early detection of autism in children aged 11-30 months, with short narrated videos demonstrating key social-communication behaviours, followed by a question; automatic calculation of a child's 'likelihood' for autism (high/low) is then presented.

Objectives: To determine the psychometric properties of ASDetect in sensitively and accurately identifying children with autism.

Methods: Parents of children aged 11-30 months were invited to participate via their MCH nurse, or via social media/word of mouth, with 1809 registrations. Parents registered their child's details on a webpage, downloaded ASDetect, and completed an assessment. Parents were also invited to complete the Social Responsiveness Scale (SRS) when their child was 30 months of age. All children at 'high likelihood' for autism on ASDetect were invited for a free diagnostic assessment by the ASDetect team; furthermore, children at 'low likelihood' for autism on ASDetect, whose parents were nonetheless concerned about their child's behaviour, and/or who met the autism cut-off on the SRS at 30 months, were also invited for an assessment. Children were assessed by blinded clinicians at intake and every 6 months until 24-30 months, with the Autism Diagnostic Observation Schedule-2, Mullen Scales of Early Learning, Autism Diagnostic Interview-Revised, and Vineland-III administered.

Results: Thirty seven percent of the 1,809 parents were from rural/regional areas, with 1,549 (86%) completing an ASDetect assessment for their child at least once. 327 children (21%) were identified at 'high likelihood' for autism, with 48.6% of parents having concerns about their child's development *prior* to completing ASDetect. Based on the follow-up diagnostic assessments, ASDetect has a sensitivity of 81.49%, specificity of 97.3%, PPV of 90.2%, and NPV of 94.5%. To further investigate the correctness of classification, likelihood ratios (weighed by prevalence), and Odds Ratio (OR), were calculated. Positive (LHR+) and negative (LHR-) likelihood ratios were 9.2 and .06, respectively, and OR was 158.92, indicating very high screening accuracy (Fischer et al., 2003).

Conclusions: The findings indicate that ASDetect has excellent psychometric properties for the early identification of autism, thus providing an easily accessible platform for parents to explore their child's social-communication development at home, and initiate the diagnostic process with their healthcare practitioner if required.

**210.002** (Panel) Initial Implementation of the Veda Telehealth Assessment Model of Autism Spectrum Disorder across Childhood

**E. Kryszak<sup>1</sup>, C. Albright<sup>2</sup>, K. G. Stephenson<sup>3</sup>, S. Harris<sup>4</sup>, M. Norris<sup>5</sup>, C. Burns<sup>6</sup>, A. Kalomiris<sup>7</sup>, A. Newmeyer<sup>8</sup>, T. Hollingsworth<sup>9</sup>, J. A. Mulick<sup>10</sup> and E. Butter<sup>11</sup>,** (1)Nationwide Children's Hospital, Westerville, OH, (2)Nationwide Children's Hospital, Westerville, OH, (3)Brigham Young University, Provo, UT, (4)Department of Pediatrics Division of Psychology, Michigan Medicine, Ann Arbor, MI, (5)Child Development Center, Nationwide Children's Hospital, Westerville, OH, (6)UNC Chapel Hill, Chapel Hill, NC, (7)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (8)Nationwide Children's Hospital/Ohio State University, Columbus, OH, (9)Nationwide Children's Hospital, Columbus, OH, (10)Ohio State University, Columbus, OH, (11)Nationwide Children's Hospital, Columbus, OH

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Background: Innovative assessment models for Autism Spectrum Disorder (ASD) that include multiple assessment pathways, including telehealth, have the potential to provide comprehensive, individualized services for a greater number of families (Zwaigenbaum & Warren, 2020). Telehealth services would aid in overcoming barriers related to transportation difficulties and distance and allow service providers to adapt more effectively during times of crisis such as the current pandemic. While models of telehealth assessment for toddlers have been developed (Wagner, et al., 2020), there is a need to develop a comprehensive model to assess children across the age span.

## Objectives:

- Present a novel, comprehensive, interdisciplinary telehealth assessment model for children across age groups.
- Present preliminary data showing the *Adapted Virtual Autism Behavior Observation (AVABO)* protocol created for this model increased clinician confidence in diagnosis and is acceptable to clinicians.

Methods: A pilot feasibility study was completed assessing initial implementation of a telehealth model of interdisciplinary ASD assessments at a large children's hospital to continue care during COVID-19 restrictions. The best practice model already in use was altered to include a gold standard interview measure (*Autism Diagnostic Interview-Revised; ADI-R*), and an observation protocol (AVABO) was created that allows clinicians to partner with parents to engage a child in activities highlighting social communication skills and to monitor unusual behaviors. The sample of completed telehealth assessments from March–August 2020, was compared to the sample of assessments completed in-clinic from March–August 2019. Age range in both samples was about 18 months to 18 years. Each evaluation consisted of up to three appointments. After each telehealth appointment, clinicians rated diagnostic confidence. Contributors to clinician confidence were assessed using linear mixed-effects models. Fixed-effect predictors included evaluation timepoint, data sources available (ADI-R, AVABO), diagnostic decision (ASD/no ASD), child age, and presence of technical difficulties. Patient and clinician were included as random factors. Acceptability, appropriateness, and feasibility of the AVABO was also assessed.

Results: No significant differences were found between telehealth and in-clinic samples based on biological sex and proportion ASD diagnoses given or ruled out (Table 1). The average age for the telehealth group was slightly younger than the in-clinic group. Older age was significantly associated with diagnosis deferral in the telehealth sample (OR=1.11,  $p=.01$ ). Biological sex was not a significant predictor. Clinician diagnostic confidence was generally high ( $M=77\%$ ,  $SD=24.6\%$ ). On average, the AVABO increased clinician diagnostic confidence by 12.29% ( $p<.001$ ). Clinicians were 15.55% ( $p<.001$ ) more confident when they believed a child had ASD vs. not and significantly less confident with older vs. younger children ( $p<.001$ ). Technical difficulties were relatively rare (11.78% of visits) and did not significantly affect clinician confidence. Clinicians viewed the AVABO as acceptable, appropriate, and feasible (Table 2).

Conclusions: The VEDA model allowed assessment services to continue near typical rates despite pandemic restrictions, with approximately 10% of children needing further assessment when restrictions were lifted. Initial analyses indicated the AVABO is a promising telehealth tool. Lessons learned during implementation and limitations of the model and observational measure will be discussed, along with plans for further validation.

### 210.003 (Panel) Feasibility of Community-Based Autism Telehealth Parent Coaching during COVID-19

C. Nadler<sup>1,2</sup>, D. Olsen<sup>1,2</sup>, M. Campbell<sup>1,2</sup>, T. Perez Crawford<sup>1,2</sup>, L. Hansen<sup>1</sup>, C. Pittard<sup>1</sup>, A. Gibson<sup>1</sup>, M. Gibson<sup>1</sup> and M. Dreyer Gillette<sup>1,2</sup>, (1)Children's Mercy Kansas City, Kansas City, MO, (2)University of Missouri Kansas City School of Medicine, Kansas City, MO

Background: Traditional autism assessment and intervention models have faced significant disruption in the wake of COVID-19. In many service areas these disruptions have been additive, with delayed access to diagnosis further delaying eligibility for and access to treatment. RUBI (Research Units in Behavioral Intervention; Bearss et al., 2015) is an evidence-based parent coaching model for disruptive behavior in young children with autism that has been piloted previously via telehealth (Bearss et al., 2018) and in clinic-based groups (Edwards et al., 2019; Burrell et al., 2020), but no large-scale community-based data exist demonstrating the feasibility of delivering these adaptations. Moreover, combination of RUBI group and telehealth modalities has not been previously attempted.

Objectives: To evaluate the feasibility of a rapid community roll-out of telehealth RUBI in the context of COVID-19, utilizing both individual and group formats for parents of children ages 2-10 diagnosed with (or suspected of having) autism and/or other developmental disabilities.

Methods: Upon local onset of restrictions, all hospital-based autism clinic assessment and outpatient therapy services were suspended. While telehealth diagnostic approaches emerged over the following months, individual RUBI telehealth service (audio/visual, as well as phone only) was immediately initiated for existing patients and offered to all eligible patients in diagnostic limbo with apparent developmental delays and disruptive behavior. After six weeks, group telehealth RUBI was initiated for the first time to accommodate escalating demand.

Results: In the six months prior to COVID-19 disruptions, staff delivered an average of 36 RUBI sessions per month; in the seven months following the transition to telehealth-only service, the average increased to almost 90 RUBI sessions per month (see

Figure 1). This dramatic increase in access occurred without any increase in staffing. Telehealth delivery increased scheduling flexibility for both parents and providers, and bypassed capacity limits imposed by the number and size of clinic rooms available. Group telehealth sessions (serving 3-5 families in 90 minutes, vs. 1 family in 60 minutes) further increased access to treatment. Phone-only sessions (7.6% of all individual telehealth) supported the access of families lacking high-speed internet connections due to geography or socioeconomic barriers. Participation in the program was stable, with no significant difference in the average number of sessions attended for families who began RUBI before vs. after COVID-19 and the transition to telehealth (9.4 vs. 8.4 sessions;  $t(39) = 0.656, p > .05$ ).

Conclusions: Telehealth roll-out led to an immediate and unexpected increase in service capacity, even prior to initiation of group telehealth options. Phone-only options preserved access for families with limited internet access, and attendance remained robust despite the change to telehealth in the context of pandemic stressors. Delivery of behavior management prior to diagnostic confirmation prevented COVID-related disruptions in assessment from delaying access to early intervention and support. While rigorous evaluation of treatment outcomes is still needed, these data support the feasibility of leveraging individual and group telehealth RUBI approaches to significantly increase clinical capacity in community settings where restrictions to in-person care and workforce shortages might otherwise impede access to evidence-based intervention.

**210.004 (Panel) Caregiver-Mediated Evaluations Via Telemedicine: A Response to COVID-19 for Young Children at Risk for Autism**

**L. Wagner<sup>1</sup>, J. F. Hine<sup>1</sup>, L. Corona<sup>2</sup>, A. S. Weitlauf<sup>3</sup>, K. L. Marsh<sup>4</sup>, A. F. Berman<sup>5</sup>, A. Nicholson<sup>6</sup>, C. Stone<sup>1</sup>, N. A. Broderick<sup>1</sup>, S. Francis<sup>6</sup> and Z. Warren<sup>1</sup>,** (1)Vanderbilt University Medical Center, Nashville, TN, (2)Vanderbilt University Medical Center - Treatment and Research Institute for Autism Spectrum Disorder, Nashville, TN, (3)Vanderbilt Kennedy Center, Vanderbilt University Medical Center, Nashville, TN, (4)Unumb Center of Neurodevelopment, Columbia, SC, (5)Vanderbilt University, Pleasant View, TN, (6)Vanderbilt University Medical Center - Treatment and Research Institute for Autism Spectrum Disorder, Nashville, NY

Background: The COVID-19 pandemic has exacerbated the delays families face in accessing ASD-related services. Telemedicine-based assessment has emerged as one opportunity for service continuation. Following suspension of in-person appointments, our group deployed a novel tool (TELE-ASD-PEDS; TAP), designed for the remote observation of ASD in young children (14-36 months). Given the pressing nature of the pandemic, and the absence of a universally-accepted and validated tool for tele-assessment of ASD, we launched a series of web-based trainings on our model. Our team has continued to collect and analyze clinical data, as well as data from external sites, to better understand how the TAP functions as a clinical tool. We also gathered input from providers and caregivers on their perceptions of tele-assessment and the TAP.

Objectives: We will provide data on our model of tele-assessment including number of children seen, diagnoses given, and factors contributing to diagnostic certainty for both the primary site and seven external sites. Additionally, we will present data on provider perceptions of tele-assessment, as well as preliminary data on caregiver perceptions of in-home, caregiver-mediated tele-assessment.

Methods: Over 2,100 providers across 39 states and seven countries attended web-based trainings on the TAP. Researchers analyzed data from 204 telemedicine evaluations completed through the primary site and 133 evaluations completed through seven collaborating sites. Providers (n=201) completed a survey on their use and perceptions of tele-assessment and the TAP approximately three months after the initial training. Additionally, a sample of caregivers (n=44) who participated in tele-assessment through the primary site completed a survey assessing their perceptions of the model.

Results: At the primary site, TAP scores predicted ASD status (Table 1), with ASD diagnosis representing a majority of the sample. Further, provider confidence scores were highest when issuing an ASD diagnosis, indicating preliminary support for use of this tool to confirm the presence of ASD via tele-assessment. Although the pattern of TAP scores across the external sites was similar across diagnostic groups, external providers reported the highest levels of diagnostic certainty when an ASD diagnosis was ruled out (Table 2). This group of children comprised a majority of the sample (51%), which has important implications for the functioning of the tool in a more heterogeneous group of children. Providers across all sites reported high levels of comfort completing tele-assessments, making diagnoses following tele-assessment, and providing feedback and recommendations. Further, the majority of caregivers reported that they understood the assessment process, found instructions easy to follow, found interaction with their child comfortable, and would recommend the procedure to other families.

Conclusions: By quickly converting diagnostic evaluations to a telehealth platform, providers across the country were able to continue to meet families' needs for timely access to ASD-related services, while considering family preference and adhering to social distancing guidelines. This rapid crisis response provides initial support and guidance for a re-conceptualization of ASD assessment, utilizing a novel tele-assessment tool that is both flexible and family-centered, that will undoubtedly continue to be

needed beyond the pandemic.

**POSTER SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT**

**Poster 414 - Diagnostic, Behavioral, Sensory and Intellectual Screening and Assessment Posters**

**414.001** (Poster) A Preliminary Investigation of Function of Fear in Those with ASD

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Background: Children with Autism Spectrum Disorder (ASD) have been found to commonly experience fear (van Steensel et al., 2012) and this fear is experienced in different capacities as they get older. Determining what is causing or maintaining that fear (the function) is imperative to understanding how to approach treatment. While this can be done with unstructured, open interviews, more systematic, efficient, and structured methods would be helpful. Additionally, more research is needed to explore fears and phobias in children with ASD.

Objectives: This study investigated the functions of fear in youth with ASD. Descriptives related to the functions of fear as well as the types of fear experienced were explored.

Methods: Twenty-two youths with ASD (16 males;  $M=10.14$  years-old,  $SD=2.62$ ) were included as part of a larger IRB-approved study. Consent/assent was obtained. Diagnoses were confirmed by the *Childhood Autism Rating Scale, Second Edition (CARS-2)* or the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)*. Full-Scale IQ, as measured by the *WISC*, for the sample (exclusion of 2 participants) ranged from 76 to 123 ( $M=93$ ,  $SD=11.83$ ). The *Motivation for Fear Questionnaire (MOTIF)*; adapted from the *QABF* was completed by each youth's caregiver in order to determine the function of fears/anxieties they may be experiencing. A preliminary factor analysis led to four factors being measured (positive reinforcement via receiving comfort or attention, negative reinforcement, control, and overall fear). The *Fear Survey Schedule for Children – Revised (FSSC-R)* was completed by each youth in order to capture the individual's total amount of fear as well as specific fear domains (fear of failure and criticism, fear of the unknown, fear of injury and small animals, fear of danger and death, medical fears).

Results: Preliminary descriptives were examined. Caregivers of youth with ASD reported a higher average total score on the positive reinforcement/comfort and attention factor ( $M=15.27$ ,  $SD=2.88$ ) compared to the other three factors. Spearman's Rho was calculated to examine associations between Age, IQ, and the *MOTIF* subscales. The *MOTIF* Control subscale was negatively associated with IQ ( $r_s=-.53$ ,  $p=.01$ ). Pearson's correlation coefficients between the *MOTIF* subscales and *FSSC-R* total score and *FSSC-R* subscales were conducted. Total Fears of the *FFSC-R* was significantly correlated with the *MOTIF* Control subscale ( $r=.49$ ,  $p=.02$ ) and the *MOTIF* Fear subscale and demonstrated a significant correlation with the *FFSC-R* Fear of Failure subscale ( $r=-.88$ ,  $p<.001$ ).

Conclusions: IQ was found to be related to the function of control as well as control being positively correlated with higher amounts of fears. This is not surprising giving that rigidity is a common symptom of ASD. Determining the function of fear in children with ASD may help elucidate the extent providers can guide families in helping their children overcome these fears. Recruitment is ongoing to allow for additional comparisons and further exploration of group differences.

**414.002** (Poster) A Qualitative Study on the Diagnostic Experience of Autistic Females in Hong Kong

**K. C. C. Chow and G. Y. H. Lam,** Department of Educational Psychology, The Chinese University of Hong Kong, Hong Kong, Hong Kong

Background:

Research on gender differences has suggested that the behavioural differences and diagnostic bias may have exaggerated the existent gender discrepancy in the incidence of Autism Spectrum Disorder (ASD) and a lack of services for autistic females. To date, however, there has been little research focusing on the experiences and needs of autistic females in Eastern countries. For example, the male-to-female ratio of autistic individuals in Hong Kong is around 7 to 1, which is higher than the ratio commonly reported in Western countries. It implies autistic females in Hong Kong might be further underdiagnosed when comparing to Western countries.

## Objectives:

This study aims to investigate the diagnostic experience of autistic females in Hong Kong. This study employs qualitative interviews to explore their perceptions of the existing autism assessment tools, diagnostic criteria, and their experiences with diagnostic services.

## Methods:

Participant recruitment and data collection are currently in progress. Data collection occurs via semi-structured interviews with ten clinically diagnosed or self-diagnosed autistic females of age 18 or above. The interview starts by filling out the Autism Spectrum Quotient (AQ). Although the scores from AQ are not being interpreted, the items and the survey experience are used to start the discussions on their views on the existing diagnostic tools. An interview guide with open-ended questions is used (e.g., “how did you find out about your autism condition?”, “How do you think the diagnostic criteria reflect your autistic characteristics?”). Thematic analysis is used to identify themes discussed by participants. Member checking is employed via brief phone calls to ask participants to review the findings to ensure the essence of their experiences is accurately captured.

## Results:

The following themes are tentative findings based on our pilot work and preliminary analysis.

First, autistic females experience delay/lack of diagnosis as clinicians are not sensitive enough with the unique features of autistic females. Autistic females display fewer outward social impairments but they have difficulties in maintaining long-term friendships and to cope with social conflicts.

Second, autistic females describe having more co-occurring internalising concerns than their male counterparts that mask their underlying autistic characteristics. Hong Kong women are expected to be shy and gentle, although these positively viewed traits might prevent clinicians from identifying their autistic characteristics and related stressors.

Third, autistic females learn to camouflage their autistic features. For example, they mimic others' facial expressions and learn social behaviours from television shows. However, they tend to describe this camouflaging experience as “normal”, as the majority of people in a Chinese society tend to hide their true self and feelings in favour of the social norm.

## Conclusions:

The experiences of autistic females in Hong Kong will help researchers and clinicians better understand the different support needs for autistic females in Hong Kong. Findings will be valuable to suggest ideas to improve the diagnostic tools that could be tailored to females in Chinese culture.

### **414.003** (Poster) Adaptive Behavior in Racial/Ethnically Diverse Children with Autism Spectrum Disorder

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**Background:** There is a growing need to understand Autism Spectrum Disorders (ASD) across underrepresented racial/ethnic and linguistically diverse populations. This is important due to the significant health and educational disparities that affect these communities (Jo et al., 2015; Magaña et al., 2013). The assessment of cognitive or IQ profiles of children with ASD is highly variable, with scores often dependent on instrument demands or children's language abilities (Charman et al., 2004; Joseph et al., 2002). Thus, assessing adaptive behavior may be more informative for evaluating long-term outcomes of children with ASD, particularly from racial/ethnic diverse communities.

**Objectives:** This study aimed to examine adaptive behavior in a racial/ethnically diverse sample of children with ASD and explore factors associated with greater adaptive behavior.

**Methods:** This study is part of a larger medical record review study of a developmental disabilities clinic in the United States. Records of children with ASD between 3 and 12 years of age who visited the clinic between 2004 and 2014 were reviewed. Data were extracted from intake forms, completed assessments, rating forms, and other records. Children with data from the Vineland Adaptive Behavior Scales (VABS) were included in this study ( $n = 150$ ). Additional data were collected on demographic characteristics (nativity, language, co-occurring conditions, maternal nativity and education, insurance status).

**Results:** The sample included Latino (50%,  $n = 75$ ), White, (20%,  $n = 30$ ), and African American (30%,  $n = 45$ ) children with ASD. Separate hierarchical linear regression analyses were conducted on the VABS Adaptive Behavior Composite (VABS-ABC) and the individual domains (Communication, Daily Living Skills, Socialization, Motor). A co-occurring intellectual disability was entered in Step 1, with additional factors entered in Step 2 (i.e., race/ethnicity, sex, age of ASD diagnosis, verbal status, speech-language impairment diagnosis, ADHD diagnosis, other diagnoses, maternal nativity, maternal education, insurance status, home language environment). These analyses found that a co-occurring intellectual disability was a significant predictor for all domains of adaptive behavior. Verbal status was a significant predictor for all except the Motor domain. Child sex was a significant predictor only for the Socialization domain ( $p < .05$ ). Child race/ethnicity was a significant predictor for the Communication, Daily Living Skills, and Socialization domains. These results suggest that having an intellectual disability, being primarily nonverbal, being male, and being of Latino or African American background were associated with lower adaptive behavior. Additional analyses will explore unique profiles of adaptive behavior across racial/ethnic groups.

**Conclusions:** This study focused on evaluating factors associated with adaptive behavior among children with ASD from racial/ethnic minority backgrounds. Significant factors that emerged were child sex, race/ethnicity, verbal status, and intellectual disability on predicting adaptive behavior, with distinct relations across domains. Adaptive behavior is critical to assess in children with ASD as it has been linked to outcomes in adulthood (Farley et al., 2009). Further studies may address how interventions can support racial/ethnic minority children with ASD on adaptive behavior. We recommend providing more services to children with ASD from racial/ethnic communities by utilizing evidence-based intervention to improve adaptive behavior.

**414.004 (Poster) Agreement and Discrepancies in Parent, Teacher and Observational Reports of Emotional and Behavioural Problems in Young Autistic Children**

**M. Palmer<sup>1</sup>, J. Tarver<sup>2</sup>, V. Carter Leno<sup>1</sup>, J. Paris Perez<sup>1</sup>, M. Frayne<sup>1</sup>, V. Slonims<sup>3</sup>, A. Pickles<sup>1</sup>, S. Scott<sup>1</sup>, E. Simonoff<sup>4</sup> and T. Charman<sup>1</sup>,** (1)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, (2)Aston University, Birmingham, United Kingdom, (3)Guy's & St Thomas' NHS Foundation Trust (Evelina Children's Hospital), London, United Kingdom, (4)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom

**Background:** Emotional and behavioural problems (EBPs) frequently co-occur in young autistic children. The use of multiple informants, such as parents and teachers, and also naturalistic observations of EBPs is necessary for a comprehensive understanding of the individual across contexts. Similar to children who are typically developing or have other psychopathology, discrepancies in reports of EBPs are common in autistic children and can lead to uncertainty in formulation, diagnosis and care planning. There are a range of factors, not related to measurement error, that may influence observation and reporting of child EBPs and lead to differences between informants. Some factors, such as situational specificity (De Los Reyes et al., 2013), and certain informant characteristics may influence reports in ways similar to non-autistic children. Whereas other factors may have differing explanations and be autism-specific (e.g. verbal ability, autism severity). Parenting stress may be a particularly important factor as parents of autistic children report elevated levels of stress when compared to parents of children with other developmental disabilities. High levels of parenting stress could confound reports of EBPs.

**Objectives:** To examine the parent, teacher and researcher observed child EBPs and explore factors associated with reports of EBPs and discrepancies between informants.

**Methods:** The sample were 83 4–8-year-old autistic children (47% minimally verbal; 53% verbal) and their parents/carers and teachers who participated in the Autism Spectrum Treatment and Resilience (ASTAR) pilot randomised controlled trial. ASTAR was designed to be as inclusive as possible, so no exclusion for child EBPs was used; nor for verbal ability or IQ. Parents and teachers completed the irritability and hyperactivity subscales of the Aberrant Behaviour Checklist (ABC-Irritability; ABC-Hyperactivity) and internalising and externalising subscales of a new measure of mental ill health in autism (The Assessment of Concerning Behaviour; ACB-Internalising; ACB-Externalising). Self-reported measures of parenting stress and wellbeing were obtained, and a parent-child/researcher-child interaction observation was completed from which a researcher coded rate of child behaviours that challenge (BTC) was derived. *T*-tests and cross-informant intraclass correlation coefficients (*ICCs*) examined differences and agreement between informants. Multivariate and univariate regression models explored factors (e.g. child verbal ability, parenting stress) associated with EBPs and discrepancies between reports.

**Results:** Parents reported significantly more child EBPs than teachers (e.g. ABC-Irritability 16.4 vs. 9.2,  $p < .001$ ; ACB-Internalising 21.5 vs. 14.7,  $p < .001$ ). *ICCs* and correlations between parents and teachers on these measures were low (*ICCs*=0.04-0.30); internalising behaviour had the lowest agreement. After controlling for other child and informant characteristics, greater self-reported parenting stress was a consistent predictor of more parent-reported, but not teacher-reported nor researcher-rated EBPs. More verbal language was associated with higher parent-reported EBPs on some measures and being minimally verbal predicted more researcher-rated child BTC.

**Conclusions:** The discrepancies between informants highlight the need for assessments of child EBP to take a cross-setting, multi-informant approach. High levels of parenting stress could be associated with more EBPs in the home environment, or alternatively parenting stress may confound parental reports. Further research is needed to better understand the relationship between parental stress and increased EBPs in the home.

**414.005 (Poster)** An Evaluation of Tele-Assessments: Perspectives of Adult Clients, Carers, and Clinicians

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**Background:** The COVID-19 pandemic has seen a rapid increase in the use of telehealth to deliver services to autistic individuals and their families. In response to restrictions on in-person services, Autism Spectrum Australia (Aspect) developed a new telehealth model to deliver diagnostic assessments for autism (tele-assessments). Research into the provision of tele-assessments is limited and no study to date has explored the clinician perspectives of delivering telehealth assessments.

**Objectives:** The aim of this study is to capture the perspectives on this tele-assessment service from participants and clinicians.

**Methods:** Sixteen adult clients ( $M_{\text{age}} = 39.00$ ,  $SD_{\text{age}} = 14.39$ ) and fifty-six carers and parents ( $M_{\text{age}} = 44.09$ ,  $SD_{\text{age}} = 9.87$ ) completed an online survey about their attitudes and experiences of tele-assessments. A subgroup of six clients and twelve carers and parents were also interviewed. Seven Aspect clinicians were interviewed.

**Results:** Overall, the responses of adult clients, parents and carers to tele-assessments were positive. Almost all participants would consider a tele-assessment option in the future and would recommend tele-assessments to others. Satisfaction levels of participants did not correlate with client age. Although the clinicians were slightly less satisfied with tele-assessment process compared to face-to-face and relied on external sources of information more than they would during a face-to-face assessment, their overall confidence in their diagnostic decision making remained high for tele-assessments.

**Conclusions:** Based on the findings from this research, a number of considerations should be made when conducting autism assessments via telehealth, including screening suitability of clients and adequately preparing clients for tele-assessments.

**414.006 (Poster)** Assessment Profiles of Toddlers Referred for ASD Concerns Based on Foster Care Status

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**Background:** Research indicates that the overall risk of experiencing foster care in childhood is roughly 6% (Wildeman & Emmanuel, 2014), and approximately 104,000 children under the age of 3 are in foster care on any given day in the United States (U.S. Department of Health and Human Services, 2017). Young children in foster care placement are known to have an increased risk for autism spectrum disorder (ASD) and developmental disabilities (Cidav, Xie, & Mandell, 2018; Kistin et al., 2016). Although it is difficult to disentangle the specific consequences of early adversity (e.g., maltreatment, unstable caregiving conditions) on developmental and behavioral functioning, research suggests that children in foster care experience an increased risk for delayed language development, social delays, and behavioral problems (Leve et al., 2012; Stock & Fisher, 2006). Given that differentiating between the presence of ASD from general developmental delays that are often present in children in foster care can be difficult, research in this area is warranted.

**Objectives:** The purpose of the current study is to consider differences in assessment profiles of toddlers referred for ASD based on foster care status and final diagnosis.

**Methods:** Retrospective chart reviews were conducted for toddlers referred for ASD evaluations who received the Autism Diagnostic Observation Schedule, 2<sup>nd</sup> Edition (ADOS-2) Toddler Module from 2/2015 to 5/2019 at a large autism center. Child-level demographic, developmental assessment results, and diagnostic information was gathered. Children in the foster care group were either in a foster care placement with a relative, foster family, or group home at the time of evaluation or had previously been in a foster care placement.

**Results:** See Table 1 for demographic information. A chi-square test of independence, which examined the relation between ASD diagnosis and foster care placement, was significant,  $\chi^2(1, N = 302) = 16.48$ ,  $p < 0.01$ . Results indicate that children in foster care ( $M = 12.11$ ,  $SD = 7.87$ ) had significantly lower Total ADOS-2 scores than children who were not in foster care ( $M = 22.45$ ,  $SD = 6.08$ ),  $t(299) = -6.69$ ,  $p < 0.01$ . In addition, when considering *Little to No Concern* and *Moderate to Severe Concern*

ADOS-2 severity levels, the overall sensitivity of the ADOS-2 for children in foster care placement and those with no foster care involvement, respectively, was 100% and 83%. The respective specificities were 88% and 97%.

**Conclusions:** Toddlers in foster care referred for ASD evaluations are less likely to receive an ASD diagnosis than toddlers who are not in foster care. However, children in foster care who do not receive ASD diagnoses demonstrate similar developmental profiles as children who are not in foster care and receive ASD diagnoses (Stock & Fisher, 2006). Results indicate that the ADOS-2 reliably identifies toddlers in foster care with and without ASD. Findings also highlight the continued need for research on factors that may differentiate between common developmental deficits from ASD-specific deficits in children in foster care.

**414.007 (Poster)** Associations between Objectively Measured Social Movements during the ADOS-2 and Autism Symptoms in Preschool Age Children with Suspected ASD

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Background:

Autism spectrum disorder (ASD) is characterized by deficits in social communication along with restricted/repetitive patterns of behaviors. Current best practice for measuring ASD symptom severity involves expert clinician observation during the Autism Diagnostic Observation Schedule-2 (ADOS-2). Objective behavioral measurement has the potential to improve our understanding of ASD symptom presentations and the utility of assessment data (Dawson & Sapiro, 2018). Initial studies indicate that objective measurements of both language use (Oller, et al., 2010) and movement (Cohen et al., 2014) suggest meaningful behavioral differences between young children with ASD and their peers.

Objectives: To investigate associations between objectively measured movement, language use, and examiner-rated ADOS-2 calibrated severity scores (CSS) during the ADOS administration.

Methods:

Thirty-five children (24 boys,  $M_{age}=41.49$  mo,  $SD=10.76$ ) with suspected ASD (32 diagnosed with ASD) were administered the ADOS-2 during a clinical diagnostic evaluation. Twenty-two children identified as White, 12 as Black, 1 as mixed race, and 24 as Hispanic/Latino. A research-reliable, hypothesis-blind examiner provided total Calibrated Severity Scores (CSS) and CSS for Social Affect (SA CSS) and restricted/repetitive behavior (RRB CSS). The assessments were recorded using a ceiling-mounted camera to track movement. Audio was recorded via examiner-worn eyeglasses and processed with the Language ENvironment Analysis (LENA) software, LENA SP Hub Version 3.3.0 (Perry et al., 2018). Videos from the ceiling-mounted camera were processed by a Mask Regional Convolutional Neural Network (R-CNN) to detect the locations of child, parent, and examiner (He et al., 2017). Objective measures included total counts of adult-child conversational turn-count and adult word count, the mean distance between the child and each adult (parent and examiner), the number of seconds the child spent within 1 meter of each adult, and the mean child velocity in moving both toward and away from each adult. The child's age at the observation was positively associated with both adult word count,  $r = .47, p < .01$ , and adult-child turn-count,  $r = .39, p < .05$ —but was not associated with any other variables.

Results:

Adult-child turn-count was negatively associated with the average velocity of the child's movements toward the parent,  $r = -.40, p < .05$ , and the examiner,  $r = -.36, p < .05$ , as well as with the average distance between the child and examiner,  $r = -.37, p < .05$ . Adult word count positively related to the number of seconds the child spent within 1 meter of the examiner,  $r = .36, p < .05$ . Finally, ADOS-2 RRB CSS was positively associated with the child's average velocity when moving toward their parent,  $r = .34, p < .05$ .

Conclusions:

Automated analysis of children's movement and language use shed new light on a gold standard procedure. Less language was produced with (turn-counts) and around (adult word count) children who move more quickly during the ADOS, and children who

moved more quickly toward their parents had greater RRB symptoms. The current study suggests that automated measurement of child movement during the ADOS-2 is associated with how adults (likely the examiner) engage vocally with children.

**414.008** (Poster) Autism Assessment in Low- and Middle-Income Countries: Feasibility and Usability of Western Tools  
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Background: Autism is a global health concern, but distribution of research is inequitable and occurs primarily in high-income countries (Elsabbagh et al., 2012). Current estimates place global prevalence at 1-2% (CDC, 2017; WHO, 2017); however, this is likely an underestimate of true rates as little is known about prevalence in low- and middle-income countries (LMIC). The lack of prevalence data in LMIC is problematic as it results in an incomplete and potentially biased understanding of ASD which may miss important cultural, social, or biological variability within ASD (Hilton et al., 2010). Additionally, prevalence data are crucial for being able to identify and plan for educational, social, and medical service needs (Myers et al., 2019). One possible explanation for the scarcity of prevalence data in LMIC is lack of access to validated screening and diagnostic tools that are feasible to implement in resource poor settings (Durkin et al., 2015). Many “gold standard” diagnostic tools are costly, time-consuming, require extensive training in order to use, and require an extensive list of materials in order to complete the assessment.

Objectives: This study examined (1) logistics (i.e., cost, number of items, training required for use, restrictions on purchasing, and materials needed), (2) readability, and (3) presence of items focusing on expressive and receptive language abilities that may inhibit the feasibility and usability of five common ASD assessment tools for determining prevalence rates in LMIC.

Methods: Assessments were analyzed for (1) readability (i.e., calculated using the Flesch Reading Ease, Flesch-Kincaid Grade Level, and Coh-Metrix L2 Reading Index), (2) logistics of assessments (i.e., initial and continued cost, training required, restrictions on purchasing, materials required), and (3) presence of items assessing functional and nonfunctional expressive and receptive language.

Results: Results of the study indicated that the majority of validated ASD assessment tools present a multitude of barriers for use in LMIC. Although most could be implemented without the need for additional materials, the start-up and continued costs for use make them not feasible for use in LMIC. Additionally, although most items could be responded to without consideration of the child’s receptive and expressive language abilities, many of the assessments fall well above basic literacy levels and had high Coh-Metrix scores indicating they would be difficult for non-native English speakers to read and comprehend.

Conclusions: Majority of screeners reviewed are not feasible for LMIC use due to cost, readability levels, and comprehension difficulties for multilingual individuals. The lack of available validated screeners that are feasible for use in LMIC represents a significant concern within the field of autism research because it prevents the collection of prevalence data and empirical research in LMIC. As a result, our understanding of ASD remains incomplete and potentially biased, and there may be important cultural, social, or biological variability that is being missed. It is critical that future researchers target the development of feasible and culturally appropriate screening and diagnostic tools for use in LMIC.

**414.009** (Poster) Autism Related and Traditional Presentations of Anxiety in Autistic Children  
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Background:

Anxiety is more prevalent in autistic children; however, reported prevalence varies greatly. One explanation is that the measures used with autistic children are not developed and validated with autistic children. Research indicates that anxiety experienced by autistic children may be ‘traditional’ anxiety which fits the DSM criteria and ‘autism related’ anxiety which is related to autistic traits. The Anxiety Disorders Interview Schedule has been revised to include an autism addendum (Autism Spectrum

Developmental Disorders [ADIS-ASDD]), to capture autism related presentations of anxiety, to aid differential diagnosis of anxiety in autistic children.

Objectives:

Using the ADIS-ASDD we aimed to:

1. Identify traditional and autism related presentations of anxiety in a treatment seeking sample of autistic children
2. Explore and describe the nature of these anxiety sub-types.
3. Finally, we aimed to explore the relationships between the anxiety sub-types and other anxiety and autistic characteristics, assessed by additional measures.

Methods:

Baseline data from 49 families from a randomised controlled trial of parent group-based intervention aimed at increasing tolerance to uncertainty in autistic children were analysed. The children were aged 6 – 16 years, had a diagnosis of autism, and were experiencing anxiety related to difficulties tolerating uncertain situations in their daily lives. Parents completed the ADIS-ASDD interview about their child's anxiety. Data from the ADIS-ASDD was coded using a coding scheme developed for the purposes of this study. The coding scheme captures data from most items in the interview, allowing a rich picture of the child's presentation as opposed to a summary of diagnoses. Inter-rater reliability between the two coders was strong ( $k=0.972$ ).

Results:

Preliminary findings show the most common 'traditional' anxiety disorders identified in our sample were: Specific Phobia (overwhelming fear of objects or situations; e.g., dogs), Generalised Anxiety Disorder (anxiety/worry about a wide range of situations) and Social Phobia (fear of social situations). Autism specific diagnoses were also present: 51% met criteria for fear of change (anticipatory worry about change to routine or environment), 35% for idiosyncratic phobia (unusual or uncommon phobias e.g. apples), 16% had special interest fear (excessive worry about access to special interest) and 16% had other social fear (an unusual presentation of social anxiety which can include lack of social motivation and/or awareness).

Conclusions:

All children in the study met the clinical criteria for at least one DSM 5 anxiety diagnosis and 94% met criteria for more than two anxiety or autism specific diagnoses. Our data highlights the complexity of anxiety in autistic children and the relationship between anxiety and characteristics of autism. This demonstrates the benefit of using the ADIS-ASDD as a more accurate measure of anxiety in this population. Therefore, interventions to tackle anxiety in autistic children should consider the interplay between anxiety and autism-related characteristics.

**414.010** (Poster) Autism Spectrum Disorder Evaluation in Children with a History of Foster Care or Trauma Exposure  
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Background: Children in foster care are at an increased risk for developmental delays (DD) and behavioral/mental health conditions (Simms, Dubowitz, & Szilagyi, 2000), and children entering care are almost twice as likely to have an existing diagnosis of ASD (Bilaver & Havlicek, 2013). Children with ASD/DD, are at increased risk for experiencing maltreatment (Dinkler et al., 2017), and therefore encounter the foster care system. However, trauma exposure and ASD have many overlapping symptoms, such as social impairment, emotional dysregulation, reduced eye contact, flat affect, behavioral rigidity, and sound sensitivity. Understanding the differences between trauma symptoms and ASD could potentially improve ASD diagnostic services as well as inform screening and referral processes.

Objectives: This study examined the prevalence of foster care or trauma exposure in a sample referred for evaluation for ASD/DD. Furthermore, this study sought to establish the rate of *diagnosis* in children with and without a history of foster care or trauma exposure.

Methods: A retrospective chart review was completed of 1,717 children and adolescents who were referred for interdisciplinary ASD evaluation at an academic medical center (mean age=6.38). Children in the study completed evaluation in a specialty ASD/DD clinic, including assessment tools such as the CARS-2 and ADOS-2. Foster care status was determined by reviewing intake forms, and children who were either in kinship care, foster care, or other "guardianship" settings were included in the

sample. Trauma exposure was determined by caregiver completion of the same intake form, where they could indicate exposure to physical or sexual abuse. The sample was primarily White (66.42%; 33.57% racial/ethnic minority) and male (74.27%, 25.15% female).

Results: Among all individuals referred for evaluation 2.5% were in foster care, compared to 0.6% of children nationally and 1.1% in the state of Kansas (Kids Count, 2018). Preliminary results indicated that those referred in foster care were also 11.9% less likely to receive a new ASD diagnosis  $\chi^2(1, N = 1230) = 6.055, p = .014$ . Those with a history of trauma exposure were 33.8% less likely to receive a diagnosis than those with no history of reported abuse,  $\chi^2(1, N = 1230) = 30.855, p = .000$ . Results of ADOS-2 comparison scores indicate that children with a history of trauma exposure or foster care also had lower observed symptoms of possible ASD,  $t(57) = 5.529, p = .000, t(892) = 3.501, p = .000$ , respectively.

Conclusions: Although children with ASD/DD are at higher risk of experiencing trauma, results from the current study indicate that children with a history of foster care/trauma may be *less* likely to have a diagnosis of ASD after being referred for evaluation. The reasons for this are unclear. Future studies may examine the overlap in symptoms of trauma exposure and ASD, which could lead to over-referral for ASD evaluation. Alternatively, it is possible that symptoms of ASD are overattributed to trauma, in a case of diagnostic overshadowing. Results of this study would be beneficial for those working in ASD diagnostic evaluation, foster care, or child welfare.

#### **414.011 (Poster) Behavioral Gender Differences in School-Age Children with ASD**

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Background: Boys are 4.3 times more likely to be diagnosed with Autism Spectrum Disorder (ASD) than girls. It is possible that behavioral differences between boys and girls contribute to differences in the ease or rate of identification of autism across genders. Girls tend to present internalizing behaviors such as poor self-regulation, difficulty concentrating, anxiety, and depression (Bauminger, Solomon & Rogers, 2010) Whereas boys tend to exhibit externalizing behaviors such as being more aggressive, stealing, vandalism, conduct issues and bullying others (Bauminger, Solomon & Rogers, 2010). These behavioral differences between boys and girls with ASD are not well understood, but may be important to understand with respect to differences in rate of diagnoses in boys and girls (Miller et. al, 2016).

Objectives: To examine the gender differences in parental reports of behavior problems in children with ASD. It was hypothesized that boys will exhibit more externalizing behaviors than girls, whereas girls will exhibit more internalizing behavior than boys. Since internalizing problems may be less obvious than externalizing symptoms this may contribute to fewer girls coming to the attention of diagnosticians.

Methods: Ninety-one children participating in a study of academic development in students with ASD provided data for this study: 17 girls ( $F = 11.0$  years,  $SD = 1.8$ ) and 74 boys ( $M = 11.4$  years,  $SD = 2.2$ ). Boys and girls were matched based on ADOS symptoms and IQ ( $FIQ > 64$ ). Externalizing behaviors such as anger control, bullying others, social disorders and internalizing behaviors such as emotional self-control and negative emotion were measured using the parent report on the Behavioral Assessment System for Children (BASC). The Manifest Anxiety Scale for Children (MASC) and the Conners-3 were used to assess externalizing symptoms associated with ADHD. Intellectual status for all children were estimated with Weschler Abbreviated Intelligence Scale (WASI). Lastly, the Social Response Survey (SRS) was used to evaluate social impairments.

Results: Unexpectedly, parent reports indicated that girls exhibited more externalizing behavior problems than boys, but not more internalizing behavior problems (Table 1). More detailed scale analyses indicated that girls displayed more evidence of negative emotional dysregulation on the BASC Anger Control,  $F(1,85) = 6.91, p < .01, \eta^2 = .07$ , Bullying  $F(1,85) = 9.73, p < .01, \eta^2 = .10$ , and Emotional Self-Control,  $F(1,85) p < .01, \eta^2 = 0$  scales. Reportedly, girls also exhibited more problems on the SRS Communication subscale compared to boys (Table 1) and the differences on this scale were correlated with BASC emotion dysregulation scores for both genders. Lastly, there were no significant correlations observed between the behavioral measures and intellectual status.

Conclusions: Contrary to the study hypothesis, parent report suggests that girls exhibited more externalizing than internalizing behaviors than boys. These problems were especially prominent with respect to negative emotion dysregulation. The small sample size of girls was a study limitation. Nevertheless, the data suggest that additional research on the role negative emotion dysregulation may play in gender differences in the diagnosis of autism is warranted.

#### **414.012 (Poster) Behavioral and Cognitive Impairments in Comorbid ASD+ADHD Group Compared to ASD and ADHD: A Preliminary Meta-Analysis**

**Background:** A dual diagnosis of autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) was only available after the implementation of DSM-5. Recent evidence has shown that 50–70% of youth with ASD meet the diagnostic criteria for ADHD, and about 15–25% of youth with ADHD meet the diagnostic criteria for ASD. However, research is yet to characterize how severe the behavioral and cognitive impairments of individuals with comorbid conditions are compared to those with a single diagnosis of either ASD or ADHD, because a direct comparison of all three groups is rarely reported. Therefore, little is known whether the ASD and ADHD symptoms will have an additive or superadditive impact on the comorbid group's behavioral and cognitive impairments.

**Objectives:** Our overarching goal is to employ a meta-analysis approach to compare individuals with comorbid ASD+ADHD to individuals with only ASD or ADHD on various behavioral and cognitive measures (social, attentional, executive, etc.) to characterize their relative severity of impairments. Specifically, if the comorbid condition occurs as only an additive outcome of ASD and ADHD, we predict that the ASD+ADHD group would show no difference from the ASD or ADHD groups. However, if the coexistence of ASD and ADHD symptoms has superadditive effects, we predict that the ASD+ADHD group would show more severe impairments to at least one of the single-condition groups.

**Methods:** We conducted a literature review search on PsycINFO and PubMed, using combinations of the following search terms: “ASD,” “ADHD,” “autism,” “attention deficits,” and “comorbidity.” After initial screening, 60 papers were selected based on the following inclusion criteria: (a) published after 2010; (b) presented data on behavioral or cognitive measures; (c) included a comorbid ASD+ADHD group and at least one of ASD or ADHD groups. After reading each paper in-detail, we only included papers that presented information on sample size, group means, and standard deviations to calculate the effect sizes. In the preliminary analysis presented here, we included 14 studies that met the inclusion criteria. We used the *Robumeta* (V2.0) package in R (V3.6.1) to conduct the meta-regression analysis with random effects and small-sample corrections.

**Results:** A total of 9 studies with 74 effect sizes were entered into the meta-regression model comparing the ASD+ADHD and ASD groups, and we found a significant effect,  $est. d=0.276, t=9.17, p=.025$ , suggesting a better performance of ASD over the ASD+ADHD on behavioral and cognitive measures. For the comparison between ASD+ADHD and ADHD groups with 10 studies of 80 effect sizes, we found a marginally significant effect,  $est. d=0.497, t=3.54, p=.073$ , suggesting a less reliable finding that ADHD has milder symptoms than the comorbid group.

**Conclusions:** Our preliminary results suggest that the comorbid condition suffers from a superadditive effect from the ASD and ADHD conditions. The coexisting ADHD symptoms make behavioral and cognitive impairments in ASD+ADHD more severe than the ASD but not much to the ADHD group.

#### 414.013 (Poster) Characteristics of Children with Conflicting ASD Diagnoses

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**Background:** Diagnosis of Autism Spectrum Disorder (ASD) is currently based on behavioral assessment according to the Diagnosis and Statistical Manual of Mental Disorder - 5th edition (DSM-5). The “Autism Diagnostic Observation Schedule - 2nd edition” (ADOS-2) is a standardized protocol for observation of behavioral symptoms, which has been developed to assist clinicians in ASD diagnosis. However, ADOS-2 classification is sometimes at odds with the final clinical diagnoses. Identifying factors associated with disagreement between ADOS-2 ASD classification and the final clinical decisions could help improve the accuracy of ASD diagnosis.

**Objectives:** To assess psychometric characteristics (i.e. sensitivity, specificity, positive and negative predictive values [PPV and NPV]) of ADOS-2 compared to DSM-5-based clinician diagnosis, and to identify characteristics associated with disagreement between these two diagnosis approaches.

**Methods:** A cross-sectional study of children enrolled at the National Autism Research Center of Israel (NARCI) and completed both ADOS-2 assessment and DSM-5 diagnosis protocol at Soroka University Medical Center (SUMC) between the years 2015-2019. Children with ADOS-2 classification of “mild-to-moderate” or “moderate-to-severe” concerns in the toddler module and “Autism” or “Autism spectrum” in modules 1-4, were assigned an “ADOS-2 ASD diagnosis”. We used the DSM-5-based

clinician diagnosis as the gold-standard reference to define true-positive (TP), true-negative (TN), false-positive (FN) and false-negative (FN) ADOS-2 diagnoses accordingly. Sociodemographic and clinical characteristics of these children were obtained from the NARCI database and compared between study groups using appropriate statistical tests.

Results: Overall, 792 children (613 males, mean age=41.8 months) participated in this study. There was agreement between the ADOS-2 scores and the final clinical diagnosis in 627 of the children (TP=500, TN=127) with a sensitivity=92%, specificity=51%, PPV=80.5% and NPV=74%. Noticeable differences were apparent across the different ADOS-2 modules with the toddler's module being the most sensitive and least specific (sensitivity=98%, specificity= 37%) and modules 2&3 being the least sensitive and most specific (sensitivity=82%, specificity= 67%). Furthermore, ADOS-2 scores exhibited higher specificity and lower sensitivity in non-verbal children vs. verbal children (sensitivity: 95% vs. 88% and specificity: 44% vs. 56%;  $p<0.001$ ). Finally, IQ and ABAS scores of children with FP and FN diagnoses were significantly higher than the scores of children in the TP group and significantly lower than the scores of children in the TN (**Figure 1**).

Conclusions: Our findings suggest that the specificity and sensitivity of the ADOS-2 changes with the age, language abilities, cognitive abilities, and adaptive behaviors of the examined child. Accounting for these characteristics in the ADOS-2 classification algorithm may improve its agreement with the ASD diagnosis by clinicians.

**414.014 (Poster)** Characterizing Dysregulation in Autistic Youth Using the Child Behavior Checklist-Dysregulation Profile  
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Background: Dysregulation is often seen in autistic youth. The Child Behavior Checklist-Dysregulation Profile (CBCL-DP), defined as the sum of T-scores across three CBCL subscales (anxious/depressed, aggressive behavior, attention problems), provides a symptom-based characterization of dysregulation. In autism, ratings on this index have been linked to poorer adaptive functioning, increased co-morbid psychiatric diagnoses, and higher autistic symptomatology, indicating that autistic youth with high levels of dysregulation represent a particularly vulnerable subgroup within autism.

Objectives: To characterize the CBCL-DP in a large sample of autistic youth and investigate relationships with age, IQ, gender, and executive functioning (EF).

Methods: CBCL data from a clinical/research database was available for 1,105 youth ages 6-18 ( $M=10.5$ ) with a DSM-5 diagnosis of autism spectrum disorder. There were 219 females and 876 males; full scale IQ ranged from 32 to 149 ( $M=95.8$ ). First, the CBCL-DP was calculated for each subject and youth were characterized into three established categories based on severity of dysregulation: normal (CBCL-DP < 180), moderate ( $210 > \text{CBCL-DP} \geq 180$ ), severe (CBCL-DP  $\geq 210$ ). Relationships between CBCL-DP and age were investigated using a Pearson correlation. In subsamples with available data, relationships between CBCL-DP and intellectual and executive functioning were probed using Pearson correlations with full scale IQ and the Global Executive Composite (GEC) from the BRIEF-2 caregiver questionnaire. A t-test was used to test for gender differences.

Results: Of the 1,105 autistic youth, 32.9% had CBCL-DP scores in the normal range, 45.6% in the moderate range, and 21.4% in the severe range. There were no relationships between CBCL-DP and either age ( $r=.03, p=.37$ ) or IQ ( $r=.00, p=.99$ ). There was a strong relationship between GEC and CBCL-DP,  $r(827)=.70, p<.001$ . Females had slightly but significantly higher reported CBCL-DP scores compared to males,  $t(1093)=2.75, p=.006$ , Cohen's  $d=0.21$ , driven by significantly higher ratings on the attention problems subscale  $t(1093)=5.2, p<.001$ , Cohen's  $d=0.40$ . Reported correlations did not differ in males and females (all  $p's>.39$ ).

Conclusions: In the largest sample to date to investigate the construct of dysregulation using the CBCL-DP, our findings support previous literature suggesting that 55-80% of autistic youth are characterized by moderate to severe levels of dysregulation. The lack of relationships of dysregulation with either age or IQ highlights the relevance of this construct across ages and functioning levels. Interestingly, slightly higher dysregulation, driven by increased attention problems, was observed in females compared to males, suggesting possible important gender differences in dysregulation that may contribute to higher vulnerability for poorer outcomes in females. The strong correlation between executive functioning and dysregulation is consistent with prior literature linking poor EF to symptoms associated with psychopathology and should be explored further. Future directions also include incorporating task-based measures of EF and other informant ratings of psychopathology (e.g., clinician, teachers) to better understand relationships with the CBCL-DP. Longitudinal analyses, including younger children, will provide important information about how the CBCL-DP may predict future outcomes, including adaptive functioning and co-morbid psychopathology.

**414.015 (Poster)** Characterizing the Heterogeneity in ASD Symptomatology in Individuals with ASD Compared to TD Controls  
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**Background:** Heterogeneity is a core feature of Autism Spectrum Disorders (ASD), but existing data-driven clustering approaches diverged on the number of clusters or symptom presentations in subgroups so that the heterogeneous patterns of symptomatology in ASD are yet to be characterized. The mixed findings resulted from variations in sample size, diagnostic and symptom measures included for clustering, and clustering methods. In addition, it is well-known that the symptom representations differ drastically across age, gender, and cognitive-ability groups in ASD, but clustering studies rarely examined how subgroups may differ in age, gender, and cognitive abilities (e.g., IQ). Furthermore, existing studies have not included a typically-developing (TD) group for the clustering, so little is known how symptom presentations in ASD subgroups differ from TDs.

**Objectives:** The overarching goal of this study is to characterize the heterogeneity of symptom presentations in ASD with a large sample using a systematic clustering approach. First, we determined the optimal number of clusters in ASD and examined the sub-cluster differences in age, gender, and IQ scores. Second, we conducted the clustering analysis in TD for a comparison with ASD.

**Methods:** Combining Autism Brain Imaging Data Exchange (ABIDE) datasets I and II, we used valid subscale scores from ADI-R ( $N_{ASD}=616$ ; Female: 91;  $M_{age}=13.27$ ; 5-39 yrs old) and from SRS ( $N_{ASD}=379$ ; Female: 55;  $M_{age}=14.78$ ; 5-62 yrs old;  $N_{TD}=442$ ; Female: 120;  $M_{age}=14.61$ ; 5-64 yrs old) for our clustering analysis. We used the *NbClust* package (*V3.0*) in *R* (*V3.6.1*) to conduct the hierarchical clustering with Euclidean distance, and used the majority vote from 30 metrics to determine the optimal number of clusters between 2 and 10.

**Results:** Based on ADI-R in ASD, 2-cluster solution was recommended with a severe-symptom subgroup ( $N=255$ ) scoring higher on social ( $t(614)=25.62$ ,  $p<.001$ ), verbal ( $t(614)=27.23$ ,  $p<.001$ ), and repetitive-restrictive behavior ( $t(614)=10.00$ ,  $p<.001$ ) than the mild-symptom subgroup ( $N=351$ ). Two subgroups differed in IQ ( $M_{severe}=103.88$ ,  $M_{mild}=108.12$ ,  $p=.002$ ), but not in age and gender. Based on SRS in ASD, a two-cluster solution was also recommended with a severe-symptom subgroup ( $N=308$ ) scoring higher on all SRS subscale scores ( $ps<.001$ ) than a mild-symptom subgroup ( $N=61$ ), but not in age, gender, or IQ. In comparison, based on the SRS in TD, three subgroups were found ( $N_{mild}=311$ ,  $N_{severe}=128$ , and  $N_{extreme}=3$ ). We only compared the mild-symptom and severe-symptom subgroups, and found significant differences in all SRS measures ( $ps<.001$ ) and age ( $M_{mild}=13.44$ ;  $M_{severe}=17.32$ ,  $p<.001$ ).

**Conclusions:** Heterogeneity in symptomatology in ASD varies on a quantitative continuum from mild symptoms to severe symptoms across all domains, showing no qualitative difference between subgroups. The similar finding in TD further suggests that ASD symptomatology is presented in a continuous format from TD to ASD. However, the heterogeneity is related with cognitive abilities in ASD but with age in TD.

**414.016 (Poster)** Children with Minimal Verbal Skills and Autism Use of Communicative Functions and Communication Partner across Naturalistic Setting  
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**Background:**

Two million people in India are suspected to have Autism Spectrum Disorder (ASD; Dababnah et al., 2018), and 30% of them fail to develop verbal communication skills (minimally verbal; Salley et al., 2019). Because of the delayed diagnosis, prevalence of children with ASD that are minimally verbal are higher in Indian context than other Western countries (Singh & Bunyak, 2019). For supporting children in developing verbal communication skills, we must assess the child's skills accurately. Most assessment materials available for evaluating communication skills require verbal responses from the children, developed for Western population (Muller et al., 2020), and without cultural adaptation for Indian context (Krupa et al., 2018). Information on assessment practices used by professionals in India for children with minimal verbal abilities remains negligible (Franz & Dawson, 2019). This study surveyed professions working on communication skills in children with ASD who are minimally verbal from Bangalore, India, on assessment practices.

**Objectives:**

## Survey professional Practice with Communication Assessment

### Methods:

A total of 22 participants completed the survey and worked with children with ASD who are minimally verbal from Bangalore, India. Majority of the participants identified as Speech-Language Pathologists (77%) and the rest as Special Educators (23%). We used survey design, which has 16-questions, separated over three subsections, ASD caseload, assessment practices, and demographics details of the participants. The electronic survey developed over the Qualtrics Survey Software were distributed to the professionals working with children with ASD in Bangalore, India.

### Results:

- Most participants reported using the Assessment of Language Development (ALD; Lakkanna, Venkatesh, & Bhat, 2008; 68%), followed by Receptive-Expressive Emergent Language test (Bzoch et al., 2003; 46%), Speech and language development chart (Gard et al., 1993; 18%), Communication DEALL developmental checklists (Comm.DEALL; Karanth, 2007; 14%), Bankson Language Screening Test (BLST; Bankson, 1977; 9%), and Northwestern Syntax Screening Test (Ratusnik et al., 1980; 4%).
- Content analysis revealed of all the assessment materials requires verbal response from the child. However, participants reported that these assessment materials directly measure the child's nonverbal communication (68%), communicative functions (55%), and allows to evaluate child's communication in naturalistic environments (55%).
- Further, the participants reported using these assessment materials for forming clinical decisions such as setting goals for interventions (91%), monitoring progress (77%), and using the test outcomes during discussions with the family members on a child's progress with intervention (72%).
- Surprisingly, most of the participants also relied on informal interviews to gain further clarity over the children's communication abilities (86%) in addition to using standardized assessment.

### Conclusions:

Professionals working on communication skills in children with minimal verbal abilities use informal assessment method guided by standardized assessment for making most of the clinical judgements. Majority of the assessment materials reported in the survey other than ALD and Comm. DEALL are not developed for Indian population. Future studies child examining the benefits and limitations of using Western assessment materials along with the informal assessments on communication development in children that fail to develop verbal communication skills in Indian context.

**414.017 (Poster)** Cognitive and Communication Profiles of Minimally Verbal Children with Autism Spectrum Disorder  
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Background: Autism spectrum disorder (ASD) is characterized by variability in communication and cognition. Current descriptions of heterogeneity are generally comprised of single characteristics or predictors versus comprehensive patterns of behavior and cognition (e.g. Tager-Flusberg & Joseph, 2003; Georgiades, et al., 2013). Less is known about minimally verbal children with ASD. The minimally verbal definition varies from 30 spoken words to zero, and encompasses a range of cognitive skill (Yoder & Stone, 2006; Kasari, et al., 2013; Bal, et al., 2016). These children are frequently absent from disability and intervention literature though they stand to benefit the most from intervention.

Objectives: The present examination identifies profiles of heterogeneity across cognitive and language measures in minimally verbal children with ASD age three to eight years old.

Methods: This secondary data analysis combines baseline data from two multisite intervention studies to yield a total of 354 participants. All children had 30 different spoken words or less, were three-eight years old, and were recruited from local public schools. Latent profile analysis was used to identify subgroups with common patterns of characteristics. Profile variables were indicators of nonverbal cognition (play diversity, nonverbal age equivalent, receptive language age equivalent) and communication behavior (total spontaneous requests, social affect, total spontaneous communication to share, number of spontaneous utterances, and number of different words). Of these variables, nonverbal age equivalent (MSEL, Mullen, 1997), receptive language age equivalent (VABS-II, Sparrow, et al., 2005), and social affect (ADOS, Lord, et al., 2012) were standardized. Play diversity (SPA; Ungerer & Sigman, 1981), total requesting & sharing communication (ESCS, Mundy, et al., 2003), and spontaneous utterances & number of different words (fNLS or PCX, Kasari, et al., 2014) were from behavioral

observations and assessments. The appropriate latent profile model was determined via examination of fit indices- information criteria (ICs), Likelihood Ratio Tests (LRTs), Bayesian fit indices, and entropy (Masyn, 2013).

Results: Results indicate that the four-profile model emerged as best fit to the data (entropy= 0.88; BPLRT=  $p < 0.001$ ). These four profiles represent distinct nonverbal versus verbal cognitive patterns. Profile 1 (n= 39) consists of those who were exhibiting the strongest skills across all variables, both verbal and nonverbal. Profile 2 (n= 69), represents those who had nonverbal skill as strong as those in Profile 1, but verbal skill that was less strong and at the sample mean. Profile 3 (n=56) represents those who had mixed skills, with nonverbal scores as strong as Profile 1, but verbal scores that were equal to Profile 4. Profile 4, the largest group, (n= 193) represents those who had the weakest scores on all measures, both verbal and nonverbal.

Conclusions: Identified profiles are largely defined by verbal versus nonverbal cognition and behavior. This comprehensive classification of minimally verbal heterogeneity in early childhood prior to intervention into an intervention study represents an important step in determining the response of children with different profiles to different treatment approaches.

**414.018 (Poster)** Comparison of Autism Diagnostic Observation Schedule (ADOS-2) Standardized Procedures to Assessment with Safety-Related Modifications Due to COVID-19

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**Background:** The recent SARS-CoV-2 pandemic has created challenges for conducting timely diagnostic evaluations in a standardized fashion. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) is the gold-standard observational tool for assessing symptoms of ASD, however, the pandemic has necessitated safety-related modifications to standardized assessment procedures. Such modifications have not been standardized and their impact on diagnostic accuracy has yet to be established. This is particularly relevant for certain ADOS modules (Toddler Module, Module 1, Module 2) which may be more significantly impacted by the use of face masks/shields and the omission of activities which promote the spread of respiratory viruses (e.g., balloon, snack). These modules are also those most likely to be used when assessing young children who are in a "critical period" for benefiting from early diagnosis and intervention. Given this, it is essential to determine the impact to diagnostic accuracy of safety-related modifications to in-person ADOS.

**Objectives:** The purpose of this study is to assess the convergence of ADOS-2 algorithm and comparison scores obtained by assessment with safety-modified administration with scores obtained with standardized administration.

**Methods:** Children aged 1-5 years are being recruited to this ongoing study if they completed a standardized in-person ASD diagnostic evaluation at our clinic between January and March 2020. Families are being invited to participate in reassessment if they completed an assessment in English and completed an ADOS-2 Module 1, 2, or Toddler during their evaluation. Participants are being invited to participate in an in-person assessment modified in the following ways – use of face masks/shields by the examiner and parents and the omission of activities which increase transmission of respiratory viruses (inflatable balloon activity) or are not possible with masks (snack, social smile).

**Results:** A total prospective sample of 195 children from racially and ethnically diverse backgrounds is currently being recruited. In their original assessment, 42% (n = 82) of children completed an ADOS-2 Toddler Module, 38% (n = 75) completed a Module 1, and 20% (n = 38) completed a Module 2. Eighty-three percent of these children received a primary diagnosis of ASD, while 16% received a non-ASD diagnosis (e.g., Language Disorder), and 1% received no diagnosis. Correspondence between standardized and adapted procedures will be assessed via Pearson correlations for the ADOS-2 algorithm and comparison scores, with adequate convergence represented by a correlation of  $r = .7$ . A priori power analysis indicates the present sample has greater than 99% power to detect target effects. Because this study is embedded in a larger study on safety adaptations to standardized assessment, correspondence of adapted in-person assessment will also be compared to correspondence of measures administered via telehealth (Childhood Autism Ratings Scale, Brief Observation of Symptoms of Autism).

**Conclusions:** This study will inform the degree to which results of ASD assessment completed with safety modifications correspond with assessment using standardized procedures. Results will provide vital information regarding the validity of adapted assessment procedures and will thus inform the quality of care received by families for whom standardized and/or telehealth assessment is not feasible.

**414.019 (Poster)** Comparison of COVID-19 Adapted Telehealth Versus Standard-of-Care Protocols for the Diagnostic Assessment of Autism Spectrum Disorder

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**Background:** The current COVID-19 global pandemic has created new challenges and significantly worsened existing systemic issues associated with timely and equitable access to comprehensive diagnostic evaluations for children suspected of having Autism Spectrum Disorder (ASD). This has necessitated significant changes to ASD assessment protocols, with pivoting to telehealth being a widely-implemented adaptation. However, there currently exists limited evidence for the efficacy of ASD assessment and validity of ASD diagnosis among children, using live-feed video-conferencing platforms that incorporate the use of gold-standard, reimbursable assessment measures (i.e., ADOS-2 Module 1; Reese et al., 2015). During the present pandemic, there exists an urgent need to evaluate whether a standardized, comprehensive ASD assessment battery—often required by insurance companies and in order to access time-sensitive interventions—is comparable to a standardized ASD assessment when administered via telehealth.

**Objectives:** The purpose of this study is to assess the degree to which telehealth-specific adaptations to assessment procedures influence the validity and diagnostic accuracy of gold-standard ASD assessment.

**Methods:** Children are being recruited to this ongoing study if they received a complete standard in-person ASD diagnostic evaluation (i.e., a Mullen or DAS-2, and an ADOS-2) by a licensed psychologist and/or supervised trainee at a large ASD specialty assessment clinic, between January and March 2020, prior to assessment modifications due to the pandemic. Participants are being invited to complete a re-assessment adapted to a telehealth context, involving a cognitive and ASD assessment battery. Specifically, participants are asked to complete the Developmental Profile-4, Ages and Stages Questionnaire-3, and/or Developmental Assessment of Young Children-2 cognitive measures via clinician-caregiver interview and child observation via Zoom. The Childhood Autism Ratings Scale, Second Edition (CARS-2) and Brief Observation of Symptoms of Autism (BOSA) are completed using standardized clinician observation and coaching of the caregiver-child interaction.

**Results:** The total prospective sample includes 246 children aged 1-14 years from racially and ethnically-diverse backgrounds. Eighty-percent of this sample received a primary diagnosis of ASD, while 16% received non-ASD primary diagnoses (e.g. ADHD, GDD), and 4% received no diagnosis. Thirty-three percent completed the Toddler Module, 36% completed a Module 1, 20% completed a Module 2, and 11% completed a Module 3. For this ongoing study, convergent validity will be assessed via correlations between initial evaluation and telehealth measures. To achieve good convergent validity ( $r = .7$ ),  $\alpha = .05$  and power of  $.8$ , we require 13 participants per measure comparison. Our goal is to conduct each possible comparison (e.g., Mullen–DAYC-2, DAS-2 School Age–DP-4, ADOS-2 Tod Mod–CARS-2-ST), which would result in  $n=130$  cognitive measure comparisons and  $n=156$  autism measure comparisons. Interrater reliability on study measures will also be ascertained via live or video review by senior clinicians.

**Conclusions:** If it is determined that adapted telehealth procedures are as efficacious as gold-standard assessment in the diagnosis of ASD, the implications for this research involve expanding access for families who otherwise may not have timely specialized diagnostic assessment available to them, due to several factors including the current pandemic.

**414.020 (Poster) Concordance between Parent and Child Report of Sleep Disturbance and Sleep-Related Impairment in Autistic and Non-Autistic Youth**

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**Background:** Sleep problems, which contribute to quality of life, are common in children with autism spectrum conditions. In gathering information about sleep problems, the choice of informant – child self-report or parent proxy – may impact the quality of information gathered, with evidence supporting the use of child self-report in typically developing adolescents. There is increased attention from the autistic community on quality of life outcomes, and prior work indicates that many autistic youth are able to report on their own quality of life across a number of domains. However, the ability of youth on the spectrum to report accurately on their own sleep quality has not been assessed. It is important to understand the accuracy of autistic youth's self-reported sleep issues to guide sleep measurement in clinical settings.

**Objectives:** To assess parent-child concordance in the Patient Reported Outcome Measurement Information system (PROMIS) Pediatric Sleep Disturbance (SD) and Sleep-Related Impairment (SRI) short forms in large samples of children with and without autism.

**Methods:** Participants were recruited from the GfK Knowledge Panel (an online sample representative of the U.S. population), and two online registries (autismMatch and the Interactive Autism network (IAN)). A total of 1355 parent-child dyads completed the PROMIS SD (Autism N = 306, No Autism N = 862) and/or SRI (Autism N = 296, No Autism N = 863) 8-item scales (see Table). Weighted kappa ( $\kappa$ ) was used to examine the agreement between parent-proxy ratings and child ratings among autistic and non-autistic children. A discrepancy score was calculated by subtracting child ratings from their own parent's ratings, and these were compared between groups using t-tests.

**Results:** On the Sleep Disturbance scale, agreement between autistic children's ratings and their parents' was substantial ( $\kappa = 0.69$ ), and was similar to the agreement between non-autistic children and their parents ( $\kappa = 0.69$ ). Similar results were observed for the Sleep-Related Impairment scale (autism  $\kappa = 0.59$ , non-autism  $\kappa = 0.65$ ). Expressed as Pearson's  $r$ , the relationship between child-parent report of SD was  $r = 0.73$  in autism, and  $r = 0.68$  in non-autism. The relationship between child-parent report in SRI was  $r = 0.61$  in autism,  $r = 0.64$  in non-autism. When parent-child discrepancy scores were compared between autism and non-autism, significant differences were observed for both SD (autism  $M = 3.63$ , non-autism  $M = 0.51$ ,  $t(523) = 6.35$ ,  $p < 0.001$ ) and SRI (autism  $M = 3.30$ , non-autism  $M = 0.25$ ,  $t(437) = 5.06$ ,  $p < 0.001$ ). This indicates that the magnitude of parent-child discrepancy is larger in autism dyads, with parents endorsing more symptoms than their children on average.

**Conclusions:** Overall, parent-child agreement was similar between autistic and non-autistic youth, with some evidence of greater under-reporting of symptoms by autistic youth than non-autistic youth compared to their own parents. This suggests that autistic youth with the cognitive and language ability to complete these scales are capable reporters of their own sleep in clinical and research contexts, with the caveat that they may slightly underreport compared to their parents.

**414.021 (Poster) Concurrent Validity of Parent Report and Behavioral Assessments of Communication and Social Skills in 18-Month-Old Infants at Low- and High-Familial-Risk for ASD**

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**Background:** Parent report measures are commonly used to screen and assess development in young children. However, the concurrent validity of these measures has been questioned in at-risk populations. Children who have an older sibling with autism spectrum disorder (ASD) are at increased risk of developing ASD and/or language difficulties (Marrus et al., 2018; Ozonoff et al., 2011). Early detection of delays in the high-risk infant sibling population relies on accurate parent report and screening measures. Understanding the relationship between parent report measures and direct behavioral assessments that are typical in research studies is especially important during COVID-19 when in-person assessments cannot be carried out.

**Objectives:** This work aims to evaluate the concurrent validity between parent report measures and in-person developmental and behavioral assessments in 18-month-old infants at low- and high-familial-risk for ASD.

**Methods:** Participants included 151 18-month-old children with high-familial-risk for autism (HRA,  $n=53$ ), defined as having an older sibling with an ASD diagnosis, or with low-familial-risk for autism (LRA,  $n=98$ ), defined by having no first-degree relative with an ASD diagnosis. Parent report measures included the MacArthur-Bates Communicative Development Inventory: Words and Gestures (MB-CDI W&G; Fenson et al., 2007), the Language Use Inventory (LUI; O'Neill, 2009), and the Ages and Stages Questionnaire (ASQ; Bricker et al., 1999). In-person developmental and behavioral assessments included the Mullen Scales of Early Learning (MSEL; Mullen, 1995) and the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2000). Concurrent validity was determined using Pearson's correlation coefficients between parent report measures and developmental and behavioral assessments. P-values shown have been corrected for multiple comparisons. Raw scores were used for all measures.

**Results:** Across low- and high-familial-risk groups, MSEL Expressive Language Scores were significantly correlated with ASQ Communication ( $r(134) = .72$ ,  $p < .001$ ), MB-CDI Words Produced ( $r(129) = .73$ ,  $p < .001$ ), and LUI Communication with Words (Part 2) scores ( $r(129) = .72$ ,  $p < .001$ ). Correlations between MSEL Receptive Language scores were also significantly correlated with ASQ Communication ( $r(134) = .56$ ,  $p < .001$ ), MB-CDI Phrases Understood ( $r(129) = .46$ ,  $p < .001$ ), and MB-CDI Words Understood scores ( $r(129) = .42$ ,  $p < .001$ ), although to a lesser degree.

Within the HRA sample, ADOS Social Affect subscale scores were significantly correlated with ASQ Communication ( $r(45) = -.52$ ,  $p = .001$ ), MB-CDI Phrases Understood ( $r(41) = -.62$ ,  $p < .001$ ), and MB-CDI Total Gestures scores ( $r(41) = -.49$ ,  $p < .005$ ). Interestingly, while ASQ Personal Social scores were significantly correlated with ADOS Social Affect scores, Pearson's  $r$  ( $r(45) = -.46$ ,  $p < .005$ ) was lower than the ASQ communication correlation.

**Conclusions:** This work highlights the ability for parent report measures to capture these differences across familial risk groups (HRA & LRA). ASQ Communication was most strongly correlated with MSEL Expressive Language. Within the HRA group, it was also significantly correlated with ADOS Social Affect. Future directions include investigating earlier and later time-points to determine whether parent report measures can serve as a potential alternative to in-person assessments at varying time-points.

**414.022 (Poster)** Consistency of Reporting Presence and Severity of Restricted and Repetitive Behaviors on Parent and Clinician Based Measures

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**Background:** Restricted and repetitive behaviors (RRBs) are seen in many developmental disorders and are a necessary symptom for the diagnosis of Autism Spectrum Disorder (ASD) (American Psychiatric Association, 2013). These behaviors can also cause significant familial stress (Harrop et al, 2016) and impede learning in children with ASD (Leekam et al., 2011). Studies have shown discrepancies in reporting of RRBs between two of the “gold standard” measures of Autism: the Autism Diagnostic Interview (ADI-R), a parent report measure of their child’s behaviors, and the Autism Diagnostic Observation Schedule (ADOS), a clinician scored assessment of the child (Lord et al., 1994; Lord et al., 2003). These discrepancies may exist for a number of reasons including if parents fail to understand the questions asked and misrepresent their child’s behaviors, and/or clinicians do not have sufficient opportunity to assess all details of RRBs in this type of brief observation (Kim & Lord, 2010; Moore & Goodson, 2003). Excluding the RRBs domain of the ADI-R leads to higher agreement between the measures (Wiggins & Robbins, 2008). However, to best understand a child’s current behavior, it is important that measures reliably capture the prevalence and severity of RRBs. The Behavior and Sensory Interests Questionnaire (BSIQ) is a parent interview that looks at the presence and severity of a large number of individual RRB’s. (Hanson et al., 2015). Comparing ratings for current RRBs across the ADOS, ADI-R and BSIQ may give insight into the most reliable combination of measures to assess these symptoms.

**Objectives:** To evaluate consistency of reporting the presence and severity of RRB’s across ADOS, ADI and BSIQ.

**Methods:** Preliminary data analysis included 30 participants (77% males, ages 61-239 months, mean = 121.7, SD = 50.21) recruited from The Phenotypic and Genetic Factors in ASD study, the Boston Autism Consortium and The Simons Variation in Individuals Project. RRB’s on the ADOS, ADI-R and BSIQ are coded on a severity scale with 0 = not present, 1 = mild and 2-3 = severe. These behaviors were sorted into three groups: 1. Unusual Sensory Interest (USI), 2. Hand/Finger and Other Complex Mannerisms (HF) and 3. Self-Injurious Behavior (SIB). Groups were broken down into behavior present (p) or not present (np) (i.e., USIp, USInp), as well as average severity (i.e., USImild, USIsevere), and compared across measures.

**Results:** T-tests showed significant differences for the following conditions: USIp/np between ADOS and BSIQ ( $p=0.04$ ); USIp/np between ADI and BSIQ ( $p=0.02$ ); HFp/np between ADOS and BSIQ ( $p=0.05$ ); and SIBp/np between ADOS and BSIQ ( $p=0.04$ ). No significance was found in other conditions. One-way ANOVA determined significance for USI severity between the ADOS and the BSIQ [ $F(2,87)=2.52, p=0.04$ ] but not between other conditions.

**Conclusions:** Preliminary results show discrepancies in prevalence and severity ratings of RRBs across the BSIQ, ADI-R and ADOS, supporting findings of previous studies. A larger sample size and more RRB groups will be analyzed in subsequent analyses.

**414.023 (Poster)** Creating Clinically Significant Cut Points within a Social Communication Measure: Application of Machine Learning to the Assessment of Minimally Verbal Children with ASD

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**Background:**

Intervention research involving minimally verbal (MV) children with autism is currently in a predicament. Many communication-based interventions aim to improve the core ASD deficits of social communication, yet methods to accurately and sensitively measure these improvements are insufficient (McConachie et al., 2015). To sensitively track and subsequently understand subtle behavioral improvements over time, researchers should first thoroughly understand children’s set of skills before intervention (Georgiades & Kasari, 2018). However, relating children’s variability in specific joint attention (JA) skills to their broader social communication ability may be difficult (Spence and Thurm 2010). This study aims to characterize MV children’s abilities at baseline by calibrating JA skills to global clinical social communication ratings within a randomized controlled trial.

**Objectives:**

To use machine learning methods to identify patterns in the variation of JA scores within the Early Social Communication Scales (ESCS; Mundy et al., 2003) and create cut points relating to varying degrees of social communication severity as measured by the Clinical Global Impressions-Severity Scale (CGI-S; Guy, 1976).

### Methods:

Baseline data (N=194) were used from a large multi-site clinical trial for MV children with ASD, AIM-ASD (NIH/NICHHD RO1HD073975).

This study primarily used a machine learning method known as classification and regression trees (CART; Breiman et al., 1984). The original dataset was split into training (70%) and testing (30%) datasets that preserved the ratio of CGI-S ratings. Building the classification tree was a recursive partitioning process that created splits among explanatory variables that produced the largest decrease in the impurity criterion, the Gini index. Splits continued until homogeneous subgroups were created. A 100-fold repeated cross-validation was used to assess the stability of the tree.

In order to corroborate variable importance, an ensemble method known as a random forest was used. A random forest fitted a more accurate model by averaging many trees together, thus reducing the variance and potential overfitting within a single tree.

All statistical analyses were conducted using R version 3.6.1 (R Core Team, 2013).

### Results:

In the model, the explanatory variables were the four main measurements from the ESCS: initiations of JA, initiations of behavior regulation, responses to JA bids, and responses to behavior regulation bids. The binary outcome variable was high or low social communication ratings from the CGI-S, which corresponded to more or less severe social communication impairment, respectively. In this sample, the three most important variables in both the CART and random forest models were 1) response to JA bids, 2) behavior regulation initiations, and 3) response to behavior regulation bids.

### Conclusions:

This study attempts to address the difficulty in JA measurement and subsequent clinical interpretation among MV children with autism (Kasari et al., 2013). Using CART, we classified specific cutoffs in JA scores into global clinical social communication severity, thus, giving more interpretability to JA frequency scores in this sample. Within this study of MV children, creating clinical cutoffs and a hierarchy of variable importance at baseline may help researchers gauge specific JA skills to target and then understand the robustness of progress made via intervention.

**414.024 (Poster)** Critical Examination of Five Major Level Two Screeners for Autism Spectrum Disorder  
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**Background:** As the prevalence of autism spectrum disorder (ASD) increases (Maenner et al., 2020), there is an increased need for reliable and valid assessment tools, prioritizing cost-effectiveness and efficiency (Zwaigenbaum & Penner, 2018). In ASD screening and diagnosis, rating scales are commonly used because they can include and allow for comparison of information from multiple raters, in addition to gathering data beyond a singular observation (Norris & Lecavalier, 2010; Scahill & Lord, 2004). Rating scales for ASD can be categorized into level one screeners (e.g., assessing for broad, atypical development) and level two screeners (e.g., assessing for more specific diagnostic criteria), and, in addition to screening, can also play a role in a more comprehensive diagnostic assessment (Kuriakose & Shalev, 2016; Norris & Lecavalier, 2010). This poster presentation will discuss and review five commonly used ASD level two screeners (Benson et al., 2019; Kuriakose & Shalev, 2016): the GARS-3 (Gilliam, 2013), SRS-2 (Constantino & Gruber, 2012) CARS2 (Schopler et al., 2010), ASRS (Goldstein & Naglieri, 2009), and SCQ (Rutter et al., 2003a). Specifically, this poster will critically review each rating scale in terms of intended use(s), characteristics and expectations of raters and examiners, psychometric evidence, and strengths and limitations. A summary table will be provided to guide clinicians in their choice of assessment tools, and important directions for future research are discussed.

**Objectives:** Presentation objectives are as follows: (a) examine the normative sample, reliability, and validity as reported in the manual of commonly used level two screeners for ASD, (b) highlight reviews and critiques of the screeners from independent

evaluators and researchers, and (c) provide a summary table for clinicians to guide their choice in assessment tool and/or to reference in the use of assessment.

**Methods:** For each of the five selected ASD level two screeners, researchers critically and systematically examined the published manual and test reviews from independent evaluators. Additionally, researchers examined independent research that supported, contextualized, or criticized information reported in the manual.

**Results:** Table 1 presents information across the five selected rating scales. Readers can compare versions, raters, ages, subscales, intended uses, and rater characteristics. Additionally, a summary of strengths and limitations are presented for each measure.

**Conclusions:** While these level two ASD screeners are all frequently used in applied settings (e.g., Aiello et al., 2017; Benson et al., 2019; Kuriakose & Shalev, 2016), these findings are important to consider when determining whether and/or which to use. For each rating scale, researchers examined characteristics of the rated individual and practical considerations included use with individuals of specific chronological or mental ages, features of the normative sample (e.g., lack of diversity in race and/or gender), screening specificity in relation to other diagnoses (e.g., differentiation from ADHD, ID, etc.), and potential adjustment of the cut score (e.g., SCQ). Each of these assessment tools has its own strengths and limitations for screening and/or as part of a more comprehensive diagnostic assessment, with this review clarifying the conditions for reasonable use and highlighting important questions for future research.

**414.025 (Poster)** Demonstration of Behavioral and Emotional Problems in Children with ASD Presented By the Dbc-P Scale  
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### **Background:**

Besides core symptoms in social interaction and restricted, repetitive behaviors and interests, children with ASD also face other problems with emotions and behaviors like all other children. This simultaneous appearance causes the impairments worse, making intervention complicated and difficult. Evaluating these problems provides the chance for children with ASD to receive the optimal intervention. The Developmental Behavior Checklist – Parent report form (DBC-P; Einfeld & Tonge, 1992, 2002) was specially designed to capture this population's behavioral and emotional problems.

### **Objectives:**

The study's goal was to examine the prevalence of behavioral and emotional problems among children with ASD on the DBC-P scales; correlations between these DBC-P scales and related variables to provide useful suggestions for professionals in the field.

### **Methods:**

Fifty-eight children identified as having ASD participated in the study. The consent form was received from parents/caregivers of those children. Besides collecting demographic information like the age of the children with ASD and their parents, gender, and birth order, two primary research methods were used: interviewing parents/caregivers on the DBC-P scale and measuring children's intelligence by the Color RAVEN (Raven's Progressive Matrices; Raven, 1948). The age of children who participated in the study ranged from 4 to 11 years old. 87.9% were male, and 12.1% were female; 60.3% are the first child in the family, 34.5% are the second one, 3.4% are the third one, and 1.7% are the fourth child. The mean age was 62.91 months.

### **Results:**

The data shows that 39.7% of the sample having Disruptive/Antisocial, 55.2% of them have Self-Absorbed, 62.1% have Communication Disturbance, 29.3% have Anxiety, and 65.5% have Social Relating are reported. There is no significant difference between males and females in all subscales. There was negative correlations between intelligent index (RAVEN) and Self Absorbed ( $r = -0.39$ ), Social Relating ( $r = -0.25$ ), but positive correlation with Anxiety ( $r = 0.22$ ). There was a positive correlation between Disruptive/Antisocial and age ( $r = 0.20$ ). Most of the subscales have a very low correlation with parents' age when the children were born.

### **Conclusions:**

Communication disturbance and social relating, and self-absorbed are the most seen in children with ASD according to the DBC-P. These abnormal behaviors have a relationship with the children's intelligence index. The higher an intelligence level is, the lower the severe level of maladaptive behavior, and the higher an intelligence level is, the higher the anxiety severity. In conclusion, this present study's results can help professionals better understand children with ASD and enhance their knowledge and skills in working with families and children with ASD.

**414.026** (Poster) Detecting Feeding Problems in Young Children with Autism Using a General Screener  
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#### Background:

Roughly 44-89% of children with ASD have feeding problems (Seiverling et al., 2018). The most prevalent is food selectivity. Parents also report disturbing feeding behaviors, such as walking away from the table, whining, and yelling, throwing or dumping foods, difficulty eating at restaurants, aggression and tantrums during eating. Also, food rituals and food anxiety are reported, which can be related to compulsive rituals, avoidance of certain types of food, and the insistence on specific methods of food preparation, food types and mealtime rules. Additionally, atypical ways of eating are reported, such as gagging, pica, overeating, rapid eating, vomiting, regurgitation, and rumination (Ledford & Gast, 2006).

Feedings problems increase the risk of malnutrition (e.g. undernutrition), suboptimal or stunted growth, and developmental and cognitive delays. Caregivers show higher levels of parental stress, including parent-child conflict and parent-spouse stress (Kuschner et al., 2017). Without adequate diagnosis and treatment, feeding problems tend to persist throughout childhood and adulthood, and may lead to eating disorders (Westwood & Tchanturia, 2017). Because feeding problems in early childhood have such aversive consequences for child development and family wellbeing, early detection is important, also in children who are yet not diagnosed with ASD.

#### Objectives:

Evaluate the use of a short general screener for feeding problems (MCH-FS) in young children with ASD.

#### Methods:

Participants were selected from a clinical ASD sample (ASD, retrospective chart review;  $n = 80$ ; 55 boys, 25 girls;  $M = 17.25$ ,  $SD = 4.8$  months; ADOS-2:  $M = 14.75$ ,  $SD = 5$ ; IQ:  $M = 90.32$ ,  $SD = 18.25$ ) and a general population sample (GPS,  $n = 1389$ ;  $M = 14.12$ ,  $SD = 7.41$  months). The Dutch version of the Montreal Children's Hospital Feeding Scale (MCH-FS; Ramsay et al., 2011; Van Dijk et al., 2011) was used to assess severity of feeding problems. This questionnaire, filled in by caregivers, measures seven main constructs: parental concern, family reactions, compensatory strategies, appetite, mealtime behaviors, oral sensory behavior, and oral motor behavior.

#### Results:

The internal consistency of the MCH-FS was good in both samples (ASD:  $\alpha = .828$ , Guttman's  $\lambda-2 = .839$ ; GPS:  $\alpha = .847$ , Guttman's  $\lambda-2 = .856$ ). In general, caregivers of children with ASD reported more feeding problems than from GPS (Mann-Whitney U test;  $U = 73.358$ ,  $z = 4.826$ ,  $p < .001$ ). Also, the score distribution in ASD seemed to be much less positively skewed than in GPS (see violin plot in Figure 1).

The response patterns on the individual MCH-FS items was highly similar. There was a slight increase in feeding problems with age for the GPS ( $\chi^2(5) = 138.282$ ;  $p < .001$ ), but not the ASD sample ( $\chi^2(5) = 4.015$ ,  $p < .547$ ).

#### Conclusions:

The MCH-FS can be used in populations that include children with ASD. Caregivers of children with ASD scored higher on this questionnaire, evidencing more feeding problems in their children. Our results are consistent Dovey and colleagues (2020) who revealed more similarities than differences in feeding problems between typically developing children and children with ASD, ARFID and picky eating.

**414.027 (Poster)** Development and Initial Validation of Simba: Sensory Sensitivity Instrument Measuring Behavioural Responses in Autism

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**Background:** Many children diagnosed with Autism Spectrum Disorders (ASD) display sensory sensitivities (SS)<sup>1,2</sup>. In clinical practice and research SS are frequently assessed through parent questionnaires which, while valuable, are prone to biases<sup>3</sup>. Behavioural assessments are less commonly used; require specialist training and specific play settings<sup>4</sup>. There is a lack of detailed observational measures of SS that could be applied during play-based assessments of autism<sup>4,5</sup>.

**Objectives:** Development and validation of an observational measure to allow detailed SS coding during play-based assessments of core autism symptoms.

**Measure development** The Sensory Sensitivity Instrument Measuring Behavioural Responses in Autism (SIMBA) covers four domains: (A) Sensory Preoccupations, (B) Sensory Avoidances, (C) Sensory Actions and (D) Social SS. Coded items, developed from the literature on SS<sup>6,7,8,9</sup>, aim to capture key clusters of observed behavioural responses to sensory stimuli elicited during play-based clinical/research assessments such as ADOS-2: Autism Diagnostic Observation Schedule-2<sup>10</sup> and BOSCC: Brief Observation of Social Communication Change<sup>11</sup>.

The coding within each domain item is made along three dimensions: frequency, duration and intensity. Observed frequency of behavioural response to a stimulus is the primary coding. If present this is then qualified with a coding for duration and/or intensity depending on item specifics. Domain specific and a total SS score are generated.

**Methods: Sample** Seventy-two children, all with core autism, recruited into the PACT-G trial<sup>12</sup>. Participants had mean age 5.38 years (SD=1.84), 77.7% were male. SIMBA was coded on videos of adult-child interaction during BOSCC administration. The same 10-minute video-samples were used as in the BOSCC coding. 103 SIMBA ratings across the 72 participants were used for validation, some subjects sampled at multiple timepoints. Inter-rater reliability was tested through independent double coding of an additional 20 videos. **Other measures** BOSCC, ADOS-2. **Analysis** Data were analysed using IBM SPSS Statistics, version-26. Two-Way Random Inter-class Correlation Coefficients (ICC) were used for calculating inter-rater reliability. Convergent and divergent validity was explored through correlations between the total SIMBA scores and appropriate scores from the concurrent BOSCC and ADOS assessments used in the PACT -G trial<sup>12</sup>.

**Results:** The total SIMBA score was normally distributed with a mean of 9.26 (SD=5.29; range 0-24). A Cronbach's Alpha =.68 across all items suggested acceptable internal consistency. Coding showed high inter-rater reliability (Table 1): SIMBA Total score: ICC = .96; Sensory Preoccupations: ICC=.95; Sensory Avoidances: ICC=.73; Sensory Actions: ICC=.75 and Social SS: ICC=.97 Construct and criterion validity was supported by the strong positive correlation between total SIMBA score and selected concurrent BOSCC scores and moderate positive correlation with independently sampled ADOS total and item scores reflecting SS (Table 2).

**Conclusions:** This initial development and validation study of SIMBA shows promising results. It shows high inter-rater reliability and promising construct and criterion validity against relevant items on BOSCC and ADOS. It produces a fine-grain profile of SS with greater detail than that available from those instruments alone. Further validation studies will be necessary, but these initial results demonstrate the potential utility of SIMBA as an instrument giving a detailed evaluation of SS from general adult-child interactions.

**414.028 (Poster)** Development of a Tablet-Based Measure of Concept Formation Ability for Children with ASD and Other Neurodevelopmental Disorders

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**Background:** There is a lack of appropriate longitudinal cognitive assessment tools for clinical trials of neurodevelopmental disorders (NDDs). Appropriate and engaging measures across functioning, with sensitivity to incremental change in ability across repeated administrations, are limited. These limitations appear particularly problematic for children with ASD due to frequently observed cognitive delays and the common discrepancy between verbal and nonverbal skills. One potential solution is the

development of computer adaptive tests. Such tests minimize practice effects and maintain sensitivity to change while increasing compliance by capitalizing on motivation for technology-based formats and increasing efficiency by using performance on previous items to select future items, reducing the number that need to be administered.

Additionally, skills domains measured by such tests are crucial. For cognition, developmental scales, which test early foundational skills, or traditional IQ tests, which test higher-level cognition, may not be appropriate as they do not capture a wide range of functioning. Instead, “transitional skills” which bridge skills from developmental scales and traditional IQ tests, should be considered. Concept formation is a transitional cognitive skill that allows one to distinguish between exemplars that belong to particular perceptual or semantic categories through allocation of attentional processes toward attributes of interest.

**Objectives:** The present study aimed to develop a tablet-based assessment of concept formation skills in young children being assessed in NDD clinics and test its feasibility.

**Methods:** A team of subject matter experts developed a bank of items aimed at capturing varying levels of concept formation ability, from exact matching through semantic categorization. Additionally, design elements to aid in nonverbal administration were discussed and integrated into the test (Figure 1). A prepilot of items and task design on a tablet confirmed that children would engage with the task on a tablet with minimal verbal instruction. Items were then integrated into an experimental iPad application using the NIH Toolbox shell. Pilot participants with NDDs were recruited through the National Institutes of Mental Health ( $n=9$ ) and Rush University Medical Center ( $n=6$ ) and feasibility was assessed through systematic observation of engagement and response.

**Results:** Children between the ages of 2-16 years old ( $N=15$ ) completed a cognitive assessment including the pilot test (IQ  $M=55.91$ ,  $SD=20.32$ ,  $n=11$ ). Pilot data shows that the majority of children were able to pass the teaching items. Administration issues identified for further development in children who passed the teaching items included: issues with the response modality (i.e., difficulty dragging target to response stimulus) (3/12), noncompliance (2/12), and understanding task demands (5/12) even after completing the practice.

**Conclusions:** A high percentage of children passed the teaching items on a pilot version of a nonverbal, tablet-based assessment of concept formation, indicating initial feasibility in children with NDDs. Issues with administration appeared largely related to motor demands of the response modality or task understanding. Future iterations of the task will allow for flexibility around response options (e.g., examiner assistance), and increase the number of teaching items before proceeding to live items to increase feasibility of this iPad-based measure of concept formation in children with NDDs.

**414.029 (Poster)** Developmental Trajectories in Autism Based on Symptoms Measured By the Vineland Adaptive Behavior Scale Second Edition Using Observational Data from North America and Europe  
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**Background:**

Symptoms and developmental profile heterogeneity among individuals with autism spectrum disorder (ASD) makes interpreting endpoint variation in response to a clinical intervention challenging. Developmental trajectories models are valuable to understand condition progression and to support clinical interpretation.

**Objectives:**

To understand natural subgroups of developmental trajectories for individuals with ASD based on symptoms measured by the Vineland™-II two-domain composite score of communication and socialization (Vineland™-II 2DC) in North America and Europe.

**Methods:**

This non-interventional longitudinal study pooled data from three sources (Autism Treatment Network [ATN], EU-AIMS Longitudinal European Autism Project [LEAP], and InFoR [Inserm, la Fondation FondaMental et Roche]) across different ages and regions. Up to four repeated measurements of Vineland™-II 2DC were available from ATN, typically within 3 years' post-

baseline assessment; one was available from EU-AIMS LEAP, 12–24 months after baseline; up to three were available from InFoR, 3, 12, and 24 months after baseline. Among 876 individuals (ATN [North America] N=526; EU-AIMS LEAP [Netherlands and UK] N=253; InFoR [France] N=97) with repeated measurements of Vineland™-II 2DC, growth mixture models were fitted to identify classes of adaptive behavior. Relationships between class and baseline characteristics were explored using multinomial logistic regression applied to baseline predictors in a complete-case analysis.

#### Results:

Two developmental trajectories were identified as measured by Vineland™-II 2DC: most individuals (836 [95.4%]) had a stable profile, and 40 (4.6%) had a steeply declining trajectory (**Figure 1**). Vineland™-II 2DC is age-adjusted, therefore these classes correspond to individuals who maintain their ability to adapt (stable profile) and those who progress but fall behind their typically developing peers (declining trajectory). Complete data to explore predictors of trajectory class were available for 705 individuals. Individuals were aged 1–55 years (median 9.8, interquartile range 5.3–14.5 years, based on age at first Vineland™-II assessment), primarily male (79.7%), and most had IQ  $\geq 70$  (72.8%). Significant predictors of trajectory class varied according to region, with IQ identified as a predictor in North America (odds ratio [OR] 1.03, 95% confidence interval [CI] 1.002–1.05,  $p=0.033$ ), indicating that individuals with lower IQ were more likely to be in the declining trajectory. Age and baseline Vineland™-II 2DC were identified as predictors in Europe (age: OR 1.17, 95% CI 1.06–1.29,  $p=0.003$ ; baseline Vineland™-II 2DC: OR 0.90, 95% CI 0.85–0.95,  $p<0.001$ ), indicating that younger children with lower baseline Vineland™-II 2DC scores were more likely to be in the declining trajectory class (**Figure 2**).

#### Conclusions:

Our study identifies developmental trajectories of ASD using a latent variable approach based on observational data from North America and Europe, thus providing insight into the progression of communication and socialization skills over time for individuals with ASD. To date, no published study has used such a range of locations and ages. Future research could assess additional Vineland™-II measurements and alternative measures of ASD symptoms. Application of these methods on cohorts in national and international registries will provide insights into the nature of the identified trajectories and may provide better understanding of subgroups that could gain most benefit from additional care/therapy.

#### 414.032 (Poster) Do the SF-36 and the Whoqol-Bref Measure Similar Aspects of Quality of Life in Autistic Adults?

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Background: Quality of life (QoL) is an important construct within the autistic population, particularly for understanding health-related impact. To measure QoL in autism, the Medical Outcomes Study 36-item short form survey (SF-36) and the World Health Organization Quality of Life BREF survey (WHOQOL-BREF) are frequently utilized, almost interchangeably; however, research has suggested that they measure QoL differently across populations and little is known about their similarity in autistic adults.

Objectives: We examined the relationship between the reports of autistic adults using the SF-36 and the WHOQOL-BREF to better understand how similarly they measure QoL. Pearson correlations were employed as a measure of effect size.

Methods: Data were collected from healthy controls ( $n = 21$ ), individuals with insomnia ( $n = 23$ ), and individuals with autism ( $n = 22$ ). Both measures were completed by the participants at the same sitting as part of a larger battery of measures. We compared the physical functioning, emotional well-being, and social functioning domains of the SF-36 with the physical health, psychological, and social relationships domains of the WHOQOL-BREF - being the domains that descriptively appear most closely related across measures.

Results: For the physical domains of the SF-36 and the WHOQOL-BREF, significant correlations were found for the autism ( $r = 0.60$ ), insomnia ( $r = 0.56$ ), and neurotypical ( $r = 0.48$ ) groups. For the emotional well-being/psychological domains, significant correlations were again found for the autism ( $r = 0.88$ ), insomnia ( $r = 0.86$ ), and neurotypical ( $r = 0.71$ ) groups. However, for the social domains, no significant correlations were found within any group. Rather, in the autism group, the social domain of the SF-36 was significantly correlated with the physical domain of both measures ( $r = 0.50$  for the SF-36 and  $r = 0.69$  for the WHOQOL-BREF), while the social domain of the WHOQOL-BREF was significantly correlated with the psychological domains of both measures ( $r = 0.80$  for both the SF-36 and the WHOQOL-BREF).

Conclusions: The SF-36 and WHOQOL-BREF demonstrated moderate to strong correlations for the physical and emotional/psychological domains (as well as other domains) in each population, with stronger correlations being found for the psychological domains. However, this was not found for the social domains, likely due to the differing content focus of each measure – with the SF-36 focusing on interference with social functioning and the WHOQOL-BREF focusing on satisfaction with relationships. While either measure may be appropriate for assessing physical and psychological factors of quality of life in an autistic adult population, further consideration is needed when considering social factors of quality of life.

**414.033** (Poster) Does Knowledge of Child Development Predict ASD Knowledge, Stigma, Recognition, and Treatment-Seeking?

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Background: General knowledge on child development could aid in recognition of atypical development. Research suggests that delays in autism identification could be due to low knowledge about child development and developmental milestones. Little research has focused on understanding the influence of general child development knowledge on autism-specific knowledge and stigma.

Objectives: To examine the influence of general child development knowledge on autism-specific knowledge and stigma, as well as the endorsement of needing and seeking treatment.

Methods: A total of 190 participants completed an online survey as part of a larger study, including a demographics questionnaire, random assignment to one of two vignette conditions depicting symptoms of ASD without mentioning the diagnosis, a mixed-method intervention-seeking measure regarding the vignettes, the Caregiver Knowledge on Child Development Inventory (CKCDI) measuring general child development knowledge, and the Autism Stigma and Knowledge Questionnaire (ASK-Q) measuring ASD-specific knowledge and stigma. Responses from the intervention-seeking measure were Yes/No to assess whether the vignette warranted professional treatment and whether one would take action to seek treatment.

Results: A series of linear and binomial logistic regressions examined the relation between CKCDI total score and ASK-Q knowledge and stigma scores, as well as dichotomized endorsement of the vignettes warranting and taking action to seek professional treatment. CKCDI score did not significantly predict ASD knowledge,  $F(1, 189) = 1.89, p > .05$ , or ASD stigma,  $F(1, 189) = 3.34, p < .10$ . ASD knowledge was independently examined as a potential moderator for the relation between CKCDI score and ASD stigma, but was not significant ( $p > .05$ ). However, CKCDI significantly predicted identification of need for evaluation,  $\chi^2(1) = 4.45, p < .05$ . The model explained 3.3% (Nagelkerke  $R^2$ ) of the variance in identification of the need for treatment and correctly classified 71.2% of cases. Those who responded “Yes” to the vignette warranting professional treatment had 1.049 times higher odds of having a higher CKCDI score than those who responded “No.” CKCDI score did not significantly predict taking action to seek treatment,  $\chi^2(1) = 1.72, p > .05$ .

Conclusions: General child development knowledge did not significantly predict ASD-specific knowledge, was trending towards significance with ASD stigma, and those who responded “Yes” to the vignette warranting professional treatment were more likely to have a higher CKCDI score than those who responded “No.” These results suggest that general child development knowledge does not significantly predict ASD knowledge, but may influence ASD stigma, increase one’s ability to recognize atypical behavior, and allow one to acknowledge when professional treatment could be warranted. However, the results also suggest that low knowledge of developmental milestones may not impact ASD-specific knowledge as it appears that ASD knowledge is a concept that stands apart from general child development knowledge. Moreover, while CKCDI score significantly predicted recognition of needing professional treatment, it did not predict one’s intent to seek treatment suggesting that a variety of factors may influence one’s decision to seek treatment. Future research should explore which facets of ASD knowledge predict treatment-seeking and which are deficit areas for parents.

**414.034** (Poster) Early Detection for Better Outcomes: Building Capacity to Identify and Support Children with Early Signs of Autism in Early Childhood Education and Care Settings

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Background:

Access to early intervention is dependent on timely and accurate identification of children showing early signs of developmental challenges, yet 22 % of Australian children have developmental delays that are undetected prior to school. Many children miss out on access to the National Disability Insurance Scheme (NDIS) due to high rates of under-identification of autism.

## Objectives:

This research programme aimed to build capacity within the early childhood education sector to monitor the development of young children in their care using evidenced- based processes to improve rates of detection of developmental delay in young children and facilitate access to early intervention.

## Methods:

Outcomes of developmental surveillance using The Social Attention Communication Surveillance- Revised (SACS-R) and the Parents Evaluation of Developmental Status (PEDS) in community health and early education settings were investigated and 14,113 children were monitored across health and early childhood education settings to establish effectiveness in the early identification of children with developmental challenges. Perspectives of stakeholders about early detection and accessibility of intervention through the NDIS are reported.

## Results:

Agreement between PEDS and SACS-R in identification of early signs of autism across both settings is only 54.84%;  $k = 0.161$ , 95 % CI (0.81 to 0.241,  $p < .0005$ ). Sensitivity of SACS-R (82%) was substantially higher than the ASD pathway on PEDS (6.7%) while interrater reliability between maternal child health nurses and early childhood education professionals was very high ( $k = 0.909$ ).

## Conclusions:

Strategic collaboration and implementation of evidence-based tools across health and education sectors can improve outcomes for children and promote access to funded early intervention supports.

**414.035** (Poster) Early Detection of ASD By Community-Based Screening Focusing on Sensory Processing Patterns  
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**Background:** It has become widely known that Autism Spectrum Disorder (ASD) has sensory problems. However, there are few studies on "patterns" of sensory processing. Identification of sensory processing patterns specific to ASD may contribute to early detection.

**Objectives:** The objective of this study was to identify specific classes of sensory processing patterns for the early detection of ASD.

**Methods:** This study targeted the total population sample of 3-year-old children in Hirosaki city, Japan (N = 1375). Caregivers of 3-year-old children completed questionnaires, including Sensory Profile short-version (SSP) and Social Responsiveness Scale Second Edition (SRS-2). We performed latent class analysis (LCA) to identify patterns of responses to the 7 domains of the SP-short (Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Under-responsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, Visual/Auditory Sensitivity). After identifying classes, t-test was performed to compare SRS scores between classes. Logistic regression analysis was conducted with the latent classes as the predictive variables and the SRS-2 cut-off scores as the objective variables.

**Results:** In LCA with the 7 section of SSP, a two-class solution was found to be the best solution. The class 1 was a group showing the average SSP score, accounting for 82.8% of the community. While, the class 2 was a group having atypical characteristics of sensory processing in which the scores of all SSP subscales were higher than those of class 1 ( $p < .001$ ,  $\eta^2 = .12-.51$ ). Comparing the SRS-2 scores between the groups, the score of class 2 was significantly higher ( $t = -24.7$   $df = 1374$   $p < .001$   $d = 1.58$ ). Logistic regression analysis with class 1 as the reference group revealed that the class 2 significantly predicted the cut-off classification of SRS-2 (Odds ratio = 18.5, 95%CI = 12.6 – 27.1  $p < .001$ ).

Conclusions: In the community-based screening, we conclude that certain patterns of sensory processing could support the diagnosis of ASD. We plan to track these children up to 5 years old, who will undergo in-person assessment for ASD. This will allow us to examine how adding sensory profile items to other questionnaire improve predictive validity of ASD diagnosis.

**414.036 (Poster)** Evaluating Feasibility and Acceptability of a Telehealth Model for Autism Spectrum Disorder Diagnostic Evaluations from Toddlerhood to Adulthood

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Background: Considerable delays between parents' first concerns related to ASD and formal diagnosis are well-documented. Public health initiatives designed to slow the spread of COVID-19 have presented even more obstacles for families seeking a diagnosis and warrant the development and testing of alternative diagnostic models (Narzisi, 2020).

Objectives: 1) To describe a telehealth diagnostic model implemented at an autism center to safely provide ASD diagnostic evaluations during the pandemic. 2) To document patient and psychologist acceptability of the telehealth model.

Methods:

Study procedures were approved by the Western Institutional Review Board. Participants included diagnostic patients seen through the clinic's telehealth diagnostic model ( $n = 99$ ; 26 females;  $M$  age = 9.10 years,  $SD = 7.65$ ; range = 1.25-38.42) from March through September of 2020. Parents of minor patients were invited to complete an online client satisfaction questionnaire ( $n = 48$ ). Telehealth acceptability questionnaires were completed for each patient by one of five licensed clinical psychologists.

Evaluations involved parent/caregiver interviews (90-minute phone interview adapted from ADI-R; 60-minute videoconference developmental history, and 45-60 minute phone or videoconference interview about adaptive functioning) and direct observation of the diagnostic patient, facilitated by telehealth technology. Parents of patients 7 years and younger used the Naturalistic Observation Diagnostic Assessment (NODA; Smith et al., 2017), a store-and-forward telehealth platform, to collect in-home videos prior to the telehealth appointment ( $n = 52$ ; NODA was used with some older children initially and upon parent request). When video evidence from NODA was inconclusive, the psychologist conducted a 45-minute structured behavioral observation through videoconferencing (developed by our clinic's team in response to the pandemic) on the day of the telehealth appointment. The structured behavioral observation was also used with all patients 8 years and older.

A feedback session was conducted through videoconferencing on the day of the telehealth appointment. If telehealth procedures were insufficient to make a diagnostic determination, the patient was scheduled for an in-person assessment.

Results:

A diagnostic determination was made for 92% of participants using only telehealth procedures. Seven participants (2 females; ages 3 to 11 years) required an in-person evaluation. Results from client satisfaction and psychologist acceptability questionnaires are reported in Tables 1 and 2. Patient age was not associated with parent-rated acceptability; however, there was a marginal negative association between patient age and psychologist reported effectiveness of NODA ( $\rho = -.21, p = .09$ ) and a significant positive association between patient age and psychologist-reported patient attentiveness during the behavioral observation ( $\rho = .47, p = .007$ ). Parents of females reported higher acceptability of telehealth procedures than parents of males (Table 1). Psychologist ratings did not differ significantly by patient gender (Table 2).

Conclusions:

Findings indicate that telehealth diagnostic procedures were acceptable for most diagnostic patients and highlight the potential of telehealth to increase families' access to diagnostic professionals. Interpretations of differences in parent acceptability by patient gender and associations with age will be discussed.

**414.037 (Poster)** Evaluating Reporter Agreement and Implications for Clinical Diagnosis of Autism Spectrum Disorder and Intellectual Disability

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**Background:** To receive a clinical diagnosis of intellectual disability (ID) and autism spectrum disorder (ASD), deficits in cognitive functioning and adaptive behavior must be present (*American Psychological Association*, 2013). Comprehensive clinical evaluation includes the use of multiple informants (Mash & Hunsley, 2005), but discrepancies occur between adaptive skill measures of youth with ASD, and youth with ID and ASD (Dickson, 2018; McDonald et al., 2016). Various factors may influence how informants respond to clinical rating scales including informant education level (Hattier et al., 2013) and youth cognitive ability (Dickson, 2018). More research is needed to evaluate discrepancies on adaptive measures and identify variables that predict discrepancies.

**Objectives:** We aimed to investigate discrepancies between parent and teacher ratings on a measure of adaptive behavior (*Adaptive Behavior Assessment System, Third Edition* [ABAS-3]) in a well-characterized clinical sample of 107 youth (*M* age 9y.,9m; 3y., 3m. to 17y, 7m) with ID (*n*=5), ASD (*n*=83), or co-occurring ID and ASD (*n*=15). We will investigate potential factors predicting discrepancies.

**Methods:** Data from youth who participated in evaluations at a specialist center for autism and neurodevelopmental disorders were extracted from an on-site database. Individuals were included if they received a diagnosis of ASD, ID, or ID and ASD and had scores from both a parent and teacher ABAS-3. Variables of interest included socio-demographic measures (e.g., caregiver SES), final diagnosis, IQ, and ABAS-3 standard cores (i.e., General Adaptive Composite [GAC], Conceptual, Social, Practical). Discrepancies between parent and teacher rating scores were identified using paired-sample *t*-tests (with Bonferroni correction) for the whole sample, and for the ID, ID and ASD, and ASD only subsamples. A Dirichlet component regression (Gueorguieva et al., 2008) will be used to evaluate predictors of identified discrepancies on ABAS-3 ratings.

**Results:** For the whole sample, parent and teacher ratings were moderately correlated for the GAC ( $r=.59, p<.001$ ), Social ( $r=.43, p<.001$ ), Conceptual ( $r=.60, p<.001$ ), and Practical scores ( $r=.59, p<.001$ ). Parent and teacher GAC scores were significantly different. Teacher ratings were higher on all domains (i.e., GAC:  $t[105]=-8.79, p<.001$ ; Conceptual:  $t[105]=-5.89, p<.001$ ; Social:  $t[105]=-8.46, p<.001$ ; Practical:  $t[105]=-9.87, p<.001$ ). This pattern held true for the ASD only subsample but not for the ID only, or the ID and ASD subsamples. The only significant difference in the ID and ASD subsample was on the Social domain with higher scores on teacher completed measures ( $t[14]=-3.05, p<.01$ ). No significant differences between ratings were found in the ID only group.

**Conclusions:** Teacher ratings on the ABAS-3 in this sample tended to be higher than parent ratings, but this pattern differed depending on final diagnosis. These findings are consistent with previous research evaluating informant discrepancies on the ABAS-3 for youth with ASD (Jordan et al., 2019), but the current study also included youth with ID, participants represented a larger age range, and a clinical sample was used. Additional analyses will investigate predicting variables. Limitations will be noted. Implications for practice in clinical and school settings will be discussed.

**414.038 (Poster)** Evaluating the Measurement Invariance of the CBCL between Minimally Verbal and Verbal Children with Autism Spectrum Disorder.

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Background:

Autism spectrum disorder (ASD) comprises a diverse range of language and cognitive abilities. Individuals with ASD experience high rates of co-occurring emotional and behavioral symptoms (EBS), although little research has considered EBS among autistic children of varying language abilities. An estimated 30% of individuals with ASD have minimally verbal language abilities (Howlin et al., 2014, Pickles et al., 2014). The relationship between language and EBS may depend on the type of measure of EBS (Fok & Bal, 2019). The Child Behavior Checklist (CBCL) is widely used in the assessment of EBS in children with ASD but may not appropriately estimate EBS in less verbal children because some items rely on verbal expression (Achenbach & Rescorla, 1991). While Dovgan et al., (2019) have demonstrated poor invariance of the CBCL in ASD with and without intellectual disability, previous work that compares CBCL scores across language groups should be interpreted with caution since there have been no studies that have specifically tested the invariance across language levels.

Objectives:

To determine the measurement invariance of the CBCL broadband internalizing and externalizing scales across minimally verbal (MV) and verbal (V) groups.

Methods:

Participants included 2,089 6-18 year old children ( $M_{age}=10.3$  years; 87% male) from the Simons Simplex Collection (Fischbach & Lord, 2010). Children were classified as MV if they received ADOS module 1 ( $n=311$ ), and V if they received ADOS modules 2-4 ( $n=1778$ ). The CBCL factor structure consists of two broadband (internalizing, externalizing) and five syndrome factors (Figure 1). We conducted a multi-group confirmatory factor analysis to examine the factorial invariance of the broadband factor structure across language groups using T-scores. We examined the configural, metric (constrained loadings), and scalar (constrained intercepts) invariance levels of model fit sequentially using statistics of chi-square, comparative fit index, and root mean squared error of approximation. Invariance models that change more than 0.015 with each sequential test indicate non-invariance (Chen, 2007).

Results:

At the configural and metric invariance levels, the CBCL broadband level demonstrates good overall model fit and equivalent factor loadings between the language groups (Table 1A). However, when we constrained the intercepts at the scalar level of invariance, there was a significant decrement in model fit indicating non-invariance (Table 1A). Further examination of the modification indices demonstrated significant differences due to the intercepts of the anxious/depressed ( $MV<V$ ) and withdrawn/depressed ( $MV>V$ ) scales (Table 1B).

Conclusions:

The 2-factor structure of CBCL internalizing and externalizing symptoms achieved configural and metric invariance, providing support for the continued use of the CBCL *within* varying language levels of ASD. However, the CBCL internalizing and externalizing breakdown was non-invariant at the scalar level, as the MV group demonstrates a lower intercept for the Anxious/Depressed syndrome scale but higher on the Withdrawn/Depressed syndrome scale. Due to intercept non-invariance, examiners cannot validly compare CBCL internalizing and externalizing T-scores *across* language groups. Future development of measures that are invariant across language groups is a critical research priority that will advance understanding of transdiagnostic mechanisms of EBS across different ability levels.

#### **414.039** (Poster) Evidence Map of Spanish-Language Measures of Autism Symptoms: A Review of Translation Methods and Psychometric Properties

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Background:

Spanish is the primary language of 20 countries, the second most common native language spoken in the world, and the fourth most common language spoken overall (Eberhard et al., 2020). In the last several decades, many clinical and research instruments measuring behavioral features of autism have been translated into Spanish. Traditionally, a forward-back translation approach has been used with parent-report and self-report instruments, with the assumption that psychometric properties of the tools (e.g. diagnostic validity, reliability, etc.) is naturally maintained from the original version (Soto et al., 2015). However, recent studies suggest that this approach may not be sufficient to maintain various dimensions of equivalence between language versions of an instrument, including psychometric properties (DuBay et al., 2019). Further, transparency in the translation and re-norming process is imperative to document relevant information that will help inform clinical and research teams who wish to use such instruments (Maneesriwongul et al., 2004; Swaine-Verdier et al., 2004).

Objectives:

The objective of this poster is to catalogue the parent- and self-report autism measures that are available for clinical or research use in the Spanish language (all dialects). We will describe translation methods and psychometric properties observed among Spanish speaking populations for each tool.

Methods:

A literature search was conducted via seven databases, using terms such as "autism," "translation," "assessment," "validation," and "Spanish." A list of instruments with Spanish translations was compiled via these searches, similar Google Scholar searches, and publishing company websites. Additional sources of data will include grey literature, instrument manuals, publishing companies, and original instrument developers in order to catalogue translation methodology and psychometric data for each identified instrument.

#### Results:

Instruments with Spanish translations include the Modified Checklist for Autism in Toddlers- Revised, Autism Spectrum Rating Scales, the Social Responsiveness Scale, Social Communication Questionnaire, Gilliam Autism Rating Scale, Parents' Evaluation of Developmental Status, and the Childhood Autism Rating Scale, among others. Descriptions of translations methods and observed psychometric properties will be presented for each tool and translation.

Preliminary results indicate that translations made prior to around 2010 typically follow the traditional forward-back methodology. Instrument developers often fail to re-assess psychometric properties in a Spanish-speaking sample for these translations. When psychometric properties are re-assessed, discrepancies are noted in many cases. Translations made after around 2010 frequently include more rigorous quality checking or cultural adaptation approaches, such as multiple translators, expert review panels, and qualitative pre-testing. Additionally, re-assessment of psychometric properties is more common among these translations, with translations meeting higher levels of standards. Also, most identified translations use the Spain dialect of Spanish, with several translations designed specifically for Latin American dialects, such as US Spanish, Mexican Spanish, Chilean Spanish, and Argentine Spanish. Translations and norming studies are extremely limited, if not absent, in other Latin American dialects.

#### Conclusions:

Findings from this review will provide much needed overview of the state of translated instruments in Spanish language up to date. This knowledge will enable researchers and clinicians searching for effective and reliable tools to utilize in their work with Spanish-speaking populations.

#### **414.040** (Poster) Examining Sex and Ethnic Parity in the Psychometric Properties of the Screening Tool for Autism in Toddlers (STAT)

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**Background:** Sex and ethnic disparities exist in the ages and rates at which children receive an Autism Spectrum Disorder (ASD) diagnosis (Wallis et al., 2020). A contributing factor may be that DSM diagnostic criteria are based primarily on characteristics present in white males (Halfon & Kuo, 2013). Early ASD screening is critical for improving long-term child and family outcomes by leading to early diagnosis and ASD-specific intervention (Zwaigenbaum et al., 2015), yet it is unknown whether screening tools may also be contributing to sex and ethnic disparities in detection, and specifically whether they are biased toward detecting white males. The purpose of this study was to examine whether the Screening Tool for Autism in Toddlers (STAT; Stone 2000, 2004), a 20-minute play-based stage-2 ASD screening measure, shows sex and ethnic parity in its screening properties. The STAT is used in a variety of contexts, including early intervention programs, primary care settings, and specialized ASD clinics, with a diverse population across urban and rural settings. It is therefore important to assess whether the STAT is equally effective across sex and ethnic groups.

**Objectives:** This study used an expanded version (STAT-E) that was developed for a formative research project for the National Children's Study (NCS). This version can be scored using the original scoring system as well as a system that incorporates examiner subjective ratings of children's social engagement (SE), atypical behavior (AB), and language level (LL). We examined: (1) whether the STAT-E, with its original scoring, showed sex and ethnic disparities when used in the diverse NCS sample, and (2) whether the examiner ratings of SE, AB, and LL increased the sex and/or ethnic parity of the STAT-E in this sample.

**Methods:** Logistic regression, ROC curves, and classification matrices were used on a sample of 236 two-year-old children to determine the psychometric properties of the STAT-E scored traditionally and with the new ratings for each of the four groups (male, female, Non-Hispanic, Hispanic). Screening results were compared to gold-standard clinical diagnoses using the ADOS-2. Chi-square tests were used to determine whether the true positive rates between groups were statistically different.

**Results:** The original STAT scoring system resulted in appreciably better psychometrics for males than females, i.e., correctly identifying 12% more males than females (Table 1). When including the new STAT-E ratings of SE, AB, and LL, the overall sensitivity of the STAT-E increased for all groups and the sex and ethnic parity increased for all psychometric statistics Table 2). However, there was no statistical evidence that the true positive rates for the STAT-E, scored traditionally, showed disparities for sex ( $X^2 = 1.3554$ ,  $df = 1$ ,  $p = 0.2443$ ,  $\phi = 0.09$ ) or ethnicity ( $X^2 = 0$ ,  $df = 1$ ,  $p\text{-value} = 1$ ,  $\phi = 0$ ).

**Conclusions:** Including subjective examiner ratings of SE, AB, and LL improved the sex and ethnic parity of the STAT-E, which is important for a stage-2 screener. Further studies are needed before these ratings can be included in formal scoring algorithms.

**414.041 (Poster)** Exploration of Anxiety Symptoms in Three-Year-Olds with and without ASD Reveals Distinctive Symptom Structure

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**Background:** Anxiety disorders are the most prevalent form of psychopathology in youth (Vasey et al. 2014; Lepine 2002), including youth with ASD (van Steensel et al. 2011). Anxiety typically emerges at school age (Vasey et al. 2014) but symptoms may appear earlier (Vasa et al., 2020). It is not known whether anxiety presents similarly in children with and without ASD (Kreiser & White 2014). Instruments measuring anxiety in young children have been constructed using typically-developing samples; validity in children with ASD is not fully established (Grondhuis & Aman 2012). We describe exploratory analyses of two parent-report anxiety measures in a sample of three-year-olds with ASD and a clinically heterogeneous, age-matched comparison group.

**Objectives:** (1) Assess three-year-olds with and without ASD on subscales of the Early Childhood Inventory-5 (ECI-5; Gadow & Sprafkin 2017) and Preschool Anxiety Scale-Revised (PAS-R; Edwards et. al. 2010). (2) Explore the structure of anxiety symptoms in three-year-old toddlers and assess potential ASD-specific differences.

**Methods:** The parents of age-matched three-year-olds ( $N=138$ ,  $M_{Age}=39.04\text{mo}$ ,  $SD=3.01$ ) with ASD ( $N=60$ ,  $M_{Age}=39.30\text{mo}$ ,  $SD=3.30$ ) and without ASD ( $N=78$ ,  $M_{Age}=38.83\text{mo}$ ,  $SD=2.78$ ) completed the ECI-5 and the PAS-R, anxiety measures normed on 3-to-5-year-olds. The non-ASD group encompassed siblings of children with ASD, as well as typically-developing and developmentally-delayed toddlers. We assessed internal reliability with Cronbach's alpha ( $\alpha$ ) and evaluated group differences in scores using Wilcoxon tests. Exploratory factor analysis (EFA) was performed on all items from both instruments, using principal axis factoring with Varimax rotation. We assessed group differences in factor scores using Wilcoxon tests.

**Results:** Both ECI-5 ( $\alpha$ : Generalized Anxiety(GAD)= 0.74, Social Anxiety(SA)= 0.58, Separation Anxiety(SEP)=0.63) and PAS-R ( $\alpha$ : GAD=0.75, SA=0.76, SEP=0.68, Specific Phobia (SP)=0.76) subscales showed only low to moderate internal reliability. Group differences were found for ECI-5 GAD (ASD>Non-ASD,  $p<0.0001$ ), SA (ASD>Non-ASD,  $p= 0.0020$ ), and SP (ASD>Non-ASD,  $p=0.0052$ ) subscales but none of the PAS-R subscales. The combined item-set was suitable for factor analysis (KMO=0.72, Bartlett's test: $p <0.001$ ). Six factors (eigenvalues>1) were retained from EFA (39.5% variance, RMSEA=0.065, RMSR=0.06, BIC=-3290) and did not entirely align with either instrument's published structure. Group differences in factor scores were found for three factors ([F2: ASD>Non-ASD, $p<0.0001$ ], [F4: Non-ASD>ASD,  $p=0.0069$ ], [F6, Non-ASD>ASD,  $p=0.0052$ ]), with a fourth approaching significance (F1, ASD>Non-ASD,  $p=0.055$ ) (see Table 1 and Figure 1).

**Conclusions:** Three-year-olds with and without ASD differed in the GAD, SA, and SP subscales of the ECI-5 but low-to-moderate internal reliability warranted investigation. Besides showing that the structure of anxiety symptoms in clinically-heterogeneous three-year-olds may not conform to that of published measures, EFA suggested that multiple sub-constructs exist for GAD. Items loading onto F2 (ASD > Non-ASD) concern activity level, inattentiveness, and irritability; in contrast, F4 (Non-ASD > ASD) items describe worry and complaints about health. The finding of group differences in sub-constructs of GAD suggests that ASD-specific anxiety symptom patterns in very young children may be obscured by published subscales. Further examination of anxiety symptom structure in children with and without ASD within narrow developmental epochs will inform development of valid measures of anxiety for very young children with ASD.

**414.042 (Poster)** Exploring Caregiver Differences in Naturalistic Developmental Behavioral Intervention (NDBI) Strategies  
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Background: Caregivers strategy use plays a critical role in caregiver-mediated intervention for children with ASD. Most caregiver-mediated interventions target increasing engagement level between children with ASD and caregivers by supporting caregivers in the use of NDBI strategies (Beaudoin, Sébire, & Couture, 2019). Yet, little research has examined individual differences among caregivers in their use of NDBI strategies. Even fewer studies have examined the effect of caregiver gender on variability in NDBI strategy use or fathers' involvement in early intervention (Saunders et al., 2001).

Objectives:

1. Compare mothers' and fathers' use of NDBI strategies with their child during free play.
2. Explore individual differences across NDBI strategy use.
3. Examine relationship between caregiver NDBI strategies and dyadic engagement.

Methods: Participants included 35 triads of toddlers ( $M_{\text{age}} = 20.54$  months) and their mothers and fathers. Mothers and fathers differed significantly in age ( $p < 0.05$ ) but not education level. Families were enrolled in a randomized control trial of Early Start Denver Model (ESDM; Rogers et al., 2019) vs a standard of care control group. Caregiver-child interaction videos were included if mother-child and father-child timepoints were within one month of one another (82.8% within 1 week of each other). To minimize variability due to treatment effects, ESDM groups only included caregivers with timepoints within a month of each other *at baseline*; these criteria were not used for families assigned to the control condition. A Measure of NDBI Strategy Implementation-Caregiver Change (MONSI-CC; Vibert et al., 2019) was used to assess 5 strategies (Table 1) and the level of dyadic engagement. Paired sample t-tests compared scores on the MONSCI-CC by caregiver gender. Follow-up analyses using ANCOVA were run to control for a confounding effect of caregiver age. Pearson correlations examined the relationship between dyadic engagement and caregiver strategies.

Results: Results from the paired sample t-tests revealed significant differences between mother and father use of active teaching and learning ( $t[34]=2.83, p=.01$ ) and naturally reinforcing and scaffolding strategies ( $t[34]=2.13, p=.04$ ). Controlling for caregiver age, caregiver gender differences remained significant for active teaching and learning strategies ( $p=.046$ ) but not naturally reinforcing and scaffolding strategies ( $p=.50$ ). As shown in Figure 1, significant variability was found across caregivers regardless of gender. Within mothers, dyadic engagement was significantly correlated to strategies targeting opportunities for engagement ( $r=.38, p=.02$ ). Within fathers, dyadic engagement was significantly correlated to strategies targeting opportunities for engagement ( $r=.42, p=.01$ ) as well as those targeting environmental set-up ( $r=.43, p=.01$ ) and active teaching and learning ( $r=.57, p<.01$ ).

Conclusions: Mothers and fathers demonstrated similar levels of many NDBI strategies, but significant differences emerged regarding active teaching and learning strategies. These caregiver gender differences in the levels of NDBI strategy use, combined with variability among individuals, call for a personalized approach when programming intervention focused on improving caregiver use of NDBI strategies. Although exploratory, strategies focused on opportunities for engagement (e.g., providing choices, turn-taking, expectant waiting) may be helpful for both mothers and fathers to build increased rates of dyadic engagement.

#### **414.043** (Poster) Feasibility of ASD Risk Assessment Training and Real-Time Support Via the Paisley Digital Platform: Preliminary Convergent Validity of the ASD-PEDS with Established Instruments

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Background: Primary care providers (PCPs), who are on the frontlines of developmental assessment, often lack adequate training in the early identification of ASD. Existing tools require extensive time, training, and financial investment, making them impractical in most community settings. As a result, many PCPs screen children for risk and then refer them either to overburdened diagnostic centers or to early intervention systems where services are limited without a clear diagnosis. To support PCPs that want to provide diagnostic feedback within primary care, any tool developed should provide real-time guidance in recognizing ASD symptoms as well as clear indicators of probability of ASD presence.

Objectives: In prior work, we developed Paisley—a digital platform for guided and rapid early assessment of ASD risk in toddlers—and demonstrated its feasibility across a range of health care professionals. Having demonstrated the feasibility of Paisley usage, we now examine the preliminary construct validity of an ASD risk assessment tool (ASD-PEDS) as delivered via Paisley. Specifically, we assess the convergent validity of the ASD-PEDS as delivered by providers using Paisley with established instruments, including a parent-report screener (Modified Checklist for Autism in Toddlers, Revised [M-CHAT-R]),

a gold standard diagnostic tool (Autism Diagnostic Observation Schedule, Second Edition [ADOS-2] Module 1 and Toddler Module), and an adaptive behavior interview (Vineland Adaptive Behavior Scales-III [VABS-III]).

Methods: Participants included 31 children (ages 18-36 months; 23 male and 8 female) clinically referred for ASD evaluation. Nine pediatric providers representing a range of professional backgrounds (e.g., developmental therapists, clinical psychologists) conducted screening assessments using the ASD-PEDS as guided and scored by Paisley. A separate provider, blinded to the results of the Paisley/ASD-PEDS assessment, then completed a comprehensive assessment using the MCHAT-R, ADOS-2, and VABS-III, and provided a “best estimate” clinical diagnosis (Yes/No ASD) for each child.

Results: We computed Pearson correlation coefficients between the ASD-PEDS total score and the scores of the aforementioned instruments. The ASD-PEDS total score is computed as the sum of seven behavioral codes, each taking on a value between 1 and 3, thus yielding a score range of 7-21, with larger scores corresponding to greater likelihood of ASD presence. The ASD-PEDS total score showed (a) a statistically significant positive association with the M-CHAT-R total score ( $r = 0.51, p = .005, CI .18$  to  $.74$ ), (b) positive associations with the total scores of both the ADOS-2 Module 1 ( $r = 0.54, p = .069, CI -.05$  to  $.85$ ) and the Toddler Module ( $r = 0.86, p < .001, CI .62$  to  $.96$ ), and (c) a statistically significant negative association with the VABS composite score ( $r = -0.64, p < .001, CI -.82$  to  $-.37$ ). The directions of all of these associations are consistent with expectations, supporting the preliminary convergent validity of the ASD-PEDS severity score

Conclusions: Research remains ongoing and further work is needed to demonstrate the discriminant validity and reliability of the tool. Although preliminary, the observed correlations between the ASD-PEDS total score and other established metrics provide early evidence of the convergent validity of the novel instrument.

#### **414.044** (Poster) How Does Parent and Examiner Question Use Differ during Natural Language Sampling?

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Background: Natural language samples (NLS) are a rich source of information about the verbal abilities of minimally and low-verbal (MLV) individuals with ASD (Barokova & Tager-Flusberg, 2018). Past research has shown that children and adolescents with autism speak more and use a higher number of different words when with their parents than when with examiners but these measures were not related to the child's speech (Barokova et al., 2020; Kover et al., 2014). Here we focus on the administrator's use of questions in this same data set because grammatically complex and open-ended questions have been reported to promote child language (Capps et al., 1998; Goodwin et al., 2015; Nadig & Bang, 2017). Examining the grammatical and semantic complexity of adult questions may provide insight on why MLV children/adolescents use more lexically diverse speech when with their parents.

Objectives: To compare **I.** the grammatical complexity and **II.** the semantic complexity of adult questions during an NLS. **III.** To examine associations between adult and child/adolescent speech.

Methods:

Twenty-two (4 females) children/adolescents with ASD (ages 6;6 to 19;7 ( $M=12;6$ )) participated. Examiners in the lab and parents in their home collected a NLS following ELSA-A protocol (Barokova et al., 2020b) that were transcribed using SALT (Miller et al., 2011). Questions were coded using a novel scheme for grammar/form, and lexical/semantic complexity. Form codes included Yes/No, Wh-, or No Syntax/Intonation. Semantic complexity codes included Closed (most constrained), Open-Low, or Open-High (least constrained) depending on the constraints on potential responses. Additional measures of grammatical complexity (noun-verb ratio) and lexical diversity (number of different words; NDW) were extracted for all questions. A kappa above .8 was achieved for reliability for 20% of transcripts at all coding levels.

Results:

Analyses involved paired t-tests (or its nonparametric equivalent) and Spearman's rank correlations (multiple comparisons correction critical **p-value is .01**). Questions made up 31.7% of parent speech ( $SD=.10$ ) and 31.37% of examiner speech ( $SD=.09$ ;  $t(21)=.003, p<0.913$ ).

**I.** Parents used significantly fewer Yes/No questions than examiners ( $t(21)=3.849, p=.001$ ), but not for other forms (**Table 1**). Parents questions had a higher ratio of nouns to verbs ( $t(21)=-4.945, p<.001$ ).

II. Parents' questions had lower NDW than examiners' ( $t(21)=4.44, p<.001$ ), but there were no differences in the degree of semantic openness.

III. The noun-verb ratio of examiner questions was positively correlated with participants' frequency of utterances ( $r_s=.562, p=.006$ ). No other measures of examiner or parent question use were correlated with measures of child/adolescent expressive language (Table 2).

Conclusions:

Parent and examiner questions differed in form, grammatical complexity, and lexical diversity. However, only grammatical complexity of examiner speech correlated with participant speech. These results suggest that parents elicit more speech from their children not because of linguistic differences, but perhaps because of non-linguistic factors such as familiarity and comfort level.

**414.045 (Poster)** I Know How I Am Feeling! Understanding Similarities and Discrepancies between Adolescent-Parent Dyads' Reports of Autistic Youths' Emotional States across a Randomised Controlled Trial of Kontakt®

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Background: Autistic youth have historically been perceived as inherently unreliable in reporting their emotional states, with parent proxy-report currently the primary measure used to understand their emotional experiences. There is however growing recognition of the importance of capturing autistic adolescents' self-reports, acknowledging that they are the experts of their own experiences.

Objectives: This study employed experience sampling method (ESM) to understand the similarities and discrepancies between autistic adolescents self-reported and their parents' proxy reports of adolescents' emotional states while participating in a 7-month randomised controlled trial (RCT) evaluating the efficacy of KONTAKT® social skills group training intervention compared to an active control cooking group (Super Chef).

Methods: Adolescents and their parents rated the adolescent's daily emotional states (happy, calm, anxious, lonely and afraid) on a 10 point Likert scale for the 7 month period. Overall, 62 autistic adolescents aged 12 to 17 ( $m=13.8, SD=1.5$ ) with an  $IQ>70$  and their parents met inclusion criterion of both answering 33% of daily texts (210 texts).

Results: An overall response rate of 64.8% (33.6-97.7) indicated a good adherence to ESM. Multilevel analysis comparing adolescent self-reports and their parents' proxy reports showed a small, but significant difference between the dyads' reports regardless of their group allocation, with adolescents perceiving all their emotions, with the exception of happiness, more positively than their parents. No further difference was observed between adolescent-parent dyads' reports for associated factors including age, gender, internalising and externalising behaviours, and group allocation over the 7 months of the trial.

Conclusions: Given the length and intensity of data collection employed in this study, these findings present strong evidence that autistic adolescents are capable of self-reporting their emotional states via ESM, highlighting the utility of ESM as a tool in enabling insight into the emotional state of autistic youth.

**414.046 (Poster)** Identifying Which Patients Seeking Autism Spectrum Disorder Evaluation May Receive Diagnostic Clarity through an Initial Virtual Assessment

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**Background:** Due to the COVID-19 pandemic, evaluation of autism spectrum disorder (ASD) has taken on different assessment modalities. Traditionally, ASD evaluations are completed in-person and include caregiver interview, behavioral observations, cognitive testing, and ASD specific measures (e.g., Childhood Autism Rating Scale, 2<sup>nd</sup> Edition; Autism Diagnostic Observation Schedule, 2<sup>nd</sup> Edition) with some measures requiring in-person administration. As a result of social distancing and safety precautions, virtual visits (VV's) evaluating for ASD have become common practice. VV's have the potential to increase access to evaluation and decrease health risks while expediting the patient's access to ASD specific treatments. However, it is unclear which patients are likely to receive diagnostic clarity during a VV and which patients are likely to be referred for further testing.

**Objectives:** The current study investigates which patients are likely to receive diagnostic clarity during an ASD VV and which patients are likely to be referred on for further in person testing based on information found within intake paperwork (e.g., demographic, psychiatric, adaptive, and educational factors) prior to being seen.

**Methods:** The sample included 38 children (24 males;  $M_{age} = 7.78$ ,  $SD_{age} = 4.65$ ; Caucasian = 75.7%) and their caregivers who engaged in ASD VV's. Demographic variables (e.g., sex, age), adaptive skills (i.e., Adaptive Behavior Assessment System, 3<sup>rd</sup> Edition; ABAS-3), psychiatric history, behavior and psychiatric concerns (i.e., Behavioral Assessment System for Children, 3<sup>rd</sup> Edition; BASC-3), individualized education plan (IEP) classification, and outcome of the VV (i.e., ASD diagnosis, further testing recommended) were collected. Thirteen participants (34.21%) received an ASD diagnosis during VV while 23 participants (60.53%) were referred for in-person testing. Two participants (5.26%) were given other psychiatric diagnoses and ASD was ruled out. These 2 participants were excluded from analyses (final  $n=36$ ). Ultimate diagnostic outcomes from in-person testing have not yet been collected for participants referred for further testing.

**Results:** Sex ( $r=0.19$ ,  $p=.307$ ) and age ( $r=-0.04$ ,  $p=.849$ ) did not significantly relate to VV diagnostic outcome and were not considered further. Regression analyses revealed higher parent-reported behavioral concerns ( $b=-0.03$ ,  $SE=0.01$ ,  $\beta=-0.84$ ,  $t=-3.36$ ,  $p=.015$ ) and not having an IEP classification of ASD ( $b=-0.90$ ,  $SE=0.24$ ,  $\beta=-0.57$ ,  $t=-3.68$ ,  $p=.014$ ) were predictive of recommendation of in-person testing. While not significant, the number of previous psychiatric diagnoses trended to recommendation of in-person testing ( $b=-0.13$ ,  $SE=0.05$ ,  $\beta=-0.37$ ,  $t=-2.35$ ,  $p=.066$ ). Adaptive skills were not related to VV diagnostic outcome ( $b=-0.01$ ,  $SE=0.01$ ,  $\beta=-0.21$ ,  $t=-1.47$ ,  $p=.201$ ).

**Conclusions:** VV's have limitations such that not every patient is able to receive diagnostic clarity, at which time a referral for in-person testing may be deemed appropriate. Findings suggest individuals presenting for a virtual ASD evaluation with comorbid behavioral concerns and prior psychiatric diagnoses, as indicated by intake paper, may require in-person evaluation for diagnostic clarity. Data indicate patients with fewer behavioral and mental health concerns, as indicated by intake paperwork, as well as a pre-existing educational classification of ASD are more likely to receive an ASD diagnosis during a VV. VV's may decrease burden on families who may not require in-person testing.

#### **414.047 (Poster) Innovative Approaches Implemented By UK Childhood Autism Diagnostic Services to Manage Increased Referrals and Reduce Waiting Times**

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*Background:* Accessing a childhood autism diagnostic assessment is a key step to gain subsequent appropriate support; however, UK NHS waiting lists are longer than those suggested by national guidance. The number of assessments teams are required to complete is a significant barrier to timely diagnosis. Identifying novel and effective methods to deliver high quality, timely assessment is a clinical and parent priority.

*Objectives:* Identify innovative approaches implemented by UK childhood autism diagnostic assessment services to improve provision.

*Methods:* A UK clinical practice survey was developed in consultation with clinicians and parents (semi-structured format with open/closed response options). UK childhood autism diagnostic assessment services (for children aged 1-18 years) were recruited through clinical and professional networks and mailing lists from June-November 2020. Data collection was via online survey. Analysis used descriptive statistics and content analysis.

*Results:* Responses were from 101 UK childhood autism diagnostic assessment services. Teams were from a range of locations: mixed urban/rural (64%) urban (31%) and rural (5%). 49% of respondents ( $n=49$ ) were from Paediatric services (Community/Neuro-disability/Child development teams); while 40% ( $n=41$ ) were from Child and Adolescent Mental Health Services (CAMHS) and Children and Young People's Services (CYPS). 11% of respondents ( $n=11$ ) were from integrated, independent and learning disability services. 25% of teams ( $n=25$ ) had access to data on referrals and assessments during the years 2015-19. Of those, 88% reported increasing referrals. The median number of referrals in 2015 was 150, rising to 378 in 2019; a 152% increase. 76% of teams ( $n=19$ ) reported increased assessments; the median number of assessments in 2015 was 130 rising to 218 in 2019; a 67% increase.

Teams described capacity challenges with completing the required number of assessments. 48% ( $n=48$ ) described one or more long-term staff vacancies; 70% ( $n=70$ ) described difficulties having the right MDT expertise to undertake the assessments required.

Teams described adaptations they had made to service provision in order to address challenges. 57% of teams (n=57) changed their multidisciplinary team (MDT) skill mix e.g. by employing teachers, nurse specialists, or by training more professionals to be diagnosticians. 19% of teams (n=19) had integrated local Paediatric services with CAMHS/CYPS. 71% of teams (n=71) adjusted how they obtain good quality information at point of referral e.g. from Early Help Services, nursery or school. 66% of teams (n=66) had introduced questionnaires for parents and education professionals to complete prior to referral/pre-first assessment appointment. Finally, 45% of teams (n=45) had introduced the use of digital technology/computerised systems/software. Further innovations described by teams included involving non-qualified staff in assessments (e.g. trainees, assistants and education staff), virtual assessments, group assessments, training CAMHS professionals to take a developmental history and screen for co-occurring conditions, and using private contractors to complete diagnostic assessments.

*Conclusions:* Innovative approaches that are being used in UK NHS autism diagnostic assessments are relevant internationally. The next stage in our research programme is identifying which approaches are most effective in reducing waiting times, whilst delivering high quality assessments that lead to valid diagnostic outcomes and high levels of parent and young person satisfaction.

**414.048 (Poster)** Intellectual Disability in a Group of African Children with Autism Spectrum Disorder: Associated Factors and Implications for Educational Placement

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**Background:** Intellectual disability and autism spectrum disorder are chronic, commonly co-occurring and severely disabling neuro-developmental disorders yet diagnostic distinction is obscure and often overlooked especially among African children. Distinct diagnoses and associated factors are implicated in the appropriate intervention and optimal child outcome for children with developmental disabilities.

**Objectives:** This study examined prevalence of intellectual disability and its correlates in a group of children with Autism Spectrum Disorder in Nigeria, sub-Saharan Africa.

**Methods:** In a cross-sectional study, seventy-five children with ASD were recruited from the Child and Adolescent Mental Health Service Centre in Lagos, Nigeria. The instruments used for data collection were the socio-demographic and clinical questionnaires, the Indian scale for Assessment of Autism (ISAA), Ravens Progressive Matrices (RPM) and comprehensive clinical assessment. Data was analysed with the use of Statistical Package for Social Sciences.

**Results:** The mean age of the study participants was  $9.12 \pm 4.23$  with a male predominance (69.3%). The prevalence of intellectual disability among children with Autism Spectrum Disorder was 64%. Factors that were significantly associated with intellectual disability in ASD were female gender ( $p = 0.001$ ), low child educational level ( $p = 0.002$ ), school type ( $p = 0.012$ ), big family size ( $p = 0.013$ ), seizure ( $p = 0.001$ ), and ASD severity ( $p = 0.002$ ).

**Conclusions:** Intellectual disability is highly prevalent in African children with diagnosis of ASD. Socio-demographic and comorbidity factors are strongly associated with the developmental disability. Findings of this study have important implications for clinical assessment and educational planning for individuals with autism spectrum disorder in Africa.

**414.049 (Poster)** Interaction of Sex and Items on the M-CHAT Increases Specificity of Autism Identification

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**Background:**

Risk for ASD is strongly impacted by biological sex<sup>1</sup>. However, sex is seldomly explicitly incorporated into screening tests for ASD<sup>2</sup>. The Modified Checklist for Autism in Toddlers (M-CHAT) is a validated screening tool used to evaluate ASD risk in toddlers<sup>3</sup>. An open question is how M-CHAT sex-specific differences<sup>4</sup> combine to predict risk and subsequently impact overall screening performance.

**Objectives:**

To explore the interaction of sex and M-CHAT items and how incorporation of these interactions impact M-CHAT sensitivity.

## Methods:

This study uses data from the Autism Birth Cohort Study (ABC), a sub-study of the Norwegian Mother, Father, and Child Cohort Study (MoBa), a prospective general population pregnancy study<sup>5</sup>. 54,455 participants (26,646 females, 27,809 males) born 1999-2009 completed the M-CHAT as part of an 18-month developmental questionnaire. ASD diagnostic status was determined at approximately 42 months in the ABC clinic or by the discharge diagnosis in the National Patient Registry. Of the 54,455 participants, 332 received ASD diagnoses. Logistic regression modelled ASD outcome prediction based on contributions of (1) individual items and (2) individual items interacting with sex. These models were compared to M-CHAT-R<sup>6</sup> scoring algorithms applied to the M-CHAT data (here called the M-CHAT-20 model), which yielded baseline sensitivity=27.6%, specificity=94.9%. We compared sensitivity between models at the baseline 94.9% specificity using McNemar tests and explored significant contributors to prediction in both models.

## Results:

Not including sex in the model, nine items significantly contributed to ASD prediction (Table 1), yielding a sensitivity of 30.1% in males, 30.9% in females, and 30.3% overall. Including sex in the model, five items contributed to increased general risk for ASD, and one additional item was associated with increased ASD risk for males (Table 2), resulting in a sensitivity of 38.3% in males, 23.6% in females, and 36.0% overall. As expected, sex coefficients indicated lower risk for ASD in females versus males (log-odds  $M=-1.82$ ,  $SD=.21$ ,  $p<.001$ ). The sensitivity in the model including sex was significantly greater than in the M-CHAT no-sex model ( $p<.001$ ) and in the M-CHAT-20 model ( $p<.001$ ). The strength of the sex model compared to no-sex model was driven by the significant improvement in sensitivity in males ( $p<.001$ ). Sensitivity was not significantly different between models for females ( $p=.134$ ).

## Conclusions:

These results suggest that explicit inclusion of sex into screening development may yield additional strategies for optimizing screening performance. For the M-CHAT, not looking to where a caregiver points was associated with increased risk for ASD for boys but not girls, and several items did not contribute significantly to models once sex was included. Future investigations are required to unpack the contributing factors responsible for differences induced by explicitly modeling sex in risk prediction, potentially resulting in more streamlined screening for ASD by sex, as well as to examine potential differences in the M-CHAT-R (vs. M-CHAT) once data from longitudinal prospective population studies are available.

1.Loomes et al. 2017. JAACAP.

2.Evans et al. 2019. JCCP.

3.Robins et al. 2001. JADD.

4.Oien et al. 2017. JADD.

5.Stoltenberg et al. 2010. Mol.Psych.

6.Robins et al. 2014. Pediatrics.

**414.050** (Poster) Interdisciplinary Assessment for Autism in Young Children: Comparative Analysis of Two Interdisciplinary Clinics at an Academic Medical Center

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Background: Although the behavioral symptoms of autism generally become apparent between 1 and 2 years of age for experienced clinicians (Kozlowski et al., 2011), many children do not receive a diagnosis until later childhood. The CDC established Autism and Developmental Disabilities Monitoring (ADDM) Network reports a much later median age (i.e., four years, five months) for earliest ASD diagnosis. Early diagnosis of ASD can be delayed by a myriad of factors including presentation of behaviors, comorbid disorders, race, gender, and limited access to qualified providers. It is widely accepted that early diagnosis of ASD is imperative given the considerable effect early intervention has on later outcomes. The “gold standard” for a diagnostic evaluation of ASD involves the clinical judgment of a qualified interdisciplinary team to determine diagnosis,

which includes utilizing empirically- sound diagnostic instruments, clinical assessment, caregiver report, and behavior observations. The core features of an evidence-based assessment for ASD includes caregiver reporting on interviews and questionnaires, autism-specific diagnostic tools and observation instruments, standardized assessment of intellectual functioning, speech/language assessment, and adaptive behavior assessment (Ozonoff, Goodlin-Jones, & Solomon, 2005). The Autism Program included in this study provides diagnostic evaluations to young children (i.e., ages 4 years, 11 months and younger) through two separate interdisciplinary clinics. These clinics prioritizes evaluations for high-need patients to assist in early diagnosis and access to early intervention.

**Objectives:** To assess differences in patient wait-time for access to care, patient age at evaluation, and diagnostic outcomes between two separate interdisciplinary evaluation clinics at an academic medical center.

**Methods:** Patients aged 4 years, 11 months and younger were evaluated through two separate interdisciplinary clinics. Both clinics prioritize evaluations for patients seeking developmental assessment and treatment recommendations. The four-discipline clinic evaluates patients 4 years, 11 months and younger. The two-discipline clinic evaluates patients between the ages of 24-36 months. We contrasted length of wait-time for evaluation, age at diagnosis, and diagnostic outcomes for 25 patients seen through these two interdisciplinary clinics.

**Results:** Average wait-time for the four-discipline clinic was 9.76 months ( $SD=3.82$ ) months from submission of patient history questionnaire (PHQ) to diagnostic evaluation. Average wait-time for the two-discipline clinic was 4.84 months ( $SD=3.16$ ) from the submission of PHQ to diagnostic evaluation. Average age of diagnosis was 41.92 months ( $SD=8.4$ ) for the four-discipline clinic and 31.33 months ( $SD=3.98$ ) for two-discipline clinic. ASD diagnosis rates were approximately the same (76.9%) for patients seen in the four-discipline (76%) versus those evaluated in the two-discipline clinic (75%).

**Conclusions:** Patients seen through the four-discipline clinic waited approximately three times longer for diagnostic evaluations than those evaluated through the two-discipline clinic and were approximately ten months older at age of initial diagnosis. Results provide preliminary support for the use of two-discipline interdisciplinary team evaluations for young children to decrease wait-time and increase early diagnosis and access to early intervention services while maintaining best-practice assessment methods and diagnostic accuracy.

**414.051 (Poster)** Investigating the Validity and Reliability of the Dutch Translation of the Camouflaging Autism Traits Questionnaire (CAT-Q-NL)

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**Background:** Camouflaging behavior is defined as using strategies to hide characteristics of autism spectrum condition (ASC; Hull et al., 2017). The Camouflaging Autism Traits Questionnaire (CAT-Q; Hull et al., 2019) is the first self-report questionnaire measuring camouflaging behavior. However, psychometric properties of translated version(s) of the CAT-Q have not yet been investigated.

**Objectives:** In this study we aim to investigate the validity and reliability of the Dutch translation of the CAT-Q (CAT-Q-NL).

**Methods:** The CAT-Q-NL and the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) were administered to 669 adults (356 ASC; 52% males; 313 comparison; 54% males) aged 30 to 92 (AsPredicted #37800). In a subsample of autistic adults (N=94), the Autism Diagnostic Observation Schedule (ADOS2; Lord et al., 2012) was administered. Cronbach's alpha was calculated to determine internal consistency and we tested whether we could replicate the original CAT-Q factor structure using confirmatory factor analyses. Convergent validity was assessed by comparing the CAT-Q-NL to the discrepancy between the ADOS2 and AQ as proxy for camouflaging behavior (Lai et al., 2016).

**Results:** Preliminary analyses showed an acceptable fit for the original factor structure. However, as measurement invariance was insufficient, further analyses will be conducted to investigate whether a different factor structure is more suitable. Using the original factors, high internal consistency was found for the total score and factor scores ( $\alpha = .82$  to  $.93$ ). Small correlations were found between scores on the CAT-Q-NL and the proxy of camouflaging behavior ( $r = .11$  to  $.25$ ). Finally, autistic adults scored higher than non-autistic adults on overall camouflaging behavior and on separate factors.

**Conclusions:** Preliminary analyses using the factors of the CAT-Q, seem to indicate good reliability and, in general, group differences seem to be in line with earlier studies. However, the low correlation between the CAT-Q-NL and the discrepancy measure, raises questions about the validity of camouflaging measures and the interpretation of obtained group differences.

Before concluding this is indeed a problem, we need to determine whether a different factor structure is more appropriate and if altered scales are solving this issue. These analyses will be run for INSAR 2021.

Baron-Cohen et al., (2001). *Journal of Autism and Developmental Disorders*, 31  
Hull et al., (2017). *Journal of Autism and Developmental Disorders*, 47  
Hull et al., (2019). *Journal of Autism and Developmental Disorders*, 49  
Lord et al., (2012). Torrance, CA: Western Psychological Services.

**414.052** (Poster) Measurement Invariance across Gender of the ASRS in a Non-Clinical Diverse Sample

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**Background:**

Accurate identification of autism spectrum disorder (ASD) relies on the use of appropriate, reliable, and valid measures. This is vital when conducting ASD evaluations for female clients. Research indicates male children are 4.3 times more likely to be identified with ASD than girls (Maenner et al., 2020). Notably, the masking effect (Bargiela et al., 2016), gender differences in symptom presentation, such as better imitation skills and more age-appropriate restricted interests (Duvekot et al., 2017; Lai et al., 2015), and a skew in the ASD research toward primarily male samples (Lai et al., 2015) may contribute to the misdiagnosis and delayed identification of females. When females are identified late or incorrectly, they miss opportunities for early intervention services.

The Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2010) is one of the more common rating forms in clinical and educational practice. The ASRS is a valid and reliable measure that assesses symptoms and behaviors related to ASD through parent and teacher report. There are several forms to accommodate different informants and child age. The current study focuses on the ASRS Parent Form for children aged 6-18. Exploratory factor analysis results indicate the ASRS has a three-factor model measuring Social/Communication (SC), Unusual Behaviors (UB), and Self-Regulation (SR). No confirmatory factor analysis (CFA) was reported.

**Objectives:**

The purpose of this study was to investigate the measurement invariance of the ASRS across child gender in a diverse non-clinical sample. Evaluations of measurement invariance allow researchers to test whether relationships between items and latent constructs remain the same across groups (Pendergast et al., 2017), an essential prerequisite to the use of measures in minoritized populations, such as females with ASD. Further, an adequate understanding of how the ASRS functions in all populations, including non-clinical cases, is necessary for comparisons across groups.

**Methods:**

Parents of children between 6 and 18 years of age ( $N=806$ ) participated in the current study. Participants reported their child's gender as male ( $n=468$ ) or female ( $n=338$ ). Participants were recruited through Amazon's Mechanical Turk. Following informed consent, parents completed a demographic survey and the ASRS. Internal consistency, differential item functioning analyses using item-response theory (DIF IRT), and multiple group CFA (MG-CFA) were performed.

**Results:**

All three subscales demonstrated high internal consistency. All three subscales exhibited test-level invariance in DIF IRT analyses. Additionally, item-level invariance was found for all but one item across groups. MG-CFA results indicated the UB subscale demonstrated measurement invariance while SC and SR had only partial invariance after the sequential release of several test items.

**Conclusions:**

Results provide some support for use of the ASRS with female children. The measurement invariance analyses suggest the factor structure of subscales operate largely the same between males and females, with differences arising at the item level. The

invariant items may suggest parents perceive specific ASD symptoms and behaviors differently for male and female children. Clinicians should consider these differences when utilizing the ASRS in the evaluation of females for ASD.

**414.053 (Poster)** Modality Influences Parents' Responses to MCHAT-R Follow-up Items

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**Background:** Screening is critical for early detection of autism. The Modified Checklist for Autism in Toddlers, Revised with Follow Up (M-CHAT-R/F) is a widely used, 2-stage validated toddler screening tool. For stage 1, caregivers answer 20 Yes/No questions ( $\leq 5$  minutes). For stage 2, caregivers of screen-positive children scoring in the moderate range (3 to 7 at risk responses) are asked structured follow-up questions to obtain additional information (5-10 minutes with a professional). Various barriers impact the screening to evaluation process, such as lack of time and resources to complete stage 2 follow-up questions and limited communication between caregivers and primary care providers (PCPs). Using an electronic adaptation of the M-CHAT-R/F addresses these screening challenges. Preliminary results (Robins et al., 2016) indicated that follow-up items performed differently when parents reported during electronic administration vs. interview with a professional.

**Objectives:** The current study evaluated Follow-Up items that demonstrated differential low- and high-risk responses based on the modality in which parents completed the questions.

**Methods:** A total of 17,558 toddlers were included (8,758 males, 8,512 females, 288 unspecified). Of this sample, 11,458 families received the paper M-CHAT-R/F with a phone follow-up (paper-phone modality), and 6,100 received the electronic version with either an immediate electronic follow-up ( $n = 3,309$ ; all-electronic modality) or a phone follow-up ( $n = 2,791$ ; electronic-phone modality). Children who screened positive, including high risk children in stage 1 or failed follow-up in stage 2 ( $n = 442$ ), were invited for diagnostic evaluations that included the Autism Diagnostic Observation Schedule (ADOS) 1<sup>st</sup> or 2<sup>nd</sup> Editions. Of the 442 children invited for diagnostic evaluation, 266 children completed evaluations, and children were classified as either ASD ( $n = 90$ ) or Non-ASD ( $n = 103$ ) for diagnostic outcomes. Chi-square analyses were used to compare at-risk and not-at-risk response rates for each item;  $p < .0025$  was used as the threshold to control for multiple analyses.

**Results:** Paper-phone and electronic-phone modalities showed no significant differences and were combined for analyses. Eight of the 20 M-CHAT-R/F follow-up items were significantly different between phone and electronic modalities (see Table 1); parents continued to endorse risk more often in electronic reporting for items assessing unusual finger movements, pointing, response to name, sensitivity to noise, walking, following gaze, and understanding language. Examination of subitems revealed significant differences in three items: Holds hands close to face (Item 5b), how child draws attention (7e), and walking without holding on (13b).

**Conclusions:** There are observable differences in reporting between electronic and phone follow-up modality. However, these differences seem to be distributed across items rather than localized to certain items or subitems of the follow-up. Although the all-electronic modality of the M-CHAT-R/F may be a valid alternative to the more labor-intensive interview administration, future research should examine additional factors that may account for the discrepancies in parent responses based on modality. Although the all-electronic M-CHAT-R/F leaves PCPs better equipped to overcome important screening challenges, specificity may be reduced. Future studies should address the utility and acceptability of different methods of screening in community populations.

**414.054 (Poster)** No Differences at Either 3 Years or 8 Years of Age between Autistic Girls and Boys Participating in a Prospective Longitudinal Study of Siblings at Elevated Likelihood of Autism in Measures of Autistic Symptomatology, Socialization or Cognitive Ability

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#### Background:

It is widely acknowledged that there is under-diagnosis of autism in females. Girls and women may often not be identified and diagnosed due to a combination of factors. Females who receive early diagnosis are likely to exhibit relatively severe autistic symptomatology, often with other clear signs of developmental disability, such as delays in language, communication and cognitive ability. Furthermore, females are often under-represented in research investigating gender differences.

#### Objectives:

To investigate differences in the profiles of girls and boys diagnosed with autism at 3 years and in mid-childhood in relation to measures of cognitive ability, socialisation and autistic symptomatology. We consider two competing hypotheses: 1) in order to receive a diagnosis of autism girls would need to demonstrate more significant levels of autistic symptomatology, social and/or cognitive impairments than boys; and 2) autistic girls would show less severe levels of autism, social and/or cognitive impairments than autistic boys, but were still identified as autistic by the research team.

#### Methods:

Participants were taking part in a prospective, longitudinal study of infants at elevated likelihood (EL) of autism due to having an older sibling with autism. Children were assessed at approximately 8, 14, 24 and 36 months and then a proportion of these children were seen again in mid-childhood (between 6 and 10 years of age). At the 3-year and mid-childhood visits various assessments were conducted, including standardised tests of cognitive ability, adaptive behaviour and autism diagnosis. Following each of these later visits, a best estimate research diagnosis of autism or not autism was made.

#### Results:

Two hundred and forty-eight EL children (122 girls; 126 boys) were seen at the 3-year visit. Of these 12 girls (9.8%) and 34 boys (27%) were diagnosed with autism. Seventy-nine children (41 girls; 38 boys) were seen at the mid-childhood visit. Of these 12 girls (29.3%) and 17 boys (44.7%) were diagnosed with autism. Main effects for diagnostic outcome were found for all measures at both time points except for cognitive ability in mid-childhood, and for gender only for cognitive ability at 3 years, and there were no interaction effects of diagnosis and gender. There were no significant differences on any measure at either age between females and males with autism.

#### Conclusions:

Neither of our two stated hypotheses stand: no significant differences between girls and boys with autism were found in either direction, both at 3 years of age and in mid-childhood. Clearly our sample is small, particularly at the mid-childhood time-point, and the children with autism relatively able (mean (SD) IQ at 3 years = 89.9 (25.6) & in mid-childhood = 107.2 (19.2)) so it is not possible to generalise our findings to the wider population of children diagnosed with autism in clinical settings. However, this is a well-characterised sample of children selected in early infancy on the basis of familial risk and without a selection bias for gender.

#### **414.055 (Poster) Non-Inferiority of a Rapid 5-Item Version of the Social Responsiveness Scale for the Identification of Autism Spectrum Disorder**

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#### Background:

Identifying individuals with autism spectrum disorder (ASD) using a screening questionnaire is valuable in research studies and in clinical settings when a medical diagnosis is unavailable. In this regard, it is common to use the validated 65-item parent-completed Social Responsiveness Scale (SRS). Although shortened 16-item and 11-item versions have been proposed, their

derivations have been limited in their ability to account for potentially important socio-demographic, familial, environmental, and community characteristics that may differ between children with and without ASD.

#### Objectives:

The aim of the present study was to derive a shortened version of the parent-completed SRS from a large sample of sibling dyads.

#### Methods:

The Simons Simplex Collection Version 15.3 was used to create sibling dyads comprising a child with a clinically confirmed diagnosis of ASD and a full sibling without ASD within the same family, all between the ages of 4-18 years. The full sibling without ASD was chosen to be closest within 5 years of age to the child with ASD. Areas under Receiver Operating Characteristics (AUROC) curves were used to estimate accuracy [ranging from 0.5 (chance) to 1.0 (perfect)] and to compare the rapid 5-item version to the 65-item SRS using a 95% two-sided confidence interval and a prespecified non-inferiority margin of -0.005 points.

Results: The sample consisted of 1596 sibling dyads. The mean (sd) age of the children with and without ASD was 9.3 (3.3) and 9.2 (3.6) years, respectively ( $p=0.55$ ). Children with ASD were significantly more likely to be male than their siblings (87% vs 47%,  $p<0.001$ ). Eighty percent were of White race. The rapid 5-item version comprised three social communication items (16.Avoids eye contact or has unusual eye contact; 22.Plays appropriately with children his or her age; 35.Has trouble keeping up with the flow of a normal conversation) and two autistic mannerisms items (24.Has more difficulty than other children with changes in routine; 28.Thinks or talks about the same thing over and over). The relationship between the rapid 5-item version and the 65-item SRS was near perfect (Pearson correlation=0.95) and both had near-perfect accuracy. The AUROC was 0.993 (95% CI: 0.991 to 0.996) for the rapid 5-item version and 0.992 (95% CI: 0.990 to 0.995) for the 65-item SRS. The resulting difference of 0.001 (95% CI: -0.001 to 0.003;  $p=0.46$ ) supported non-inferiority of the rapid 5-item version. Using a cut-point of 4 or higher (corresponding to a median-split of a scale ranging from 0 to 15), the rapid 5-item version had sensitivity=97.6%, specificity=96.2%, predictive value positive=96.3%, and predictive value negative=97.6%.

#### Conclusions:

From this unique data resource that accounts for shared family environments, the rapid 5-item version of the SRS has been shown to have near-perfect accuracy and to be non-inferior to the 65-item SRS. In research settings where participants are often overburdened by the volume of questions, the rapid 5-item version can be administered in under one minute and may be considered to replace the commonly used query asked of parents, "Has your child ever been diagnosed with autism spectrum disorder?".

**414.056** (Poster) Normative Sample of the Alsolife Skills Assessment System and Comparisons to Children with Autism  
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Background: Research has supported the success of applied behavior analysis (ABA) in teaching children with autism spectrum disorder (ASD) in a variety of domains. However, given the critical shortage of ABA therapists in China, many parents of young children with ASD must prepare themselves to teach their children at home settings. To form a home-based ABA therapy, parents need a comprehensive assessment to evaluate all aspects of child development to generate a tailored educational plan to meet the child's unique needs and strength. The purpose of ALSOLIFE skills assessment system (ALSOLIFE Assessment) is to provide a free online tool for caregivers who wish to work with their preschool children with ASD at home settings. It comprises 6 skill-domains covering 22 skill subdomains (Fig 1) including various key skill sets across early childhood period. It has been tested with satisfied reliability and validity, but an evaluation of normative sample data will further strengthen the utility of ALSOLIFE Assessment.

Objectives: To examine typical child development across the 6 skill-domains and repertoires of the ALSOLIFE Assessment, we conduct the current study for providing a normative sample of the ALSOLIFE Assessment and a subsequent comparison to children with ASD.

Methods: We administered the ALSOLIFE Assessment to 376 neurotypically developing children (228 boys and 148 girls) with the ages ranged from 0.9 to 10.92 years from 29 of 34 provinces of China. To match age and sex with the normative sample, a total of 391 children (237 boys and 154 girls) diagnosed with ASD age from 1.5 to 9.85 were selected to participate in our study.

Results: There was a strong relationship between the ALSOLIFE Assessment total scores and ages in the normative sample ( $r = 0.77, p < 0.001$ ), and a cubic regression provided a strong fit for the data ( $R^2 = 0.82, p < 0.001$ ). In ASD sample, the results also showed a significant correlation between the ALSOLIFE Assessment total scores and ages ( $r = 0.64, p < 0.001$ ), while  $\beta$  value of cubic function didn't achieve the significant level ( $R^2 = 0.434, p = 0.089$ ) (Fig 2). For the normative sample, the children, by age of five, achieved full scores in two of six domains in skills repertoires of the ALSOLIFE Assessment: cognitive skills and social interaction skills. Then academic skills, social regulation skills and life skills arrived at the ceiling one year later. The living skills domain was the latest to be mastered completely by age seven (Fig 3).

Conclusions: The present data suggest that ALSOLIFE Assessment would be an useful tool offering present level information for practitioners at home settings.

#### 414.057 (Poster) Objective Assessment of Sensory Reactivity in Adnp Syndrome

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**Background:** Sensory reactivity symptoms are prominent in individuals with autism spectrum disorder (ASD) and are incorporated into the Diagnostic and Statistical Manual of Mental Disorders, 5<sup>th</sup> Edition criteria for ASD. Sensory patterns include hyperreactivity (over-responsiveness), hyporeactivity (under-responsiveness), and sensory seeking, which can occur across multiple sensory modalities. There is a growing body of literature describing sensory symptoms in individuals with syndromic ASD, however, few studies have prospectively examined sensory symptoms using a battery of standardized assessments.

**Objectives:** To describe the sensory reactivity phenotype in children and adolescents with pathogenic variants in *activity dependent neuroprotective protein (ADNP)*. ADNP syndrome represents one of the most common single-gene causes of ASD.

**Methods:** One hundred seventy-eight individuals between the ages of 2 and 17 years old received a battery of standardized observations, caregiver interviews, and questionnaires measuring sensory reactivity. The Sensory Assessment for Neurodevelopmental Disorders (SAND), Short Sensory Profile (SSP), Autism Diagnostic Observation Schedule, 2<sup>nd</sup> Edition (ADOS-2), and the Autism Diagnostic Interview-Revised (ADI-R) were administered to all participants. Participants included 22 individuals with ADNP syndrome (10 female,  $M_{age}=7.72$ ), 109 with idiopathic ASD (iASD) (16 female,  $M_{age}=6.48$ ), and 47 controls (26 female,  $M_{age}=5.90$ ).

**Results:** All participants with ADNP syndrome presented with mild-to-profound ID and only half met DSM-5 criteria for ASD. All participants displayed clinically significant sensory symptoms on at least one measure and 91% (20/22) displayed sensory reactivity abnormalities on every measure. A distinct sensory phenotype was identified characterized by high levels of sensory seeking across tactile, auditory, and visual domains. On the SAND, mean total scores were  $>3$  SDs higher than TD norms ( $p < .0001$ ) and similar to overall iASD sensory abnormalities. Sensory seeking was  $>2$  SDs higher than the TD controls across visual, tactile, and auditory domains ( $p < .0001$ ), and approximately 1 SD higher than iASD in tactile and auditory domains ( $p < .0001$ ). ASD diagnosis and severity did not impact sensory symptoms identified by the SAND, SSP, or ADOS-2, indicating that the sensory phenotype in ADNP is generalizable across the syndrome, rather than driven by a subset with ASD. Cognitive functioning, adaptive behavior, age, and sex did not impact SAND or ADOS-2 scores, both of which capture direct observation of symptoms. Cognitive functioning, adaptive behavior, and age were correlated with several SSP scales, suggesting that the higher the cognitive or adaptive level and older the individual, the fewer abnormal sensory responses parents reported.

**Conclusions:** These findings demonstrate that sensory symptoms were present across individuals with ADNP syndrome regardless of age, sex, cognition, adaptive skills, and most importantly, irrespective of ASD diagnosis. Sensory symptoms, particularly seeking, appear to span the range of individuals with ADNP syndrome and can be quantified using existing standardized instruments. The SAND appears to be the most robust sensory assessment, independent of functioning level or age, unlike the SSP. The sensory domain may represent a relevant target for treatment in ADNP clinical trials, and clinically, can inform treatment recommendations based on an individual's unique sensory preferences.

**414.058** (Poster) Observed Sensory Modulation Behaviors and Their Relationship to Parent- and Child-Reports in Children and Adolescents with Autism Spectrum Disorder

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### **Background:**

Individuals with Autism Spectrum Disorders (ASD) often exhibit sensory modulation atypicalities (Leekam et al., 2007; Miller et al., 2017). Sensory modulation challenges include Sensory Over-Responsivity (SOR): exaggerated negative responses to aversive sensory input, Sensory Seeking (SS): craving a higher level of sensory input, and Sensory Under-Responsivity (SUR): reduced responses to sensory input (McCormick et al., 2015). Currently, the vast majority of ASD sensory modulation studies use parent-report questionnaires, and there is a strong need to develop standardized observational assessments of sensory processing challenges, particularly those that can be used across a wide range of ages, including adolescents.

### **Objectives:**

To investigate how an observed behavioral assessment of sensory processing atypicalities differentiated ASD compared to typically-developing (TD) school-aged children and adolescents, as well as to examine correlations between observed behavior and parent- and child-report of sensory symptoms.

### **Methods:**

Forty-one ASD and 33 age- and performance-IQ-matched TD participants, aged 8-17 years participated in the Sensory Processing 3-Dimensional (SP3-D) Assessment (Mulligan et al., 2019). This study examined responses to the tactile, visual, and auditory sensory modulation items. Sensory stimuli were designed to be ecologically valid (e.g., bright flashing lights, musical instruments, scratchy materials). Participants' responses to the sensory stimuli were then scored as typical or atypical for each item using standardized scoring, based on showing any aversive response/avoidance (SOR), difficulty disengaging (SS), or lack of expected negative response (SUR). Participants and parents completed the SP3-D Inventory (Miller et al., 2017) to report on participants' SOR, SS, and SUR.

### **Results:**

Compared to TD participants, the ASD group had more atypical SOR ( $t(72)=-2.49, p=0.02$ ) and SS ( $t(72)=-2.48, p=0.02$ ) responses across visual, tactile, and auditory domains on the SP3-D Assessment. Within both ASD and TD groups, child-reported SS was moderately correlated with visual and auditory seeking on the SP3-D assessment ( $r=0.33, p=0.04$ ;  $r=0.38, p=0.02$ ). There were no significant correlations between parent-reported and observed sensory processing. For both diagnostic groups, younger children showed greater SS and SOR observed scores. Within the adolescents only (13 to 17-year-olds), diagnostic group differences were found in tactile SOR ( $t(43)=-2.467, p=0.018$ ) but not in SS, potentially indicating that seeking decreases with age more than SOR does for the ASD group.

### **Conclusions:**

Here, we showed that the SP3-D Assessment of SOR and seeking behaviors differentiated ASD and TD diagnostic groups across a large age range of youth with cognitive skills in the normal range. Within an adolescent-only sample, SOR, particularly in the tactile domain, revealed the strongest diagnostic group differentiations, consistent with reports that tactile stimuli are among the most bothersome for individuals with ASD (Tomchek & Dunn, 2007). Additionally, the low correlations between questionnaire reports and direct observations are consistent with previous literature (Tavassoli et al., 2019); this further highlights the importance of combining questionnaires and observed data to form a more complete understanding of individuals' sensory processing. Results suggest the SP3-D assessment may provide further insight into SOR over and above child- and parent-reports, but future research is needed to determine how questionnaire and direct assessment data can best be combined.

**414.060** (Poster) Online Administration of the ADOS for Research in Response to the Pandemic

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**Background:** Coronavirus-related restrictions present novel barriers to research and have led to the use of online data collection methods. In addition, there is a need for telehealth diagnostic tools to serve individuals in remote locations and with few expert service providers. Adult diagnosis is increasingly in demand (Howlin & Moss, 2012). To address these clinical service gaps, it is critical to develop online methods to reliably capture ASD symptomatology. Two prior studies compared in-person versus remote assessments; however, both required in-person staff support at the client site, as well as special technology.

**Objectives:** This study evaluates the reliability and validity of an online administration of the ADOS-2 Module 4 assessment, implemented without specialized equipment or on-site clinical or technical staff.

**Methods:** Twenty-nine adults ages 19-32 years with and without a history of autism spectrum disorder (ASD) completed a videoconference session during which the adapted version of the ADOS-2 was administered; they also completed the Autism Spectrum Quotient (AQ) via Qualtrics as a measure of self-reported ASD symptomatology. Parents or caregivers completed the Vineland Adaptive Behavior Scales and the Achenbach Adult Behavior Checklist to provide parental impressions of the participant's current social and communicative functioning. The ADOS-2 was reviewed and scored by trained clinicians.

Modifications to the ADOS included: a gaze calibration procedure; online presentation of scanned versions of the Cartoons and Picture Description tasks; sending of Tuesday books and the Creating a Story objects by snail mail, in advance; and omission of the optional Construction and Break activities.

**Results:** The videoconference sessions went smoothly; problems were infrequent and easily resolved. Inter-rater reliability in scoring the ADOS-2 was "substantial" ( $k = .67$ ). ADOS item-based analyses indicated reliabilities ranging from .67 to 1.0, with an average of .86. Items that were expected to yield low reliability given prior research (Eye contact; Repetitive mannerisms) were, in fact, highly reliable. Correlational analyses of the ADOS with the AQ ( $r(24) = .52^{**}$ ), VABS (Communication,  $r(22) = -.79^{***}$ ; Socialization,  $r(22) = -.65^{***}$ ), and Achenbach (Friends scale,  $r(23) = -.70^{***}$ ) suggested that the online ADOS-2 results showed significant convergence with other assessments of ASD-relevant symptoms and characteristics.

**Conclusions:** The on-line ADOS-2 was highly reliable, and correlated highly with parent-report measures of socialization, communication, and friendships. It also correlated highly with the individual's autism scale self-report (AQ), suggesting that participants' own assessments of their autistic traits were consistent with clinician impressions. Altogether, the substantial reliability of scores, together with the convergence of results with external measures, suggests that this method is effective for ascertaining ASD behaviors in a verbal adult population. While any online assessments must be used with caution, the approach described here has sufficient validity and reliability to fill current urgent clinical and research needs.

**414.061 (Poster)** Pain Anticipation and Empathy for Pain Towards Social and Non-Social Agents in Adults with ASD: A Novel Psychophysiology Artificial Neural Networks Based Study  
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Background:

Although abnormal pain sensitivity has become one of the diagnostic criteria for Autism Spectrum Disorder (ASD), this area is still under-investigated. Specifically, a very few studies focused on the anticipatory components characterizing pain experience related to self and others in ASD.

Objectives:

The present study was aimed at investigating psychophysiological responses in adults with High Functioning Autism (HFA) when observing a painful stimulus approaching (pain anticipation) their own skin (self-condition), another participant skin (other social agent condition) or a robotic hand (other non-social agent condition).

Methods:

Skin Conductance Responses (SCR) were measured in a group of adult participants with ASD diagnosis and a control group of participants without any psychiatric or neurological diagnosis. The experimental sessions consisted of a naturalistic paradigm where the participants observed a painful (sterilized needle) or a neutral (cotton bud) stimulus that could approach their own skin, the skin of another person or the hand of a robot (Figure 1). Data were analysed by implementing a new Machine Learning

approach combining predictive modelling (i.e. Artificial Neural Networks) and Auto-Contractive Maps, that is an emerging data mining approach able to detect connectivity associations among variables through an artificial adaptive system.

Results:

The predictive model was 91% accurate and able to differentiate ASD participants from control group participants. Two distinct patterns were found for each group. Specifically, ASD individuals exhibited a lower physiological activation than controls when the noxious stimulus (needle) approached their skin after repeated stimulations. Interestingly, ASD participants showed a higher response when the robotic hand was approached by the painful stimulus, whereas no differences related to the human social agent between the two groups emerged.

Conclusions:

These results can contribute to clarifying the psychophysiological mechanisms underlying pain experience in ASD individuals. Implications for the study of the self-injury phenomenon, often observed in ASD, will be discussed.

**414.062 (Poster)** Parent Concerns of Infants at Familial Risk for Autism during the COVID-19 Pandemic  
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Background: A diagnosis of autism spectrum disorder (ASD) in an older sibling increases the risk of developing ASD in infant siblings (HR; 15-20%). Parental concerns can help determine if their children should be monitored and screened. Caretakers of HR infants may be particularly sensitive to developmental red flags given they have older children with ASD. Prospective studies among HR infants showed that parent concerns at 12 and 24 months predicted later ASD diagnoses. The COVID-19 pandemic poses new challenges for families of children with neurodevelopmental disabilities, including the suspension of in-person learning and navigating intervention access. Despite these hardships, caretakers can now closely observe their HR infants. Given the value of parent concerns and the unique situation that the pandemic has placed upon families, we investigated their intersection.

Objectives: To examine parent concerns of HR infants before and during the COVID-19 pandemic and assess their agreement with a validated developmental screening tool.

Methods: Parents of HR infants reported concerns about development and behavior at 18-months ( $n=31$ ; male=15, female=16) as part of a longitudinal study. A coding system using inductive analysis categorized responses into (1) ASD-related (restrictive and repetitive behaviors [RRBs], speech/language, social, unspecified ASD), (2) General (motor/sensory, medical, behavior/temperament, general development), and (3) Total Concerns (the sum of ASD-related and General). Two blinded research members coded the data and discrepancies were discussed to reach consensus. The Modified Checklist for Autism in Toddlers, Revised, with Follow-up (M-CHAT-R/F) screened for delays and ASD. Infants were grouped as “pre-COVID” ( $n=13$ ) or “COVID” ( $n=18$ ) to evaluate concerns at each respective time point.

Results: The majority of parents during COVID (78%, 14/18) and nearly half pre-COVID (46%, 6/13) disclosed concerns about their HR infants at 18 months (see Figure 1). Of ASD-related concerns, the COVID group most commonly reported worries about speech/language (56%, 9/16) and the pre-COVID group reported equally high proportions of speech/language and RRBs concerns (36%, 5/14). Regarding general concerns, motor/sensory were highest for both groups (COVID: 47%, 8/17; pre-COVID: 71%, 5/7). Parents in the COVID group reported a greater proportion of general concerns than the pre-COVID group;  $\chi^2(2, 31)=3.90, p<.05$ . No differences in ASD-related or total concerns were observed, although the latter approached significance. ASD-related concerns and MCHAT-R/F scores had a significant moderate positive correlation across time points (see Figure 2);  $r(29)=.675, p<.001$ .

Conclusions: During COVID-19, parents of 18-month-old HR infants predominantly expressed worries in speech/language and motor/sensory domains. Findings indicate that parents are highly attuned to their infants’ development and may be recognizing more subtle delays as they are with their infants more often during COVID-19 restrictions. Furthermore, concerns across time points were in agreement with a developmental screening measure, highlighting their potential clinical validity. Caretakers’ ability to accurately detect early delays in their infants could assist in receiving evaluations and services during the pandemic. Higher-powered studies should further investigate the nature and value of parent concerns of HR infants, especially during this unprecedented time when access to diagnostic assessments is limited.

**414.063** (Poster) Parental Experiences with Early Identification and Initial Care of Their Child with Autism. a Mixed-Method Design

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**Background:**

Due to multiple benefits, early identification of autism spectrum disorder (ASD) has been deemed a priority over the last years. The experiences of parents regarding the diagnostic process of ASD are well documented (Boshoff et al., 2018; Crane et al., 2016), but less is known about their experiences with the process of early identification and initial care. Since early identification generally starts with parents expressing their concerns regarding their child's development, it is highly important that their experiences and perspectives of the process are better understood.

**Objectives:**

The current study aims to explore parental experiences with the process of early identification and received initial care for their child with ASD.

**Methods:**

A mixed-method design was conducted. First, an online survey was completed by 45 parents (39 birthmothers, 6 birthfathers). They were asked to share their initial concerns of their child having ASD and their search for adequate care. Participants rated on a five-point Likert scale (with 1 being *not concerned* and 5 being *very concerned*) how severe initial concerns were for mothers, fathers and first line healthcare professionals. A paired samples t-test was conducted to compare the severity of concerns between parents and professionals. Also, the average time delay between initial concerns and receiving an ASD diagnosis was calculated, together with the average number of visited healthcare professionals. Next, an additional focus group (n=10) was held to gain more in-depth insights into perceived barriers and improvement strategies for early identification and initial care. Grounded theory was used to analyze the focus group data (Glaser & Strauss, 2017).

**Results:**

Results indicated that a) parents seemed to report a higher severity of initial concerns (M=3.64, SD=.89) than first line healthcare professionals (M=2.55, SD=1.10,  $t(41)$ ,  $p < .001$ ). Specifically, mothers (M=3.89, SD=.98) compared to fathers (M=3.27, SD=1.03), experienced the most severe concerns ( $t(42)$ ,  $p=.001$ ); b) there was an average delay of 26 months between initial concerns (M=22, SD=12.96) and receiving an ASD diagnosis for their child (M=48, SD=15.35); c) parents visited a wide range (0-6) of healthcare professionals before their child's diagnosis, with an average of 2.5; d) parents experienced the following barriers during the process of early identification and initial care: limited professional knowledge & expertise, limited personal attention to parental needs, obstacles in the healthcare system (e.g. inflexibility, waiting lists and fragmentation of care); e) parents suggested the following improvement strategies: additional training to improve professional's knowledge & expertise on the early symptoms of ASD and have attention to parental needs by acknowledging parental concerns instead of dismissing them. Parents also suggested strategies to target the obstacles in the healthcare system by improving the collaboration between first line healthcare and specialized mental healthcare.

**Conclusions:**

Taken together, these findings indicate that the process of early identification and initial care can be challenging for parents. Overall, there seems to be a risk that parents initial concerns can be dismissed during initial care, contributing to an overall delay in the early identification of ASD. Implication of findings will be discussed.

**414.064** (Poster) Parental Knowledge in Screening for Autism Spectrum Disorder

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Background: Parent-report screening tools (e.g., the Modified Checklist for Autism in Toddlers – Revised; M-CHAT-R; Robbins et al., 2014) are widely used to aid timely diagnosis of autism spectrum disorder (ASD), which is associated with improved outcomes for children with ASD (e.g., Charman & Baird, 2002). Whereas some parents notice symptoms of ASD as early as 14 months of age, many parents first notice symptoms much later (Chawarska et al., 2007), leading to delays in age of first diagnosis (Baio et al., 2018). When rating ASD symptoms, parents tend to display some inaccuracy (Baranek, 1999), and this inaccuracy may vary across different items that measure different aspects of ASD (Hampton & Strand, 2015). Low knowledge about ASD among parents may contribute to inaccuracy in recognizing symptoms of ASD (Daniels & Mandell, 2014).

**Objectives:** This study sought to test whether parents accurately identify atypical behaviors when shown behaviors characteristic of ASD and to understand how parental knowledge of ASD symptoms relates to parents' abilities to accurately identify these behaviors.

**Methods:** 288 parents ( $M_{\text{age}} = 34$ ,  $SD_{\text{age}} = 8$ ; 52% Female; 58% White) of children 18-30 months old participated. Parents completed measures of child development knowledge, ASD knowledge, and parental self-efficacy. Next, parents viewed videos (~5 minutes each) of two children with ASD (one scored 'Moderate' on the ADOS-2 and one scored 'Severe') and rated each child's behavior on a modified version of the M-CHAT-R. Ratings were compared to two clinicians' ratings of the same children for accuracy. Item response theory assessed whether parents accurately identified behaviors characteristic of ASD and how difficult each behavior was for parents to rate accurately. Structural equation modeling (SEM) examined which factors related to parental accuracy.

**Results:** Parental accuracy ranged from 38% to 97% across items. 79% of items yielded a negative IRT item difficulty parameter, with no difficulty parameters greater than 0.380, suggesting that most items were classified as Easy or Very Easy difficulty (Baker & Kim, 2017). SEM results indicated that accuracy in identifying "moderate" symptoms of ASD ( $R^2 = .218$ ) was related to greater Parent Knowledge ( $\beta = .184$ ,  $p = .004$ ), greater number of children raised ( $\beta = .158$ ,  $p = .020$ ), and greater parental self-efficacy ( $\beta = .202$ ,  $p = .005$ ). Accuracy in identifying "severe" symptoms of ASD ( $R^2 = .647$ ) was related to greater Parental Knowledge ( $\beta = .463$ ,  $p < .001$ ), less parental education ( $\beta = -.263$ ,  $p < .001$ ), and greater parental self-efficacy ( $\beta = .513$ ,  $p < .001$ ).

**Conclusions:** This study found that the majority of behaviors characteristic of ASD assessed during the screening process were easy or very easy for parents to correctly identify. Greater parental knowledge of child development norms and knowledge of ASD helped parents to accurately identify symptoms of ASD, particularly when these symptoms were severe. Results of the current study help to highlight a fundamental challenge in screening, wherein more severe symptom presentations of ASD may be easier for parents to identify, while milder, less severe symptom presentations of ASD may be more difficult for parents to identify.

#### **414.065 (Poster) Parenting Stress in Mothers and Fathers of Children Who Have Autism Spectrum Disorder or Intellectual Disability**

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**Background:** A large body of literature has demonstrated that parents who have a child with a developmental disability such as autism spectrum disorder (ASD) or intellectual disability (ID) experience higher levels of stress compared to parents of typically developing children (Hayes & Watson, 2012). Some characteristics that contribute to parental stress include problem behaviors, autism symptom severity, and lower adaptive functioning. Other stressors that can also impact aspects of the family include financial difficulty and trouble accessing services (Mello et al., 2019). Thus, developmental disabilities have repercussions for both children and their parents. However, much of the research has focused on mothers in the family only, with less attention devoted to fathers and both parents. Stress in both parents is necessary to address, because the couple who has a child with a developmental disability is particularly disadvantaged; these stressors can negatively affect couples' relationships and partner satisfaction, ultimately leading to divorce (Bluth et al., 2013).

**Objectives:** Therefore, the current study aimed to (1) provide a descriptive comparison of mother and father stress upon examination of family demographics and characteristics and (2) investigate how mother and father stress are associated with each other when taking into account children's clinical profiles.

**Methods:** Participants included fifty-nine mothers and fathers from Quebec, Canada, who recently received an ASD or ID diagnosis for their child ( $M_{\text{age child}} = 4.29$  years). They completed measures assessing family demographics (e.g., education, income, employment, number of children, immigration), parenting stress (Parenting Stress Index; Abidin, 2012), and child intellectual functioning (Wechsler Preschool and Primary Scale of Intelligence-IV; Wechsler, 2012), adaptive behavior (Adaptive Behavior Assessment System-II; Harrison & Oakland, 2003), behavioral and emotional problems (Child Behavior Checklist; Achenbach, 1991), and symptom severity (Childhood Autism Rating Scale; Schopler et al., 1980).

**Results:** Although mothers' and fathers' stress did not differ within families, one-way ANOVAs demonstrated that they were each significantly linked to different family characteristics. Furthermore, correlations between parent and child variables demonstrated significant associations between mother stress, father stress, and child characteristics. To assess these relations

further, parent and child variables were entered into hierarchical multiple regression models. The results showed that mothers and fathers accounted for unique variance in each other's stress above and beyond family-level and child-level predictors.

Conclusions: Findings are discussed in terms of orienting services for the entire family; for instance, in addition to tending to their children's needs, parents may also be able to support each other in their own difficulties. The results from the current study demonstrate that mothers and fathers seem to have different types of stressors, thus working together may help couples manage and alleviate the stress that they experience when raising a child with a developmental disability.

**414.066** (Poster) Pediatrician Referral Practices for Early Self-Injury in Young Children with Intellectual and Developmental Disabilities

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Background: Self-injurious behavior (SIB) is a class of non-suicidal behavior defined as repetitive physical acts performed on one's body that may inflict tissue damage (e.g., head banging, face slapping, and hair pulling).<sup>1</sup> It is most commonly used to gain attention, avoid undesirable situations, or act as a form of communication. Children with intellectual and developmental disabilities (IDD) demonstrate SIB at higher rates. When SIBs emerge in young children, families commonly view their primary care pediatrician (PCP) as one of the first points of contact for support and assistance.

Objectives: The goal of this analysis is to consider current referral practices and recommendations of PCP's who evaluate children with IDD exhibiting SIB. Utilizing a chart review, we examined the frequency and quality of PCP recommendations for children with IDD and SIB to investigate primary care SIB management from the time of initial concern to specialty referral as recommended by the American Academy of Pediatrics (AAP).

Methods: Two hundred and fifty children meeting study criteria (i.e., 10 - 59 months of age; had an ICD-10 developmental disability in their pediatric primary care electronic health record (EHR); and documented parent concern of SIB in at least two separate clinical notes) were randomly selected. The following data was extracted from the EHR: patient age at first parent SIB concern, ethnicity, and ICD-10 primary diagnosis. Clinical notes were reviewed prior to and after parents' first SIB concern was documented until the patient was referred to an appropriate specialist, the SIB resolved, or until the last recorded pediatrics primary care note during the chart review (conducted 3/2020 – 6/2020). Other data extracted were: if a referral was made, if an SIB-related injury beyond general redness (e.g., swelling, laceration, bleeding, etc.) had occurred, and SIB-specific recommendations provided by the PCP. When documented, a list of SIB-specific recommendations was tabulated.

Results: The majority of the sample (mean<sub>age</sub> = 27.7 months; SD = 12.4 months) were white (65.2%), male (75.2%), had delayed speech (57.2%), and engaged in headbanging (82.4%). No child experienced a SIB-related significant injury. Only two children had a clear remission of SIB. Out of the 250 children whose parents expressed concerns regarding early SIB, only 8.0% (n = 20) were referred by their PCP to an appropriate specialist per AAP guidelines. Across those 20 children, the average time from first parent concern to initiation of a SIB-specific and appropriate referral was 6.7 months (SD = 5.1 months). No specific recommendations to address SIB were provided to 157 (62.8%) children. For the other 93 (37.2%) children, SIB recommendations were present but varied widely.

Conclusions: Outcomes from the data suggest that only an extremely small portion (8%) of young children with delays and early SIB received AAP recommended intervention via referral to subspecialty providers by their PCP. More research should be done with larger samples or with more well-developed data collection paradigms in an attempt to gain a better understanding of PCP practices for evaluation and treatment of early SIB in this patient population.

**414.067** (Poster) Phenotypic Sex Differences and Sex Ratio in Latin-American Children with Autism

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Background:

Latin-American children are under-represented in autism research dealing with identification of sex differences in the expression of symptoms. Researchers have identified that adaptive function manifest differently in cross-cultural samples with ASD. Furthermore, it is not strongly predicted by the autism symptom severity in Asian children. This contrasts with the findings in white American children, where adaptive impairment is a direct function of standardizing autism symptom severity. This is critical because both severity and adaptive profiles are utilized for diagnostic, service referral, and intervention programming.

Objectives:

The purposes of this study were to identify the symptom severity, adaptive function, and intellectual profiles of Latin-American children; and to identify the relationship between autism symptom severity and adaptive function in a clinical Venezuelan children population with ASD after controlling for age and intelligence.

#### Methods:

One-hundred and three children from a clinical sample in Maracaibo, Venezuela were included in this study. Ages ranged from three to seven years,  $X=4.6$  (1.4). ASD symptom severity was measured by the Autism Diagnostic Observation Schedule (ADOS), adaptive function via the Vineland Adaptive Behavior Scale (VABS), and intelligence by the Raven Matrices, which measure non-verbal intelligence to control for cultural and linguistic factors. A psychologist confirmed ASD diagnosis as per the diagnostic criteria of the DSM-V-TR. The final sample revealed a boy: girl ratio of 3.91:1. All measures were administered in Spanish.

#### Results:

Independent samples T-test revealed not-significant sex differences in autism symptom severity, adaptive function, and intellectual profiles. Four multiple regression models were designed and used global symptom severity, intelligence, and age as predictors to each of the four domains of adaptive function as per the VABS. Symptom severity was not a significant predictor for adaptive function.

#### Conclusions:

This study echoes with research identifying no sex differential in autism, specifically in pre-school and early-school aged children. This sample's sex ratio was similar to that from the CDC's 2020 general population. autism sex ratio. These findings also supplement the limited cross-cultural research identifying a weak or nonexistent relationship between autism symptom severity and adaptive function in Asian children. The overall findings indicate that culture could play a role in the manifestation in the ASD profile or their parent interpretations. Females with ASD typically report lower cognitive profiles compared to boys. In this study, that was not the case, indicating that such differences could be better accessed with non-verbal IQ, which controls language and cultural influences, or with a comprehensive measure of cognitive profile. This is the first study to provide a comprehensive profile of children with autism from Latin-America. Nonetheless, future research should address these scales' psychometric validity; further research is needed to formulate an ASD evaluation process that controls for sex and cultural differences in children with ASD.

#### **414.068** (Poster) Practitioners' Experiences in Assessing Females with Autism

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**Background:** The process of obtaining a diagnosis among females is likely to be a different, more protracted process than for males. Several explanations have been suggested to explain this phenomenon, including the social camouflage theory which delays identification, a lack of assessment/screening measures that are sensitive to the female phenotype, and a higher potential for misdiagnosis or missed diagnosis.

**Objectives:** To explore the training received, assessment practices and diagnostic taxonomies used, and confidence in assessment and diagnosis when assessing autism in females among practitioners in Australia.

**Methods:** 135 practitioners completed an online survey and seven psychologists participated in a semi-structured interview conducted via Zoom.

**Results:** Speech pathologists were more likely to report receiving no training in their course around diagnosing autism, but most practitioners reported that diagnosing autism in females specifically was rarely addressed (74.2%). Practitioners said their practice in the assessment of females was most significantly influenced by the current diagnostic criteria (87.9%), the reliability/validity of the assessment tools they use (78.5%), and professional development they have attended in the last 5 years (71.3%). Almost all practitioners used the DSM-5. The most common assessment components used were conducting an interview with the parents and a standardised autism assessment. The ADOS was the most commonly used tool, with only one practitioner saying they would only use the ADOS for assessing males. Psychologists and speech pathologists were more confident than paediatricians in diagnosing adult females, but confidence levels were similar across clinicians for other age groups. In the interviews, the main themes that emerged were: the female phenotype; the assessment process; missed diagnoses and misdiagnoses; applying the diagnostic criteria; and the need for more training.

Conclusions: While the female autism phenotype is gaining traction in research, the theory-practice gap is still evident. While most practitioners reported receiving training in diagnosing autism, the notion that gender differences may exist was often not addressed and subsequently shaped the practices of many practitioners in their early years. While practitioners reported that more recent professional development offerings have influenced their assessment practice, interviewees emphasized that finding relevant training was difficult. The interviewees identified that the current assessment tools available are less sensitive in detecting traits associated with the female phenotype. While the survey identified the ADOS as the most widely used tool, several interviewees described how they modified the protocol when assessing females. While it is positive that practitioners felt fairly confident in their assessment practices, the identified need for more training and more valid assessment tools for females that can be used “as is” (not modified) suggests that there is still scope for improvements in these areas to minimise misdiagnosis and missed diagnoses.

**414.069** (Poster) Predicting Diagnosis of Autism Spectrum Disorder Using Health Claims Data in Young Children  
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Background: Early diagnosis and intervention are keys to improve long-term outcomes of children with autism spectrum disorder (ASD). Universal screening has been advocated to improve early ASD identification, but could be challenging to implement widely in practice due to limited clinical resources of screening and diagnostic evaluations. Pre-identifying high-risk individuals for a risk-based screening could utilize clinical resources more effectively; however, there lacks a systematic approach for assessing ASD risk of young children prior to the screening in pediatric care settings.

Objectives: To predict the ASD risk in children between 18- and 30-month-old using medical insurance claims data.

Methods: Using the 2005-2016 MarketScan® database, we retrospectively created a study cohort of young children with and without ASD. The inclusion criteria of ASD subjects included: (1) at least 2 outpatient or 1 inpatient ASD diagnoses (ICD-9 codes 299/ICD-10 codes F84); and (2) continuous enrollment during age 3-30-month-old. For non-ASD subjects, we required continuous enrollment from age 3-60-month-old to exclude possible ASD subjects that remain undiagnosed due to limited follow-up time (**Figure 1**). We extracted variables of demographics (gender, age, etc.), number of emergency department (ED) visits, and number of diagnosis and procedure encounters up to 24-month-old to predict risk of ASD diagnosis. For better clinical interpretability, we aggregated the diagnosis and procedure codes using Clinical Classification System. We employed two machine learning models, Lasso logistic regression (LR) and random forest (RF), which were trained on a balanced sample of the cohort (N=20,000, ASD:non-ASD=1:1) and tested on an independent sample with the same prevalence of ASD in the general population (N=16,123, ASD:non-ASD=1:54). To evaluate the prediction performance, we estimated sensitivity, specificity, positive predictive value (PPV), and the area under receiver operating characteristic curve (AUROC). We also compared the risk prediction at different post-birth window at the end of 18- and 30-month, respectively.

Results: We identified 12,743 ASD subjects and 25,833 non-ASD subjects in total. At the age of 24-month, our prediction models achieved similar performance with AUROC of 0.752 (95% Confidence Interval [CI]: 0.745-0.759) by LR and 0.766 (0.759-0.773) by RF (**Table 1**). When the sensitivity target was 50%, the LR prediction model showed the specificity of 83.1% (82.1-84.2%) and PPV of 5.2% (4.9-5.5%), equivalent to 3.1 times of the baseline ASD risk in general population; the RF model showed a higher specificity of 95.5% (95.0-96.0%) and PPV of 12.1% (11.1-13.1%). As the sensitivity threshold increased, specificity and PPV decreased in both models. Comparing the ASD prediction models at ages of 18, 24, and 30-month-old, we found that the prediction accuracy increased as more claims data were available for model training at an older age. Both models identified clinically meaningful variables such as gender, ED visits, upper respiratory infections and otitis media as key predictive factors.

Conclusions: Our study demonstrated the feasibility and promising performance of predicting ASD diagnosis using machine learning models and healthcare claims data. Our findings highlighted the potential of risk-based screening strategies in a more targeted manner. Further research in determining the effective risk cut-off is warranted.

**414.070** (Poster) Psychometric Analysis and Measurement Invariance of a Measure of Challenging Behavior in Infants and Toddlers with Autism Spectrum Disorder  
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Background: Individuals diagnosed with Autism Spectrum Disorder (ASD) often present with high rates of challenging behavior. Similar to school-aged children, many early-identified children present with challenges such as emotional dysregulation and

behavior problems. While previous research has adeptly described the occurrence of challenging behaviors in adolescents and school-aged children, there is inadequate information available on young children with ASD.

**Objectives:** This study examines novel psychometric elements of a commonly used measure of challenging behavior, the Child Behavior Checklist (CBCL) in a group of young children diagnosed with ASD.

**Methods:** Charts from 496 children aged 18-48 months with and without a diagnosis of ASD were reviewed. Psychometrics of the CBCL were analyzed including internal consistency, factor structure, and measurement invariance. The current study examines the previously established hierarchical factor structure of the CBCL with 2 higher-order factors (internalizing and externalizing), each with respective lower order factors (subscales). Measurement invariance (MI) was then evaluated, comparing 'non-ASD' and 'ASD' groups. MI is typically assessed through multigroup confirmatory factor analyses, which examines changes in various goodness-of-fit indices as increasing constraints are imposed on the models.

**Results:** Internal consistency values were strong for externalizing, internalizing and total problems subscales for the CBCL in the both groups. Results from the CFA indicated acceptable fit for the tested model with 6 first-order factors and 2 second-order factors. All three levels of measurement invariance were tested for each subscale. The Emotional Reactivity, Anxious/Depressed, Withdrawn, and Aggressive Behavior subscales achieved scalar invariance, while the Attention Problems subscale achieved metric invariance and Somatic Complaints subscale did not achieve configural invariance.

**Conclusions:** The CBCL had strong internal consistency in both ASD and non-ASD samples, congruous with scores from the normed sample, implying reliability among the subscales and higher-order factors. This study is one of the first to evaluate the factor structure of the CBCL in a large, well-characterized sample of young children with ASD. Standardized item loading values indicated that the existing factor structure had good convergent validity. Good model fit indicates the CBCL constructs of challenging behavior in young children with ASD is consistent with the nature of the previously conceptualized constructs. These findings support the use of the CBCL in a clinical setting to assess level of challenging behavior in young children with ASD. With regard to MI, a sufficient level of invariance was established for the Emotionally Reactive subscale, Anxious/Depressed subscale, Withdrawn subscale, and Aggressive Behavior subscale, implying the subscales measure the constructs in similar ways that the resulting scores can be compared across groups. Due to the lack of scalar invariance on two subscales, using only item level data is appropriate when comparing children with and without ASD on the Somatic Complaints, and Attention Problems subscales. Overall, results demonstrate support for the construct validity of the CBCL in young children with ASD. In conclusion, the CBCL can be considered a reliable instrument for identifying challenging behavior in young children with ASD. This information can then be used to inform intervention planning and direct treatment goals.

**414.071 (Poster)** Relationship between Social Impairment and Sensory Patterns Assessed with the Italian Sensory Profile 2 in Children with Autism Spectrum Disorders

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**Background:** Given the high prevalence of sensory peculiarities in Autism Spectrum Disorders (ASD), the availability of a standardized and agile tool for their assessment is crucial. In Italy, this was missing until our recent publication of the Italian adaptation of Dunn's Child Sensory Profile 2 (SP-2), a questionnaire for parents that results in the evaluation of sensory processing patterns, sensory channels, and related behaviors. Since each individual's sensory processing patterns support or interfere with functional participation in everyday contexts, a relationship between sensory peculiarities and social impairment in ASDs has been hypothesized. Although evidence was reported, there are still no conclusive results on what sensory patterns and specific sensory channels are actually involved. Furthermore, possible effects of different functioning levels have not been explored.

**Objectives:** The aim of this study was to test the association between sensory patterns/sensory sections of the Italian Child SP-2 and total score and subscales of the Social Responsiveness Scale (SRS) in a group of high and low functioning Italian children.

**Methods:** Mothers of 40 ASD children (mean age 6.49 years  $\pm$  2.07, 22 high- and 18 low-functioning) completed the Child SP-2 and the SRS. T-tests on the differences in SP-2 scores between the high- and low-functioning subgroup were conducted. Pearson correlation was calculated between sensory patterns or sensory sections and SRS scores. Linear regression models with SRS total score or subscales as dependent variable and sensory patterns and functioning level as independent variables were tested. Moreover, a linear regression model for the SRS total was explored with the sensory sections as independent variables. A stepwise procedure was run on all regression models. A Bonferroni correction for multiple comparisons was applied to all analyses.

Results: 80% of the participants had at least one sensory pattern and 77.5% at least one sensory section with a higher than normal score. The high-functioning group showed lower scores for the pattern *Registration* ( $p = 0.045$ ) and the section *Movement* ( $p = 0.046$ ) than the low functioning group. *Registration* correlated positively with the total SRS score ( $p = 0.003$ ), *Social Cognition* ( $p = 0.015$ ) and *Mannerisms* ( $p=0.00002$ ) and was the only independent variable reported in the corresponding reduced models ( $p < 0.01$ ). The pattern *Seeking* was the only variable selected with the stepwise procedure for the *Social Awareness* subscale ( $p = 0.0035$ ), with which it correlated positively ( $p = 0.0021$ ). The total SRS score also correlated positively with the sensory section *Movement* ( $p = 0.033$ ), reported as the only variable in the reduced model ( $p = 0.021$ ).

Conclusions: Italian ASD children tested with the new Italian Child SP-2 showed sensory peculiarities. The patterns with a high sensory threshold seem to affect social responsiveness, probably due to the difficulties to detect social cues either because of a passive self-regulation behavior (*Registration*) or an excessive engagement in providing themselves with more sensory input (*Seeking*). *Movement* appears the most involved sensory section. A possible effect of functioning levels on the relationship between sensory and social aspects in ASDs should be further investigated.

**414.072 (Poster)** Reliability and Validity of a Denver Developmental Screening Test Complemented Autism Screening Checklist in Chinese ASD Population

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Background:

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with core symptoms of abnormal functioning in social interaction and communication, and restricted, repetitive behavior. Early screening, early diagnosis, and early intervention are of great importance for ASD children. However, the ability in early screening of ASD in mainland China is still limited to some extent: first, the primary care physicians in community hospitals are not well prepared to recognize early signs of ASD; second, most early screening tools for autism are introduced and adapted from other countries, therefore having some problems in localizing and popularizing, as those tools may be not well suited for local population or primary care physicians may have limited access to those tools.

Objectives:

Based on Denver Developmental Screening Test (DDST) which is widely used by primary care physicians in community hospitals in mainland China, referring to Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5) Autism Spectrum Disorder (ASD) criterion, widely used ASD screening tools, and rich clinical experiences, we developed a DDST Complemented Autism Screening Checklist, which is performed by physicians and takes about 10 minutes to finish. The checklist contains 13 items in total, which are divided into three subscales (social, communication and restricted and repetitive behaviors/RRB). The current study examined the psychometric properties of the tool and intended to promote the ASD screening in mainland China.

Methods:

This study included 15 patients diagnosed with ASD (aged 2.1-7.3 years) and 10 patients diagnosed with Intellectual Disability (aged 0.8-8.2 years) according to the DSM-5 criteria at an early intervention center in Beijing from September 2020 to October 2020. Child and adolescent psychiatrists gave diagnosis and examined all participants with the DDST complemented Autism Screening Checklist. Discriminative validity, criterion validity and internal consistency of the tool were examined.

Results: The Cronbach's  $\alpha$  of the total score of the autism screening checklist was 0.864 ( $P < 0.01$ ). For discriminative validity, the total scores of the autism screening checklist in autism group ( $8.2 \pm 2.62$ ) were significantly different with the total scores in mental retardation group ( $5.0 \pm 2.26$ ). For criterion validity, ROC curve was drawn taking clinical diagnosis as gold standard. Area under ROC curve (AUC) was 0.817 ( $P < 0.01$ , Figure 1). According to the rule of the greatest Youden's index, when the cut off value was set as 5, the sensitivity was 0.933, and the specificity was 0.6.

Conclusions:

The DDST complemented Autism Screening Checklist has good validity and fair reliability. For criterion validity taking clinical diagnosis as gold standard, the tool has high sensitivity and fair specificity. To optimize our Autism Screening Checklist, we would further modify items and factors to improve the internal consistency, include interrater and test-retest data, and enlarge our

sample.

**414.073 (Poster)** Reliability and Validity of the Alsolife Skills Assessment System in Chinese Families of Children with Autism Spectrum Disorders

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**Background:** To improve the transition to adulthood for individuals with autism spectrum disorders (ASD) in China, a novel intervention conception named “ALSO” is proposed with an emphasis that “for children with ASD, current interventions should be guided by future needs in adulthood, and future goals in adulthood must be practiced in current interventions.” Therefore, ALSO sets “Occupational and independent-living skills” in early adulthood as the ultimate goal in individualized education for children with ASD, and proposes that “Occupational and independent-living skills” (O) in early adulthood could be achieved via training on “Academic and cognitive skills” (A), plus “Living and life skills” (L), plus “Social interaction and social regulation skills” (S) from early intervention to adolescent education for individuals with ASD. This intervention conception can be summarized as “A+L+S=O” and is therefore abbreviated “ALSO”. To facilitate implementing ALSO, an ALSOLIFE skills assessment system (ALSOLIFE Assessment) was developed after seven years’ interdisciplinary research. The ALSOLIFE Assessment comprises six skill-domains, which include 22 skill subdomains covering 511 skills (Fig 1). ALSOLIFE Assessment aims to assist caregivers in evaluating skills for children with ASD as the basis for individualized education in home life during the preschool period, and is free for life to the families of the children with ASD.

**Objectives:** Although more than 100,000 caregivers of children with ASD have used the ALSOLIFE Assessment to assist their children’s early intervention in home context, the validation of the ALSOLIFE Assessment is still unknown. Assessment is the basis for IEP, it is important to know the reliability and validity of the ALSOLIFE Assessment and whether its scoring is validation compared to other well validated assessment systems for children with ASD (e.g., PEP-3 or VB-MAPP). To explore the answers for these questions, we conducted this study to comprehensively examine the reliability and validity of the ALSOLIFE Assessment in children with ASD in China.

**Methods:** A sample of 1,050 children diagnosed with ASD by DSM-5 was randomly recruited from 31 provinces of China. The ages of the enrolled children with ASD ranged from 1.52 to 10.43 years (mean = 4.46±1.52), and the sex ratio was 5.40:1 (886 boys and 164 girls). Their primary caregivers were invited to use the ALSOLIFE Assessment to evaluate the ability of their children. The VB-MAPP and PEP-3 were also administered to some of the children in the sample to determine the criterion-related validity.

**Results:** Items analysis found that the content validity of the ALSOLIFE Assessment met psychometric requirement after reduction from 511 to 464 items. Exploratory factor analysis of ALSOLIFE Assessment scoring data yielded six factors, and confirmatory factor analysis verified that the best fitting model is a bifactorial model with six group factors. The ALSOLIFE assessment total score significantly predicted the VB-MAPP and PEP-3 scores. The reliability tests indicated strong internal consistency, test-retest reliability, and inter-rater reliability of the overall ALSOLIFE Assessment as well as each of the six underlying components.

**Conclusions:** The reliability and validity of the revised ALSOLIFE skills assessment system (464-items) satisfied psychometric requirements.

**414.074 (Poster)** Role of Provider Concern during Primary Care Screening for Early Identification of ASD

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**Background:** Pediatric providers identify ASD risk in toddlers through the complementary processes of standardized screening and surveillance, the latter captured by provider indication of concern. The contributions of each strategy to ASD detection warrant a closer look. In this project, we evaluate the added value of provider-indicated concern during primary care screening in early identification of ASD.

**Objectives:** This study aimed to 1) evaluate rates of provider-indicated concern when providers are simply encouraged to indicate concern compared to when they are required to do so, and 2) evaluate the Positive Predictive Value (PPV) when screening or concern, or both indicates ASD risk.

**Methods:** Participants were children screened for ASD during primary care check-ups ( $n=6,204$ , aged 14.8 to 22.17 months), during two multi-site studies. Parents completed the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009). In addition, for each participant, providers had the option to indicate whether or not they had ASD concerns. In one study, providers were encouraged, but not required to indicate concern ( $n=4,274$ ;  $M=18.52$  months,  $SD=0.87$ ). In the other study, providers were required to indicate whether they have an ASD concern before they accessed M-CHAT-R/F results ( $n=1,930$ ;  $M=18.76$  months,  $SD=0.87$ ). Children at risk for ASD either through screen result or provider concern ( $n=562$ ) were invited for an ASD evaluation; 268 children attended the evaluation and were classified as ASD or non-ASD. PPV (likelihood that positive result is a true ASD case) was calculated by dividing true positive ASD cases by all screen positive cases.

**Results:** Providers were equally likely to indicate concerns for ASD whether they were required or just encouraged to do so (2.9% vs. 2.6%;  $\chi^2(1, N=6204) = 0.41, p = .525$ ). Combined across both studies, PPV was .628 when both screener and provider concern indicated ASD risk, compared to .500 for concern only, and .426 for screener only; overall these were significantly different ( $\chi^2(2, N=268) = 9.17, p = .010$ ). Pairwise comparisons of PPV indicated screener only was significantly lower than concern only or both ( $\chi^2(1, N=248) = 9.17, p < .01$ ), but not for both vs. concern only or for screener vs. concern ( $ps > .29$ ).

**Conclusions:** Requiring providers to indicate whether they are concerned a child may have ASD in order to access the M-CHAT-R/F results did not change the rate of endorsement of ASD concern, suggesting that when providers have ASD concerns, they indicate them irrespective of the prompt level (required vs. encouraged). Our results also highlight the benefit of providers indicating concern for ASD, as a combined method of incorporating standardized screening and provider surveillance resulted in highest likelihood that a positive result is a true ASD case. Consistent with the recommendation of the American Academy of Pediatrics, early detection of ASD risk during well-child visits should therefore incorporate both screening and surveillance. Further studies are needed to explore types of concerns indicated by the providers, in order to identify symptoms providers are observing that augment those identified by screening measures.

**414.075 (Poster)** Scatter on Stanford-Binet 5th Edition Routing Subtests Reduces Predictive Validity of Abbreviated Battery IQ in a Clinical Sample of Youth with Ndds

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**Background:** Scattered cognitive profiles are thought to be common in children with ASD and there is some concern that significant scatter between various cognitive subdomains decreases the validity of global IQ scores. Despite this apprehension, research suggests that the presence of scatter in subdomains does not invalidate FSIQ scores, particularly with Wechsler Intelligence Scales. However, this question has not been investigated with the Stanford-Binet 5<sup>th</sup> Edition (SB-5) abbreviated battery IQ (ABIQ), which is commonly used in research and clinical applications as an estimate of cognitive ability. Given that the ABIQ is based on administration of only the two routing subtests, it is possible that the ABIQ is more susceptible to an attenuation of validity due to significant scatter.

**Objectives:** To determine whether scatter among SB-5 routing subtests impacts the validity of the ABIQ in predicting FSIQ. We hypothesized that scatter would not significantly impact ABIQ.

**Methods:** The sample included 1679 youth (21% female) ages 6-16 ( $M=9.1, SD=2.9$ ) who presented for evaluation at a large children's hospital who had a clinical diagnosis of ASD and/or ADHD. Participants completed a full SB-5. Two groups were formed based on presence (56.3%) or absence (43.7%) of ASD diagnosis. Using multiple regression, predictors of FSIQ included ABIQ, scatter between routing subtests, and their interaction. We tested both linear and curvilinear (quadratic) effects of ABIQ.

**Results:** There were no group differences in scatter [ $t(1656.3)=-1.88, p=.06, d=.09$ ]. Both linear and quadratic regression models were significant. The quadratic model fit the data best [ $F(5,1672)=1555, p<.001, R^2=.82$ ]. All predictors were significant. Scatter was a significant moderator, such that higher scatter was associated with an increasing *overestimation* of FSIQ, particularly at moderate values of ABIQ (e.g., 80-115; see Fig. 1). There were no differences in these effects between the two groups.

**Conclusions:** Results suggest that, on average, ABIQ overestimates FSIQ when there is significant scatter between routing subtests, especially when ABIQ is in the average range. The use of the SB-5 ABIQ in research and clinical applications, without consideration of scatter on routing subtests, is potentially problematic.

**414.076** (Poster) Screening for ASD with Telehealth Rapid Interactive Screening Test for Autism in Toddlers (RITA-T)  
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Background:

Amidst the COVID-19 pandemic, telehealth and remote video evaluations have been propelled to the forefront. As we continue to develop guidelines to best evaluate ASD via telehealth, it has become important to identify and test tools and measures that will allow the remote early identification of young children at high risk for ASD. There are no empirically validated telehealth ASD screening measure for those 18-36 months. The in-person RITA-T (*Rapid Interactive screening Test for Autism in Toddlers*) has been shown to demonstrate similar cut-off scores for those 18-24 months and 24-36 months. It has a proven record of effective training, broad and affordable access to providers, and a targeted focus on socio-developmental constructs relevant to ASD that are observable in very young children.

Objectives:

To validate a modified version of the RITA-T as a telehealth tool for those 18-36 months, and to identify a cut off score to differentiate between those with ASD and those with non-ASD.

Methods:

We have developed a modified telehealth RITA-T and we have been validating it remotely. This project is ongoing. Thus far, 30 toddlers have been enrolled in the study. Of those, 10 had received the interactive RITA-T, and all were identified in the high-risk range for ASD. Parents had no concerns for ASD in another 10 of those toddlers, and the remaining 10 were referred for concerns of ASD and with a positive score on the MCHAT-R/F. Ages in the study varied between 18 and 34 months with a mean of 28 months. The telehealth RITA-T includes modified activities and behavioral prompts the parent is instructed to complete with the toddler. These prompts mirror the validated items drawn from the RITA-T. The modified telehealth RITA-T has a maximum score of 20 (vs. 30 for the RITA-T). After consent was obtained, a trained research assistant instructed the families regarding each prompt, and then scored the test. Parents engaged readily in this project, and results show they were able to perform each prompt successfully. The diagnostic remote evaluation then included history, observation of play and structured prompts and any available previous testing. Children in the study were also evaluated using current DSM-5 criteria and the Childhood Autism Rating Scale- 2.

Results:

Those children with an eventual diagnosis of ASD had a score higher than 10 on the telehealth RITA-T. Those with a non-ASD diagnosis (typically developmental delays in speech and language) had a score of less than 9. All 10 toddlers who previously scored in the high-risk range for ASD on the interactive RITA-T, had a score higher than 10 on the modified telehealth version.

Conclusions:

In the wake of COVID-19 and the rapid development of remote telehealth evaluations and diagnosis, we report on promising results and our current work validating a modified telehealth version of the RITA-T. It is likely that this method can continue to be used and applied efficiently after the COVID-19 crisis subsides in those areas where obstacles to identification lead to significant delays in diagnosis and intervention.

**414.077** (Poster) Screening for Depression in Young Adults with Autism Spectrum Disorder  
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Background: Autism spectrum disorder (ASD) is a neurodevelopmental condition that is characterized by increased symptoms of depression (Hedley *et al.*, 2018); depression in ASD is significantly underdiagnosed (Bitsika, 2015). High rates of undetected depression in ASD could suggest that the comorbid presentation of depression is unique, that there is somewhat reduced insight into symptoms, or that screening tools fail to capture critical symptoms in ASD (Hill & Frith, 2004).

**Objectives:** In this study, we tested the convergence of self- and parent-reported symptoms of depression in young adults with ASD, as compared to an age-matched typically developing (TD) university sample.

**Methods:** Individuals with a confirmed ASD diagnosis ( $n=112$ ; 61 females) and TD undergraduates ( $n=387$ ; 262 females), ages 18-24 years, completed the Beck-Depression Inventory-II (BDI-II) and the Autism Questionnaire (AQ). Only individuals who endorsed paying close attention to the task were included. In addition, only TD students with AQ scores under 26 were included; final sample,  $n=107$  ASD and  $n=255$  university students. Some parents completed the Adult Behavior Checklist (ABCL) to report symptoms of depression:  $n=40$  (ASD group) and  $n=52$  (TD group). There was no difference between participants who did versus did not have parental measures,  $p's > .08$ . Analyses tested absolute rates and convergence of self- and parent-reported depression symptoms in ASD versus TD groups. We contrasted the contributions of somatic versus affective items to BDI scores, to test whether the ASD group had differential reporting of physical versus emotional symptoms. Exploratory analyses tested effects of gender on convergence.

**Results:** Participants with ASD reported significantly more symptoms of depression,  $p < .001$ , Fig. 1A. Both groups reported significantly more somatic than affective symptoms,  $p < .001$ , Fig. 1B; the interaction of group and symptom type was not significant,  $p = .35$ . Child and parent depression scores were significantly correlated in *both* ASD,  $r(40) = .85$ , and TD,  $r(52) = .82$ , groups,  $p's < .0001$ , Fig. 1C/D. Child-parent concordance in the ASD group was significantly correlated for both men  $r(40) = .88$ ,  $p < .001$  and women,  $r(31) = .72$ ,  $p = .003$ ; there were too few TD men to test gender differences.

**Conclusions:** Young adults with ASD reported significantly more symptoms of depression compared to their TD peers, consistent with findings that autism severity is associated with loneliness and depression (Hedley *et al.*, 2018). Alexithymia, characterized by difficulty recognizing emotions from internal bodily states, is frequent in ASD (Hill & Frith, 2004), and prompted an examination of whether somatic symptoms might be more readily reported in our ASD sample. However, both groups reported more somatic than affective symptoms, with no group difference. Strong parent-child concordance for *both* ASD and TD groups was consistent with prior work (Ozsivadjian *et al.*, 2014). While women with autism, particularly those with cognitive abilities in the typical range, are often misdiagnosed (Lai *et al.*, 2017), and might be expected to camouflage symptoms, findings suggest similar parent-child concordance in males and females. Overall, the current results suggest that the BDI-II may be adequate for probing depression symptoms in ASD.

#### **414.078 (Poster) Sex Differences in Universal Autism Screening Using the M-CHAT in Primary Care**

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**Background:** Universal autism screening is essential for timely referrals for assessment and access to intervention; however, there is growing evidence for sex differences in screening accuracy. Our evaluation of large-scale universal screening at the Children's Hospital of Philadelphia (CHOP; Guthrie *et al.*, 2019) using the Modified Checklist for Autism in Toddlers (M-CHAT; Robins *et al.*, 2001) revealed positive predictive value that was significantly higher in boys (20%) than girls (8%), suggesting greater false positives for girls. Given well-documented discrepancies in diagnostic rates and how symptoms present across sexes, this study sought to examine sex differences in item-level performance on the M-CHAT.

**Objectives:** Examine the extent to which individual M-CHAT items differentially predict ASD diagnosis among girls and boys, in a large sample of children screened for ASD in primary care and followed until age 4-6 years using data from the electronic health record (EHR).

**Methods:** Universal screening of children aged 16-30 months was conducted using the M-CHAT at CHOP primary care clinics. Children were identified within the EHR for inclusion if the M-CHAT was completed between ages 16-30 months, and the child presented to primary care for follow-up at age  $\geq 4$  years. Diagnostic outcomes were abstracted from EHR records from pediatricians and ASD specialists within CHOP. The final cohort included 20,375 children, with an overall ASD prevalence rate of 2.2% (3.4% in boys, 1.0% in girls).

**Results:** Across children who did and did not go on to have ASD, parents of boys endorsed several items more frequently than parents of girls (items 4-7, 9, 13-15, 17, 19-21, 23 after controlling for multiple comparisons). Individual logistic regressions testing for sex differences (i.e., significant interaction between sex and M-CHAT item score in predicting ASD diagnosis) identified five differentially predictive items. Girls with the following items endorsed were significantly more likely to be diagnosed with ASD than boys: pretend play, response to name, response to joint attention, receptive language (5, 14, 15, 21); however, the latter two items did not survive Benjamini-Hochberg corrections for multiple comparisons. In contrast, responsive social smile (12) was significantly more predictive of ASD in boys than girls.

Conclusions: Using the M-CHAT in a clinical setting, important sex differences in how early ASD symptoms predict later diagnosis were revealed, with specific patterns behind differential prediction varying across items. Responsive social smile was a better predictor in boys, likely because this item was rarely endorsed in girls (3% and .5% in ASD and non-ASD groups) compared to boys (25% and 13% respectively). Conversely, girls with ASD were more likely to not respond to their name compared to boys (17% vs. 8%). Difficulty with pretend play was endorsed relatively evenly across girls and boys with ASD (26% vs. 28%), but was rarer in girls without ASD vs. boys (1% vs. 3%). Sex differences in early socialization experiences, developmental expectations, and/or thresholds for parental concerns may have contributed to these findings, warranting future research. Continued examination of sex differences in autism screening may inform sex-specific screening methods for improved accuracy.

**414.079 (Poster) Sex Differences in the ADOS-2 in ASD Verbal Youth**

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**Background:** Autism spectrum disorder (ASD) assessments require research with females to account for sex and gender differences in presentation and ascertainment. Social and behavioral differences between males and females with ASD include increased use of compensatory strategies (e.g., rote-memorization and repetition) for females, in part because females with ASD show relative strengths in awareness of deficits and aspects of social understanding (Lai et al., 2011). Females' social deficits may be apparent later in development, as female social demands increase in intensity and complexity in adolescence (Kopp & Gillberg, 2011). Observers may also be more likely to miss or misunderstand female ASD behaviors because the formation and validation of diagnostic criteria and assessments are largely based on males (Koenig & Tsatsanis, 2005). In one study on sex differences on the ADOS-2 module 3, females showed less atypicality on some individual items (i.e., excessive interests, hyperactivity items) and less direction of facial expressions. However, there were no differences in overall calibrated severity scores in analyses when IQ was not controlled (Ratto et al., 2018). As most research on sex and gender differences in ASD assessments used the DSM-IV and original ADOS (e.g., Tillman et al., 2018), follow-up is needed.

**Objectives:** To conduct exploratory logistic regressions predicting sex by ADOS-2 item.

**Methods:** 229 participants (age 8 to 17 years 11 months;  $M_{age} = 12.78$ ) completed the ADOS-2 module 3 or 4 as part of a multisite NIMH study on sex differences in ASD. Youth had a prior clinical diagnosis and most ( $n=186$ ) met CPEA research criteria for ASD (Kau & Cooper, 2013). Sex was defined as sex assigned at birth ( $n = 99$  females).

**Results:** A forward stepwise logistic regression was conducted to predict sex from individual ADOS items and interactions of items. Positive coefficients (see Table 1) indicate increased likelihood of being male. Individuals who showed less gesture use and/or had less reciprocal communication were more likely to be male. However, the interaction of less reciprocal social communication and less eye contact predicted increased likelihood of being female. Individuals who asked for less information were also more likely to be female. The model had 69.4% accuracy distinguishing between males and females with ASD. The area under the curve was 0.65 (95% CI: 0.59-0.71).

**Conclusions:** Findings indicate that items on the ADOS-2, primarily those relating to content and quality of verbal and nonverbal communication, distinguish between sex. Some interactions emerged that need to be validated but suggest that items that typically predict being male are predictors of being female when in conjunction with other behaviors and vice versa. These findings may inform screening and assessment, as providers may need to consider combinations of atypical behaviors when assessing girls with ASD.

**414.080 (Poster) Telehealth Evaluation of Autism Spectrum Disorder during COVID-19: Comparative Outcomes from Implementation of the Tele-ASD-PEDS**

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**Background:** The COVID-19 pandemic has exacerbated longstanding barriers to accessing diagnostic evaluations for young children at risk for autism spectrum disorder (ASD) and demanded rapid development of novel diagnostic approaches. Telehealth has been implemented as a widespread clinical solution during the pandemic, safely allowing for continuity of ASD diagnostic and evaluation services. Although research has explored telehealth ASD diagnostic models with promising results, extant studies

have largely focused on homogenous samples of high-risk children, employ a strict research evaluation protocol, and/or do not allow for comparative between-group analysis.

**Objectives:** To examine clinic-wide outcomes of telehealth evaluation for young children at-risk for ASD. Specifically, we sought to 1) compare child-, clinician-, and caregiver-reported outcomes between ASD diagnostic evaluations that did and did not include administration of the TELE-ASD-PEDS, and 2) determine associations between TELE-ASD-PEDS and clinical best-estimate ASD diagnosis.

**Methods:** In response to the COVID-19 pandemic, the Riley Child Development Center (RCDC), a large Midwestern academic medical center neurodevelopmental evaluation clinic, transitioned the evaluation model for all children  $\leq 48$  months of age referred for ASD assessment from face-to-face to telehealth evaluation. Clinicians were trained in the TELE-ASD-PEDS, a novel caregiver-led, clinician-coached remote ASD observational assessment tool, and those clinicians employed this tool in their evaluation protocol. Children referred to the clinic were assigned to clinicians randomly by a clinic scheduling team. Clinicians completed a survey after each evaluation consisting of questions related to diagnosis, diagnostic certainty, and satisfaction with telehealth. Caregivers were asked to complete a satisfaction survey for their child's evaluation experience.

**Results:** Since May 2020, 57 children (mean age: 32.0 months; SD: 8.2) received an evaluation with the TELE-ASD-PEDS, and 24 children (mean age: 35.3 months; SD: 8.2) received evaluation without an ASD observational tool. No between-group demographic differences in child age, insurance type, race/ethnicity, family income, or caregiver education were found (all  $p > .10$ ). Clinicians were able to provide a definitive diagnosis more frequently (93%) in evaluations using the TELE-ASD-PEDS, as compared to those that did not use an observational tool (54%;  $p = .0001$ ). Similarly, clinicians rated diagnostic certainty as somewhat/completely certain in 79% of evaluations using the TELE-ASD-PEDS (compared to 58% of those without an observational tool). 91% of clinicians were satisfied with the information obtained for evaluations using the TELE-ASD-PEDS (compared to 75% of those without an observational tool). Overall, caregiver satisfaction ratings were high across both groups with no significant between-group differences. TELE-ASD-PEDS categorical risk aligned with clinician best-estimate diagnosis in 63% of ASD diagnostic outcomes and 50% of non-ASD outcomes.

**Conclusions:** Use of the TELE-ASD-PEDS as part of a telehealth ASD evaluation protocol is associated with significantly improved ability to provide a diagnosis, moderate concordance with clinician best-estimate diagnosis, and appears to result in higher clinician ratings of diagnostic certainty and some indices of satisfaction. Overall, caregivers were highly satisfied with telehealth ASD diagnostic evaluation. Together, our findings suggest that deployment of telehealth ASD evaluation services has the potential to address access barriers to high-quality diagnostic services during the COVID-19 pandemic and beyond.

**414.081 (Poster)** The Feedback Session of an Autism Assessment: A Scoping Review of Clinical Practice Guideline Recommendations

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**Background:** Clinical practice guidelines exist to assist clinicians with all elements of an autism assessment, including the feedback of results and diagnosis to families. The feedback session can be the interface between the assessment process and a period of understanding, support and intervention for families. To date, reviews of autism assessment guidelines have not examined recommendations for providing feedback.

**Objectives:** The objective of this scoping review was to assess the quality and content of recommendations for delivering feedback within internationally published clinical practice guidelines. Specifically, it aimed to examine how feedback should be conducted and what information should be provided to families.

**Methods:** We systematically searched multiple electronic databases and government websites for autism assessment guidelines. The Appraisal of Guideline Research and Evaluation Second Edition was used to assess the quality of each included guideline. A content analysis was conducted of each guideline's recommendations for feedback of results and diagnosis.

**Results:** Seventeen guidelines fit inclusion criteria. Five did not provide recommendations for feedback. The majority of recommendations for feedback were based on the expert opinions of the individual guideline's development groups. Five guidelines used expert consensus to form recommendations and only one reported using a formal method of reaching consensus. Details of feedback recommendations were tabled and related to who should attend, the timing and mode of delivery, how the clinician should conduct themselves and what should be discussed. Recommendations from different guidelines did not often

contradict each other, however inconsistencies did exist, and recommendations emphasised as important in some guidelines were omitted from others.

Conclusions: Considerable variations were observed between autism assessment guideline's recommendations for feedback. The majority of recommendations were created based on the expert opinions of the respective guideline development groups and the limited empirical research that exists within this area. These factors likely contribute to the variability in recommendations. There is evidently a need for further research into this important element of the autism assessment process.

**414.082 (Poster)** The Impact of Demographic Variables and Comorbidities on the Timing of ASD Diagnosis and Access to Services: Data from a Large National Survey

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Background: Female, BIPOC (Black, Indigenous, and People of Color), and low-income children with Autism Spectrum Disorder (ASD) are understudied and underserved in their access to timely ASD diagnoses (Bargiela et al. 2016, Nowell et al. 2015). Under-identification, diagnostic disparity, and diagnostic lag delay the start of vital early intervention services, necessary for overall wellbeing and functioning (Zwaigenbaum et al. 2015).

Objectives: Using large-scale national data, we investigated the interplay of assigned sex at birth, race, income, and co-occurring conditions in the prediction of age at ASD diagnosis and frustration in access to services. Our research will contribute to a greater understanding of ASD identification in US children.

Methods: Survey data from 1,245 parents of ASD children from the 2017-2018 National Survey of Children's Health (CAHMI) were analyzed (79% male, 21% female; 67% white, 13% Hispanic, 13% Multiracial/Other, 6.6% Black;  $M_{age} = 11.45$  years,  $SD_{age} = 4$  years). CAHMI surveys are completed by caregivers of youth across the United States. Data for each year come from 1 child per household. Generalized linear models were used to analyze study questions.

Results: The distributions of diagnostic age varied by assigned sex: a higher proportion of males were diagnosed under the age of three [ $X^2(1, 1245) = 8.37, p = .003$ ] and more females were diagnosed over the age of five [ $X^2(1, 1245) = 17.74, p < .000$ ]. When accounting for urban vs. rural, race, and sex, children in families with lower incomes were diagnosed later ( $\beta = -0.09, p < 0.01, R^2 = 0.002$ ). Assigned sex, metro vs. rural status, income and age of diagnosis predicted co-occurring conditions; after accounting for race, males ( $\beta = 0.06, p < 0.05, R^2 = 0.1$ ), living in a rural area ( $\beta = 0.07, p < 0.02, R^2 = 0.1$ ), from lower income families ( $\beta = -.08, p < 0.001, R^2 = 0.1$ ), and with a younger age of ASD diagnosis ( $\beta = -.07, p < 0.04, R^2 = 0.1$ ) had a higher number of co-occurring conditions. With regards to family frustration in accessing services, children with co-occurring conditions (anxiety, depression, ADHD, behavioral disorder, speech disorder, intellectual disorder, and developmental disorder) significantly predicted family frustration in access to services ( $\beta = 0.35, p < 0.000, R^2 = 0.11$ ), after accounting for sex, race, age of ASD diagnosis, metro vs. urban, "working poor", and income level.

Conclusions: Our research supports previous findings that disparities in age at ASD diagnosis exist by sex and demographic variables and predict rates of co-occurring conditions. Greater numbers of co-occurring conditions predicted higher parent reported frustration in access to services. Notably, low-income level was the most common predictor of later age at ASD diagnosis, higher service-access frustration, and higher numbers of co-occurring conditions. Targeted work is required to increase timely ASD diagnosis and access to services in low-income families.

**414.083 (Poster)** The Impact of Diagnosis Scale – Revised (IODS-R)

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Background:

Health professionals frequently communicate what can be life changing diagnoses. The Impact of Diagnosis Scale (IODS) has been developed in relation to Borderline Personality Disorder (Courtney & Makinen, 2016) but as yet no measurement tool exists to determine the psychological impact of receiving a diagnosis of autism. Autism is increasingly diagnosed in adulthood,

however, the few studies that explore self-reported impact of receiving a diagnosis have been primarily qualitative. A standardised measure to examine the impact of receiving an autism diagnosis in adulthood is needed.

#### Objectives:

Our aim was to develop an impact of diagnosis scale suitable for autistic adults by revising the IODS developed for Borderline Personality disorder.

#### Methods:

Following a promising trial of a co-produced, preliminary revision of the IODS (Arnold et al., 2020), the research team and autistic advisors developed an expanded pool of 46 items, scored on 7-point Likert scale, within 6 hypothesised domains; “Service Access, Well-being, Self-acceptance and self-understanding, Diagnostic process, Accuracy of diagnosis, Relating with others”. Participants were drawn from the Autism CRC Australian Longitudinal Study of Autism in Adulthood (ALSAA). Scale reduction processes were applied to data from 108 formally diagnosed autistic adults aged 25+ years.

#### Results:

Following iterative rounds of exploratory factor analysis using principal factors with promax rotation, 22 items were retained across 4 domains. Domains showed acceptable internal consistency and were named “Well-being” ( $\alpha = .87$ ), “Clinician support” ( $\alpha = .82$ ), “Self-understanding” ( $\alpha = .75$ ) and “Service Access” ( $\alpha = .76$ ). Overall internal consistency was good ( $\alpha = .81$ ). Mean scores reiterated themes from preliminary findings, of a generally positive “Well-being” ( $M=5.27, SD=1.41$ ), “Self-understanding” ( $M=6.36, SD=.75$ ), and “Clinician support” ( $M=5.76, SD=1.17$ ), though poor “Service access” ( $M=3.34, SD=1.46$ ).

Qualitative data reiterated previous findings of Self-Understanding, Identity and Acceptance, Support and Services, Valence of Response, Relationships and Camouflaging. Regarding adulthood autism diagnosis many “spent my entire life thinking... there was something wrong”. For most diagnosis “was a relief” and “changed my life” or even “saved my life”. However, for some it was the “worst decision”, “very difficult emotionally”, going as far as saying “I am still devastated”.

#### Conclusions:

The IODS-R adds new understanding to the experience of receiving an autism diagnosis in adulthood. It is unique in quantitatively measuring the self-reported impact of receiving a diagnosis. More post- diagnosis support is needed for autistic adults. The IODS-R may prove useful for evaluating diagnostic services.

#### **414.084** (Poster) Toward Earlier Screening for ASD: A New Factor Structure of the First Years Inventory (FYIv3.1)

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Background: Early screening for ASD risk in the community is critical to increasing families’ access to early intervention. Yet, few autism-specific screening tools have been developed and tested for the general population of infants <18 months. The First Year(s) Inventory (Baranek et al., 2003; Reznick et al., 2007) showed promise for detecting ASD risk in a community sample of 12-month-olds. Of note, the sensory reactivity/regulation domain added specificity and prediction accuracy over the social-communication domain alone (Turner-Brown et al., 2013; Ben-Sasson and Carter, 2013), likely because sensory features emerge in infancy prior to full ASD manifestations (Canu et al., 2020). A new version of the FYI (v3.1), with clinical utility for a wider age range, is available but requires empirical validation of the factor structure (to include items tapping sensory reactivity/regulation and social-communication domains) with a new sample.

Objectives: This study aimed to (a) validate the factor structure of the new FYIv3.1 with a large community sample of infants, and (b) determine correlations among factors and age.

Methods: Participants (N=6,427) were parents of infants (6-16 months) recruited from the community through state birth records. FYIv3.1 surveys were collected online and by mail. This cross-sectional study applied factor analytic models to determine the optimal number of underlying constructs. Exploratory structural equation models and confirmatory factor analyses (CFA) were run allowing for evaluation of the reliability of the proposed structure, the match between items and constructs, and the

relationships of these factors to each other, as well as to age. All 69 items were scored for frequency of specific child behaviors using five response categories (“Never” to “Always”). Given the ordinal variables and the planned missingness (due to two different forms-A/B with 27 overlapping items), we used robust maximum likelihood estimation. We specified the model to have at least three items per factor and no cross-loadings.

Results: The exploratory models suggested five to nine oblique factors. Review by the clinical/research team resulted in the retention of seven factors that were retested by CFA:

1) Communication, Imitation & Play (CIP), 2) Social Attention & Affective Engagement (SAE), 3) Sensory Hyperresponsiveness (Hyper), 4) Sensory Hyporesponsiveness (Hypo), 5) Self-regulation in Daily Routines (SReg), 6) Sensory Interests, Repetitions, Seeking Behaviors (SIRS), and 7) Motor Coordination and Milestones (Motor). The 7-factor model had good fit (SRMR=.05); >90% of items had standardized factor loadings >.30. Inter-factor correlations ranged from <.01 to .75 (Table 1). Age was moderately correlated with CIP and Motor.

Conclusions: These results provided support for a theoretically sound, clinically distinct, and empirically validated 7-factor model underlying the new FYIv3.1. Two factors represented aspects of social-communication, four represented aspects of sensory reactivity/regulation, and one represented motor development. As expected, social-communication and motor were more related to age than were aspects of sensory reactivity/regulation. Future directions for research about the new FYIv3.1 include assessment of differential item function (across age, prematurity status, and SES) as well as determination of optimal scoring algorithms/cutoffs for screening based on ASD clinical outcomes later in life.

**414.086 (Poster)** Unveiling Autism in Girls: Efficacy of Girls’ Questionnaire for Autism Spectrum Conditions (GQ-ASC) As a Screening Tool for Five to Twelve-Year-Old Girls in Malta.

*M. Mifsud, TAASC, Birkirkara, Malta*

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Background: This explorative study offers novel information about the efficiency of the Girls’ Questionnaire for Autism Spectrum Conditions (GQ-ASC, Attwood, Garnett & Rynkiewicz, 2011) as a screening tool for five to twelve-year-old females in Malta. The GQ-ASC contains 54 questions relating to play, friendships, social situations, abilities, interests, sensory profiles and mental health. This tool is still being piloted and to date, there are no cut off scores for this age range. Nevertheless, it is suggested that the higher the score, the higher the indication of autism symptomology (Ormond et al., 2018; Minds and Hearts, n.d).

Objectives: This study aimed to explore whether the GQ-ASC is an effective tool to screen for autism in five to twelve-year-old females in Malta, with and without intellectual impairment. It also investigated whether there is a relationship between poor mental health symptoms and risk of autism in females; and whether a multidisciplinary assessment impacts assessment conclusions in comparison to stand-alone assessments. Additionally, the researcher explored the age of diagnosis for females in Malta and initial parental concerns with respect to their daughters’ development.

Methods: Data were collected through parent-reported online questionnaires which included the GQ-ASC and additional questions. Parents of females aged five to twelve years were recruited via state and private assessment clinics and social media (n=29 parents of females assessed for autism; n=39 parents of neurotypical females). The study used quantitative methodology to examine the relationship between GQ-ASC scores for females assessed for autism and neurotypical females. Statistical analysis was used to investigate the relationship between GQ-ASC scores for assessed females and the independent variables: IQ; diagnosis and mental health symptoms. Similarly, statistical tests were used to analyse the impact of multidisciplinary assessment on diagnostic conclusions or lack thereof; and the age when females are diagnosed. The statistical analyses involved the two independent sample t-test, one-way ANOVA, the Tukey post-hoc test and cross-tabs. Furthermore, qualitative methodology was used to explore the initial concerns of parents of females assessed for autism through thematic analysis.

Results: The GQ-ASC was found to be a discriminant screening tool particularly for females without intellectual impairment and for females experiencing symptoms related to depression, anxiety and/or panic attacks. Females assessed for autism had statistically significant higher GQ-ASC scores (n=29, M=138) in comparison to neurotypical females (n=39, M= 124). This study found that multidisciplinary assessments may offer more conclusive results than stand-alone assessments. In Malta, most females are assessed by six years; and initial parental concerns tally with current diagnostic criteria.

Conclusions: This is the first study to compare GQ-ASC mean scores of assessed and neurotypical females aged between five and twelve years. A cut-off score of 124 is being proposed for females within this age range. While a larger scale study is required to support the findings of this research, this does not discount the novel and valid contribution offered by this research supporting the GQ-ASC as a discriminant screening tool for autism in five to twelve-year-old females in Malta.

**414.087 (Poster)** Use of Child Behavior Checklist in Toddlers with Autism

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**Background:** Emotional and behavioral problems are common comorbidity of autism. The emotional and behavioral problems in toddlers with autism and the use of the CBCL as a screening tool for ASD are not explored adequately in China.

**Objectives:** To investigate the emotional and behavioral problems in toddlers with autism and explore efficacy of Child Behavior Checklist (CBCL) (version for 2-3 years children) for screening of autism in toddlers.

**Methods:** A total of 200 toddlers aged 2 to 3 years (2.68±0.5 years old) continuous diagnosed by experienced child psychiatrists of the research group from outpatient department of Peking University Sixth Hospital during 2016 to 2018, meeting criteria of autistic disorder (AD) in Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) were enrolled to our study. 200 typically developing(TD) children (2.72±0.5 years old) according to the ratio of 1:1 matched with autistic group in gender and age from Kindergartens in Beijing were included from 2016 to 2018. All subjects were evaluated by Achenbach Child Behavior Checklist (CBCL, 2 to 3 years old) and some of them were rated with Autism Behavior Checklist (ABC) at the same time. Scores of CBCL (2 to 3 years old) and positive rate of CBCL (2 to 3 years old) factors were compared between the two groups. Data were also analyzed with the Logistic regression model and the Spearman correlation to assess the validity of the CBCL in screening children with autism.

**Results:** The total score, scores of subscales (internalization and externalization subscales) and scores of each factor of CBCL (social withdrawal, depression, somatic complaints, sleep problems, aggressive behavior and destructive behavior) in AD group were higher than those in TD group (P<0.001). The positive rate of each factor of CBCL (2 to 3 years old) in AD group was higher than that of TD group (P<0.05). Using Logistic regression analysis, the withdrawn factor has the highest OR value for the diagnosis of autism(OR=1.34, P<0.001). The results also showed that the Spearman Correlation coefficients were 0.41 and 0.33 between the score of CBCL internalization subscale, social withdrawal factor and ABC total score (P<0.001). The internalization subscale and social withdrawal factor yielded the better discrimination between the two groups using 14 and 8 as a boundary score respectively. The Area Under the Curve (AUC), sensitivity and specificity were 0.88, 0.77, 0.81 for internalization subscale and 0.87, 0.75, 0.76 for social withdrawal factor separately.

**Conclusions:** Toddlers with autism have more emotional and behavioral problems than typically developing children. The internalization subscale and social withdrawal factor of CBCL (2 to 3 years old) could differentiate toddlers with ASD from typical toddlers effectively.

**414.088 (Poster)** Using M-CHAT to Screen for Autistic Spectrum Disorder in Toddlers from Ethnic Minorities in Israel: Experiences and Perspectives of Public Health Nurses

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**Background:**

The prevalence of autistic spectrum disorder (ASD) is rising sharply. Disparities in the diagnosis of ASD, especially at young ages for whom intervention is most likely to be effective, among ethnic populations in Israel have been reported elsewhere. One of the largest gaps observed is between the Jewish and Bedouin populations in southern Israel.

In order to address this issue, the southern district Ministry of Health collaborated with Soroka University Medical Center, leading a project to improve early detection of children with ASD using the M-CHAT administered by public health nurses in maternal and child health centers. Children who screened positive are further examined by a specialist nurse and, if appropriate, referred for a specialist examination at Soroka University Medical Center.

**Objectives:**

To examine the perspectives of public health nurses regarding the factors influencing the potential use of the M-CHAT screening tool.

## Methods:

A qualitative research method based on interpretive theory was used. 56 public health nurses participated in seven focus groups conducted through structured interviews.

## Results:

In reviewing the transcripts, four topic clusters came up. These four clusters were transformed into open codes. Within each of these four open codes, a number of sub-topics were identified that were labeled as axis codes.

### (1) Potential benefits of using a specific screening tool:

A. Using general developmental milestones to detect developmental delay versus using M-CHAT. B. Enhancing professionalism. C. Raising confidence in professional decision-making.

### (2) Challenges that arise from using M-CHAT:

A. Use of the term autism. B. Technical difficulties. C. Lack of time and work force. D. Lack of parental awareness.

### (3) Unique aspects related to cultural and social characteristics of the patients:

A. Traditional and patriarchal cultural barriers. B. Language barriers. C. Parental suppression of information and stigma.

### (4) Strategies that could further promote the screening process:

A. Empowering parents as part of the diagnostic process. B. Adapting the screening tool culturally. C. Adjustment of the layout of the examination room. D. Professional development of the nurses. E. Separating the developmental visit at the age of 18 months from other preventive visits such as vaccines.

## Conclusions:

The present study revealed several key benefits and challenges of using M-CHAT to screen for autism in children from the Bedouin population as perceived by public health nurses. Using the tool, the nurses, developed additional ways of assessing their patients and were empowered in making professional decisions.

The nurses emphasized the difficulty of navigating administrative and technical barriers, time and work force constraints and cultural barriers of patients and families.

Given these challenges and the need for effective use of the screening tool, a policy is required to define the time and resources required to implement this important screening tool in children from ethnic minorities.

**414.089** (Poster) Using Machine Learning to Enhance Autism Screening with the Social Communication Questionnaire: A Cross-Cultural Approach

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## Background:

Machine learning has recently been employed to enable improvements in the detection of autistic symptomatology using screening instruments. Trained on existing screening data from individuals who have completed the diagnostic process, machine-learning algorithms can discover intricate patterns that underlie the categorisation of individual responses into diagnostic categories. This knowledge can subsequently be applied to predict autistic symptomatology in new unseen data with higher sensitivity and specificity than the cutoff-based algorithms that typically accompany screening instruments.

Machine learning approaches to autism offer a promising framework, however, they have so far been limited to data from English-speaking cultures. This bias, which coincides with a more general bias in autism research towards the study of the condition within statistically prominent cultures, hinders the usage of computational screening methods in languages and cultures in which autism is less well understood and in which fewer diagnostic data are available.

#### Objectives:

In this study, we applied machine learning methodologies to a cross-cultural dataset, which included parental responses to the English and the Greek versions of the Social Communication Questionnaire (SCQ), a parent-report screening instrument based on the Autism Diagnostic Interview gold-standard assessment. Our first aim was to examine the effectiveness of different machine learning methodologies in two target languages. Our second aim was to examine the diagnostic performance of machine learning algorithms that have been trained on data from one language and tested on data from the other language, as well as algorithms trained and tested on pooled data from the two languages.

#### Methods:

To address our first aim, we trained representative machine learning algorithms on the English (N = 332 individuals, 104 autistic, mean age: 6-20 years old ) and the Greek data (N = 162 individuals, 62 autistic, age range 4-26 years old) and assessed their diagnostic performance in unseen data from the two target languages (with stratified 10-fold cross-validation method). To address our second research aim, we trained machine learning algorithms on English (Greek) data and assessed their diagnostic performance in Greek (English) data. We also performed experiments in which machine learning algorithms were trained and tested on pooled English and Greek data.

#### Results:

For both English and Greek, several machine learning algorithms outperformed SCQ's default cutoff-based algorithm in detecting autism. Furthermore, the same types of machine-learning algorithm achieved the best performance in the English and the Greek SCQ data (see Table 1). Our results also suggest that gains from machine learning transferred from English to Greek and vice-versa, and held for the experiments with the pooled dataset (see Table 2).

#### Conclusions:

Our findings suggest that machine learning can be applied cross-culturally and enable improvements in autism screening. Our results also suggest that machine learning methodologies are potentially transferable across cultures. This implies that large-scale datasets from prominent cultures could support screening for autism with computational methods in cultures that are underrepresented in autism research. Our current work involves using machine learning to understand cross-cultural differences in the identification and the diagnosis of autism.

**414.090** (Poster) Using Word Embeddings to Detect Autism Based on Language Data from an Assessment of Cognitive Ability  
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#### Background:

Word embeddings are a powerful resource from computational linguistics; they are grounded on the distributional hypothesis, according to which words with similar meanings tend to occur in similar contexts. Broadly speaking, word embeddings enable the representation of meanings of words or sentences in a multi-dimensional Euclidean space capturing semantic regularities. For example, the meaning of the word CUP will be represented as a vector in a, say, 300-dimensional space. Importantly, CUP will fall closer to MUG and MILK than to JACKET and TREE.

Recent studies have employed word embeddings to characterise the linguistic profiles of autistic children in structured interactions within diagnostic assessments for autism (e.g., ADOS-2: Goodkind et al., 2018; Prud'hommeaux, Van Santen, & Gliner, 2017). This research has offered new insights into the unique ways with which autistic children use language and showed the potential of word embeddings to support the diagnosis of autism from language data.

## Objectives:

In this study, we use word embeddings to characterise the linguistic profiles of autistic children in the Wechsler Abbreviated Scales of Intelligence (WASI-II; Weschler, 2011), a general-purpose assessment of cognitive ability (rather autistic symptomatology per se). Our first aim is to use word embeddings to account for language ability in the WASI-II Vocabulary task, in which participants are asked to describe what a list of target words mean. Our second aim is to train machine learning classifiers on Vocabulary-task data from autistic and typical children represented with word embeddings, and evaluate their ability to distinguish between responses of autistic and neurotypical children.

## Methods:

To address our first aim, we represented sample responses provided in the WASI-II's scoring manual in a multidimensional space using word embeddings (Word2vec and GloVe). We then examined whether the distances between the target word and the sample responses in the multidimensional space were consistent with the gold-standard scoring of the sample responses. To address our second aim, we applied machine learning classifiers to a dataset with the WASI-II responses from 50 typical and 25 autistic children, aged 6-14 years old, represented in a multidimensional Euclidean space.

## Results:

Our results showed that the distances between the target word and the sample responses in the multidimensional space were consistent with the gold-standard scoring in 81% of the cases. The best classification results on the human data were obtained when a Support Vector Machine with a linear kernel was trained on the dataset represented with the GloVe word embeddings (see Table 1). Diagnostic performance (see Table 1) was moderate and varied considerably across individual WASI-II items (mean sensitivity = 37.25, range = 8.70-100).

## Conclusions:

Our preliminary results suggest that word embeddings can be used to characterise language ability and also detect autistic symptomatology using WASI-II responses with moderate success. Our current work aims to implement methods that take into account age and gender.

### 414.091 (Poster) Using the Big Data Approach to Clarify the Structure of Restricted Repetitive Behaviors across the Most Commonly Used Autism Spectrum Disorder Measures

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**Background:** Despite the mounting evidence suggesting that restricted and repetitive behaviors (RRB) in autism spectrum disorder (ASD) are not a unitary construct but encompass several distinct domains, the ability of commonly used diagnostic and quantitative ASD measures to assess these domains separately has not been systematically evaluated. By conflating distinct constructs, overly broad domain scores can cloud the understanding of RRB trajectories, the recognition of associations with other clinical domains and hinder understanding of neurobiological mechanisms. Given the wide use of measures such as the Social Responsiveness Scale-2 (SRS-2), the Social Communication Questionnaire (SCQ), and the Autism Diagnostic Observation Schedule (ADOS) across research and clinical contexts, and their availability in several large-scale databases that also include neuroimaging and genetic data, rigorous psychometric evaluation of the ability of these instruments to capture different RRB constructs is needed.

**Objectives:** The main objective of the current investigation was to conduct a psychometric evaluation of the ability of the SRS-2, the SCQ, the ADI-R and the ADOS to capture different RRB constructs.

**Methods:** Exploratory Structural Equation Modeling (ESEM) was conducted using individual item-level data from the SRS-2, SCQ, ADI-R and the ADOS. Data were obtained from five existing publicly available databases. For the SRS-2, the final sample consisted of N= 16761 individuals ( $M_{age}=9.43$ ,  $SD=3.73$ ; 18.5% female); for the SCQ, of N= 15840 ( $M_{age}=7.99$ ,  $SD=4.06$ ; 18.1% female); for the ADI-R, of N= 8985 ( $M_{age}=8.86$ ,  $SD=4.68$ ; 19.4% female); and for the ADOS, of N= 6314 ( $M_{age}=12.29$ ,  $SD=6.79$ ; 17.7% female).

**Results:** The three-factor structure provided the most optimal and interpretable fit to data for all measures (comparative fit index  $\geq .983$ , Tucker Lewis index  $\geq .966$ , root mean square error of approximation  $\leq .028$ ). Repetitive-motor behaviors (RMB), insistence on sameness (IS) and unusual (UI) and/or circumscribed interests (CI) factors emerged across all instruments. No acceptable fit was identified for the ADOS. The three-factor model performed well across sex and age. Associations with age, cognitive functioning, internalizing and externalizing symptoms suggested somewhat distinctive patterns. Higher RMB ratings across all scales and UI ratings across the SCQ and ADI-R were associated with younger age and lower verbal IQ (VIQ) and non-verbal IQ (NVIQ). IS scores across all measures and CI scores on the SRS-2 were directly correlated with age and to a lesser degree but in the same direction with VIQ and NVIQ. Child Behavior Checklist (CBCL) internalizing T scores were strongly positively associated with the SRS-2 and ADI-R IS scores. CBCL externalizing T scores were positively associated with IS and CI scores across all measures.

**Conclusions:** Reported findings demonstrate the capacity and the limitations of the SRS-2, SCQ and ADI-R to measure RRB in individuals with ASD. These measures were not specifically developed to capture distinct RRB domains, however, they are widely used in research and clinical practice and have been collected in several large datasets that are available to the research community. Reported findings also highlight the directions for future measurement development.

**414.092 (Poster)** Using the Brief Observation of Social Communication Change (BOSCC) to Measure Changes in Social Communication of Minimally Verbal Children

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Background:

The Brief Observation of Social Communication Change (BOSCC) provides a standardized and efficient method of measuring changes in social communicative behaviors in children with ASD, observed in naturalistic environments. The BOSCC can detect significant change in minimally verbal children's social communication behaviors over time (Grzadzinski et al., 2016; Kitzerow et al., 2016), using coders blinded to treatment status and timepoint. This study is a replication of initial BOSCC studies using a pre-post design. Additionally, we will use this data to determine the feasibility of the online BOSCC coding platform that is currently in beta.

Objectives:

- 1) Use preliminary BOSCC data to examine change in social communication behaviors over time in minimally verbal children undergoing intensive intervention.
- 2) Examine correlates of change in BOSCC scores.
- 3) Examine the relation between BOSCCs that are hand-coded vs. coded using an online coding platform.

Methods:

Participants included 25 minimally verbal children (Mage=46.39 months, SD=13.89) enrolled in a center-based comprehensive intensive partial hospitalization program for young children with ASD.

The BOSCC is a 12-minute videotaped play interaction between an individual and play partner blind to treatment status. BOSCCs were completed at entry and exit (10 weeks of program enrollment) by research assistants. The BOSCC coding includes 15 items coded on a 6-point scale. Items are categorized into two domains: social communication (SC) and restricted and repetitive behaviors (RRBs), as well as a core total. Due to COVID-19, BOSCC coding training and reliability meetings were conducted remotely. Following training, BOSCCs were hand-coded by coders blind to timepoint. Online coding is in progress and results will be available by May 2021.

At entry, participants completed the Mullen Scales of Early Learning and Vineland Adaptive Behavior Scales. Parents also completed the Child Behavior Checklist (CBCL) and Social Responsiveness Scale-2 (SRS) at entry and exit.

Results:

Remote training of coders resulted in strong interrater reliability (% agreement  $\pm 1$  point=.904; ICC<sub>SC</sub>=.975; ICC<sub>RRB</sub>=.982; ICC<sub>Total</sub>=.985)

Children demonstrated significant improvements in BOSCC SC between entry (Md<sub>entry</sub>=30.00) and exit (Md<sub>exit</sub>=25.50; Wilcoxon signed-rank Z=-2.34, p=.019, ES=-.331), but not in RRBs or total scores.

Entry communication scores on the Vineland related to change on BOSCC SC (B=-.097, R<sup>2</sup>=.214; p=.046). Children demonstrated significant improvements on the CBCL (p=.012) and SRS (p=.036) total scores between entry and exit; changes were not related to changes on the BOSCC SC domain.

#### Conclusions:

Consistent with previous studies examining the BOSCC, the BOSCC detects subtle changes in observed social communication due to a brief intervention period in minimally verbal children with ASD. These changes in social communication behavior provide different information than parent-reported change in social skills and behavioral problems. The BOSCC presents the potential to provide data that is truly blinded, though a limitation of this study is the lack of a control group. The online platform represents an opportunity to streamline the training process, coding process, and to increase accessibility to a wider audience of clinical researchers.

#### 414.093 (Poster) Utility of Electronic Measures of Cognition in the Age of COVID-19

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**Background:** In order to reduce risk of exposure to COVID-19, many researchers are now required to conduct data collection remotely. Measuring cognitive ability in autism spectrum disorder (ASD) research is critical to the diagnostic process. The use of personal protective equipment limits the validity of in-person IQ testing and therefore examining the utility of web-based measures of cognition is of great interest to the field.

**Objectives:** To examine the accuracy of two electronic measures of cognition in predicting IQ on an examiner-administered assessment in individuals with ASD and their immediate family members.

**Methods:** Ninety-two individuals completed this study including 19 probands (10.68 years $\pm$ 4.9), 46 parents (46.5 $\pm$ 7.0), and 27 siblings (11.56 $\pm$ 4.8). Participants completed (1) the Wechsler Abbreviated Scales of Intelligence, Second Edition (WASI-II) administered by a clinician, (2) an electronic version of the Peabody Picture Vocabulary Test, Fourth Edition (e-PPVT-4), and (3) an online Visual Reasoning test (VR) developed by TestMyBrain.org. The majority of participants completed their assessments within the same day and a laptop computer with a standard mouse was used for electronic measures. Data collection occurred prior to COVID-19.

#### Results:

Measures were completed by all participants, with the exception of one proband who was unable to complete the VR test. Mean scores in probands on the WASI-II FSIQ-4 standard score, e-PPVT-4 standard score, and VR z-score were 90.21 $\pm$ 23.6, 87.58 $\pm$ 23.4, and -0.85 $\pm$ 1.18, respectively. On the same measures, mean scores in parents were 112.37 $\pm$ 11.1, 103.78 $\pm$ 9.9, and 0.3 $\pm$ 0.78, respectively, and 115.78 $\pm$ 11.1, 109.19 $\pm$ 11.0, and 0.7 $\pm$ 0.99 in siblings. Mean scores were significantly lower in probands relative to both parents and siblings on the WASI-II (p=.001; p<.001), e-PPVT-4 (p=.008; p=.001), and VR (p=.007; p=.010). There was no significant difference between parent and sibling scores (p's>.05).

Pearson's correlation coefficients indicated that WASI-II FSIQ-4 standard scores were significantly correlated with both e-PPVT-4 standard scores (r=0.789, p<.001) and VR z-scores (r=0.694, p<.001). However, only 28.3% of participants' e-PPVT-4 standard scores fell within the 95% confidence interval of their WASI-II FSIQ-4 standard scores. When the sample was divided based on scores one standard deviation below the mean (i.e., SS $\geq$ 85 and Z-score $\geq$ -1), the e-PPVT-4 accurately predicted 97.6% of participants, and the VR accurately predicted 84.5% of participants. Among participants whose WASI-II FSIQ-4 scores were below 85 (all were probands), classification accuracies for the e-PPVT-4 (n=8) and VR (n=7) were 62.5% and 85.7%,

respectively. For probands with WASI-II standard scores above 85 ( $n=11$ ), 90.9% were correctly classified on the e-PPVT-4 and 81.8% on the VR. The e-PPVT-4 and VR accurately classified 97.8% and 84.8% of parent scores, and 100% and 85.2% of sibling scores, respectively.

**Conclusions:** Correlations between electronic measures of cognition and the WASI-II suggest all three assessments are measuring the same construct. However, variability at the individual level indicates that the electronic measures do not provide adequate estimates of a specific IQ score. The electronic measures may be useful to understand cognitive capacity of individuals with and without ASD at a group level, although additional measures should be explored to provide more reliable individual estimates of IQ.

**414.094 (Poster)** Utility of the Modified Anxiety Dimensional Observation Scale (M-Anx-DOS) in Preschoolers with Autism Spectrum Disorder

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**Background:** Co-occurring anxiety affects ~50% of individuals with autism spectrum disorder (ASD) and results in greater impairments and poorer quality of life than ASD alone. However, little is understood about how anxiety manifests early in childhood in ASD, particularly in children with intellectual disability, in part due to the paucity of measures designed to assess anxiety symptoms in very young children with ASD. Improved observational measurement and a better understanding of anxiety in young children with ASD is critical to the development of prevention programs, which have been shown to be highly effective at mitigating the long-term impacts of anxiety in typically developing (TD) children.

**Objectives:** In the present study, we modified the Anxiety Dimensional Observation Scale (Anx-DOS), an existing observational measure of anxiety symptoms in young children and examined its reliability and validity in preschool-aged children with ASD and comorbid intellectual disability.

**Methods:**

This study included 48 children with ASD (41 male, 7 female;  $M(SD)$  age=43.96(7.12) months) and 31 typically developing controls (24 male, 7 female;  $M(SD)$  age=43.62(11.64) months). Of the children with ASD, 81.3% ( $n=39$  out of 48), had an IQ < 70. The Modified Anx-DOS (M-Anx-DOS) included five presses designed to elicit anxiety-related behavior: Spider, Auditory Startle, Mystery Jar, Maternal Separation, and Stranger Approach. Each press was coded offline from video for a variety of behaviors, including fear arousal, exaggerated startle, physical avoidance, and proximity seeking, and a global anxiety rating was also assigned. Cronbach's alpha was computed to examine internal consistency within each press. Intra-class correlations (ICCs) were utilized to investigate inter-rater reliability. Convergent validity was investigated via Pearson correlations with the Preschool Anxiety Scale (PAS) subscales. Predictive validity was evaluated via binary logistic regression models predicting clinical best estimate anxiety diagnoses. The proportion of children with at least one anxiety diagnosis was marginally higher in the ASD group (47.83%) than the TD group (29.03%),  $\chi^2(1)=2.72, p=.099$ .

**Results:** All presses showed good internal consistency, with alphas ranging from .70 to .92. ICCs ranged from .81 to 1.00, reflecting strong inter-rater reliability. In the ASD group, several Anx-DOS press scores were associated with social, separation, and generalized anxiety symptoms on the PAS,  $r_s \geq .26, p_s < .05$ . When groups were combined, the Anx-DOS press scores were a marginally significant predictor of anxiety diagnosis,  $\chi^2(5)=9.55, p=.089$ , with sensitivity of .39 and specificity of .87. When run separately, the model was non-significant in the ASD group,  $\chi^2(5)=2.89, p=.717$  (sensitivity=.55; specificity=.67), but significant in the TD group,  $\chi^2(5)=20.28, p=.001$ , (sensitivity=.67; specificity=.96).

**Conclusions:** The M-Anx-DOS exhibited strong reliability and convergent validity in preschool-aged children with ASD. Interestingly, the M-Anx-DOS predicted clinical best estimate anxiety diagnoses in the TD group, but not the ASD group. These findings suggest that while the M-Anx-DOS may be effective at eliciting anxiety symptoms in very young children with ASD, it may not correspond as closely with categorical anxiety diagnoses. This may reflect the challenges inherent in assigning anxiety diagnoses in young children with ASD, particularly those with intellectual disability.

**414.095 (Poster)** Utilizing the CBCL As an ASD Screener and Outcome Measure for a Social Skill Intervention in Autistic Adolescents

Background:

Autistic adolescents' social challenges contribute to lower quality and quantity of friendships, greater loneliness, and victimization (Adams et al., 2016; Kasari et al., 2011; Mazurek & Kanne, 2010). Furthermore, common comorbidities (i.e. depression, anxiety) increase social challenges, increasing the possibility for autistic individuals to experience detrimental outcomes (Bellini, 2004; Mazurek & Kanne, 2010). As the prevalence rates of Autism Spectrum Disorder (ASD) increase (Baio et al., 2018), it is imperative to explore potential screeners, functioning to screen individuals at high-risk for an ASD diagnosis and suggest further evaluation. The Child Behavioral Checklist (CBCL; Achenbach & Rescorla, 2001) provides one such potential ASD screener and intervention outcome evaluation for the *Program for the Evaluation of the Enrichment of Relational Skills (PEERS®; Laugeson & Frankel, 2010)*.

Objectives:

The purpose of the present study was twofold. First, in light of prior discrepant research findings (e.g., Bölte et al., 1999; Havdahl et al., 2016; Mazefsky et al., 2011), a replication of CBCL subscale score examination for differences between two adolescent ASD and age-controlled, IQ-matched typically developing (TD) samples was conducted. Second, this study investigated the outcomes of *PEERS® for adolescents* via the CBCL scales to examine the use of a broadband measure of behavior to quantify widespread intervention outcomes.

Methods:

122 participants aged 11-16 ( $M=13.55$ ; 93.9 % male) were recruited and enrolled in the current study and placed within the following conditions: Experimental (EXP;  $n=56$ ), Waitlist (WL;  $n=53$ ) Control (TD;  $n=13$ ). EXP and WL conditions were randomly assigned for autistic individuals without a cognitive disability ( $IQ>70$ ). All groups completed self- and parent-report questionnaires, including the CBCL, at two timepoints: pre- and post- intervention (*PEERS® for adolescents*). Aim one utilized a Multivariate Analysis of Variance (MANOVA) to examine group differences (EXP vs. WL vs. TD) on CBCL Syndrome scales scores (Anxious/Depressed, Withdrawn/ Depressed, Social Problems, Thought Problems, Attention Problems, and Aggressive Behavior scales). Aim two examined a Group (EXP vs WL) by Time (pre- vs. post-intervention) repeated measures MANOVA conducted on the aforementioned scales.

Results:

Results for aim one indicated elevated scores for the CBCL present in ASD EXP and WL groups as compared to TD groups on the Anxious/Depressed, Withdrawn/Depressed, Social Problems, Somatic Problems, and Attention Problems subscales (Wilks' Lambda = .594,  $F(16, 224) = 4.168$ ,  $p < .001$ ; see Table 1). Results of the second aim showed a significant effect of Time x group (Wilks' Lambda = .884,  $F(6,102) = 2.242$ ,  $p = .045$ , Partial  $\eta^2 = .116$ ). Follow-up univariate tests showed significant decreases in the Social Problems and Withdrawn/Depressed mean scores for the EXP group (See Table 2).

Conclusions:

Findings support prior research indicating the CBCL as a potential screener for ASD in adolescents by the identification of a unique scale elevation pattern. Furthermore, outcomes provide additional support for the efficacy of *PEERS® for adolescents* in ameliorating social challenges and collateral symptoms. Findings implications include the importance for further evaluation of the CBCL as an ASD screener, and the need for greater dissemination of social skills interventions.

**414.096 (Poster)** Validating an Adaptive Age Equivalent and Adaptive Developmental Quotient Using the National Database for Autism Research (NDAR)

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Background: Estimates of developmental functioning are critical for contextualizing other developmental skills and behaviors. Gold-standard evaluations of developmental level are typically conducted in highly-standardized contexts but are not always feasible due to financial or behavioral constraints. Adaptive skills are associated with developmental level (Perry, Flanagan, Geier, & Freeman, 2009) and can be accurately assessed remotely via parent report. Thus, adaptive skills may serve as a proxy for estimating developmental functioning when in-person testing is not possible. However, no quantitative methods exist for translating adaptive skills to estimates of developmental functioning.

Objectives: We evaluate the convergent and divergent validity of two new metrics—the adaptive age equivalent (AAE) and the adaptive developmental quotient (ADQ)—that can be calculated from parent-report data using the Vineland Adaptive Behavior Scales, 3<sup>rd</sup> Edition (Vineland-3) and may serve as developmental functioning proxies.

Methods: Our sample included 403 children with autism spectrum disorder (ASD) aged 17-166 months from the National Database Autism Research (NDAR). We included participants with raw scores for each of the seven primary subdomains of the Vineland-3: Receptive Language (RL), Expressive Language (EL), Personal Skills (PER), Interpersonal Skills (IP), Play & Leisure (PL), Fine Motor (FM), Gross Motor (GM). For each subdomain, we calculated a developmental quotient (DQ) score by (1) converting raw scores to age equivalent (AE) scores and (2) dividing the AE score by chronological age. We conducted two separate exploratory factor analyses (EFA) for the AE and DQ scores. Subdomains that loaded  $>|.40|$  onto the first factor were averaged to create AAE and ADQ scores. We then explored associations with convergent and divergent measures, listed in Table 2. We hypothesized that AAE and ADQ scores would demonstrate at least medium associations with convergent validity measures ( $r \geq .50$ ) and smaller associations ( $r < .30$ ) with divergent validity measures.

Results: Analyses were conducted in R using psych and lavaan packages. EFAs demonstrated that five subdomains loaded onto the first factor for the AAE model and three subdomains loaded onto the first factor for the ADQ model (Table 1). We conducted Pearson's partial correlations of AAE and ADQ with each validity measure, covarying for chronological age. Results partially supported our hypotheses for convergent validity (Table 2), with AAE and ADQ demonstrating medium-to-large associations ( $r$ 's  $> .57$ ) with chronological age and the Mullen Scales of Early Learning, whereas associations with other convergent measures were small ( $r$ 's  $< .32$ ). Results supported our hypotheses for divergent validity; AAE and ADQ demonstrated significant but small associations with executive functioning, ASD symptomatology, and repetitive behaviors ( $r$ 's  $< .28$ ).

Conclusions: Our findings suggest adequate validity of AAE and ADQ scores and support their use for approximating developmental level for children with ASD. Convergent analyses suggest that AAE and ADQ metrics may be better suited as proxies for developmental skills (e.g., language, motor) as opposed to cognitive ability (e.g., fluid reasoning, verbal comprehension), consistent with the types of skills primarily captured by the Vineland-3. This study represents an important step towards overcoming barriers to research on early development by establishing valid metrics of developmental level that can be obtained remotely.

#### 414.098 (Poster) Validation of the Autism Detection in Early Childhood-Japanese (ADEC-J)

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Background: In Japan, universal 18-month health check-ups at Public Health Centers provide an opportunity to screen children aged 18–24 months for developmental concerns, including autism. However, children who are detected as having developmental concerns and referred for follow-up services are rarely assessed further, thereby delaying formal diagnosis. Although research emphasizes the importance of autism screening as part of follow-up services, the use of standardized autism screening instruments within these services is rare. This is likely due to a lack of well validated autism screening instruments available in Japanese.

Objectives: To compare the screening properties of a new Japanese version of the Autism Detection in Early Childhood (ADEC-J), a brief, play-based Level 2 autism screening tool designed for young children (up to 3-years), with the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2) in young Japanese children classified as high or low likelihood for a developmental disability based on service use.

Methods: Participants were 60 Japanese children (31 male,  $M_{age}=28.87$  months,  $SD=7.13$ ) who were assessed with the ADEC-J, ADOS-2 (Japanese version), the New Kyoto Scale of Psychological Development, and the Social Maturity Scale-Third Edition. The use of follow-up services at their local Public Health Center was utilized as an index of high likelihood for a developmental disability ( $n=29$  children). Two children had existing diagnoses of autism and two were suspected as having autism. The

administrators of the ADEC-J and ADOS-2 were blind to participants background, group status, and any diagnostic information, as well as each other's assessment results.

Results: Children in the high-likelihood group scored significantly higher on both the ADEC-J and ADOS-2, and significantly lower on developmental and adaptive skills, compared to the low-likelihood group. The ADEC-J scores were significantly and highly correlated with the Social Affect, Total, and Comparison Scores of the ADOS-2 ( $r = .80-86, p < .001$ ), and moderately correlated with the Restricted and Repetitive Behavior scores ( $r = .64, p < .001$ ). One of the children with an autism diagnosis and two suspected cases met cut-off scores on both the ADEC-J and ADOS-2. One older (41 months) child with autism met criteria on ADOS-2 but not ADEC-J.

Conclusions: The findings of high ADOS-2 scores and low developmental and adaptive skills in children using Public Health Center follow-up services in Japan suggests the presence of autism and possible developmental delays; yet many children did not have any formal diagnosis suggesting the need for developmental pediatric assessments in this population to identify, or rule out, autism and other conditions. The newly developed ADEC-J was strongly correlated with the ADOS-2 and was effective in identifying autism in young children indicating the promise of this tool for use in Japan. Our findings support its introduction as part of the developmental assessment of children identified with developmental concerns as part of routine screening throughout the public health network.

**414.099 (Poster)** Validation of the Autism Diagnostic Observation Schedule with Open-Access Data

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Background: The Autism Diagnostic Observation Schedule (ADOS) has been the gold-standard for autism diagnosis for many years. However, the algorithm items for the ADOS-G (Lord et al., 2000) were initially validated on only 223 samples, and later revised based on a new validation set of 1,630 assessments for the ADOS-2 (Gotham et al., 2007) that were then validated on an independent sample of 1,282 assessments (Gotham et al., 2008).

Objectives: We sought to validate the ADOS algorithm items using a large set of open-access data and to investigate the potential predictive value of a singular set of core autism items, accurately differentiating between autism and no autism across age and language level.

Methods: Data from the ADOS-2 Modules 1-3 were downloaded from the NIMH Data Archive (NDAR). After removing invalid or missing data, 10,042 assessments remained. Assessments were from children aged 17 months to 192 months, labeled as either having autism ( $n = 6558, \text{Age} = 87 (SD = 45)$  months) or not ( $n = 3487, \text{Age} = 60 (SD = 37)$  months). We selected the 18 ADOS items that were common across the three modules and collapsed data across modules. Item values were ordinal, with ratings between 0 and 3. Exploratory and confirmatory factor analyses were conducted to identify how items covaried and grouped into either one, two, or three-factor constructs. Logistic regression models were then conducted using the ADOS items selected from these factor models to predict autism diagnosis. Specificity and selectivity of the logistic regression models were based on 20% of the data after training the models on an initial 80% of the data.

Results: Factor analyses provided statistical support for both a single-factor model combining core autism features and a two-factor model with constructs similar to what the ADOS-2 has previously defined as "Social Affect" (SA) and "Repetitive and Restricted Behavior" (RRB) domains (**Table 1**). In the single-factor model, core features were a significant predictor of diagnosis (log likelihood = -4022.4,  $p < 0.001$ ). In the two-factor model, SA and RRB were significant predictors of diagnosis (log likelihood = -4121.1,  $p < 0.001$ ; SA: log likelihood = -4162.6,  $p < 0.001$ ; RRB: log likelihood = -5189.2,  $p < 0.001$ ). Furthermore, logistic models using single- and two-factor model items to predict autism diagnosis performed with a sensitivity of ~93% and specificity of ~88% (**Table 2**).

Conclusions: Analyses validated a two-factor model of the ADOS with a substantially larger sample size from open-access repository data and demonstrate the potential predictive value of a single-factor algorithm that captures core features of autism across language level modules.

**414.100 (Poster)** Validity of the Boscc across Settings and Interaction Partners

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**Background:** The *Frankfurt Early Intervention Program for preschool children with ASD (A-FFIP)* is a manualized low-intensive therapist-delivered and parent-supported early intervention program, which is currently studied for efficacy by a German multi-center randomized controlled trial (target sample N = 134 preschool-aged children at four study sites). The primary outcome measure is the *Brief Observation of Social Communication Change (BOSCC)* with an unknown administrator. Several additional secondary outcome measures as well as mediating mechanisms are studied. The BOSCC is a relatively new instrument and has mainly been used to code parent-child interactions. Additionally, the ADOS\_BOSCC was developed to allow coding of more standardized situations with an unknown tester. The Early social communication scales (ESCS) are widely used in early intervention trials and might also be appropriate for recoding with the BOSCC. To date (1) the usage of an ESCS\_BOSCC has not been studied, and (2) no study has directly compared BOSCC scores of four different settings with different interaction partners.

**Objectives:** To (1) present psychometric properties of the BOSCC coding based on selected ESCS video-scenes, and (2) to compare BOSCC scores derived from parent-child interaction scenes (DCMA) and interactions with unknown testers (BOSCC, ADOS-2, ESCS).

**Methods:** Cross-sectional data of N = 30 minimally verbal children, aged 2-5.5 years old are reported. The BOSCC coding system was applied to four different 12-minute video scenes: DCMA, BOSCC, ADOS-2, and ESCS. (1) Score distributions, Cronbach's alpha, confirmatory factor analyses and consensus are reported; (2) repeated measures ANOVAs were performed to elicit differences between the different settings.

**Results:** (1) Psychometric properties of the ESCS\_BOSCC were satisfying. (2) There was a significant difference in the BOSCC total scores by setting ( $F=5.74, p=.005, \eta^2=.175$ ) and the domain scores (social communication (SC):  $F=7.76, p<.001, \eta^2=.223$ ; restrictive and repetitive behavior (RRB):  $F=5.57, p=.002, \eta^2=.171$ ). Children showed less RRBs in the parental interaction but had higher SC scores, compared with the other more standardized situations with an unknown tester. Regarding the situations with an unknown administrator most RRBs were noticed in the free-play interaction, least RRBs in the highly structured setting of the ESCS, whereas SC scores were comparable over the three settings involving an unknown tester.

**Conclusions:** The BOSCC is a feasible instrument that may be used with different settings to measure autism symptoms. Based on our study, validity of BOSCC scoring based on ESCS scenes was satisfying. To compare study results, existing ESCS videos can be recoded with the aim to capture more autism-symptom related behaviors. Also, this study highlights the importance of being aware about influencing factors when choosing specific BOSCC settings and interaction partners. Specific interventions might improve social-communication skills during parent-child interaction, but more global measures and standardized settings show greater degrees of generalization that differ from the behaviors shown in parent-child interactions. The results on the varying RRB-scores show setting related behaviors that need to be taken into account for when interpreting study findings.

#### **414.101 (Poster) Variability and Change in Autism Symptom Severity Trajectories across Childhood**

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**Background:** Autism symptom severity in an individual can change across childhood. However, the prevalence of change is still not well understood. Several publications have documented small groups of children that increased or decreased in symptom severity across childhood. But, we previously found that nearly half of the autistic children experienced significant change in symptom severity during early childhood, suggesting change might be more common than previously portrayed (Waizbard-Bartov et al., 2020).

**Objectives:** Symptom severity trajectories were evaluated for a group of 183 autistic children (128 boys, 55 girls) at three time points across childhood: beginning of early childhood (T1; approximately age 3), end of early childhood (T3; approximately age 6), and during middle childhood (T4; approximately age 11).

**Methods:** Autism symptoms were measured using the Autism Diagnostic Observation Schedule-2 (ADOS-2) and symptom severity was quantified using the Calibrated Severity Scores (CSS). Symptom trajectories were modeled using Latent Change Score models and Mixture Models. Symptom severity change was also evaluated using the Reliable Change Index, to determine the amount of change (in CSS) between measurement points that could be considered significant change in severity.

**Results:** The ADOS trajectory for all participants taken together indicated a small decrease in severity during early childhood (T1-T3; 3-6 years of age) followed by a small increase in severity during middle childhood (T3-T4; 6-11 years of age). However, symptom severity change demonstrated large individual differences between children, and subgroups were identified that demonstrated a common change tendency across childhood. Two groups of children consistently decreased in severity across

childhood: one group (20.5% of the sample) decreased from high to moderate severity levels and the other (5%) from moderate to minimal severity levels, no longer meeting diagnostic criteria for autism. A third group (27.4%) experienced a large increase in symptom severity. Symptom severity change also differed across developmental phases; children who decreased in severity during early childhood tended to increase in severity during middle childhood, and vice versa (Figure A). The two core domains, Social Affect (SA) symptoms and Restricted, Repetitive Behaviors (RRB), showed opposite change patterns; during middle childhood, SA severity increased for a large proportion of children while most children decreased in RRB severity. Girls demonstrated a stronger tendency to decrease in symptom severity than boys, which became more evident through childhood and led to girls having lower scores with age (Figure B).

Conclusions: Up to 48% of children experienced symptom severity change, either decrease or increase in severity, during different periods of childhood. Symptom severity change was highly variable and characterized by three types of differences: individual differences between children, differences within children across time and differences between the core domains. These differences balanced out in the combined ADOS trajectory for all children, creating a stable presentation across time that did not reflect the extent of change occurring in the individuals that constituted the sample. Determining what biological and social factors contribute to the varying trajectories of autism severity during childhood will be a fertile area for research in the future.

**414.102 (Poster)** Verification of New Screening Tools for Neurodevelopmental Disorders in 5-Year-Old Children, Including the Use of Web Systems

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Background: Early intervention for neurodevelopmental disorders (NDD) requires early detection, but the spread of Covid-19 makes it difficult to perform developmental screening for infants and young children. In addition, long-term epidemiological studies are needed on the impact of COVID-19 on NDD. We created the NDD screening algorithm for 5-year-old children in 2014, and then started using it as multiple questionnaires. This system, which began to be used as a Web system in 2019, can still be used even under the spread of COVID-19 infection.

Objectives: This study reports the results, including the verification of the Web system in 2019.

Methods: In 2013, we created an algorithm for NDD risk group extraction from multiple questionnaires filled out by parents and teachers of 954 5-year-olds, detailed examinations of 156 people, and DSM-5 diagnostic data. We conducted 965 children in 2014, 1004 in 2015, 1031 in 2016, 967 in 2017, and 1040 in 2018 to verify the usefulness of the algorithm. The verification method is as follows. First, we compared the proportion of risk children under the old and new algorithms for each year. Next, we compared changes in the proportion of children who underwent detailed examinations who were diagnosed with NDD and needed assistance and those who were below the diagnostic criteria but needed observation. Finally, the sensitivity and specificity of the old and new standards were calculated.

Results: According to the new algorithm, the rate of children at risk of NDDs in all 5-year-olds of the year was 18.6% in 2014, 20.0% in 2015, 17.4% in 2016, 16.4% in 2017, 17.1% in 2018 and 17.6% in 2019 compared with 23.8% in 2013 (fig.1). The ratio of NDD risk group extraction was lower in the new algorithm than in the old one. In addition, despite the decline in the number of children at risk, the proportion of children diagnosed with NDD among those who underwent detailed examination increased to 72.7% in 2014, 62.1% in 2015, 73.1% in 2016, and 80.2% in 2017, 69.2% in 2018 and 69.7% in 2019 compared with 47.8% in 2013 (fig.2). We were able to prove that about 90% of children, including those in the need for observation (NDD gray zone), needed follow-up and intervention support in each year. In the algorithm we created, the sensitivity of NDD diagnosis was 79.8% and the specificity was 99.1%. The sensitivity of follow-up judgment was 89.1% and the specificity was 98.8%.

Conclusions: This study proved that the algorithm we created can efficiently detect developmental disorders in preschool children. This web screening system is expected to have a high level of participation even under COVID-19 infection and will be beneficial to children and parents in need of support for primary school enrollment.

**414.103 (Poster)** Virtual Diagnostic Evaluation of Young Children for Autism Spectrum Disorder: The Observation of Play Screener: Home Edition

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Background: The Corona virus pandemic resulted in the shutdown of face-to-face diagnostic services for young children with suspect Autism Spectrum Disorder (ASD). The shutdown significantly delayed referral of young children with ASD to the limited treatment services available and connecting families with online resources on ASD.

Objectives: Develop a valid and reliable virtual play assessment as part of a virtual diagnostic evaluation of young children referred with suspect ASD.

Methods: The virtual diagnostic evaluation was conducted during two 1 hour virtual visits (by Zoom) scheduled 2 weeks apart. During the first visit, a structured interview based on DSM 5 criteria for ASD (\_\_\_\_, unpublished) is conducted with parents and developmental/medical history is completed. Prior to the second visit parents are requested to create and upload videos of 3 or 4 household routines for review. During the second visit, a structured virtual play assessment is conducted, the Observation of Play Screener: Home Edition (OOPS:HE, \_\_\_\_\_, 2020), and surface physical exam for minor anomalies and birth marks and observation of gross motor skills are obtained. Parents are sent a description of OOPS:HE prior to the second virtual visit including a list of recommended toys and the 12 structured activities (Recipe for Success: A Structured Play Observation with Your Child). The examiner prompts the parent to complete all of the activities with their child during the session.

The OOPS:HE was developed for use with children 12-36 months of age and has 20 items arranged in three sections: Social Communication (SC), Social Emotional Reciprocity and Relationships (SERR), and Restricted and Repetitive Behaviors (RRB). The test items for the SC and SERR sections are behaviors typically seen in toddlers. They are spontaneous behaviors you observe (e.g., to-and-fro vocalizations, seeking contact with parent, use of words and gestures), and the toddler's responses to specific activities of the play session (e.g., response to name being called, requesting, rolling a ball back, imitation). The test score is the number of items failed (not present) for SC and SERR sections plus the number of RRB items present. The examiner also circles whether a diagnosis of ASD is definite, probable, possible or not present.

Results: 20 children have completed the virtual diagnostic evaluation to date, all save one OOPS:HE sessions were adequate technical quality. Ages ranged from 16 months to 3 years, OOPS:HE scores ranged from 2 to 20, 8 rated as definite ASD (mean score 16), 6 probable ASD (mean score 13), and 5 no ASD (mean score 3). The rating of OOPS:HE (probable, definite ASD) agreed in all cases with the results of the DSM interview. 19 families submitted home videos of which 14 were sufficient quality. Results were consistent with the OOPS:HE. Children are now being scheduled into child development clinic for further assessment to confirm their diagnosis and review progress.

Conclusions: Preliminary results support the ability of parents to conduct a virtual play assessment with their child. Continuing research on virtual diagnostic evaluations of young children with suspect ASD is needed.

**414.104** (Poster) Visual and Tactile Sensory Experiences of Children with ASD: Voices of Those with Autism from Their Autobiographies grant No. T73MC29073 from the Health Resources and Services Administration.

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Background:

The Diagnostic and Statistical Manual, 5<sup>th</sup> Edition (DSM-5, APA 2013) incorporated sensory symptoms as a new diagnostic criterion for autism spectrum disorder (ASD) under the Restricted and Repetitive Behaviors (RRB) domain. This resulted in research and clinical challenges resulting from the lack of an established construct definition and the dearth of corresponding instruments (Cascio et al., 2016; Schaaf & Lane, 2015). Much of the recent research in the area of RRBs and sensory symptoms used psychophysical and brain imaging methods (Gliga et al., 2018; Haartsen, et al., 2019). There is also the need to understand the perspective of those experiencing these symptoms. As many autistic individuals who are verbal, insightful, and have written about their lives, autobiographical material may be an important complementary resource for information about sensory experiences. This study systematically recorded quotes from such autobiographies to perform a content analysis of these statements.

Objectives:

To examine the experience and contexts of sensory symptoms involving vision and touch as described in autobiographies of those with ASD.

Methods:

Nine conventionally-published autobiographies were identified through internet and online book-selling sources. One autobiography was excluded because it was written entirely through facilitated communication, which as been shown to be unreliable. Two readers read each book and extracted quotes using a standardized recording form. Quotes that described either visual or tactile experiences from the childhood period were identified by consensus of research assistants, and then confirmed by the lead authors. The sensory behavior was classified as either Seeking (wanting to experience it, often repeatedly) or Avoiding (finding the experience aversive). In addition to recording the quote in this way, any elaborated information was classified into three areas: phenomenology (e.g., “it felt like my skin was on fire); associated behavior (“when she tried to take my hand, I jerked it away.”); and explanations for “why” the author did the behavior (“I found it very relaxing,” “...it would help me cope with the overstimulation.”).

The results were then tabulated in terms of percentages of similar descriptions and themes in the area of description (type of behavior), phenomenology, behavior, and explanations.

Results:

The most common type of visual behavior was in the Seeking area of wanting to create repetitive visual experiences. Explanations for these often centered around being relaxing or pleasurable. A second visual Seeking type was that of using peripheral vision to experience the sight in a more comprehensible way. The most common Avoiding visual experiences involved fluorescent or excessively bright lights. In the area of touch, Avoiding behavior was more commonly described, and its phenomenology often involved reported experiences of painful and/or overstimulating touch. The most common Seeking behavior related to touch was towards full-body deep pressure, and secondarily towards stroking or feeling carpet, hair, or fabric.

Conclusions: Autobiographical statements from autistic individuals about their sensory experiences in childhood in the areas of vision and touch showed consistency in description, phenomenology, associated behavior and offered subjective explanations for behaviors. Therefore, these descriptions may be valuable as complementary information to more controlled investigations.

**414.105** (Poster) What's behind the Mask? Evaluating Methods of Measuring Camouflaging  
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Background:

In recent years there has been increasing interest in the measurement of camouflaging or masking strategies (hiding of and compensating for autistic characteristics) used by autistic people. Several different methods of measurement have been developed, however until now there has no evaluation or direct comparison of these different methods. Researchers therefore have little guidance when choosing which methods are most appropriate for their studies.

Objectives:

To evaluate established methods of measuring camouflaging in autism, and to compare three such methods in an autistic adolescent sample.

Methods:

Methods of measuring camouflaging were identified through systematic review and evaluated using COSMIN criteria by two independent reviewers. Two of these methods (self-report questionnaire and a 'discrepancy' approach) and a newly developed method (informant-report questionnaire) were applied to a sample of 59 autistic adolescents (29 female, mean age 14.5 years, mean IQ 100.6), in addition to a parent-reported measure of social skills.

Results:

Evaluation using COSMIN criteria revealed that the most commonly used measures of camouflaging appear to be the most psychometrically rigorous, providing evidence of good structural validity, and some indication of reliability. In the adolescent sample, self-report and informant-report measures, and informant-report and discrepancy measures, were strongly positively correlated ( $r = .47$  and  $r = .46$  respectively). None of the measures were significantly correlated with participants' social skills.

Conclusions:

Researchers should be aware of the strengths and limitations of the methods available to measure camouflaging. Different methods of measuring camouflaging are related to each other but distinct from social skills, suggesting that they each tap into a similar underlying construct of 'camouflaging'. Where participants are not able to report on their own behaviours, informant-report and discrepancy methods can be used to identify camouflaging behaviours.

**414.106 (Poster)** Youth at Low Risk for Receipt of an ASD Diagnosis: Identification of Predictor Variables to Improve Screening and Triage

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**Background:** Given the increased demand on diagnostic assessment services, families seeking evaluations for autism spectrum disorder (ASD) are facing extremely long waitlists and corresponding delays in diagnosis. To address this crisis, a potential strategy is to maximize efficiency of services by using scores from screening instruments to triage youth referred for ASD diagnostic evaluations to specific clinics based on their level of risk. However, evidence suggests psychometric properties of screening instruments may vary depending on a variety of child and family factors (Rosenberg et al., 2018). Thus, it is important that other indicators be identified to supplement screening measures such that youth at risk for receipt of an ASD diagnosis are triaged to the most appropriate diagnostic services.

**Objectives:** We aimed to characterize a sample of youth referred to a low-risk ASD diagnostic clinic. Secondly, we aimed to explore predictor variables from commonly administered measures that may be associated with receipt of an ASD diagnosis.

**Methods:** Data were extracted from an on-site database for 233 youth (79% male; *M* age = 7.17 yrs., range: 3-19 yrs.) who were referred for an ASD diagnostic evaluation at a specialist center serving individuals with autism and neurodevelopmental disorders. Youth included in this study were at low risk for receipt of an ASD diagnosis based on SCQ scores (< 12) and triaged to an interdisciplinary clinic designed specifically for this population. Descriptive statistics were used to characterize the sample, and logistic regression analysis was used to examine a model with ASD diagnosis as a dichotomous dependent variable. Predictor variables included the following: demographic variables (i.e., household income, gender, and race), *Social Communication Questionnaire* (SCQ) scores, *Adaptive Behavior Assessment System-Third Edition* (ABAS-3) domain scores (i.e., Conceptual, Social, Practical), and *Child Behavior Checklist* (CBCL) subscale scores.

**Results:** Of the sample, 44.2% (74% male; *M* age = 7.14 yrs.) received an ASD diagnosis. The binomial logistic regression model was significant ( $\chi(14) = 50.36, p < .001$ ) and resulted in the following additional pertinent findings: SCQ scores were not predictive of an ASD diagnosis (Odds = 1.049,  $p = .590$ ); the ABAS-3 Social domain score was significantly *negatively* related to receipt of an ASD diagnosis (Odds = .940,  $p = .004$ ); the CBCL: Withdrawn/Depressed subscale (Odds = 1.139,  $p = .005$ ) and CBCL: ADHD subscale score (Odds = 1.173,  $p = .003$ ) were predictive of an ASD diagnosis. Specifically, the model indicated that for every standard deviation increase in withdrawn/depression scores or ADHD score, the odds that a child get an ASD diagnosis increased by 13.9% or 17.3% while accounting for the effects of all variables in the equation.

**Conclusions:** Results suggest that, in this sample of youth, scores from the SCQ were not helpful in differentiating youth who ultimately received an ASD diagnosis. However, there appear to be other predictors from commonly administered measures that could be used in conjunction with other data to appropriately triage youth to ASD diagnostic clinics. Limitations, clinical applications, and future directions will be discussed.

**414.107 (Poster)** • Validation of a New Digital Tool, the Pirates Autism Assessment App, to Aid Screening of Primary School Children Referred with Possible Autism for Formal Diagnostic Assessment

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Background:

With increasing demand and waiting times for autism diagnostic assessment, we need to improve the timeliness of diagnostic assessment (National Health Service (NHS) England Long Term Plan 2019). Digital tools which are task-specific and adapted for inclusive use can engage children across the neuro-diverse spectrum positively; and have potential to deliver more efficient diagnostic pathways. We present the results of a validation study of a novel autism assessment app (Pirates). This includes tests of Theory of Mind, Affect Recognition, Fantastic Stories and Understanding of Idiom presented in a pirate adventure game format. This can be played with the child, alongside history taking and school information, at initial clinical assessment of a child referred for possible autism.

#### Objectives:

- Determine if children diagnosed with autism perform differently to Neurotypical (NT) children using the Pirates app.
- Establish sensitivity and specificity.

#### Methods:

Following statistical advice, and NHS ethical approval, we aimed to recruit 120 children (60 autism, 60 NT) attending mainstream primary school (age 4 to 11). With written informed consent children played on the app with a researcher, and responses to each question were recorded. From this a score was calculated based on number of errors (if no errors, score 28, each error scores +1 to total, so max score 56 (28 errors). Statistical significance tested by unpaired T-test.

#### Results:

Children with autism (N=51, study closed early as unable to assess children during Covid) made a larger number of errors (mean score 35) than NT (n=59) (score 31  $p<0.000001$ ). Number of errors decreased in both groups with age, reflecting that developmental skills such as Theory of Mind improve with the age of the child: NT key stage one (KS1) (<90 months) mean score 32, key stage two (KS2) (over 90 months) 31, and in autism group KS1: score 37, KS2: 34. From this, cut-offs between likely autism and likely NT were determined according to age. Using these cut-offs overall sensitivity was 75%, specificity 86%, improving to 77% and 94% for KS1 age group. It was also observed that playing with the child using the app gave additional helpful information about their social interaction, e.g. whether they responded socially to shared humour during some scenarios, or needed reminders to listen to the question before pressing buttons “impulsively”. Previous published pilot work has shown high acceptability with parents and children, and suggests digital-clinical interaction typically takes 10-15 minutes to complete, fitting well into a standard 60-90 minute initial paediatric developmental assessment.

#### Conclusions:

The Pirates app shows promise as a tool that can be used alongside initial clinical assessment including history taking and information from school, to determine whether full, detailed, diagnostic assessment is required. In some cases, it may support an early and shortened diagnostic pathway of the child at the initial stage of the diagnostic process. By improving early decision making, including increasing confidence in deciding whether or not a child needs to proceed to full diagnostic assessment, this could help improve the timeliness of diagnostic assessment, and reduce service delivery costs.

## Early Development (< 48 months)

### ORAL SESSION — EARLY DEVELOPMENT (< 48 MONTHS)

#### Oral 308 - Assessment & Social Development

##### **308.001** (Oral) Screening for ASD in Toddlers Born Premature: Psychometric Properties of the M-CHAT-R/F

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**Background:** Medical advances have contributed to higher rates of survival for infants born preterm, yet these children remain at increased risk for cognitive and behavioral disabilities (Peralta-Carcena et al., 2017). Early work suggests infants born premature show increased rates of positive screens on autism spectrum disorders (ASD) screening measures (13-14%; Gray et al., 2014; Guy et al., 2015). However, diagnostic outcomes in toddlers born premature are not well understood, in part because the process from screening to diagnosis is often not completed (Monteiro et al., 2019), which may be due to both family and provider/system factors. A better understanding of ASD screener performance in children born premature is critical to informing early detection and intervention.

**Objectives:** This study explores the association between gestational age and screening results, evaluation completion, and diagnostic outcomes.

**Methods:** Across three toddler screening studies, seventy primary care practices screened for ASD using the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins et al., 2009). A total of 8352 toddlers (50.28% male) met inclusion criteria: screened during a toddler well-visit and parent-reported gestational age. Participants were classified using WHO-defined categories of prematurity (extremely [EP] <28 weeks; very [VP] 28-32 weeks; moderately [MP] 32-37 weeks), or as full term (FT>37 weeks). Children identified as at risk from screening or provider/caregiver concern were invited for a diagnostic evaluation (see Table 1).

**Results:** More severe categories of prematurity were related to higher rates of positive M-CHAT-R/F screens ( $\chi^2(3, N = 8352) = 285.96, p < .001$ ). Evaluation attendance ranged from 71.58% (FT) to 89.01% (MP) but did not vary considerably between groups ( $p = .14$ ). The M-CHAT-R/F showed decreasing sensitivity by gestational age category with highest sensitivity for those in EP and VP groups. Conversely, specificity increased by gestational age category, with highest specificity in the MP and FP groups (see Table 2). Diagnostic outcomes revealed ASD prevalence of 14.63% in EP, 2.06% in VP, 2.86% in MP, and 1.46% in FT children, and global developmental delay (GDD) prevalence of 13.41% in EP, 8.27% in VP, 2.55% in MP, and 0.65% in FT children.

**Conclusions:** Findings suggest a higher screen-positive rate for infants born preterm that increases with more severe categories of prematurity. Despite a presumed history of medical involvement, those with prematurity did not attend evaluations at higher rates; thus, there is a need to examine potential barriers to follow-up and to provide support for evaluation referral/completion, especially in high-risk groups. Overall, the EP group evidenced increased rates of both ASD (14.63%) and GDD (13.41%), suggesting a unique, elevated risk related to disrupted developmental trajectories associated with prematurity. Lower specificity in more severely premature groups observed in this study indicates that future research should explore tailored scoring of screeners to improve psychometrics to aide in differentiating ASD risk for this group. This increased risk demonstrates that it is crucial for providers to implement universal screening in vulnerable groups and refer for developmental diagnostic evaluations when concerns arise to promote early intervention.

**308.002** (Oral) Testing the Accuracy and Clinical Value of Novel Tools for Tele-Assessment of ASD in Young Children  
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**Background:** Telemedicine offers tremendous potential for addressing healthcare disparities related to early accurate identification of ASD in traditionally underserved communities. Telemedicine consultation potentially can alleviate time, travel, and geographic burdens for many families that often drastically limited access to services; speed entry into appropriate care; empower parents and medical providers to take a more active role in care; reduce wait times at specialty clinics; and help ensure that for those families for whom further assessment is recommended, the associated waits and expense are truly necessary. Our preliminary work suggests that telemedicine consultation in rural pediatric clinics can potentially rapidly, accurately identify large percentages of young children as with ASD with high levels of family and provider satisfaction, but this work to date was been powerfully constrained by the fact that no specific tools explicitly developed for telemedicine consultation of early ASD were available (i.e. preliminary work required both an expert clinician and a trained technician utilizing traditional assessment within community practice setting).

**Objectives:** In the current work we set out to conduct a rigorous initial evaluation and comparison of two telemedicine assessment tools (*TELE-STAT* and *TELE-ASD-PEDS (TAP)*) that could allow parents or naïve providers in remote locations to complete an ASD risk assessment under in via telemedicine consultation with an expert psychologist.

**Methods:** As part of an ongoing trial (ClinicalTrials.gov: NCT03847337), we will present interim results of young children (n=77; ages 18-36 months) randomized to evaluation with either *TELE-STAT* or the *TELE-ASD-PEDS*. We rigorously evaluated the ability of these to facilitate accurate telemedicine supported diagnostic decision making in comparison to blinded comprehensive evaluations.

**Results:** Interim analyses revealed a total accuracy of telemedicine based classification across all tools and processes ranging from 86-95%. Some 42 of 44 children [*ADOS-2 CSS* of 8.83 (*SD*=1.42), *MSEL: M* = 54.88 (*SD*=11.58), & *VABS-3 ABC: M* = 56.03 (*SD*=10.85)] were accurately classified (i.e. ASD / Other concerns) via assessment processes utilizing the TAP by psychologist with expertise in ASD assessment. Trial completion and full data analyses are anticipated by conference date.

**Conclusions:** Parent-mediated administration of the telemedicine tools for ASD assessment yielded a very high level of agreement regarding ASD risk classification with blinded gold-standard evaluation. Although promising, this work was limited by its reliance on (1) controlled laboratory settings, standardized materials, and researcher-provided technology as well as (2) a sample of clinically referred children with high levels of concern for ASD, recruited from a single site, and evaluated by expert providers. Future work should (a) evaluate in-home use in a broader community sample with novel groups of diagnostic clinicians and (b) rigorously evaluate value, impact, and disparity/harm for those underserved and under-resourced families most likely affected by existing barriers to traditional evaluation.

**308.003 (Oral)** Infants with Later ASD Have Less Night Sleep, and This Relates to Emerging Developmental Differences in Social Attention

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**Background:** Sleep is a crucial aspect of development (Field, 2017). Infant sleeping patterns have been shown to be related to later attentional abilities, executive functioning, temperament and self-regulation (Williams et al., 2016). Sleep problems have been implicated in neurodevelopmental disorders, such as Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), persisting from early development to adulthood (Rydzewska et al., 2020). Further, sleep duration is related to ASD symptom severity (Veatch et al., 2017); as such it is important to examine sleep in development and its relation to emerging attentional abilities in ASD.

**Objectives:** In this study, we report sleep findings from a prospective longitudinal infant sibling study (infants with an elevated likelihood of developing ASD, ADHD, ASD+ADHD or neither).

**Methods:** We assessed sleep using two parent report measures; the Sleep and Settle Questionnaire (Matthey, 2001) and the Infant Behaviour Questionnaire Revised (Putnam et al., 2014) at 5, 10 and 14 months of age from a sample of 151 infants. From a factor analysis, a primary factor of 'Night Sleep' emerged which encapsulated night sleep duration, night awakening frequency and night sleep onset duration; with higher scores indicating better sleep. Infants also took part in a number of eye-tracking (ET) tasks, at the above time points, that measured social attention.

**Results:**

Infants with an elevated likelihood of ASD had less Night Sleep than those without a family history of ASD [ $F(1, 133) = 10.08, p = .002, \eta^2 = .07$ ; Figure 1]; sleep did not vary by familial likelihood of ADHD [ $F(1, 133) = .17, p = .68, \eta^2 = .001$ ] or ASD\*ADHD-L [ $F(1, 133) = .03, p = .87, \eta^2 = .0$ ]. Children with a 36 month ASD-Outcome also had less Night Sleep than those without ASD [ $F(1, 109) = 4.6, p = .03, \eta^2 = .04$ ]; this varied by Age [ $F(2, 166) = 9.68, p < .001, \eta^2 = .1$ ] such that the ASD group had less Night Sleep at 14-months. [ $t(96) = 4.1, p < .001, d = 1.46$ ], but not at 5 [ $t(72) = .49, p = .62, d = .16$ ] or 10-months [ $t(98) = 1.41, p = .16, d = .47$ ].

To investigate the relationship between sleep and social attention, we conducted several cross lagged structural equation models. We found that higher levels of Night Sleep at 10 months were associated with higher attentiveness to a social ET task at 14 months ( $\beta = .27, p = .03$ ) and more time spent looking to the face during a Face Popout task at 14-months ( $\beta = .23, p = .01$ ). However, interestingly, we found the opposite pattern at earlier timepoints; *lower* levels of Night Sleep at 5-months were associated with greater looking to the face at 10-months ( $\beta = -.28, p = .01$ ; see Figure 2).

Conclusions:

Our findings show that infants at an elevated likelihood of ASD, and those who go on to have ASD, demonstrate decreased levels of Night Sleep, which relates to later social attention. However, this relationship differs across developmental time.

### **308.004 (Oral) Quantifying Latent Social Motivation and Its Developmental Associations with Joint Attention and Language in Infants at High and Low Risk for Autism Spectrum Disorder (ASD)**

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Background:

Social motivation –the psychobiological predisposition for preferential social orienting, seeking social contact, and maintaining social interaction –is hypothesized to contribute to the development of social communication and the ontogeny of ASD (Chevallier et al., 2012). However, the lack of early social motivation measures has constrained the ability to delineate associations between social motivation, other social abilities affected in ASD (e.g., joint attention), and ASD-related outcomes. Recent work supports psychometric validity of early childhood social motivation measures (e.g., Phillips et al., 2019) and the influence of social motivation on language in toddlers with ASD (Su et al., 2020). Here, we use a latent factor model of novel infant social motivation measure and examine associations between early social motivation, joint attention, and language skills in a sample of typically and atypically developing children with varying familial ASD liability.

Objectives:

- To derive a latent factor model of social motivation that exhibits measurement invariance –a psychometric property important for making meaningful substantive comparisons (Bauer, 2017) –across age, ASD risk, and sex.
- To use factor scores from this model to examine developmental associations between early social motivation and joint attention behaviors and their contribution to language outcomes in infants at high (HR) and low (LR) familial risk for ASD.

Methods:

534 HR and LR infants (n=229 females; n=214 LR, n=68 ASD) were assessed at ages 6, 12, and 24 months in the Infant Brain Imaging Study and assigned a 24-month clinical best estimate diagnosis.

Six and 12-month items with strong face validity for social motivation were identified from well-established parent-report measures (Infant Behavior Questionnaire-Revised, Vineland Adaptive Behavior Scales, Macarthur-Bates Communicative Development Inventory, First Year Inventory). The Dimensional Joint Attention Assessment (Elison et al., 2013) indexed 12-

month response to joint intention (RJA), while item 7 from the Communication and Symbolic Behavior Scales indexed 12-month initiation of joint attention (IJA). The Mullen Scales of Early Learning indexed 24-month receptive and expressive language.

Moderated Nonlinear Factor Analysis (MNLFA; Bauer, 2017) was used to generate latent social motivation scores adjusting for item measurement non-invariance across age, ASD risk, and sex. Using path analyses, associations between social domains – 6- and 12-month social motivation, 12-month RJA, and 12-month IJA – and 24-month receptive and expressive language were examined.

#### Results:

Latent social motivation scores were continuously distributed (Figure 1). Preliminary path model results indicated that neither 6- nor 12-month social motivation was associated with 24-month language outcomes (Figure 2). Twelve-month social motivation was concurrently associated with RJA ( $p=0.018$ ) and IJA ( $p=0.004$ ). Both 12-month IJA and RJA were significantly associated with 24-month receptive ( $p_{IJA}=0.001$ ;  $p_{RJA}=0.024$ ) and expressive language ( $p_{IJA}=0.002$ ;  $p_{RJA}=0.038$ ).

#### Conclusions:

This study offers a novel measurement invariant latent modeling approach to quantifying infant social motivation, its interrelationships with other social domains, and influence of these domains on language. Social motivation functions concurrently with 12-month RJA and IJA, which, consistent with prior research, associates with 24-month language outcomes. This approach, by more precisely modeling the developmental interdependencies of these domains, may inform the developmental science of ASD and timing of interventions.

## POSTER SESSION — EARLY DEVELOPMENT (< 48 MONTHS)

### Poster 415 - Early Development (< 48 months) Posters

**415.001** (Poster) A Prospective Study of Anxiety and Perceptual Sensitivity As Early Markers for Restricted and Repetitive Behaviors in Infants with Typical and Elevated Likelihood of Autism Spectrum Disorder.

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#### Background:

Autism Spectrum Disorder (ASD) is defined by its observable manifestations in social and communication impairments (SCI) and restricted and repetitive behaviours (RRB). Evidence indicates that RRBs are associated with anxiety and atypical sensory features (e.g., differences in perceptual sensitivity). Studies of children with autism do not clarify the order of emergence of these traits, therefore creating a need for longitudinal prospective studies. Identifying which early markers relate to later manifestations of ASD is important for understanding causal paths to symptom development. Prospective studies of infant-siblings of children with ASD, of whom ~20% will go on to develop ASD themselves, have provided important insights into early developmental trajectories associated with a later diagnosis of ASD. The current study uses this prospective longitudinal infant-sibling design to investigate whether infant traits of early anxiety and perceptual sensitivity relate to later manifestations of RRBs and SCIs.

#### Objectives:

To examine the longitudinal relations between Fear/Shyness and Perceptual Sensitivity at 9, 14 and 24-months and RRB and SCI at 36-months.

#### Methods:

As part of the British Autism Study on Infant Siblings (BASIS: <http://www.basisnetwork.org>), 247 infant-siblings participated in a longitudinal study. All elevated-likelihood (EL) participants (N=170) had at least one older-sibling with a diagnosis of ASD whereas all typical-likelihood (TL) participant (N=77) had no known immediate family members with a diagnosis of ASD. Parents rated infant's traits of early anxiety and perceptual sensitivity using the Infant Behavior Questionnaire (IBQ; Fear and Perceptual Sensitivity subscales) at 9 and 14-months, and the Early Childhood Behavioral Questionnaire (ECBQ; Shyness and Perceptual Sensitivity subscales) at 24-months, RRBs and SCIs were assessed using subscales of the parent-rated Social Responsiveness Scale (SRS-2) at 36-months. Longitudinal cross-lag structural equation models tested 1) bidirectional pathways between fear/shyness and perceptual sensitivity between 9-24 months and 2) predictive pathways from fear/shyness and perceptual sensitivity at 9-24 months and RRBs and SCIs at 36-months.

#### Results:

Results found significant auto-regressive pathways (e.g., within-domain continuity) for both fear/shyness and perceptual sensitivity between 9-14 and 14-24 months (Figure 1). Cross-lagged paths indicated that higher levels of fear at 14-months were associated with higher levels of perceptual sensitivity at 24-months. All other cross-lagged associations were not significant (all  $p \geq 0.20$ ). The cross-lagged auto-regressive model provided a good fit to the data ( $\chi^2(2) = 3.87, p = 0.144; CFI = 0.993, RMSEA = 0.062$ ). Both higher levels of shyness and perceptual sensitivity at 24-months were significantly associated with heightened levels of both RRB and SCI symptoms at 36-months (Figure 2). There was a significant positive correlation between RRB and SCI symptoms at 36-months.

#### Conclusions:

Relative stability was found over time in both fear/shyness and perceptual sensitivity, indicating some developmental continuity of the traits. At a trait level, early infant manifestations of anxiety (e.g., fear/shyness) and perceptual sensitivity precede and relate to later RRBs and SCIs in toddlerhood. This demonstrates novel developmental pathways to later emerging RRBs but also calls into questions theories that argue that these domains specifically underlie RRBs rather than the broader range of behaviours which are associated with ASDs.

#### 415.002 (Poster) ASD-Related Characteristics in Infancy in Relation to Autonomic Functioning

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**Background:** The autonomic nervous system (ANS) is responsible for maintaining homeostasis and includes sympathetic and parasympathetic influences. Differences in ANS activity have been found in ASD, including heightened sympathetic activity (e.g., Hirstein et al., 2001) and reduced parasympathetic activity (e.g., Bal et al., 2010). Furthermore, recent work with infants at high risk for ASD (HRA; by virtue of an older sibling with ASD) and low-risk control infants (LRC) has found that atypical parasympathetic activity in the first year of life across both groups predicted elevated ASD-related characteristics at 36 months (Nyström et al., 2018).

**Objectives:** The current study will examine both sympathetic and parasympathetic activity in infancy as it relates to concurrent measures of ASD-related characteristics in HRA and LRC.

**Methods:** Participants included 21 infants ( $M_{age} = 10.16$  months,  $SD = .66$  months, Range = 6.13–19.10 months; HRA:  $n = 3$ ; LRC:  $n = 18$ ). As part of a larger testing session, heart rate (HR), respiration, and skin conductance (SC), a measure of sympathetic processing, were recorded using a Biopac MP150WSW system during a 5-minute baseline period as infants sat on their parent's lap quietly engaged with silent toys and bubbles. At the end of the session, the Autism Observation Scale for Infants (AOSI; Bryson et al., 2008) was conducted to assess ASD-related characteristics. Using MindWare software, HR and SC data were divided into five 60-second segments, and responses were averaged across all segments. Respiratory sinus arrhythmia (RSA), a measure of high-frequency heart rate variability associated with the parasympathetic system, was also calculated with a respiration frequency range of .24–1.04 Hz (see Bar-Haim et al., 2000), and RSA segments with peak respiration in this range were averaged. AOSI total score was used as a measure of ASD-related characteristics, with higher scores reflecting more ASD-related traits.

**Results:** Correlational analyses showed that AOSI scores were positively correlated with SC ( $r(19) = .53, p = .014$ ; see Figure 1) and negatively correlated with RSA ( $r(19) = -.44, p = .047$ ; see Figure 2). This suggests that elevated ASD-related characteristics are associated with higher sympathetic and lower parasympathetic activity in infancy. These results remained the same with and without the inclusion of HRA infants. Because age was significantly negatively correlated with the AOSI ( $p = .038$ ), analyses

were also repeated with age partialled out. After accounting for age, the association between AOSI scores and SC remained significant ( $r(17) = .68, p = .002$ ), but the relationship between AOSI and RSA became marginal ( $r(17) = -.43, p = .068$ ).

**Conclusions:** The current study is among the first to examine both sympathetic and parasympathetic functioning alongside ASD-related characteristics in HRA and LRC infants. Consistent with research on ANS function in children with ASD (e.g., Bal et al., 2010; Hirstein et al., 2001), infants with elevated ASD-related traits showed heightened sympathetic activity and reduced parasympathetic activity. These results held with and without the inclusion of HRA, suggesting that individual differences in ANS activity could relate to variability in ASD-related characteristics more broadly during infancy.

**415.003 (Poster) Associations between Child Sensory Reactivity Patterns and Caregiver Responsiveness**

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**Background:** Caregiver responsiveness has been shown to predict outcomes for children with and at risk for autism spectrum disorder (ASD), especially in verbal development (Edmunds, Kover, & Stone, 2019; Haebig, McDuffie, & Weismer, 2013; McDuffie & Yoder, 2010). Many factors influence caregiver responsiveness, including children's sensory and communicative behaviors (Edmunds, Kover, & Stone, 2019; Kindard et al., 2017). Caregivers tend to talk less and use more play actions when children demonstrate sensory hyporeactive patterns and limited communication (Kinard et al. 2017). Despite evidence for the impact of caregiver responsiveness on development, there is limited research on caregiver responsiveness to children's sensory-related cues and factors that influence that responsiveness.

**Objectives:** This poster aimed to examine the association between infant sensory reactivity and caregiver responsiveness to sensory reactivity cues. We hypothesized that hyporeactivity and hyperreactivity scores will be negatively associated with caregiver responsiveness.

**Methods:** Participants were a community sample of 63 11-16-month-old infants (M=13 months; 63.5% elevated likelihood for ASD; 68% male; 87% White) and their caregivers (68% biological mothers; 70% with at least a college degree). Risk status (elevated likelihood for ASD) was measured via the First Years Inventory v3.1- Lite, a screening tool for ASD (Baranek, Watson, Crais, Turner-Brown, & Reznick, 2014). Sensory processing was measured via the Sensory Processing Assessment (SPA; Baranek, 1999), a semi-structured observational tool that measures hyporeactivity; hyperreactivity; and sensory interests, repetitions, and seeking (SIRS) behavior patterns. Caregiver responsiveness was measured with a behavioral rating scheme applied to recordings of caregiver-child interaction during 4 contexts: free play, an anticipatory game, a snack, and a caregiving activity. Scores ranged from 1 (unresponsive) to 7 (highly responsive), with one rating assigned per context. Caregiver responsiveness scores across all contexts were averaged to compute a single mean score. Hierarchical linear regression was performed to analyze the associations between sensory reactivity patterns and caregiver responsiveness, with hyporeactivity entered first, followed by hyperreactivity, then SIRS. Sample size will be approximately 75 participants prior to the conference.

**Results:** Children at elevated likelihood for developing ASD differed from children with lower likelihood on hyporeactivity, SIRS, and caregiver responsiveness ( $p < .05$ ). However, interactions between risk group and sensory patterns and differences in correlations across risk groups were non-significant and not included in the final models. See Table 1 for correlations among variables. Hyporeactivity demonstrated the only main effect; see Table 2 for regression results.

**Conclusions:** The association between hyporeactivity and caregiver responsiveness may be due to caregivers having difficulty noticing and responding to hyporeactivity, which often presents as more subtle behaviors than the other sensory reactivity patterns. The loss of association with hyporeactivity after the addition of SIRS could be due to the potential shared effect of SIRS behaviors and hyporeactivity on caregiver responsiveness. Further research is needed in a larger, more diverse sample to understand the manner in which child sensory reactivity patterns and other child features affect caregiver responsiveness.

**415.004 (Poster) Associations of Brain Injury and Race on Autism Diagnosis and Severity**

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**Background:**

Incidence of brain injury during the early developmental period has been associated with deficits characteristic of neurodevelopmental disorders, such as autism spectrum disorder (ASD; Singh, Turner, & Ngyuen, 2016). These deficits extend to intellectual functioning (Barlow et al., 2005). Within ASD, racial differences in intellectual functioning and symptom severity are notable with children of color often exhibiting higher symptom severity and greater intellectual deficits than White children (Baio et al., 2014). Less is known about the interaction of race on the association between brain injury and ASD diagnosis.

Objectives: The present study examined 1) if race was associated with incidence of brain injury among those at risk for ASD and 2) if the association of race and injury was associated with ASD symptom severity.

Methods:

This sample consists of 950 children (419 White, 531 Children of Color (CoC) including 270 Black, 50 Asian, see Table 1; 205 with ASD, 354 with developmental delay (DD), see Table 2) in a multi-site study referred for diagnostic evaluations after a positive screen on the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F) or pediatric provider concern for ASD. Parents completed a history questionnaire that collected information on gestational age at birth, pregnancy and labor complications, and brain injuries, as well as demographic information. Diagnostic evaluations included the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), Mullen Scales of Early Learning (MSEL), and Vineland Adaptive Behavior Scales (VABS-II). Children were considered brain-injured if they had a history of a specific brain injury or had their umbilical cord wrapped around their neck at birth and were treated in the neonatal intensive care unit. Children were considered to have a probable brain injury if they were born severely premature (<32 weeks).

Results:

Chi-square analysis indicated a significant association between brain injury and a diagnosis of DD, but not ASD, in both racial groups ( $\chi^2(4, N=950)=17.02, p=.002$ ). Specifically, brain injuries and probable brain injury in CoC was associated with DD, and probable brain injury in White children was associated with DD. Regarding symptom severity and developmental delays, MANOVA analyses indicated a significant main effect of race, but no main or interacting effects of injury, on VABS-II composite scores ( $F(56, 588)=1.82, p=.049$ ). There were no main or interacting effects of injury and race on ADOS-2 or MSEL composite scores. Post-hoc analyses revealed that CoC demonstrated higher VABS-II scores than White children ( $F(1, 588)=6.37, p=.012$ ).

Conclusions:

Early-life brain injury appeared to be associated with developmental delays, but not specifically with ASD symptomology. This association is apparent in both racial groups with evidence of a stronger association within CoC. Autism symptom severity was unrelated to brain injury. However, race was associated with developmental outcomes such that in our sample, White children demonstrated greater deficits in adaptive functioning than CoC. Race did not interact with injury to predict ASD symptom severity. Of note, this study relied on parent report of history. Thus, future research should include review of medical records.

**415.005 (Poster)** Behavioural Reactions to a Task Intended to Elicit Fear in Infants at High Risk for Autism Spectrum Disorder  
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Background: Compared to typically developing peers, children at risk for or diagnosed with autism spectrum disorder (ASD) exhibit more negative affect and avoidance behaviours (Clifford et al., 2012; Garon et al., 2008), and express fear differently (Evans et al., 2005; Macari et al., 2018; Turner & Romanczyk, 2012). To explore these differences, we examined behavioural reactions of infants at high familial risk for ASD to stimuli that typically elicit fear in older children.

Objectives: (1) To determine whether 18-month-olds' behavioural reactions to tasks intended to elicit fear differ between typically developing infants and infants at high familial risk for ASD. (2) To determine if behavioural reactions at 18 months are related to ASD symptoms at 24 months in infants at risk for ASD.

Methods: Participants include 32 high-risk infants (HR; younger sibling of a child with ASD; 18 females) and 19 low-risk infants (LR; no family history of ASD; 7 females). At 18 months, infants were shown two masks that commonly elicit fearful responses

in older children. Reactions were video-recorded and coded offline using Noldus Observer. Approach (yes/no) and avoidance (intensity: low (0) to high (2)) behaviours were coded in 5-second intervals. Crying and freezing durations were recorded, and gaze aversions and smiles were coded as point events (frequency). At 24 months, infants were assessed with the Autism Diagnostic Observation Schedule 2<sup>nd</sup> ed. – Toddler module (ADOS-T). A 2 x 2 repeated measures ANOVA was conducted on each dependent variable, with group as a between-subject factor and mask as a within-subject factor. Pearson correlations were used to examine associations between coded behaviours and ADOS-T scores.

Results: A significant main effect of group emerged for smiling ( $F(1, 49) = 5.10, p = .03$ ) with LR infants ( $M = .71, SD = 1.08$ ) smiling more frequently than HR infants ( $M = .28, SD = .83$ ). Approach, avoidance, and gaze aversions were positively correlated with 24-month ADOS-T scores. Increased approach behaviour was associated with more severe symptoms in the Social-Affect domain ( $r = .34, p = .02$ ). Higher avoidance intensity was related to more severe Restricted and Repetitive behaviour (RRB) symptoms ( $r = .34, p = .02$ ). Gaze aversion increased with total ASD symptom severity ( $r = .32, p = .03$ ), with this relationship being driven by symptoms in the Social-Affect domain ( $r = .36, p = .01$ ).

Conclusions: Consistent with previous research, findings suggest that LR infants smile more often than HR infants (Filliter et al., 2015). Findings also demonstrate that increased levels of approach, avoidance, and gaze aversion at 18 months are related to ASD symptoms at 24 months in HR infants. Atypical responses to stimuli that typically elicit fear in children may be seen in infants with higher levels of ASD symptoms. A better understanding of the nature and implications of these differences may inform early detection and intervention in ASD.

**415.006 (Poster) Brainstem Integrity Dissociated with Linguistic Competence in Young Children with Autism**  
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**Background:** Delayed auditory brainstem response (ABR) latencies were observed in infants younger than 3 months who later diagnosed with autism (Cohen et al., 2013; Miron et al., 2016). Others have found that such abnormality can persist into childhood, although with considerable heterogeneity (Talge et al., 2018). ABR latency delay has also been linked with language delay in young children with suspected autism (Roth et al., 2012). These work provide compelling evidence for the role of subcortical brain structures in early emergence and language impairment of autism. However, it is still unclear to what extent brainstem integrity might regulate developmental progression in young children with and without autism and what specific elements it implicates.

**Objectives:** The current research aimed to verify whether ABR latency was abnormal in young children who developed autism in comparison with clinical controls who did not develop autism. The results were expected to help make inferences about specific developmental processes to target for understanding brainstem-behavior relationships in young children with neurodevelopmental disorders.

**Methods:** Click-ABRs were recorded from a total of 87 children admitted to Pediatric Rehabilitation Unit. The age at the ABR testing was on average 31 month, ranging from 14 to 55 months. Developmental outcomes were assessed using the Gesell Developmental Schedule concurrently or shortly after the ABR testing at age 14~57 months. The mean time interval between ABR and Gesell was 18 days (0~5 months). Thirty-five of these children were diagnosed with autism. The remaining 52 were diagnosed with developmental language disorder (DLD). The two groups were matched on age at ABR testing and age at Gesell assessment. Pearson correlation was performed for the latency of ABR Wave V and each Gesell subscale.

**Results:** The Wave V latency in the autism group (mean = 5.74 ms) did not differ from the DLD group (5.73 ms). Neither group showed age-related latency changes. The two groups differed on language and sociability but not on adaptation, gross motor, or fine motor on the Gesell, that the autism group scored lower for language and sociability ( $p < 0.01$ ). Language was the only measure that was significantly correlated with latency, that faster Wave V was associated with better language in the DLD group ( $r = -0.29^*$ ) but not in the autism group.

**Conclusions:** We showed that Wave V latency of click-ABR largely stabilized after age 14 months in the children with neurodevelopmental disorders. The weak but significant relationship between Wave V and language in the DLD group provides supporting evidence for the role of the ascending subcortical pathways in scaffolding early linguistic competence. The results also suggested that compared to DLD peers, the young autistic children experienced extra language and social challenges. However, their language impairment appeared to be somewhat dissociated from general brainstem integrity under 5 years of age. Future work may tap more sophisticated brainstem functions in relation to language outcomes, i.e., speech encoding, in autism during early critical periods.

**415.007 (Poster) Caregivers Training Groups: Viable Alternative for Public Health in Brazil?**

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**Background:** Prevalence studies show that, in the United States, the rate of children with Autism Spectrum Disorder (ASD) is 1 in 54, and it's a scientific consensus that early intensive intervention relates to positive prognosis in later years. Although lacking large statistical research, a pilot study in Brazil points that there are around 40 thousand people with ASD in a city nearby São Paulo, one of the most populated cities in the world. Many studies have evaluated the efficiency of parents/caregivers conducted stimulation, showing that stimulation programs implemented by the family lead to positive results for the child as well as the parents. Given the high prevalence of children with autism, it is important to highlight that expensive treatment costs and socioeconomic vulnerability in Brazil can limit the access of many families to quality treatment, which considerably affects the child's development, may increase the families' stress levels and interfere with their sense of self-efficacy as parents

**Objectives:** To evaluate the efficacy of parents/caregivers training groups as a viable alternative for the Brazilian public health context.

**Methods:** The groups consisted of 10 on-site weekly meetings with 3 to 5 families of children from 0 to 4 years old, diagnosed, or with suspicion of ASD diagnosis. The meetings were facilitated by a senior psychology student and were based on the methodological design suggested in the Early Start Denver Model, as well as themes more relevant to the Brazilian reality, and 2 extra meetings suggested by the groups. Pre and post-tests were used to measure changes in parental stress (Parental Stress Scale); Self-efficacy (Parental Self-Efficacy Scale in the Management of Asperger's Syndrome); family involvement (Family Involvement Questionnaire), and the ESDM Checklist Curriculum conducted with the children. Training strategies consisted of videomodeling, roleplay, online monitoring through WhatsApp groups, and analysis of the video content brought by the parents/caregivers, in which they implement the methods discussed in the meetings. Selfcare activities were also suggested every week. These on-site groups are the first step in a research that seeks to develop an app for parental training, in which public healthcare professionals and university students can monitor the family's progress in training and implementing stimulation programs at home. For this case study we analyzed the data of 3 families: 2 mothers and 1 father, randomly selected.

**Results:** Post-test results showed that the children had significant improvements only in Self Independence skills, suggesting that the training might not replace an intensive intervention program. However, the post-test scales indicated a great reduction in parental stress and increase in self-efficacy; they also organized their daily routines better, dedicated more time to take the children to public places; were more involved in school-related tasks such as homework and dialoguing with teachers, and finally, had an increase in efficacy when managing the children's behaviors.

**Conclusions:**

The study indicated that parents had an overall better elaboration of the autism diagnosis, given how the parents had a significant reduction in the discomfort related to the children's behaviors.

**415.008 (Poster) Developmental Profiles and Associated Rates of ASD in Early Intervention: A Confirmatory Latent Profile Analysis**

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**Background:**

Part C Early Intervention (EI) is a US federal program that seeks to support children ages zero to thirty-six months who demonstrate delays in developmental functioning, including children with autism spectrum disorders (ASD). The Battelle Developmental Inventory, Second Edition (Newborg, 2005) is frequently used in EI to assess the developmental functioning of children across five domains—Communication, Cognitive, Motor, Adaptive and Personal/Social—yet relatively little is known about child developmental profiles given their domain scores and how profiles are associated with ASD.

**Objectives:** This study will aim to replicate and extend findings from the only known study (Elbaum & Celimli-Aksoy, 2017) that has conducted a latent profile analysis of child developmental profiles measured by the Battelle for children in Part C EI.

**Methods:** Children included in this study (N=28,983) were a subset of those enrolled in one of twelve Part C EI agencies in the state of Massachusetts between 2011-2019 and completed a Battelle assessment. A confirmatory latent profile analysis, using the

five Battelle domains as indicator variables, was conducted in Mplus. Children were assigned to their most likely class given posterior probabilities. Associations between class membership and child ASD diagnosis were investigated in Stata.

Results: Over half of the sample was male (61.6%). The average age was 15.48 months at the time of assessment, and over half of the sample was non-White or White Latinx (53.9%). Six percent of children had a record of an ASD diagnosis. Confirmatory latent profile analyses yielded a close replication of previous findings from Elbaum et al., 2017, such that a four-class model demonstrated the best and most parsimonious fit to the data. Furthermore, entropy and the pattern of profiles (see Figure 1) were consistent with those in the previous study. Two classes, one indicative of larger delays (Class 1, 13.9% of total sample) and one indicative of milder delays (Class 3, 30.5%), demonstrate a primary delay in communication relative to the other domains. The other two classes, also differentiated by overall level of delay (Class 2, 7.5%; Class 4, 48.1%), demonstrate relatively level functioning across domains. Average child age and ASD status differed significantly by assigned class (see Table 1). The greatest proportion (29.9%), and approximately half (49.2%), of children with ASD diagnoses were assigned to Class 1, which is differentiated from the other classes by its primary and severe communication delay. Approximately one quarter of children with an ASD diagnosis were assigned to Classes 3 and 4 (23.0% and 24.1%, respectively). These findings differ from those of Elbaum et al.

#### Conclusions:

Using latent profile analyses and a significantly larger sample, we replicated previous findings regarding pattern of developmental profiles of children in EI. Findings suggest that the observed patterns may hold true across geographic regions in the U.S. In this study, children who ultimately received an ASD diagnosis were most likely to be assigned to Class 1, which included approximately half of all ASD cases. This suggests that this profile may contribute to earlier identification of children at greater risk for ASD.

#### **415.009 (Poster)** Differences in Temperament during Early Childhood in Children at Familial Risk for Autism with Low Versus High Parent Reported Autism, ADHD and Anxiety Symptoms

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Background: Temperament, the way someone reacts and regulates their behaviour, has been associated with social behaviours and behavioural problems as well as neurodevelopmental disorders, such as autism, ADHD and anxiety. Less is known about how individual differences in temperamental trajectories in early childhood relate to later distinct neurodevelopmental outcomes.

Objectives: We compare parent-reported Surgency, Negative Affect (NA) and Effortful Control (EC) of children between 4 months and 10 years to see if trajectories differ between groups who show low versus elevated symptoms of neurodevelopmental disorders in mid-childhood. The cohort consists of children at elevated likelihood of autism because of an older diagnosed sibling. High co-occurrence of neurodevelopmental disorders means they are more likely to show symptoms of ADHD and anxiety.

Methods: 52 typical likelihood and 81 elevated autism likelihood children were seen at multiple timepoints as part of an ongoing longitudinal study. Parents completed the infant (4, 8, 14 months), early childhood (24 months) and children's (mid-childhood, 7-10 years) behaviour questionnaires to measure temperament. Children were assigned to low versus elevated mid-childhood symptom groups based on their T-scores on the Social Responsiveness Scale for autism ( $\geq 60$ ), Spence Children's Anxiety Scale for anxiety ( $\geq 60$ ) and Conners for ADHD ( $\geq 65$  on either Inattentive or Hyperactivity subscale) symptoms. Nine mixed models were run (3 neurodevelopmental outcomes x 3 temperament constructs). The effect of time may be affected by the version of the questionnaire and is not considered. Post-hoc comparisons are Bonferroni corrected.

Results: Thirty children had elevated symptoms of *autism*, 37 of *ADHD* and 21 of *anxiety*. *Autism*: Groups did not differ on overall Surgency. The interaction between time and group was significant ( $p=.027$ ), but groups did not differ at any timepoint. For EC, there was a significant group and interaction effect ( $p<.001$ ). The elevated-autism group had lower EC, which became significant from 14 months and increased over time. The elevated-autism group showed increased NA ( $p<.001$ ), but the interaction with time was not significant. *ADHD*: Groups did not differ on overall Surgency, but there was an interaction effect ( $p<.001$ ). The elevated-ADHD group had higher Surgency at mid-childhood. The group and interaction effect of EC and NA were both significant ( $p<.001$ ). The elevated-ADHD group had lower EC from 8 months and the difference increased over time. NA became significantly higher in the elevated-ADHD group from 14 months. *Anxiety*: There were no differences in Surgency.

Children with elevated anxiety had lower EC ( $p=.041$ ) and the interaction effect was significant ( $p=.027$ ). Scores differed at 14 months and mid-childhood. For NA, the group and interaction effects were significant ( $p<.001$ ). The elevated-anxiety group had higher scores on NA at all timepoints, except 4 months.

Conclusions: Children with elevated symptoms of autism, ADHD or anxiety in mid-childhood show similar temperamental profiles, but the time of onset differs. Lower levels of EC emerge first in the ADHD group, whereas higher NA is first evident in the autism and anxiety groups. The next step is to see how patterns differ between neurodevelopmental disorders considering their co-occurrence, using structural equation models.

**415.010 (Poster)** Distinguishing Symptoms of ASD from Global Developmental Delay on Screening and Diagnostic Instruments  
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Background: Autism spectrum disorder (ASD) can be reliably diagnosed in children before their second birthday (e.g., Klin et al., 2015). However, cognitive impairment or delay in young children may impair diagnostic clarity in distinguishing children with ASD from those with other neurodevelopmental disorders, such as global developmental delay (GDD; Gardner et al., 2018; Thurm et al., 2019).

Objectives: This study attempts to distinguish symptoms primarily related to cognitive delays from those more highly related to ASD by comparing children who have ASD with cognitive impairment (ASD-low-MA) and children with GDD on an ASD screener (M-CHAT-R/F) and a diagnostic observational instrument (ADOS-2 Toddler Module).

Methods: Participants were drawn from studies of the Modified Checklist of Autism in Toddlers (M-CHAT-R/F; Robins et al., 2014) in Connecticut, Pennsylvania, and Georgia. The current sample includes all children ( $n=30$ ) between 15-26 months with ASD-low-MA, defined as meeting criteria for ASD, with Mullen Scales of Early Learning (Mullen, 1990) language and cognitive age equivalents below 12 months. A subset of children with GDD ( $n=30$ ) was selected to match the ASD-low-MA group as closely as possible on Mullen Expressive Language age equivalents (Table 1). Mullen Visual Reception (VR) was about one month higher in the GDD group ( $t(58)=2.04, p = .046$ ) and the distribution of race was also significantly different ( $\chi^2(1, N = 54) = 6.03, p = .014$ ) (Table 1).

Results: The groups did not differ in total M-CHAT-R/F scores, which have a maximum of 20 at-risk items (Table 1). Chi-squares were used to identify differences between groups on M-CHAT-R/F and ADOS-2 items, with Holm-Bonferroni corrections for multiple comparisons. We then regressed out VR age equivalents to see if group differences on specific items were partly attributable to developmental delays (Table 2). Three M-CHAT-R/F items discriminated the groups: The ASD-low-MA group was less likely to *follow a point, imitate others, and show interest in other children* than the GDD group; these held after controlling for VR. Eighteen ADOS-2 items were more likely to be endorsed in ASD-low-MA children; all except 'pointing' survived VR regression (Table 2).

Conclusions: On the ASD screener, items that differentiated the groups were in the social behavior domain. The remaining M-CHAT-R/F items may not be particularly specific to ASD in toddlers who are also globally delayed. The ADOS-2 successfully captured ASD symptomatology even in children with mental ages below 12 months. Behaviors in all ASD diagnostic domains (social interaction, communication, repetitive behaviors, sensory and restricted interests) differentiated the diagnostic groups, suggesting that even very delayed children with ASD show classic symptoms, and that the ADOS-2 Toddler Module can be used with very young and delayed children. Furthermore, almost all significant group differences on both instruments survived regressing out VR, suggesting that these behaviors are strongly indicative of ASD and not of developmental delays. Future research should confirm these findings with a larger sample and explore whether the race by diagnostic group discrepancy is replicated and, if so, factors that might contribute to this finding.

**415.011 (Poster)** Early Development of Emotional Self-Regulation: Differences in Behavioural Dynamics at 9-Months Due to Premature Birth in a Longitudinal Birth Cohort

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## Background:

Preterm infants are at risk of inattention, social and emotional difficulties and the severity of symptoms can result in diagnoses of ADHD, anxiety or Autism Spectrum Disorder (ASD) (Johnson and Marlow 2011). Early difficulties with emotion regulation are common in ASD, often manifesting as tantrums and “meltdowns” in childhood (Mazefsky & White., 2014). Studying how preterm birth affects early development of socioemotional processing across cognitive, motor and attentional systems to regulate emotions has the potential to understand the developmental processes that might implicate emotion regulation difficulties in ASD.

## Objectives:

The objective of this study is to investigate in 9-month-old term and preterm infants, using the well-established still-face paradigm, differences in the dynamics of emotional self-regulation (ER) behaviours.

## Methods:

131 term and preterm infants (born at <33 weeks gestation age (GA)) participating in Theirworld Edinburgh Birth Cohort Study (Boardman et al., 2020) and followed up at 9-months were included in this study. Videos of infants participating in an extended ‘still-face’ paradigm were obtained, which comprised three 2-min episodes of normal playful interactions with their caregiver, alternating with two 2-min still-face episodes (SF1 and SF2), where their caregiver draws a neutral expression and stops interacting. Infant’s ER behaviours (eg. self-comforting, object exploration behaviours), previously reported in the still-face literature, were coded second-by-second to obtain a categorical time series for SF1 and SF2. Using Recurrence Quantification Analysis (RQA) (Webber & Zbilut., 2014), each time series (120 samples) was processed for measures quantifying how ER behaviours occur, recur or persist over each 2min still-face episode. Recurrence Rate (RR), Laminarity (LAM), Trapping Time (TT) and Entropy (catH), respectively indicating the rate of recurrences of behavioural states, periods of state stability, length of persisting states and patterns in which the same state was revisited, were analysed using mixed-effects models with prematurity and still-face episode as predictors. Analyses were conducted in R (v3.6, crqa and lmer packages).

## Results:

As the study is ongoing, this abstract reports on a subset of data coded and processed to date. In this subset of 40 infants (25 male, 15 female), 26 infants were born at term age (mean GA 39.5 weeks, range 36.0-41.0) and 14 were born preterm (mean GA 29.8 weeks, range 27.0-31.0 weeks). Compared to term infants, we found weak evidence that infants born preterm showed lower LAM (Effect=-3.40%, CI=-6.84 – 0.05), lower RR (Effect=-4.11%, CI=-8.85% – 0.63%) and lower catH (Effect = -0.16, CI = -0.34 – 0.03), but no evidence of differences in TT (Effect=-0.72, CI=-2.33 – 0.88).

## Conclusions:

We found trends towards developmental differences in the dynamic structure and patterns of ER behaviours at 9-months due to premature birth. In particular, reduced entropy (catH) indicates greater similarity in the patterns of self-regulatory behaviours. Differences in dynamics highlights the importance of coordinating of neural subsystems for socioemotional processing during development, providing a novel perspective on how altered motor and socio-cognitive development in ASD might influence the activity of the emotion regulation system as a whole. Full analyses are anticipated in March 2021.

### **415.013** (Poster) Early Patterns of Social Visual Engagement in Preterm and Full-Term Toddlers with Autism Spectrum Disorder

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Background: Preterm toddlers are at higher risk for neurodevelopmental abnormalities that could lead to atypical developmental trajectories (Soul & Spence, 2020, Woodward et al., 2006). For example, preterm toddlers (pre-36 weeks gestational age (GA)) are at a higher risk for autism spectrum disorder (ASD) compared to their full-term counterparts (Guy et al., 2015). It is estimated that the prevalence rate for ASD in preterm toddlers is 7%, while it is 1.85% (1:54) in the general population (Agrawal et al., 2018, Maenner et al., 2020). Past developmental social neuroscience studies have shown that there are disruptions in patterns of

early social visual engagement (SVE; collected using eye-tracking technology) in toddlers with ASD (Klin et al., 2013). Full term infants later diagnosed with ASD show atypical gaze patterns to faces, with declines in eye-looking over the first 2 years of life. These gaze patterns may also be related to developmental outcomes such as language ability and social disability. Given the increased prevalence of ASD in preterm toddlers, here we investigate whether atypical patterns of SVE—and the adaptive value of SVE for language and social development—differ for preterm and full-term ASD toddlers.

**Objectives:** This study aims to quantify patterns of SVE in preterm and full-term toddlers with ASD, in order to elucidate shared and/or unique mechanisms of atypical development in these populations.

**Methods:** Participants were preterm (GA<36 weeks) toddlers with ASD (n=30, M<sub>age</sub>(SD)=25.12 (5.23) months) and a chronological age-matched sample of full-term (GA>36 weeks) ASD toddlers (n=134, M<sub>age</sub>(SD) = 24.99 (5.09) months). Receptive and expressive language was assessed with either the Mullen or Bayley-III. Social ability was measured with the ADOS-2. Eye-tracking data were collected while children viewed naturalistic videos of social interactions; these data were quantified as percentage of time spent visually fixating on facial ROIs (i.e. eye and mouth regions).

**Results:** There were no differences in patterns of visual fixation to eye and mouth regions between the full-term and preterm groups ( $r_{eye}=0.663$ ,  $p_{mouth}=0.439$ ). However, the adaptive value of these fixation patterns differed between groups: full-term ASD toddlers' eye-and mouth- looking were positively associated with receptive ( $r_{eye}=-0.357$ ,  $p<0.001$ ;  $r_{mouth}=-0.367$ ,  $p<0.001$ ) and expressive ( $r_{eye}=0.373$ ,  $p<0.001$ ;  $r_{mouth}=0.286$ ,  $p<0.01$ ) language age equivalences. In contrast, in preterm ASD toddlers, eye- looking was associated with receptive (but not expressive) age-equivalent language scores ( $r_{eye}=0.398$ ,  $p=0.040$ ); mouth- looking was not associated with language ability in preterm toddlers. Full-term ASD toddlers' fixation to eyes and mouth was also negatively associated with total ADOS scores ( $r_{eye}=-0.315$ ,  $p<0.001$ ;  $r_{mouth}=-0.268$ ,  $p<0.01$ ), while this only held true for eye- looking in preterm toddlers ( $r_{eye}=-0.543$ ,  $p<0.01$ ).

**Conclusions:** Preliminary analyses indicate that preterm and full-term toddlers with ASD allocate similar levels of visual attention to facial regions when viewing scenes of naturalistic social interactions. However, the adaptive value of attending to these facial regions may differ between them. These results point to potential differences in the social learning mechanisms underlying language development and social interactions in the first years of life, in these subgroups of children with ASD.

#### **415.014 (Poster) Early Sleep Differences in Young Infants with Autism Spectrum Disorder**

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#### **Background:**

Sleep-wake cycles change dramatically in the first year of life, characterized by decreasing daytime sleep and increasing nighttime sleep. At approximately two months of age, increased melatonin production promotes circadian rhythm development, leading to the onset of asymmetry in daytime vs. nighttime sleep. Individuals with ASD experience disrupted sleep patterns in childhood that may be a direct consequence of abnormal melatonin production (Rossignol & Frye, 2011). It is unclear, however, how sleep patterns may differ for infants with ASD in the first six months of life, during a time of significant neurodevelopment and consolidation of the circadian rhythm.

#### **Objectives:**

The current study uses parent report in the context of a prospective longitudinal design to examine differences in early sleep patterns between infants who are later diagnosed with ASD and typically developing (TD) infants.

#### **Methods:**

Participants (n=42) were enrolled in a longitudinal infant sibling study prior to 6 months of age and were determined to be TD (n=30) or diagnosed with ASD (n=12) at 24 months. Beginning at 1 week of age, caregivers completed a sleep diary every month until 6 months. From this report, we investigated trajectories of daytime and nighttime sleep duration (i.e., total hours asleep) and examined associations between early sleep trajectories and autism severity at 24 months.

#### **Results:**

Linear mixed-effects models were used to compare the relationship between age and sleep duration across diagnostic groups. As expected, nighttime sleep significantly increased over time while daytime sleep significantly decreased from birth to 6 months for both groups. The groups did not differ in trajectories of nighttime sleep, but a significant interaction was observed for daytime sleep ( $F(1,101) = 6.59, p = .012$ , see Figure). Infants later diagnosed with ASD and TD infants exhibited a similar decline in daytime sleep from birth to 3 months, but beginning at about month 4, this decline was significantly less for the ASD group. By six months of age, infants with ASD were sleeping nearly 1.5 hours more than TD infants during the day. Daytime sleep duration at six months was significantly associated with autism severity (ADOS CSS,  $r = .598, p < .001$ ), but not measures of language or cognition (Mullen: Expressive Language  $r = -.031, p = .886$ , Visual Reception  $r = .097, p = .6505$ ).

#### Conclusions:

The results of this study suggest that sleep differences in infants later diagnosed with ASD emerge between 4-6 months of age. Previous literature indicates that melatonin levels rapidly increase in infancy between three to six months, such that infants become better able to sustain wakefulness in the day and experience uninterrupted sleep at night (McGraw et al., 1999; Kennaway et al., 1992). Findings of this study point the possibility of early differences in melatonin production that may disrupt sustained wakefulness during the day for infants with ASD. These potential differences in circadian rhythm development may occur very early in life for children with ASD. Additional research is needed to examine neurodevelopmental differences in early infant sleep and their relationship to clinical outcomes.

#### **415.015 (Poster) Early Temperament Profiles in Infants at High Risk for ASD and ADHD**

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Background: Autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) likely share developmental pathways. Early atypical temperament profiles may distinguish individuals with later diagnoses of ASD and/or ADHD from those developing typically. Variations in temperament profiles such as negative affect and effortful control are observed in older children with ASD (Mallise, 2020) and, to some extent, in ADHD (DePauw, 2011). Longitudinal studies suggest associations between early temperament differences and later ASD and ADHD symptomatology. Given the potential for overlapping risk factors, questions remain regarding early shared and distinct temperament profiles that may distinguish these groups.

Objectives: To examine similarities and differences in parent-reported temperament profiles at 12 and 18 months in infants at high and low risk for ASD and ADHD.

Methods: Participants included infants with a family history of ASD (older sibling with ASD;  $n=97$ ), ADHD (older sibling/parent with ADHD;  $n=46$ ), and low-risk comparison infants (no family history of ASD/ADHD;  $n=40$ ). Parents completed the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003) at 12 months and the Early Childhood Behavior Questionnaire (ECBQ; Putnam, 2006) at 18 months. At 36 months, participants were classified into one of the three outcome groups: ASD (*DSM-5* diagnosis;  $n=22$ ), ADHD Concerns (elevated ADHD symptoms based on parent or teacher report, and/or examiner observation;  $n=26$ ), and a Comparison group (non-ASD/non-ADHD Concerns;  $n=114$ ). A series of one-way ANOVAs with planned contrasts were conducted to examine group differences for each temperament subscale.

Results: At 12 months (IBQ-R), there were main effects of outcome group for the rate of recovery from distress ( $p=.004$ ), sadness ( $p=.02$ ), and vocal reactivity ( $p=.03$ ) subscales. The ADHD Concerns outcome group exhibited a reduced rate of recovery from distress ( $p=.001$ ) and higher sadness ( $p=.007$ ) relative to the Comparison group, as well as reduced vocal reactivity relative to both the Comparison ( $p=.01$ ) and ASD ( $p=.04$ ) groups. At 18 months (ECBQ), there were main effects for high-intensity pleasure ( $p=.01$ ), positive anticipation ( $p=.001$ ), and sadness ( $p=.001$ ). The ASD group showed reduced high-intensity pleasure relative to the Comparison group ( $p=.005$ ) while the ADHD Concerns group exhibited reduced positive anticipation relative to both the Comparison ( $p<.001$ ) and ASD ( $p=.02$ ) groups. Both the ASD ( $p=.005$ ) and ADHD Concerns ( $p=.003$ ) groups scored higher on sadness relative to the Comparison group.

Conclusions: Relative to the Comparison group, infants developing concerns for ADHD exhibited differences in temperament profiles at both 12 and 18 months, while differences among infants developing ASD were restricted to 18 months. Children with ASD and ADHD Concerns showed variations in distinct temperament domains, except for sadness which was seen in both groups at 18 months. Results partially support previous research showing variable temperament profiles in ASD during early development (Mallise, 2020). Findings are consistent with the limited body of research suggesting temperament differences among infants at risk for ADHD (Auerbach, 2008; Miller, 2019). A combination of shared and distinct temperament profiles may

be present among infants developing ASD and ADHD symptoms, with possible differences in developmental trajectories. Further research is needed to examine associations between temperament domains and dimensional symptoms.

**415.016 (Poster)** Effects of Mechanism of Genetic Transmission of Autism on Clinical Characteristics of Infants and Toddlers with Emerging Autism Symptoms

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**Background:** Genetic factors account for a substantial share of liability to autism spectrum disorder (ASD), and influence symptom expression among affected individuals. The genetic architecture of autism, and the relative contribution of inherited familial genetic factors versus spontaneous, non-familial genetic factors, is thought to differ among individuals with ASD from multiplex (multiple affected family members) and simplex (one affected family member) families (Leppa et al., 2016). Differences in symptom severity and incidence of intellectual disability among multiplex and simplex individuals with ASD have been reported (e.g., Robinson et al., 2014), suggesting that mechanism of genetic transmission (i.e., familial, as in multiplex ASD, or non-familial, as in simplex ASD) may influence behavioral phenotypes. However, the extent to which such differences are observable among infants and toddlers with *emerging* autism symptoms remains unclear.

**Objectives:** Evaluate the association between mechanism of genetic transmission and clinical presentation among infants and toddlers with emerging autism symptoms.

**Methods:** This study used data collected for two larger autism intervention studies for infants and toddlers showing behavioral signs of ASD (P50-HD055784-5843, P50-HD055784-8487, PI: Kasari). Participants ( $N=121$ , 22.3% female) were between 12-36 months of age at enrollment ( $M=20.9$  months). Three groups were formed: multiplex (MPX,  $n=29$ ; at least one sibling with ASD), simplex younger siblings (SPX-Sib,  $n=38$ ; at least one typically-developing older sibling and no family history of ASD), and simplex first-borns (SPX-FB,  $n=54$ ; no older siblings and no family history of ASD). Scores from baseline assessments (ADOS-2, Mullen) were used to address study aims.

**Results: Cognitive Ability.** A MANCOVA revealed significant group differences in cognitive ability (Pillai's Trace=.102,  $F_{(4,222)}=2.99$ ,  $p=.020$ ) after controlling for age, sex, and cohort. Univariate follow-up analyses found significant group differences in both dependent variables (Nonverbal DQ and Verbal DQ,  $p's<.05$ ). See Figure 1 for results of univariate tests and pairwise comparisons. **Language Delay.** The majority of children (71.8%) presented with expressive language delay (Mullen Expressive Language T-score  $\leq 35$ ). SPX-Sib children were more likely to present with language delay than MPX children ( $p=.014$ , OR=6.57) after controlling for age, sex, cohort and Nonverbal DQ. **Autism Symptomatology.** A MANCOVA revealed significant group differences in core autism symptoms (Pillai's Trace=.098,  $F_{(4,230)}=2.97$ ,  $p=.020$ ), after controlling for age, sex, and cohort. Follow-up univariate tests found significant group differences on both dependent variables (ADOS-2 Social Affect and RRB scores,  $p's<.05$ ). In separate analyses, ANCOVA revealed group differences in ADOS-2 calibrated severity score ( $p=.006$ ) after controlling for age, sex, and cohort. See Figure 2 for results of univariate tests and significant pairwise comparisons.

**Conclusions:** Results reveal clinically-meaningful differences in behavioral phenotypes of simplex and multiplex infants and toddlers. Children from multiplex families demonstrated stronger cognitive skills and less severe autism symptoms than those from simplex families. These findings suggest that multiplex-simplex differences previously reported in older children are observable in the first years of life, and before autism symptoms fully emerge. Future work is needed to probe *biological mechanisms* (e.g., genetic, neural) and *environmental factors* (e.g., family context) driving phenotypic differences, and examine the effects of familial genetic risk on developmental trajectories.

**415.017 (Poster)** Emotional Availability in Mother-Child and Father-Child Dyads

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**Background:**

A positive and reciprocal parent-child interaction is crucial for child development. The growing literature highlighted that both mothers and fathers play a fundamental role for the early development for children with typical and atypical development (Flippin & Crais, 2011, Cabrera, & Tamis-LeMonda, 2013; Flippin, & Watson, 2015, Cano, Perales, & Baxter, 2019). As for typically developing children, in the case of Autism Spectrum Disorder (ASD) the majority of previous studies about parenting primarily focused on mothers. In fact, the affective quality of fathers in interaction with their children needs further investigation since they may have a specific role on child development, as suggested in previous studies (Cabrera, & Tamis-LeMonda, 2013).

## Objectives:

The aim of this study was to compare mothers' and fathers' interactive behaviors with their children with ASD, to identify common characteristics, specific differences and the differential impact of child's variables on parents' interactive skills.

## Methods:

This study involved n=76 children with ASD (M chronological age=43.67 months, SD=11.22; M mental age=41.85 months, SD=11.38; 11 females), with their mothers (M chronological age=37.96 years, SD=5.69) and with their fathers (M chronological age=41.21 years, SD=6.94), for a total of 152 parent-child interactions. The relationship between parent and child was evaluated using the Emotional Availability Scales (EAS, Biringen et al., 2008). Data was collected during a 10-min play session, in which parents were asked to play with her or his child, as they typically would do in the home context. Inferential statistics and linear mixed effect models have been applied to investigate cross-sectional differences between mothers and fathers while interacting with their child.

## Results:

There were no significant differences between mothers and fathers in the mean levels of Sensitivity, Structuring, Non-intrusiveness and Non-hostility. The scores fall in the moderate to good range. Also, there were no differences neither in the mean level of child Responsiveness nor in the mean level of Involvement of the child considering mothers and fathers. We further investigated if parent gender, child's cognitive level and symptoms severity could predict Adult and Child EA Scales. Results highlighted that Adult EA scales of both mothers and fathers seem not to be predicted by the child's cognitive functioning nor symptom's severity. Interestingly, concerning the child's scales, symptoms severity, but not cognitive functioning, resulted to be a significant predictor for both Responsiveness ( $b=-0.645$ ,  $p<0.001$ ) and Involvement ( $b=0.5150$ ,  $p<0.01$ ) with both the parents.

## Conclusions:

Similar levels of Emotional Availability (EA) might constitute a positive foundation on which to build early-parents child interventions. Further, understanding the specific role of father's may have important service delivery implications for effectively involving parents in play-based early interventions for children with ASD. It is also important to understand if and how mothers' and fathers' involvement may differentially impact on treatment outcomes and child's gains over time. Finally, considering non-optimal adult EA strengthens the importance of involving caregivers into the therapeutic setting.

### **415.018** (Poster) Examining Profiles of Mental Health Symptoms and Neurodevelopment Among Younger Siblings of Youth with Autism Spectrum Disorder

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**Background:** Siblings of youth with Autism Spectrum Disorder (ASD) are at increased risk for developing ASD, as well as impairments in cognition, emotion regulation, and social development. Previous research has identified clear heterogeneity in these domains, though investigation of early profiles of behavioral and mental health symptoms has been limited.

**Objectives:** The current study utilized data from the Early Autism Risk Longitudinal Investigation (EARLI) to examine how younger siblings at high familial risk clustered based on parent-reported mental health and adaptive behavior rating scales.

**Methods:** We conducted a latent profile analysis (LPA) using the DSM-oriented subscales of the Child Behavior Checklist (CBCL) and the subscales of the Vineland Adaptive Behavior Scales (VABS), collected at the sibling's 36-month follow-up visit. We identified the best-fitting model using fit statistics and clinical judgement. Latent profile regression was used to determine the association between profile membership and the sibling's diagnosis at 36 months, sex assigned at birth, and maternal anxiety and/or depression during pregnancy.

Results: The sample included 170 younger siblings at high familial risk from the EARLI study (mean age = 36 months +/- 3 months, 54% Male) and resulted in a 4-profile model. Profile 1 (n = 20, 12%) labelled “Moderate Developmental Problems,” was characterized by elevated levels on the CBCL pervasive developmental problems subscale and clinically significant language and motor impairment on the VABS. Profile 2 (n = 36, 21%) labelled “Typically Developing”, was characterized by normative scores on all subscales. Profile 3 (n = 95, 56%) was labelled “Mild Developmental Problems”, as the siblings in this group had mild motor and language delays on the VABS. Profile 4 (n = 19, 11%) was labelled “Mental Health and Developmental Problems” given that siblings in this group had elevated scores on the CBCL affective, pervasive developmental, and oppositional defiant subscales and impaired motor and language skills on the VABS. Younger siblings with an ASD diagnosis were most likely to belong to the “Moderate Developmental Problems” profile compared to the “Typically Developing” ( $\chi^2 = 10.77, p < .01$ ) or the “Mild Developmental Problems” ( $\chi^2 = 8.93, p = .01$ ) profiles. Males were more likely to belong to the “Moderate Developmental Problems” profile than the “Typically Developing” ( $\chi^2 = 21.21, p < .001$ ) or “Mild Developmental” ( $\chi^2 = 22.47, p < .001$ ) profiles than females. Siblings whose mother had a history of anxiety or depression were more likely to be in the “Mental Health and Developmental Problems” profile than any other profile (vs. Profile 1:  $\chi^2 = 7.65, p < .01$ , Profile 2:  $\chi^2 = 17.18, p < .001$ , Profile 3:  $\chi^2 = 23.00, p < .001$ ).

Conclusions: Younger siblings of youth with ASD show differential profiles of mental health and neurodevelopmental impairments at 36 months, and these profiles are associated with child- and maternal-specific factors. These profiles further our understanding of borderline and clinically impairing phenotypic expression among non-typically developing siblings, as well as help to identify siblings who may be in need of cognitive, emotional, and/or social early intervention services.

**415.019 (Poster)** Examining the Relationship between Parent-Child Interactions and Social Communication Skill Acquisition in Early Intervention Settings

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**Background:** Parent-mediated interventions for young children focus on parents learning and practicing techniques to support their child in the home and other community settings. Active parent engagement in services is best practice for young children with social communication challenges (Zwaigenbaum et al., 2015), but parents can often struggle to learn and use complex interventions with full fidelity (e.g., Stahmer et al., 2019). As such, it may be helpful to identify key components or strategies used by parents that are positively related to child progress. Examining parent behaviors used to promote social communication skills during participation in early intervention programs can support identification of possible relationships between parents’ use of certain techniques and child progress. This information may help identify key areas to target for parent support within the context of parent-mediated intervention.

**Objectives:** This study explored the relationship between use of certain parent behaviors during parent-child interactions and child progress on a proximal measure of social communication skills after three months of early intervention.

**Methods:** In this community-based early intervention study, Part C providers delivered services to 24 parent-child dyads. Children averaged 23.16 months (SD = 5.03) of age, were 71% male, and 46% Hispanic/Latinx. A total of 100% of participating parents were biological mothers. Child social communication skills were evaluated via provider report at intake and after three months of treatment, using the revised Social Communication Checklist (SCC-R; Wainer et al., 2017). The SCC-R is a 70-item checklist covering four primary domains: social engagement, expressive communication, receptive communication, and imitation/play. SCC-R total scores were calculated for all participants. Parent behavior was evaluated using the Parent Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al., 2013) at the conclusion of treatment. Trained observers scored the PICCOLO via video-recorded parent-child interactions to examine parenting behaviors of Affection, Responsiveness, Encouragement, and Teaching. Multiple regression was used to test if parenting behaviors observed with the PICCOLO at the conclusion of treatment were significantly related to change in child social communication scores on the SCC-R across three months of early intervention.

**Results:** Results demonstrated that the PICCOLO Teaching domain significantly predicted change in children’s social communication scores ( $\beta = .54, p < .05$ ), but the Affection, Encouragement and Responsiveness domains were not significantly related. The ability to detect significant relationships within this analysis was likely impacted by the high collinearity of parenting behaviors as measured by the PICCOLO (VIF values from 1.25 to 1.97).

**Conclusions:** The current exploration provides preliminary evidence on the importance of encouraging parent teaching behaviors related to children’s social communication skill acquisition. Teaching, as defined by the PICCOLO, involves creating stimulating parent-child interactions by sharing conversation (e.g., expanding words and sounds; labeling objects and actions) and play (e.g.,

extending what the child is doing; suggesting activities). Building upon current teaching behaviors could be a future area of focus within parent-mediated interventions for young children with social communication challenges.

**415.020 (Poster)** Exploring Face Inversion Effects and Attentional Biases in Infants at High Risk for ASD

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**Background:** Decades of research have debated whether visual processing abilities in ASD result from enhanced featural processing, configural processing deficits, or both (Simmons & Todorova, 2018). In typically-developing infants, faces are processed configurally by the second half of the first year (Scott & Nelson, 2006), seen also by increased attention to the left side of the face (Guo et al., 2009). Configural processing can be disrupted through face inversion (Freire et al., 2000), though in ASD these effects are diminished (Falck-Ytter, 2008), as are biases to the left side of the face (Dundas et al., 2012a). By 11 months, infants at high risk for ASD (HRA; by virtue of an older sibling with ASD) also differ from low-risk control infants (LRC) in attention to the left and right sides of upright faces (Dundas et al., 2012b), and the current study will expand on past research to look at face inversion effects and left vs. right face attention in HRA and LRC infants at 6, 9, and 12 months.

**Objectives:** The current aim is to evaluate patterns of visual scanning to faces in infancy that could reflect similarities and differences in configural and featural processing between HRA and LRC.

**Methods:** Participants included 53 6-month-olds (HRA:  $n=23$ ; LRC:  $n=30$ ), 57 9-month-olds (HRA:  $n=22$ ; LRC:  $n=35$ ), and 62 12-month-olds (HRA:  $n=20$ ; LRC:  $n=42$ ). Infants viewed 12 upright and 12 inverted faces, each for 3.5 sec, while a Tobii eye-tracker captured visual attention. Analyses examined looking to the face overall, and to the left and right sides of the face.

**Results:** A repeated-measures ANOVA with orientation (upright,inverted) as the within-subjects factor and group (HRA,LRC) and age-months (6,9,12) as the between-subjects factors, revealed an orientation\*group interaction for attention to the face,  $F(1,166)=4.797, p=.03$ . Groups showed non-significant trends in the opposite direction for attention to upright vs. inverted faces, with LRC looking longer to upright than inverted ( $p=.12$ ) and HRA looking longer to inverted than upright ( $p=.074$ ; see Figure 1). A second ANOVA added face-region (left,right) as a within-subjects factor and found an orientation\*face-region\*age-months\*group interaction,  $F(1,166)=3.364, p=.037$ . Follow-up ANOVAs for each age were conducted, and an orientation\*face-region\*group interaction at 12 months was found ( $p=.049$ ; see Figure 2), with different patterns of attention to the left and right side depending on orientation for each group.

**Conclusions:** The current study found differences in face inversion effects and attention to the left and right sides of faces between HRA and LRC in the first year of life. LRC showed a trend towards more attention to upright than inverted faces, while HRA showed the opposite pattern. When examining side biases in attention, differences in looking to the left vs. right for upright and inverted faces varied most for LRC and HRA at 12 months. More work is needed to understand whether these differences might indicate enhanced featural or disrupted configural processing in HRA. Future work will include infant diagnostic outcomes to further understand how these measures of visual processing might also differentiate HRA later receiving an ASD diagnosis.

**415.021 (Poster)** Factors Associated with Toileting Resistance in Preschool-Aged Children with Autism Spectrum Disorder and Other Developmental Delays/Disabilities

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**Background:** Most typically developing children achieve daytime continence by 3 years of age. Some studies suggest that children with autism spectrum disorder (ASD) achieve continence later than children in the general population (POP) and those with other non-ASD developmental delays (DD). Factors associated with toileting resistance in adolescents/adults with ASD include intellectual disability, behavior problems, gastrointestinal (GI) issues, and ASD diagnostic symptoms. There is little literature on factors associated with toileting resistance in preschool-aged children with ASD compared to other children.

**Objectives:** (1) Compare toileting resistance among children ages 3–5 years who were classified as ASD, DD, and POP in a multi-site community-based study and (2) identify behavior problems and GI issues associated with toileting resistance in children with ASD and DD.

**Methods:** Families of children ages 2–5 years were enrolled in the Study to Explore Early Development Phase-2 (SEED-2) from 2012 to 2016. Mothers were first asked to complete an ASD screen. Children who did not demonstrate risk on the ASD screen completed the Mullen Scales of Early Learning (MSEL) and were defined as DD or POP. Others were additionally asked to complete the Autism Diagnostic Observation Schedule and Autism Diagnostic Interview – Revised to determine ASD status. MSEL scores of 70 points or less defined intellectual disability (ID).

Mothers self-reported education and race/ethnicity and completed the Child Behavior Checklist 1½–5 years (CBCL) including whether the child rarely or sometimes/often resisted toilet training in the last 3 months. CBCL scales for anxiety, attention deficits/hyperactivity, and oppositional problems defined behavior problems in this study. Mothers also completed a child health history form including whether the child rarely or sometimes/often had specific GI issues within the past year (Table 1).

**Results:** Children ages 3–5 years with complete CBCL data and classified with ASD (n=746), DD (n=768), or as POP (n=701) were included. Children with ASD were significantly more likely to resist toilet training sometimes/often (49.1%) than DD (23.7%) or POP (8.4%) children ( $\chi^2=308.2$ ,  $p<.001$ ) (Table 1). They were also significantly more likely to have behavior problems and GI issues than DD or POP children (Table 1). Constipation was the most frequent GI issue reported for children with ASD (35.7% vs. 23.0% [DD] and 15.8% [POP]). After adjusting for child sex and ID and maternal education and race/ethnicity, logistic regression analyses found that attention deficits/hyperactivity (OR=1.6; 95%CI=1.1,2.3), constipation (OR=1.7; 95%CI=1.2,2.5), and diarrhea (OR=1.6; 95%CI=1.1,2.5) were significantly associated with toileting resistance in children with ASD. Oppositional behaviors (OR=2.6; 95%CI=1.4,4.6) and diarrhea (OR=2.5; 95%CI=1.5,4.6) were significantly associated with toileting resistance in children with other DD (Table 2).

**Conclusions:** Our study suggests a significantly higher proportion of children with ASD (i.e., one-in-two) resist toilet training, compared with other children. Addressing factors associated with toileting resistance in the preschool years may help tailor interventions that could prevent toileting problems later in life. Our results support the need to identify and treat constipation and diarrhea and co-occurring attention deficits/hyperactivity when toilet training young children with ASD.

#### **415.022** (Poster) Gross Motor Development and Its Relation to Language Skills in Infants at Low and High Familial or Screen Risk for ASD

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#### Background:

Infants who later develop autism spectrum disorder (ASD) show early gross motor problems, including delays in motor milestones (Lloyd et al., 2013; Ozonoff et al., 2008). Also, significant differences in gross motor development between infants at high and low familial risk for ASD have been reported (Bhat et al., 2012), albeit mixed findings (Iverson et al., 2019). What remains unknown is whether a non-familial risk group of infants (i.e., those who fail a developmental screener at 12 months) show differences in gross motor development. Moreover, it remains unclear whether the relation between early gross motor and language development, found in typically developing populations, extends to infants at high familial or screen risk for ASD.

#### Objectives:

To investigate whether infants in three groups – (1) infants at low risk of ASD due to having no older siblings with autism and having passed a 12-month screener (Low-Risk Controls, or LRC), (2) infants at familial risk for ASD due to having at least one older sibling with autism (High-Risk for Autism, or HRA), and (3) infants at developmental risk for ASD based on early behavioral differences detected on a 12-month screening instrument (High-Risk Screeners, or HRS) - differ in gross motor development between 12 and 24 months and to examine whether gross motor skills are related to language skills in the three groups.

#### Methods:

The Communication and Symbolic Behavior Scales (Wetherby & Prizant, 2002) was used at 12 months to identify infants for inclusion in the HRS group. Infants from each group (LRC:  $n = 120$ ; HRA:  $n = 72$ ; HRS:  $n = 49$ ) were administered the Mullen Scales of Early Learning (MSEL; Mullen, 1995) at 12, 18, and 24 months to measure gross motor and language skills. Because data were not normally distributed, nonparametric tests were used to test group differences in gross motor scores across HRA,

HRS, and LRC groups. Spearman's correlations were used to examine associations between concurrent gross motor and language scores at each age.

#### Results:

The HRS group had significantly lower gross motor scores than the HRA group at 12 and 24 months ( $p < .05$ ). The HRS group also had significantly lower gross motor scores than the LRC group at 12 and 18 months ( $p < .05$ ). There were significant, positive correlations between gross motor and receptive language scores in the LRC group at 12, 18, and 24 months ( $r_s = .23-.48$ ,  $p < .05$ ). However, there were no robust associations between gross motor and language scores in the HRA and HRS groups.

#### Conclusions:

Infants in the HRS group had significantly lower gross motor scores compared to infants in the HRA and LRC groups in the first two years of life. The association between gross motor and language skills was significant only in the LRC group, suggesting that the gross motor-language relation may be robust in typically-developing infants, but not those who are at high familial risk for ASD or those who fail a developmental screener.

#### **415.023 (Poster)** Individual and Parental Factors Affecting Behavior and Emotional Problems of Italian Toddlers with Low-Functioning Autism Spectrum Disorder

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Background: The expression of behavior and emotional problems (BEP) in toddlers with low-functioning Autism Spectrum Disorders (ASD) may be associated to several individual and parental factors, to consider for a complete picture of the child. Parents' socio-cultural level (SCL) is relevant for the development of children. It is composed by three dimensions: (1) socio-economic status (SES), with educational level, type of job and income as indicators; (2) cultural capital, with participating, consuming and expert using as dimensions; and (3) social capital, with bonding and bridging as indicators (Bordieau, 1986; Bornstein & Bradley, 2003).

Objectives: The present study aimed to examine whether the BEP of 148 Italian toddlers aged from 18 to 37 months old ( $M = 30.84$ ,  $SD = 4.62$ ; 82% males) with low-functioning ASD are affected by individual and parental factors.

Methods: As individual factors, toddlers' age, birth order, development level (Griffiths Mental Development Scale; Griffiths, 1996; Luiz et al., 2006), autistic symptomatology (ADOS-2; Lord et al., 2012), and adaptive behavior (Vineland-II; Sparrow et al., 2005) were considered. As parental factors, both parents' age, years of education, occupational prestige, cultural capital (Scale of Cultural Capital; Balboni et al., 2019), and social capital (Personal Social Capital Scale; Chen et al., 2009) were investigated. Toddlers' BEP were assessed with the CBCL 1½-5 (Achenbach & Rescorla, 2000) (see Table 1). First, Pearson's correlation coefficients were calculated to examine the relationships among individual and parental factors. Then, only those individual and parental factors which resulted statistically significantly correlated with BEP were entered at Step 1 and at Step 2, respectively, as independent variables in hierarchical regression models with each CBCL syndrome or DSM-oriented scale as dependent variable. For each factor found to significantly affect BEP, the  $f^2$  effect size was computed (Cohen, 1988).

Results: Correlations' results showed that toddlers' development level, socio-affective autistic symptomatology and adaptive behavior were related with the majority of CBCL scales, while toddlers' age, birth order, restricted-repetitive behaviors autistic symptomatology, mothers' age, both parents' years of study, occupation, consuming and expert using cultural capital, and bonding and bridging social capital were associated only with specific CBCL scales. Regressions' results showed that higher levels of BEP are affected by higher toddlers' age, birth order and socio-affective autistic symptomatology, and by lower adaptive behavior, restricted-repetitive behaviors autistic symptomatology, mothers' age, both parents' bonding social capital, and fathers' expert using cultural capital. Among all factors, only toddlers' adaptive behavior affected the majority of CBCL scales and with the highest power, showing moderate and large effect sizes for some CBCL scales, while all other individual and parental factors affected only specific CBCL scales and with small effect sizes.

Conclusions: Already at early age, the expression of BEP of toddlers with ASD is influenced by parents' SCL as well as specific individual factors (i.e. adaptive behavior, birth order, restricted-repetitive behaviors autistic symptomatology). Hence, measuring all these individual and parental factors may be useful for several clinical purposes, like planning individualized interventions focused on better children's quality of life and inclusion in the community.

**415.024** (Poster) Investigating Associations between Older Siblings' ASD and ADHD Traits and Infant Siblings' Temperament  
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#### Background:

Autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) are both highly heritable conditions. Having an older sibling with ASD increases the likelihood of developing autism symptoms and dimensional variation in proband symptomology has been shown to be a predictor of familial ASD recurrence risk. Similarly, people that have a relative with ADHD are more likely to develop ADHD themselves. Previous prospective studies have indicated that perceptual sensitivity and fear/shyness in infancy could be possible early predictors for later ASD traits, while activity level and infant attentional temperamental traits (duration of orientating, attentional focus/shifting) might predict later ADHD traits. However, there is a lack of prospective studies investigating how proband traits of ASD and ADHD are associated with early infant developmental traits in their younger siblings.

#### Objectives:

To investigate the associations between older siblings' ASD and ADHD traits and early childhood predictors of ASD, ADHD and anxiety in infant siblings at typical and elevated likelihood of ASD and/or ADHD.

#### Methods:

The study included 411 infant participants (male = 213, female = 198) and their older siblings with ASD (n=250), ADHD (n=31), both (n=21) or neither (n=106) from the British Autism Study of Infant Siblings (BASIS) and Studying Autism and ADHD Risks (STAARS) studies. Parents completed the Infant Behavior Questionnaire (IBQ) for the infant sibling at 8-months and 14-months and the Early Childhood Behavior Questionnaire (ECBQ) at 24-months. Perceptual sensitivity and fear/shyness were used as possible early predictors for ASD, while activity level, duration of orientation and attentional shifting/focus were used for ADHD.

For the proband ASD traits, parents completed the Social Communication Questionnaire Lifetime version (SCQ Lifetime) (n=329), and the Conners 3 questionnaire (n=198) for ADHD traits, from which the subscales for inattention and hyperactivity/impulsivity were used. Latent growth curve models were used in statistical analysis.

#### Results:

##### *ASD*

Older siblings' higher SCQ scores (more symptoms) were associated with higher initial infant fear and its decline over time (figure 1). The model for older siblings' SCQ scores and infant perceptual sensitivity ( $\chi^2(2) = 4.43, p = .109; CFI = .985, RMSEA = .055$ ) showed that higher proband SCQ scores associated with infants' lower stable perceptual sensitivity ( $\beta = -.013, p = .045$ ), but there was no significant change over time.

##### *ADHD*

Older siblings' higher levels of inattention were associated with higher initial infants' activity levels, but not with the change (slope) over time (figure 2). Proband hyperactivity/impulsivity did not associate with infants' activity level. Neither inattention nor hyperactivity/impulsivity were associated with infants' attentional measures.

#### Conclusions:

This is one of the first studies investigating proband trait association with infant sibling temperament. The results show that older siblings' ASD and ADHD traits do associate with their infant siblings' temperamental developmental trajectories, although the

pattern was different across the different constructs. As these temperamental traits might be early predictors for later emergence of ASD and ADHD, futures studies should explore how proband traits might relate to their infant sibling's later development.

**415.025 (Poster)** Investigating Attention to Non-Social and Social Stimuli and Underlying Mechanisms of Language Development in a Prospective ASD and ADHD Infant-Sibling Study

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**Background:**

Neurodevelopmental disorders like autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) are diagnosed in early childhood and frequently co-occur. It is important to understand the early mechanisms that could contribute to later difficulties in these disorders through prospective studies. One important component in early learning is how the social relevance and temporal structure of events influences attention. Infant's attention to particular frequencies may shape their arousal and attention to social contexts like language. Here we explore patterns of attention to different temporal frequencies in social and non-social contexts in infants with first-degree relatives with and without ASD and/or ADHD.

**Objectives:**

To investigate attention to temporal structure (i.e. information presented at different frequencies) in a prospective study of infants at typical-likelihood (TL) and elevated-likelihood (EL) of ASD and/or ADHD due to family history.

**Methods:**

This study included 93 five-month old infants (51 males) from the British Autism Study of Infant Siblings, Studying Autism and ADHD Risks (STAARS; [www.staars.org](http://www.staars.org)). 25 TL controls, 42 EL-ASD, 14 EL-ADHD and 12 EL-ASD+ADHD infants completed an eye-tracking paradigm ('Frequency Task'). Ten-second videos of non-social stimuli (checkerboard pairs) and of social stimuli (face pairs) were presented to the infants. Three trials were presented for each condition, respectively. In both non-social and social conditions, each stimulus in the pair alternated at a different frequency; either low (1Hz), mid (6Hz; i.e. the frequency of human syllabic speech) or high (10Hz) frequency.

**Results:**

Infants showed a side bias for stimuli presented on the right of the screen; therefore, this was included as a covariate along with age in days. There were no group differences in looking time. There was an effect of frequency ( $F(2, 922.62) = 80.80, p < .001$ ) with infants showing a looking preference for low<mid<high frequency stimuli. There were no differences in the overall amount of looking at social and non-social stimuli. However, there was a significant interaction between stimulus type and frequency ( $F(2, 912.04) = 21.90, p < .001$ ). Infant's looking patterns to non-social stimuli were more modulated by temporal frequency than for social stimuli (see Figure 1).

**Conclusions:**

Typical-likelihood and elevated-likelihood for ASD and/or ADHD infants showed similar modulation of attention by temporal frequency and social content. Infants did not show a consistent preference for 6Hz stimuli over 1Hz and 10Hz, suggesting they were not perceptually tuning in to the frequency of human syllabic speech. The study also provides behavioural evidence of content-related modulation as preference for faces or checkerboards varied by frequency. These fundamental processes appear similar in very early development of infants with elevated-likelihood for neurodevelopmental disorders. Future work will take a longitudinal approach to explore attention to temporal structure in these infants, and its relation to later language and ASD outcomes.

**415.026 (Poster)** Joint Engagement Experiences Are Associated with Communication Skills and Autism Severity in Toddlers with ASD.

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**Background:** Joint engagement is positively associated with communication outcomes concurrently and prospectively in toddlers with autism spectrum disorder (ASD; Adamson et al., 2009, 2019; Bottema-Beutel, 2014). However, there is heterogeneity in communication skills and symptom severity across the autism spectrum that impact early intervention approaches (Kim et al., 2016; Wiggins et al., 2012) and long-term outcomes. Play with others, such as parents, is an opportunity for children to further develop their social and communication skills (Pierucci, 2015).

**Objectives:** The present study explores the relation between joint engagement experiences for toddlers with ASD during parent-child play and their communication and socialization abilities, and ASD severity.

**Methods:** Toddlers (18–32 months at evaluation,  $M = 23.85$ ,  $SD = 3.45$ ;  $n = 103$ ) with ASD were recruited from an early detection study. Participants were included if they completed all measures, no more than two months apart. In one session, toddlers participated in a joint engagement study, producing video of 15-minute, semi-structured parent-child interaction using the Communication Play Protocol (CPP; Adamson et al., 2016). Videos were reliably rated using three 7-point rating items from the Joint Engagement Rating Inventory (JERI; Adamson et al., 2020). Total Joint Engagement (TJE) describes overall quantity of joint engagement; Scaffolding assesses caregiver's support and furtherance of child's interactional experiences; and Fluency & Connectedness (F&C) characterizes flow of the interaction. In a separate session, the Mullen Scale of Early Learning (MSEL; Mullen, 1995), Vineland Adaptive Behavior Scale- 2nd Edition (VABS-II; Sparrow et al., 2016), and Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012) were collected. Correlations examined associations between the three JERI items and measures of communication (MSEL Expressive and Receptive Language developmental quotients [DQ; age equivalent/chronological age\*100]), socialization (VABS-II Socialization Standard Score), and ASD severity (ADOS-2 Total Calibrated Severity Score).

**Results:** Communication scores were significantly and positively correlated with all three JERI items (Table 1; all  $r > .21$ ;  $p < .038$ ). Socialization results revealed significant small positive correlations with Scaffolding ( $p = .048$ ) and F&C ( $p = .043$ ), but no association was found for TJE. A small significant negative correlation between ASD severity and Scaffolding ( $p = .028$ ) and F&C ( $p = .050$ ) exists, but not for TJE.

**Conclusions:** Results indicate that for toddlers with ASD, parents' scaffolding and the flow during parent-child interactions are associated with children's communication and socialization abilities and with ASD severity. Additionally, the time a child with ASD is in joint engagement during these interactions is associated with their communication abilities. One manifestation of deficits in quality of interactions among toddlers with ASD is difficulty engaging in reciprocal play. Our findings suggest that variability in the quality of interaction these toddlers experience reflects in part heterogeneity in their language skills and autism severity. These findings present an opportunity to inform early intervention and parent-mediated therapy by focusing on maximizing children's time spent in joint engagement, parents' support of child's activities, and balance and flow of interaction in dyadic play, which may affect future outcomes for children with ASD.

**415.027 (Poster) Language Abilities in Children with Autism and Language Development in the First Two Years of Life in Their High-Risk Siblings**

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**Background:** A recent report found that quantitative variation in language abilities and autism traits in children with autism spectrum disorder (ASD) may help inform the development of their high-risk younger siblings (Girault et al., 2020). Younger siblings of children with ASD have been shown to exhibit altered trajectories of language development as early as 12 months of age (Estes et al., 2015), which may serve as a target for intervention. Here we examine how the language abilities of older ASD siblings (probands) may inform language development in their high-risk siblings from 6 to 24 months of age.

**Objectives:** In this study, we assessed the predictive utility of proband language abilities for developmental trajectories of expressive (EL) and receptive (RL) language in high-risk (HR) siblings in the first two years of life.

**Methods:** Three hundred and eighty-four proband-sibling pairs were included in this study; 89 were concordant for ASD (i.e. both diagnosed with ASD). Proband EL and RL was evaluated using the Vineland Adaptive Behavior Scale and ASD trait level was measured with the Social Communication Questionnaire (SCQ). Sibling language abilities were evaluated at 6, 12, and 24 months using the Mullen Scales of Early Learning and the Vineland. Additional measurements of language were captured using the Communication and Symbolic Behavioral Scales (CSBS) and MacArthur-Bates Communicative Development Inventories (MCDI) at 12 and 24 months.

**Results:** Pearson correlation estimates revealed proband Vineland RL was significantly correlated with 24-month RL scores of HR siblings who developed ASD (HR-ASD) on the Vineland ( $r = 0.43$ ,  $q = 0.016$ ) and Mullen ( $r = 0.41$ ,  $q = 0.016$ ), and the number of phrases understood on the MCDI ( $r = 0.41$ ,  $q = 0.031$ ). Proband Vineland EL scores were significantly correlated with HR-ASD sibling EL scores on the Mullen at 24-months ( $r = 0.39$ ,  $q = 0.029$ ). We found no associations between proband language abilities and HR sibling language at 6 or 12 months (**Figure 1**). Proband SCQ was not associated with sibling language development at any timepoint. Longitudinal mixed models adjusted for age, sex, and study site identified significant associations between proband and sibling Vineland RL and EL scores (**Figure 2**). Given that a subset of HR siblings negative (HR-Neg) for ASD have been shown to exhibit language delay (Ozonoff et al., 2014), we also tested whether proband categorical language delay (Vineland EL or RL score  $<10$ ) predicted sibling categorical language delay (Mullen EL or RL t-score  $<35$ ). Regardless of diagnostic outcome, proband language delay significantly predicted language delay in siblings at 24-months (OR = 2.26, 95% CI 1.29 to 4.08,  $p = 0.005$ ).

**Conclusions:** These results extended previous work to reveal that ASD proband language abilities explain significant variation in HR sibling language skills at 24-months, but not before, among siblings who develop ASD. Language delay in probands was predictive of language delay in HR siblings at 24-months regardless of diagnostic outcome. This suggests that HR siblings of children with ASD and language delay should be monitored closely in the first two years of life.

**415.028 (Poster)** Longitudinal Trajectories of Social Visual Engagement Distinguish between Language Profiles at Two Years in Autism Spectrum Disorder

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**Background:**

Language outcomes among individuals with Autism Spectrum Disorder (ASD) are highly variable, ranging from those who remain minimally- and non-verbal to those who develop fully functional speech (Tager-Flusberg, Paul, & Lord, 2005). Language skill in early childhood is one of the strongest predictors of functional success for children with ASD, yet our understanding of the heterogeneity of communicative development remains limited (Mawhood, Howlin, & Rutter, 2000). Eye-tracking measures of Social Visual Engagement (SVE) have previously been used to differentiate children with ASD from typically developing children and identify mechanisms of social disability within ASD (Jones & Klin, 2013). Little work has explored how trajectories of SVE might differentiate children with ASD who present heterogeneously. These trajectories may elucidate mechanisms of variable language outcome and provide preliminary SVE predictors of language among children with ASD.

**Objectives:**

Prior studies have described two meaningful subgroups of children with ASD: those with significant language impairments and those with more typical language acquisition (Tek et al., 2014). This project aimed to model and compare developmental trajectories of SVE in these two subgroups, across the first two years of life.

**Methods:**

50 male infants later diagnosed with ASD were followed prospectively from birth until age two years. SVE measures (quantified as percentage of time spent fixating on different Regions Of Interest (ROIs): eyes, mouth, body, and objects) were collected a maximum of 12 times ( $M=6.84, SD=2.8$ ) between birth and 2 years. Children were assessed for developmental functioning at 2 years using the Mullen Scales of Early Learning. Those who received T-scores greater than 1 SD below the mean in either the

Expressive or Receptive Language sub-scales were classified as ASD-Typical Language (ASD-TL(N=34)), while those with T-Scores less than 1 SD below the mean in either language sub-scale were classified as ASD-Language Delayed (ASD-LD(N=16)). Functional data analysis was utilized to model longitudinal trajectories of SVE in both language groups.

#### Results:

Despite individual heterogeneity, results indicate differential trajectories of SVE between children with ASD with and without language delays at 2 years ( $F=2.85, p=0.09$ ) reaching trending significance. In ASD-LD children, eye-looking declines across the first 2 years, whereas in ASD-TL group, eye-looking appears to initially increase (2-6 months) and remains comparatively high thereafter. Conversely, in the ASD-LD group, mouth-looking appears to increase more rapidly and stay elevated, reaching a plateau at 18 months, whereas ASD-TL children show more gradual increases in mouth-looking from 2-18 months, after which this behavior appears to decline (18-24 months).

#### Conclusions:

Previous studies have shown reduced eye-looking in ASD compared to typically developing children, and also showed an association between the extent of decline in eye-looking that a child's outcome level of social disability (Jones & Klin, 2013). Here, in a larger sample of infants with ASD, results show that decline in eye-looking also appears to be associated with outcome levels of language function and highlights heterogeneity in outcomes across the Autism Spectrum. Trajectories of SVE may both predict and suggest mechanisms by which children with ASD develop heterogeneous functional outcomes, such as language.

#### 415.029 (Poster) Maternal Depressive Symptom Trajectory and Brain and Behavioral Development in Infants at High and Low Risk for Autism

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Background: Children of depressed mothers are more likely to have atypical frontal brain activity and develop internalizing and externalizing behavior problems than children of nondepressed mothers (Dawson et al., 1999; Barker et al., 2012). Although a large body of research documents the relations between maternal depression and various developmental outcomes in typically developing children, it remains unknown whether similar associations are found in infant siblings of children with autism spectrum disorder (ASD).

Objectives: We aim (1) to identify trajectories of depressive symptoms in mothers of high-risk infant siblings later diagnosed with ASD, high-risk infants not diagnosed with ASD, and low-risk infants between 6 and 24 months of age and (2) to examine the associations between trajectory class and infants' brain and behavioral development.

Methods: Participants were 142 parent-infant dyads (high-risk:  $n=85$ , low-risk:  $n=57$ ). Maternal depressive symptoms were measured using CESD-R when their infants were 6-, 12-, 18-, and 24-months old. Infants' baseline EEG and socio-emotional behaviors (measured using ITSEA) were collected at 24 months. Frontal EEG asymmetry, a trait marker of vulnerability to depression (Coan & Allen, 2004), was calculated from subtracting the left hemisphere alpha power from the right hemisphere alpha power. ASD outcomes were assessed using ADOS and clinical best estimate at final visit.

#### Results:

(1) Using latent class growth curve analysis, we identified three trajectories of maternal depressive symptoms. Mothers with "high-decreasing" symptoms (7%) started out with a high level of depressive symptoms at 6 months (intercept=30), but the level significantly decreased over time ( $b=-5.52, p<.001$ ). Mothers with "mid-increasing" symptoms (49%) initially reported a moderate level (intercept=12), but the level significantly increased over time ( $b=1.06, p=.041$ ). Finally, mothers with "low-decreasing" symptoms (44%) started out with a low level at 6 months (intercept=4), and the level significantly decreased over time ( $b=-0.61, p=.001$ ). There were no associations between trajectory class and the infant's ASD risk or eventual diagnosis.

(2) Using ANOVAs, we found significant differences in alpha asymmetry at 24 months ( $F(2,75)=3.35, p=.041$ ) among trajectory classes (Figure 1). Infants whose mothers had "high-decreasing" symptoms had significantly lower asymmetry scores ( $M=-0.10, SE=0.17$ ), indicating reduced relative left hemisphere power, compared to infants whose mothers had "low-decreasing" symptoms ( $M=0.00, SE=0.12; p=.037$ , Bonferroni). There was no effect of group or interaction effect between class and group.

There were significant differences in internalizing behaviors at 24 months among trajectory classes ( $F(2, 92)=4.48, p=.014$ ) as well as the groups ( $F(2,92)=3.39, p=.038$ ). Infants whose mothers had “mid-increasing” symptoms had significantly higher internalizing behaviors ( $M=52.21, SE=1.39$ ) than infants whose mothers had “low-decreasing” symptoms ( $M=46.91, SE=1.38; p=.024$ , Bonferroni; Figure 2). High-risk infants not diagnosed with ASD had significantly higher internalizing behaviors ( $M=52.98, SE=1.44$ ) than low-risk infants ( $M=46.48, SE=1.48; p=.006$ ; Bonferroni). There was no interaction effect between class and group.

Conclusions: Maternal depressive symptom trajectories were associated with in 24-month alpha asymmetry and internalizing behaviors in infants at high and low risk for ASD, suggesting a need to examine not just child-level factors but also family-level factors to understand brain and behavioral development of high- and low-risk infants.

**415.030** (Poster) Multimodal Pathways into Sustained Attention during Dyadic Toy Play for Children with and without Autism  
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Background: Sustained attention (SA) is the ability to maintain attention on a stimulus for an extended amount of time and has been linked to positive language and cognitive development for both typically developing (TD) children and children with autism spectrum disorder (ASD) (Bakeman & Adamson, 1984; Johansson et al., 2015; Yu et al., 2019). The use of head-mounted eye-trackers has broadened our understanding of the mechanisms underlying SA in both children with and without ASD. First, *parent social attention and action* relates to extended SA (Suarez-Rivera et al., 2019; Yu & Smith, 2016; Yurkovic et al., 2020). Second, *child manual action* frequently results in hand-eye coordination which constrains and supports the child's attention (Bambach et al., 2017; Yu & Smith, 2017a, 2017b; Yurkovic et al., 2020).

Objectives: It remains an open question how these mechanisms may be utilized to enter SA. We aim to determine if pathways into SA impact the duration of SA moments and if different pathways are more likely to achieve SA.

Methods: Thirteen TD dyads and 17 ASD dyads contributed data. Parents and children engaged in toy play while wearing head-mounted eye-trackers (Figure 1a). We operationalized SA as a child look to an object lasting  $\geq 3$  seconds. We computed the proportion of the 5 seconds preceding SA where each of the following behaviors were directed towards the target of SA: child look, child touch, parent look, parent touch, and parent naming (Figure 1b).

Results: An unsupervised clustering approach (*k*-means) was used to characterize four specific pathways into SA (Figure 1c,d). The four pathways can be characterized as spontaneous (1a), parent-led (1b), joint hand-eye coordination (2a), and child touch led (2b). The groups utilized the pathways at a similar rate ( $\chi^2(1, N=412)=1.40, p=0.70$ ). A linear mixed effects model on duration revealed no main effect of pathway ( $F(3,404)=0.21, p=0.89$ ) and a trending group by pathway interaction effect ( $F(3,404)=2.46, p=0.06$ ) on SA duration. We next analyzed the success of each pathway by assigning all of the short looks ( $<3$ s) to one of the pathways based on the 5 seconds preceding the look (Figure 2b). Pathway 1a (“spontaneous”) is the most utilized and least successful pathway for achieving SA ( $\chi^2(1, N=4227)=115.92, p<0.001$ ). This result is maintained when SA from TD and ASD children are analyzed separately. Additionally, Pathway 2a (“joint hand-eye coordination-led”) is more successful than Pathway 1b (“parent-led”) overall and for the TD group, but not for the ASD group. Surprisingly, children with ASD are more effective at utilizing Pathway 1b (“parent-led”) than their TD peers.

Conclusions: TD children and children with ASD utilize similar pathways at a similar rate to enter into SA moments. Notably, for both groups, the pathway into SA does not impact the “quality”, or duration, of SA. However, pathways differ in “quantity”, or their likelihood of achieving SA. This understanding of the mechanisms that parents and children can use to support the child's attention during play may provide key insights into the co-development of social and attentional processes in both typical and atypical populations.

**415.031** (Poster) Parental Needs of Children in Early Intervention for Autism Spectrum Disorder in Brazil  
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Background: Many recent and scientifically relevant approaches understand that children with Autism Spectrum Disorder (ASD) require early, specialized and intensive intervention. Early intervention programs point to positive outcomes regarding the

children's self-independence and their families' well-being, considering their individual potential. Scientific literature also show that even low-intensity interventions with parents and caregivers, focused on interaction and play strategies with their young children with ASD, able to result in immediate effects on the child's social behaviors and communication. Those studies rely on well-designed clinical trials with randomized control groups. However, how those programs affect the family is yet to be measured.

**Objectives:** The present study sought to understand the needs of the parents of children with ASD undergoing early intervention in the Brazilian context.

**Methods:** An online assessment for parents and caregivers of children, ranging from 0 to 60 months, old, with confirmed or suspected ASD diagnosis, was applied. This assessment was released and shared on social media, mainly Instagram and whatsapp, and had 150 answers spread across 23 of 27 of Brazilian states, and 3 answers from Brazilian families living in Portugal and Germany.

**Results:** The results showed significant lack of proper service, support, and quality scientifically knowledge regarding autism and intervention programs. We identified that the main barriers were therapy costs (57,3%); low service availability (44%). 64,7% of the participants reported financial issues and 63,3% had to reduce their work hours. Internet is the main source of information for the families (76,7%), while health professionals are sought by only 10%. Most participants evaluate their own knowledge on developmental domains as average.

98% of answers were given by mothers, which highlights issues shown in literature, where mothers are protagonists of care, generating great stress. Children undergoing early intervention averaged between 2 and 3 years old, starting intervention between 12 and 24 months, a great improvement when compared to a 2017 study, that indicated access to intervention at 6 years old. This was possible because healthcare institutions, the Unified Health System (SUS) and political fields have worked towards sharing the importance of early screening, diagnosis, and treatment for ASD.

Finally, in the open question "what is early intervention in your opinion and understanding?", most participants demonstrated some understanding of neuroplasticity; many responses indicated expectation of cure and spectrum correction, which shows that neurodiversity paradigm is still an issue in Brazil.

**Conclusions:** Access to early intervention is still limited in Brazil, and information and support is even more restricted, even for those who have access to intervention; they still face lack of proper service and programs. 84% of the sample had a higher education level, indicating a socioeconomic bias. Thus, we still need to confirm the findings through another type of public access (such as the application of the same questionnaire in public health; primary, for example). The situation is even more critical specially on north and northeast states or in cities that are not capital ones. Further research is required.

**415.032 (Poster)** Parents of Children with and without Autism Coordinate Object Labeling with Child Behaviors during Dyadic Play

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**Background:** Parents of typically developing (TD) children scaffold their child's language learning environment by coordinating object labeling utterances with their child's behavior (Suanda et al., 2016). Specifically, children learn words in contexts where their visual attention to toys is coordinated with their manual actions (hand-eye coordination), thereby reducing visual clutter and providing a clear target for the label (Yu & Smith, 2012). The ability to integrate visual and motor information during play is also positively related to language abilities in children with ASD (Hellendoorn et al., 2015), a disorder characterized by social deficits and language delays.

**Objectives:** It remains an open question if children with ASD are exposed to a similar rate of object labeling compared to TD children, and if labeling occurs during informative hand-eye coordination moments.

**Methods:** Data were collected from 24-48mo children and their parents (ASD: n=17, TD: n=14). Of note, the ASD group was significantly delayed in both expressive and receptive language (Mullen Scales of Early Learning Developmental Quotient: 39.9 (SD=±17.9)); 45.0 (17.2), respectively). Dyads played together with 24 toys while wearing head-mounted eye-trackers. Child gaze was calibrated offline, and targets of gaze and manual action were then coded. Parent speech during play was divided into utterances, defined as speech moments separated by at least 400ms of silence. These utterances were fully transcribed to find moments where parents labeled the toys. Parent perception of child vocabulary size was also recorded using the MacArthur-Bates Communicative Development Inventories (MCDI).

Results: There was no difference between groups in the number of parent labels per minute (ASD: 5.43 (0.68); TD: 4.51 (0.67);  $t(29)=0.95$ ,  $p=0.35$ ). The rate of parent labeling was correlated with MCDI in children with ASD but not TD children (ASD:  $r(16)=0.68$ ,  $p=0.01$ ; TD:  $r(13)=-0.22$ ,  $p=0.46$ ). Further, parents of children with ASD used almost three fewer words per labeling utterance than parents of TD children (ASD: 4.85 (0.33); TD: 7.45 (0.53);  $t(29)=-4.37$ ,  $p<0.01$ ). Parents in both groups labeled toys most frequently during child hand-eye coordination. Interestingly, parents labeled toys during both hand-eye coordination moments that are informative (child looking at and touching the labeled toy) (ASD: 31%; TD: 24%) and misleading (child looking at and touching another toy) (ASD: 30%; TD: 22%). There were no differences between groups (informative:  $t(28)=1.29$ ,  $p=0.21$ ; misleading:  $t(28)=0.35$ ,  $p=0.14$ ).

Conclusions: Parents in both groups utilized informative child hand-eye coordination moments, suggesting that children with ASD are exposed to similar rates of learning moments as their TD peers. Parents in both groups also frequently labeled toys during misleading moments, possibly resulting from parents redirecting their child's attention or scaffolding combinatorial play (playing with multiple toys together). Despite similarities in the rate and context of labeling, parents of children with ASD used fewer words per labeling utterance than parents of TD children. This is likely an adaptive behavior to reduce the complexity of speech and support child engagement. Child language abilities have been shown to improve following interventions that coach adults to use fewer utterances and words during play with the child (Kasari et al., 2008).

**415.033 (Poster)** Quantifying Social Visual Engagement in Preterm Toddlers with and without Autism Spectrum Disorder  
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Background: Compared to full-term infants, preterm infants born before 36 weeks gestational age are at a higher risk of atypical neurodevelopmental outcomes such as autism spectrum disorder (ASD) (Joseph et al., 2017; Limperopoulos et al., 2008). While the community prevalence of ASD is 1 in 54 (1.85%), the ASD prevalence in preterm children is approximately 7% (Agrawal et al., 2018; Maenner et al., 2020). Although preterm infants face a disproportionately high risk of ASD, their unique medical needs and developmental delays can create barriers to the early identification of ASD.

Measures of social visual engagement (SVE)—collected via eye-tracking technology—quantify how children visually explore, engage with, and learn from their surrounding world at different stages of development. Past research suggests that SVE is disrupted in ASD, which may lead to a cascade of developmental effects associated with the core symptoms of the disorder (Jones & Klin, 2013; Klin et al., 2009). Patterns of SVE may also shed light on typical and atypical neurodevelopment in preterm populations, with implications for effective early detection and intervention. However, SVE has not been extensively studied in preterm populations.

Objectives: This study quantifies patterns of SVE to social stimuli close to the earliest point of diagnosis in preterm toddlers with diagnoses of ASD and non-ASD developmental disorders (DD), as well as preterm toddlers who are not showing developmental delays (TD).

Methods: Participants ( $n=47$ ) were toddlers with a gestational age below 36 weeks and diagnoses of ASD ( $n=19$ ), DD ( $n=9$ ), or TD ( $n=19$ ). Eye-tracking data were collected between ages 12 and 28 months ( $M_{age}=22.24$ ) during viewing of naturalistic videos of social interactions. Data were quantified as the percentage of time participants spent fixated on regions of interest (ROIs) within the stimuli (Eyes, Mouth, Body, and Object regions). Toddlers were later diagnosed by expert clinicians upon review of gold-standard assessments.

Results: Significant ROI by diagnosis interactions were found (Eyes, Mouth, Body:  $F(4, 88)=3.248$ ,  $p=0.016$ ; Eyes, Mouth, Object:  $F(4, 88)=4.227$ ,  $p=0.004$ ). Post hoc comparisons revealed that preterm ASD and TD toddlers allocated significantly different proportions of visual attention to all ROIs: Eyes ( $t(36)=-2.787$ ,  $p=0.008$ ), Mouth ( $t(36)=-3.318$ ,  $p=0.002$ ), Body ( $t(36)=2.336$ ,  $p=0.025$ ), and Object ( $t(26.01)=2.528$ ,  $p=0.018$ ). Preterm ASD toddlers also differed significantly from DD toddlers in visual attention to Eyes ( $t(26)=-2.839$ ,  $p=0.009$ ), Mouth ( $t(26)=-2.209$ ,  $p=0.036$ ), and Object ( $t(26)=2.476$ ,  $p=0.020$ ) regions. TD and DD toddlers did not differ significantly in allocation of visual attention to any ROI. Overall, preterm toddlers with ASD looked significantly less at eyes and mouths and more at bodies and objects than TD and DD preterm toddlers.

Conclusions: Preliminary results suggest that SVE patterns may distinguish ASD from TD and DD in preterm toddlers, who are at heightened risk for neurodevelopmental disorders. These findings are similar to previous research with full-term ASD toddlers, indicating the ability to diagnostically differentiate ASD in preterm toddlers despite their increased diagnostic complexities. Future analyses will explore whether SVE may elucidate mechanisms of development and disability across severity within the preterm population (e.g. between extremely preterm versus moderately preterm subgroups).

**415.034 (Poster)** Screen Time in 18 and 24-Month-Olds at Increased Risk for ASD and ADHD

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**Background:** Screen time has been associated with various aspects of child development. This may be particularly relevant to children at increased risk for atypical development such as those with a family history of Autism Spectrum Disorder (ASD) or Attention-Deficit/Hyperactivity Disorder (ADHD). Prior research documents negative associations between greater screen time and increased ASD symptoms in community samples (Heffler et al., 2020), as well as ADHD symptoms and lower receptive and expressive language among 36-month-olds with a family history of ASD or ADHD (Hill, et al., 2020).

**Objectives:** To examine associations between screen time, ASD symptoms, ADHD symptoms, and language development between 18 and 24 months of age in a sample including children at increased familial risk for ASD or ADHD.

**Methods:** Participants included 116 children with a family history of ASD ( $n = 49$ ), ADHD ( $n = 34$ ) or no family history of either disorder ( $n = 33$ ). Standardized evaluations at 18 and 24 months of age included the Mullen Scales of Early Learning (MSEL) Receptive (RL) and Expressive Language (EL) subscales, the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), and the Behavioral Rating Inventory for Children (BRIC), which is a measure of observed ADHD-relevant behaviors (inattention, hyperactivity, impulsivity). Parents reported average daily hours of television and/or video viewed by the child at both 18 and 24 months.

**Results:** Multivariable regression analysis showed a significant effect of outcome group on screen time at both 18 months,  $F(2, 114) = 6.11, p = .003$  and 24 months,  $F(2, 86) = 3.38, p = .04$  (adjusting for maternal education and child sex). The ASD-risk group engaged in significantly more screen time than the low-risk group (estimated difference, 0.65 at 18 months, 0.66 at 24 months [i.e., 39-40 min],  $p = .004$  and  $.01$ , respectively). Multivariable regression analysis adjusting for maternal education and child sex revealed that higher screen time at 18 months was associated with higher ASD symptom severity scores at 24 months ( $p < .001$ ); the association with 24-month BRIC scores was non-significant but trend-level ( $p = .08$ ). After adjusting for maternal education, child sex, and baseline/18-month BRIC and ADOS-2 comparison scores, higher screen time at 18 months was also associated with lower RL scores at 24 months ( $p = .03$ ); the association between 18-month screen time and 24-month EL was non-significant.

**Conclusions:** Children with a family history of ASD engaged in more screen time at both 18 and 24 months of age than those in the low-risk group. Greater screen time at 18 months also predicted higher ASD symptom severity and lower receptive language scores at 24 months across all groups; there was a trend-level relationship between 18-month screen time and 24-month ADHD-relevant behaviors. This suggests an association between screen time, greater accumulation of ASD symptoms, and decreased receptive language acquisition over time even when accounting for the influence of baseline ASD symptoms. There was no association between screen time and expressive language skills. Future longitudinal studies incorporating 36-month categorical outcomes are needed to further explore these findings.

**415.035 (Poster)** Sex Differences in the Adaptive Value of Social Visual Engagement in Preterm Toddlers with Autism Spectrum Disorder

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**Background:**

Males are four times more likely than females to be diagnosed with autism spectrum disorder (ASD). Although much remains unknown, past research points to sex-based phenotypic differences in the expression of ASD. For example, in full-term toddlers at high risk for ASD, females have been shown to exhibit stronger expressive and receptive language functioning than males (Messinger et al., 2015). In studies using measures of social visual engagement (SVE), collected via eye-tracking, full-term females at high risk for ASD showed increased attention to faces relative to males, which was associated with improved socio-communicative functioning (Chawarska et al., 2016).

Compared to full-term infants, preterm infants, born before 36 weeks gestational age, are at higher risk for atypical neurodevelopmental outcomes such as ASD (Joseph et al., 2017; Limperopoulos et al., 2008). However, degree of prematurity is a more salient risk factor for ASD in preterm females than preterm males (Allen et al., 2020). Past work suggests that in general, male preterm infants are at higher risk for less favorable outcomes than females (Yaari et al., 2018), who demonstrate more developmentally-appropriate language and cognitive functioning than males (Skiöld, 2014). Sex-based phenotypic differences have not yet been studied in preterm infants and toddlers with ASD.

#### Objectives:

This study explores sex differences in the cognitive development, language development, social functioning, and SVE of a cross-sectional cohort of preterm toddlers with ASD.

#### Methods:

Chronologically (CA) and gestationally (GA) age-matched male (N=21, M<sub>CA</sub>=27.42months, M<sub>GA</sub>=32.21weeks) and female (N=13, M<sub>CA</sub>=28.81months, M<sub>GA</sub>=32.19weeks) preterm toddlers with ASD were evaluated with the Mullen Scales of Early Learning (MSEL) or Bayley-III, and the Autism Diagnostic Observation Schedule (ADOS-2). Participants were also eye-tracked while passively viewing videos of toddlers engaged in naturalistic peer interactions. ASD diagnoses were confirmed by clinical best estimate procedures from expert clinicians blind to eye-tracking. MSEL or Bayley-III expressive and receptive language age equivalents were used as measures of language functioning, and MSEL visual reception or Bayley-III cognitive age equivalents were used as measures of cognition. ADOS-2 Social Affect (SA) and Restricted and Repetitive Behavior (RRB) scores were examined separately as measures of social disability. Eye-tracking (SVE) data was quantified as the percentage of time toddlers spent visually fixating on regions-of-interest (ROIs) within videos (i.e. face, body, and object/background). We tested for sex differences in language, cognition, social disability, and SVE. Spearman correlations examined associations between SVE and developmental measures.

#### Results:

Male and female preterm toddlers with ASD did not significantly differ in receptive language, expressive language, cognition, indices of social disability, or face-, body- or object-looking (all  $p > .160$ ). However, face-looking positively predicted receptive language ( $r = .682, p = .021$ ), and negatively predicted SA ( $r = -.685, p = .020$ ) in preterm ASD females, but not males. Additionally, body-looking predicted higher SA scores ( $r = .667, p = .025$ ) and object-looking predicted higher RRB scores ( $r = .669, p = .024$ ) in preterm ASD females, but not males.

#### Conclusions:

Our exploratory analyses found no sex-based differences in receptive language, expressive language, cognition, indices of social disability, or SVE in preterm toddlers with ASD. However, our results suggest that SVE may have differential adaptive value for male and female preterm toddlers with ASD.

#### **415.036 (Poster) Social Visual Engagement Predicts Developmental Stability of Quantitative Autistic Traits**

**K. Lineback<sup>1</sup>, N. Marrus<sup>2</sup>, A. L. Glowinski<sup>3</sup>, A. Klin<sup>4</sup>, W. Jones<sup>4</sup> and J. N. Constantino<sup>2</sup>, (1)Washington University School of Medicine in St. Louis, St. Louis, MO, (2)Washington University School of Medicine, St. Louis, MO, (3)Washington University in St. Louis, St. Louis, MO, (4)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA**

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#### Background:

Prospective studies have demonstrated that autism spectrum disorder (ASD), a highly heritable neurodevelopmental disorder, is often preceded by atypical development across multiple heritable domains. Characterizing how early variation in ASD endophenotypes relates to the emergence of core autistic traits is crucial for elucidating ASD's ontogeny and advancing early risk assessment. Here, we focused on developmental associations between two ASD endophenotypes, social visual engagement (SVE), preferential attention to social stimuli, and reciprocal social behavior (RSB), an indicator of quantitative autistic traits (QATs), both of which are robust recurrence predictors of ASD. We examined these associations in general population toddler twins, an approach which maximized detectable variation for resolving inter-relationships across the continuum of familial liability for ASD.

#### Objectives:

To assess relationships between RSB and SVE in toddlers, including testing whether interactions between RSB and SVE influence developmental stability of RSB, and by extension, QATs.

#### Methods:

An epidemiologic toddler twin sample (n=129; monozygotic=29 pairs; dizygotic=34 pairs; 3 unmatched twins) from the general population was longitudinally assessed from ages 18 to 48 months. At 18 months, RSB was quantified with the “Video-referenced Rating Scale of Reciprocal Social Behavior,” a downward extension of the Social Responsiveness Scale (SRS), a validated instrument indexing QATs as deficits in RSB. 18-month SVE was quantified as percent fixation for eye- and mouth-looking in an established eye-tracking paradigm featuring child-friendly videos of social interactions. At 36 or 48 months, RSB outcome was measured with the SRS. Generalized estimating equations (GEE) accounting for twin relatedness tested contributions of 18-month RSB, 18-month SVE, and their interaction to 36/48-month RSB outcome. Twin concordances were evaluated using intraclass correlation coefficients (ICCs).

#### Results:

18-month eye- and mouth-looking were inversely correlated ( $r=-0.86$ ,  $p<.01$ ), and 18-month-olds looked more at mouths than eyes (55% versus 24%). Separate GEE models for mouth- and eye-looking identified relationships between 1) 36/48-month RSB outcome and 18-month RSB and 2) the interaction between 18-month RSB and 18-month SVE (Table 1). 18-month RSB accounted for 34.3% variance in later RSB (i.e., QATs), while the interaction of 18-month RSB and SVE contributed an additional 4% variance for mouth-looking and 3% variance for eye-looking. Lower mouth-looking and higher eye-looking corresponded to a stronger association (i.e., greater developmental stability) of RSB across age (Figure 1). When comparing identical twin concordances for RSB outcome in groups divided by high versus low levels of fixation, higher concordances were observed for participants with low versus high mouth-looking [ $ICC_{\text{low mouth}}=0.99(0.97,0.99)$ ;  $ICC_{\text{high mouth}}=0.71(0.25,0.89)$ ] and high versus low eye-looking [ $ICC_{\text{high eyes}}=0.99(0.98,0.99)$ ;  $ICC_{\text{low eyes}}=0.76(0.41,0.89)$ ], a distinction not observed for 18-month RSB.

#### Conclusions:

18-month SVE moderated the stability of QATs during toddlerhood, when ASD arises. Higher identical twin concordances for 36/48-month RSB stratified by earlier levels of SVE suggests potential overlap between heritable factors underlying SVE and developmental consolidation of QATs. These findings imply a mechanism whereby interactions between distinct ASD endophenotypes may contribute to stabilization of QATs, consistent with ASD’s complex genetic architecture. Developmental surveillance tracking multiple endophenotypes may be key for improving early identification and interventions.

#### **415.037 (Poster)** The Sensory Assessment for Neurodevelopmental Disorders: Infant and Toddler Version

**P. M. Siper<sup>1</sup>, J. Bragg<sup>2</sup>, C. F. Layton<sup>3</sup>, M. Rowe<sup>1</sup>, J. Zweifach<sup>1</sup> and T. Tavassoli<sup>5</sup>,** (1)Seaver Autism Center for Research and Treatment, Department of Psychiatry, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, (2)Neonatology, Mount Sinai Medical Center, New York, NY, (3)Seaver Autism Center, Department of Psychiatry, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, (4)UCSF, San Francisco, CA, (5)Centre for Autism, School of Psychology & Clinical Language Sciences, University of Reading, Reading, United Kingdom

**Background:** The Sensory Assessment for Neurodevelopmental Disorders (SAND) is a newly developed measure that has been validated for use in children ages 2-10 years. Combining a clinician-administered observation and corresponding caregiver interview, the SAND demonstrates high internal consistency, inter-rater, test-retest reliability, and good convergent validity. Literature from studies of high risk infant siblings indicates that parent-reported sensory symptoms differentiate infants who go on to develop ASD as early as six months of age, often before core symptoms of autism emerge. To date, there are no clinician-administered assessments for infants and toddlers under 24 months of age. Early identification of sensory reactivity differences during infancy and toddlerhood may improve access to treatment.

**Objectives:** To develop and test the feasibility of the SAND: Infant and Toddler Version in a high-risk cohort of infants and toddlers under 24 months of age.

**Methods:** The SAND: Infant and Toddler Version was developed by adapting examples within the original SAND interview to be more appropriate for a younger population and to account for typical sensory behaviors during this early period of development. The observation and all scoring remains the same between versions. Twelve infants/toddlers ages 8-20 months ( $M=15$ ,  $SD=4.9$  months) presenting to Mount Sinai’s NICU follow up program participated in this study. Convergent validity was examined between the SAND: Infant and Toddler Version and the Infant/Toddler Sensory Profile (I/T SP). The SAND quantifies sensory symptoms in hyperreactivity, hyporeactivity, and seeking domains across visual, tactile, and auditory sensory modalities. Higher SAND scores indicate a greater number of sensory symptoms. The I/T SP is a caregiver questionnaire that measures sensory processing patterns in children birth to 36 months. Lower SP scores indicate a greater number of symptoms.

Results: All participants successfully completed the SAND observation and interview. SAND: Infant and Toddler Version total score was significantly correlated with the I/T SP total score ( $r=-.816, p=.002$ ). Observed scores ( $r=-.647, p=.031$ ) and reported scores ( $r=-.878, p<.001$ ) were also significantly correlated. In addition, I/T SP Low Registration scores were significantly correlated with overall hyporeactivity domain scores ( $r=-.808, p=.001$ ) and reported scores ( $r=-.826, p=.001$ ), but not observed scores. SAND hyperreactivity domain scores were significantly correlated with SP sensation avoiding scores ( $r=-.678, p=.022$ ).

Conclusions: Administration of the SAND: Infant and Toddler Version was successful in all participants. Correlations between the SAND and the I/T SP were driven by the caregiver interview, which is consistent with findings from validation studies of the original SAND and suggests that the clinical observation provides useful information about sensory reactivity that is not captured solely by caregiver report. Studies are ongoing to further examine the psychometric properties of the SAND: Infant and Toddler Version in both high- and low-risk samples. Ultimately, establishing methods for early detection of potentially modifiable sensory processing differences may improve longer-term outcomes.

**415.038 (Poster)** Validity of the Toddler Autism Symptom Inventory (TASI) in White and Black/African American Children  
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**Background:** Despite work showing no racial differences in age of first concern (Jang et al., 2014), racial disparities in detection of autism spectrum disorder (ASD) persist. Standardized screening reduces these disparities (Herlihy et al., 2014), but Black/African American children are still diagnosed 1.5 years later than White children (Constantino et al., 2020). Early detection of ASD facilitates early intervention, which optimizes long-term outcomes.

Parent and clinician factors, including bias and culture may play a role in these disparities (Donohue et al., 2019). Some differences in symptom expression have been reported; ethnic minority children diagnosed with ASD are more likely to demonstrate impaired expressive language and emotional lability than White children (Becerra et al., 2014).

Diagnostic evaluations of ASD integrate information from multiple sources, including direct observation and caregiver report. It is important to assess these measures for bias or differential validity for different racial or ethnic groups, so that children in specific groups are not excluded from access to diagnosis and treatment.

**Objectives:** Determine whether any differences exist in caregiver responses of Black/African American and White families to a novel semi-structured interview for children age 12-36 months.

**Methods:** Children ( $n=294$ ) 12 to 36 months old were referred for evaluation after a positive screen or pediatrician concern. Evaluations included observational measures of autism symptoms (ADOS-2) and developmental testing (Mullen Scales of Early Learning Composite, ELC). Caregivers were administered the Toddler Autism Symptom Inventory (TASI; [mchatscreen.com/tasi](http://mchatscreen.com/tasi)), a 40 item semi-structured interview designed to elicit caregiver report of toddler autism symptoms. Children were assigned diagnoses of ASD, another developmental delay (DD), or typical development/no diagnosis (TD/ND). Caregivers reported their child's race; 52% of the sample was White ( $n=153$ ), while 23% was Black/African American ( $n=69$ ); the remainder reported other racial identities.

**Results:** Significant differences were found in mean developmental level, diagnoses, SES, and TASI score (Table 1). More Black children were diagnosed with DD, while more White children were diagnosed TD/ND; percent of ASD diagnoses was not different between groups. Black/African American children scored lower than White children on ELC, although a regression indicated that this was explained by annual income. Similarly, regression analyses demonstrated that although race predicted TASI score ( $R^2=.029, p=.011$ ), race was no longer a significant predictor ( $B=-.346, p=.728$ ) after inclusion of ELC and SES in the model ( $p's<.002$ ; overall model  $R^2=.169$ ).

Validity of the TASI cutoff score is comparable in both racial groups (Table 2). Sensitivity and specificity are greater than .9 and .7, respectively, for both groups. Area under the curve in ROC analyses was approximately .9 for both groups. Examination of item-level responses between racial groups revealed *no differences* (Bonferroni adjusted  $\alpha=.00125$ ) in percent endorsement of any TASI question (Table 2).

**Conclusions:** Caregiver responses to a novel semi-structured interview reveal that the TASI cutoff for ASD risk is valid for both Black and White children. Results suggest no significant differences between the two groups in ASD symptom expression in toddlers aged 12-36 months.

**415.039 (Poster)** White Matter Microstructure and Language Abilities in Infants at High Familial Risk for Autism Spectrum Disorder

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**Background:** Autism spectrum disorder (ASD) is a highly heritable (~80%) neurodevelopmental disorder. Approximately 20% of infants who have an older sibling diagnosed with ASD develop ASD themselves (Ozonoff et al., 2011). An additional 28% of infants who do not have ASD diagnoses display other developmental concerns including language delays (Ozonoff et al., 2014). To date, studies have demonstrated atypical patterns of white matter development in various fiber tracts spanning the brain in infants who later develop ASD (Wolff et al., 2012). While white matter microstructure has been shown to relate to language development in the first two years of life in typical development (Girault et al., 2019), these associations are unexplored in ASD.

**Objectives:** In this study, we examined white matter circuitry in relation to language development in high-risk infant siblings and controls at 24 months.

**Methods:** Data come from the Infant Brain Imaging Study. A total of 76 controls (low familial risk for ASD and negative for a diagnosis; LR-Neg) and 225 familial high-risk (HR) siblings with diffusion weighted images (DWIs) and language assessments at 24 months were included. 47 HR siblings received a clinical best estimate ASD diagnosis at 24 months (HR-ASD) and 178 HR infants were negative for ASD (HR-Neg). Measures of language include Receptive Language (RL) and Expressive Language (EL) from the Mullen Scales of Early Learning (MSEL). Nonverbal Developmental Quotient (NVDQ) calculated from the fine motor and visual reception domains on the MSEL was also included to test for specificity of findings to language. Fiber tractography was performed and tract-average fractional anisotropy (FA) values were generated for analyses. Tracts of interest included the bilateral arcuate, uncinate, and inferior longitudinal fasciculus (ILF) as well as the genu, splenium, and body of the corpus callosum. To determine whether white matter FA in tracts of interest at 24 months is related to language abilities at the same age and test whether this association differs by group we implemented multiple linear regression for each fiber tract adjusting for age, sex, and study site.

**Results:** Linear models revealed significant positive associations between FA in the left arcuate tract and RL ( $b=0.73$ ,  $t=4.93$   $p<0.0001$ ) and EL ( $b=0.52$ ,  $t=3.08$   $p=0.0023$ ) in the HR-ASD group that differed compared to the control group (**Figure 1A-B**). FA in the right arcuate tract was also significantly associated with RL ( $b=0.51$ ,  $t=3.62$   $p=0.00035$ ) and EL ( $b=0.35$ ,  $t=2.17$   $p=0.03$ ) in the HR-ASD group (**Figure 1C-D**). Associations between language scores and bilateral arcuate FA did not differ between the HR-Neg and LR-Neg groups. The association between FA in left arcuate tract and NVDQ in the HR-ASD group ( $b=0.38$ ,  $p=0.02$ ) was relatively weaker than that observed with RL or EL. No associations were observed between FA in the right arcuate tract and NVDQ in the HR-ASD group ( $b=0.24$ ,  $p=0.11$ ). No associations were found between FA in the other tracts analyzed and language or non-verbal abilities.

**Conclusions:** Findings highlight the key role of left and right arcuate white matter microstructure in language development in high familial risk infants who develop ASD.

**415.040 (Poster)** Associations between Socioeconomic Variables and Local Cortical Gyrification in Language Regions in Preschoolers with Autism Spectrum Disorder

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**Background:** Although language delay is no longer a diagnostic criterion for autism spectrum disorder (ASD), many individuals with ASD show delayed language development, which is often the first sign suggesting the possible presence of ASD. Socioeconomic status (SES) is associated with language and brain development in early childhood in typical development (e.g.,

Johnson et al., 2016). Our previous work has shown that SES variables positively correlate with language skills in young children with autism, over and above the effect of diagnosis on language skills (Olson et al., 2020). Less is known regarding associations between SES and indices of cortical maturation in brain regions supporting language in ASD. One such feature of brain maturation that has shown associations with SES in typically developing children is local gyrification (Jednorog et al., 2012), representing the folding of the cerebral cortex, which mainly occurs during prenatal and early postnatal life.

**Objectives:** To examine associations between socioeconomic variables and local gyrification in language-related brain regions in preschoolers with ASD.

**Methods:** T1-weighted anatomical MRI was acquired in 37 toddlers with ASD (mean age: 39.0±13mo., range: 17-66 months; 27 males) during natural sleep. Clinical best estimates of ASD diagnoses were established according to DSM-5 criteria, supported by the ADOS-2 and the Autism Diagnostic Interview, Revised. FreeSurfer v.5.3.0 was used for cortical surface reconstruction and to calculate local gyrification index (LGI) in language-related regions of interest in each hemisphere using the Desikan-Killiany atlas (8 ROIs total: bilateral superior temporal gyrus, transverse temporal gyrus/primary auditory cortex, inferior frontal gyrus: pars opercularis, and inferior frontal gyrus: pars triangularis). Data quality was inspected by two independent raters. SES variables included Maternal Educational Level, Income-to-Needs Ratio, Median Income in the postal code area, and Neighborhood Adversity Index (PCA-derived index of neighborhood SES variables from 2019 census data). Multiple linear regression models were used to examine associations between SES variables and LGI in language regions. Total brain volume, age, and sex were used as nuisance regressors, and retained in models when significantly associated with LGI outcome measures.

**Results:** Both Income-to-Needs Ratio and Neighborhood Advantage Index were positively associated with LGI in the left superior temporal gyrus (STG;  $r_s > 0.35$ ,  $p_s < 0.05$ ; see Figure 1a,b). Median Income (derived based on postal code) was positively associated with left hemisphere transverse temporal gyrus LGI ( $r = 0.36$ ,  $p = 0.04$ ; see Figure 1c).

**Conclusions:** Findings suggest that, in young children with ASD, local gyrification in auditory/language regions (transverse temporal gyrus, superior temporal gyrus) is higher with increased access to social and economic resources (i.e., increased family income, neighborhood advantage). These associations indicate that factors associated with low SES in autism may impact patterns of cortical maturation in areas that subservise language function very early in development. These findings highlight the need for targeted early intervention and effective implementation strategies for children with ASD from low-resource households and communities, and for policies designed to improve access to resources for these young children and their families.

## Early Phase Drug Discovery

### POSTER SESSION — EARLY PHASE DRUG DISCOVERY

#### Poster 416 - Early phase drug discovery Posters

**416.001** (Poster) Low Dose Amitriptyline for Repetitive Behaviors and OCD in Autism Spectrum Disorder: Three Illustrative Cases.

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Background: Autism spectrum disorder (ASD) prevalence has increased markedly over recent decades, but treatment studies are seriously lacking. Although selective serotonin reuptake inhibitors (SSRIs) are the most commonly prescribed medications in ASD, evidence is largely lacking for their use while side effects are common. Two studies of fluoxetine were negative in youth with ASD, along with a negative multisite randomized controlled trial of citalopram for repetitive behaviors. Amitriptyline is a tricyclic antidepressant (TCA) with established action, unlike any other TCA or SSRI of increasing phosphorylation of TrkB, the receptor for BDNF by which it regulates multiple neurotrophic actions in the brain, including in the hippocampus. Empirical observations suggest amitriptyline superiority clinically, although it is not universally tolerated and should still be used with caution. Amitriptyline has less overdose risk of in ASD since most such individuals don't self-administer medications.

Objectives: To review and discuss three illustrative cases of treatment-resistant patients with ASD, severe repetitive behaviors and OCD, as well as ADHD and various levels of intellectual disability, all of whom were prescribed amitriptyline. Amitriptyline treatment outcomes will be described in each, in terms of dosing, concomitant medications, symptom outcomes and improvements in function. Previous medications tried will also be discussed.

Methods: We reviewed in detail the charts of the three cases (2 females and 1 male), and extracted demographic data including age, gender, disabilities, challenging behaviors, diagnoses, amitriptyline dosing and any side effects, including any dose reductions made.

Results: Cases included a 15-year old WF and a 16-year old WF both of whom were legally blind. Both had severe ASD and repetitive behaviors as well as behavioral rigidity, while the 15-year old had more severe intellectual disability. The third was a 27-year old WM with severe ASD and Mild ID, OCD, and ADHD. All manifested significant self-injury on presentation. All had failed trials of SSRIs, stimulants and alpha agonists, along with side effects. Each case will be discussed in detail. All responded to low dose amitriptyline (Case 1: 25mg daily at bedtime plus risperidone 1mg, Case 2: 25mg bid plus buspirone 10mg bid, and Case 3: monotherapy with 25mg bid plus 50mg at bedtime), and all were Much Improved on the Clinical Global Impressions scale. The 15-year old who had more severe intellectual disability required amitriptyline reduction from 25 mg bid to 25 mg daily, due to behavioral activation following an initial improvement, however her response was then recaptured. All cases also showed improved cognitive abilities and communication in addition to repetitive behavior improvements.

Conclusions: Low dose amitriptyline significantly improved repetitive behaviors and functioning as well as communication in the 3 individuals with ASD described. The female with more severe intellectual disability and ASD became activated after her initial response to 25mg twice a day, but response was recaptured with dose reduction to 25 mg daily at bedtime. Based on its mechanism of action, and empirical observations that amitriptyline may improve repetitive behaviors and other core ASD symptoms as well as cognition, further studies are warranted.

## Education

### ORAL SESSION — EDUCATION

#### Oral 323 - Factors in Effective Education

##### **323.001** (Oral) Supporting Paraprofessionals Use of Ebps with Autistic Elementary School Children

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**Background:** In U.S. schools, evidence-based instructional practices are increasingly delivered by paraprofessionals to autistic children. However, in most states paraprofessionals are not required to have training related to autism or in the implementation of EBPs (Russel et al., 2015). AFIRM for PARAs (AFP) is a professional development program design to train paraprofessionals to use EBPs with elementary aged autistic students. It consists of online training about EBPs and coaching by the supervising teacher. The EBPs were reinforcement (R+), prompting (P), time delay for prompts (TD), visual cues (VC), and peer interaction (PI).

**Objectives:** The objectives of this study are to: 1) Determine the efficacy of the STELAR program for promoting paraprofessional use of EBPs with fidelity and 2) To explore the immediate effects of the increased efficacy on students accomplishment of short-term learning goals.

**Methods:** This study employed a single case, multiple probe design implemented in four special education classrooms and then replicated in a second set of four inclusive classrooms. In each classroom, one paraprofessional and one teacher participated in implementation of EBPs with autistic children in their class. The dependent variable was the percentage of correct features of the EBP implemented, as measured by an observational assessment of fidelity. During the initial baseline, R+ fidelity (of practice used with one child) was assessed. In the second phase, AFP for R+ was implemented while baseline for P was assess for a different learning task. The pattern of baseline and intervention data collection continued in subsequent phases. To explore effects on children, a mini-Goal Attainment Scale (GAS) was calculated to measure children's program toward their learning goal over a short period of time (0-4 rating, with 0 being baseline and 4 being accomplishing expected goal performance).

**Results:** The COVID 19 pandemic interrupted this planned study when schools closed in March, 2020 (Peer-EBP training never implemented). However, enough of the study was completed to establish experimental control (at least three replications) for R+, P, and TD in the special education classes and R+ and P in the inclusive classes.(Reviewer note: could only upload one figure-other comparable). For the inclusive classes, the first class did end its participation early because of staff issues. A statistical analysis that embedded a Bayesian approach within a multi-level model for EBPs (Swaminathan et al., 2012) was conducted for those EBPs for which we had experimental control. This analysis generated an effect size (ES) conceptually comparable to Cohen's *d*. The ESs for the special education and inclusive classes respectively were 6.89 and 5.79 for R+, 4.93 and 3.70 for P, and 4.74 for TD—all indicating extraordinarily strong effects. For students, the mean GAS rating, averaged across EBP sessions, was 3.23 (out of 4), indicating substantial progress.

**Conclusions:** The pattern of findings indicated strongly that AFP generated increases in the fidelity with which paraprofessional used EBPs with elementary-aged autistic children. Also, the GAS ratings suggested that children made progress on their learn goals during instructional sessions. Together this provides positive evidence supporting AFP as an efficacious professional development program

##### **323.002** (Oral) General Education Teachers Use of Evidence-Based Practices: The Role of Training, Knowledge and Barriers to EBP Use.

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**Background:**

While evidence-based practices (EBPs) are widely recommended for use with children with autism in educational settings, teachers continue to implement practices with little scientific support and experience a number of barriers in adopting EBPs. As children with autism are more frequently being educated in general education settings, exploring General Education (GE)

teachers use of EBPs and barriers they may experience is important in ensuring high-quality inclusive education for students with autism. To date, few studies have examined GE teachers use of EBPs and factors that may impact them, with the majority of research in this area being conducted in special education or clinical settings.

**Objectives:**

This study aims to examine factors that impact on GE teachers use of EBPs.

**Methods:**

112 GE teachers in the Republic of Ireland completed an online survey. The survey measured teachers training, their knowledge and use of EBPs (*Early Intervention Practices Scale; Paynter & Keen, 2014*), their attitudes towards EBPs (*Evidence Based Practice Attitudes Scale; Aarons, 2005*) and the barriers teachers experienced when implementing EBPs (*Barriers to Behavioural Interventions Scale; McGoey et al., 2014*).

The associations between EBP use and training, knowledge, attitudes and barriers were examined using correlations. Further analysis was conducted using hierarchical multiple regressions.

**Results:**

The data revealed that over a third of teachers received no autism and EBP training prior to teaching a student with autism. Results suggested that teachers used EBPs infrequently, and their knowledge of EBPs was low. Teachers had largely positive attitudes towards EBPs. Teachers experienced a number of serious barriers to implementing interventions including class size, lack of training and lack of time.

Training, teachers satisfaction with training, knowledge of EBPs, openness to EBP use and appeal of EBPs were all associated with EBP use. No barriers were associated with EBP use. A hierarchical multiple regression examining the association between barriers and EBP use while controlling for training, knowledge and attitudes revealed that no barriers were predictive of EBP use, however, knowledge and openness to EBPs were strong predictors of EBP use.

**Conclusions:**

Teachers scored many barriers as serious, however, none of these were associated with EBP use. Despite much research dedicated to examining barriers to EBP use, this data demonstrated that knowledge of EBPs and openness to EBPs may be key factors impacting the use of EBPs in GE settings. This may be particularly so in this context, as Irish teachers generally had low levels of knowledge and use of EBPs. More hours of training was associated with higher levels of knowledge and use of EBPs, indicating the need for intensive training to upskill GE teachers. As GE teachers are more frequently tasked with the education of children with autism in Ireland, this research highlights the need for high-quality training to improve teacher knowledge of EBPs.

**323.003** (Oral) Moving Beyond Individual Factors: Environmental Support and Barriers to the Social Participation of Autistic Adolescents in Inclusive Education

*Y. L. Chen and K. P. Koenig, Occupational Therapy, New York University, New York, NY*

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**Background:**

Autistic adolescents experience challenges in social participation in inclusive education, yet positive peer experience is critical to adolescents' mental health and quality of life. Extant research on peer social participation of autistic students primarily focuses on individual social characteristics, while few studies examine the environmental factors supporting and hindering social participation.

**Objectives:**

To explore the environmental factors associated with autistic students' high and low social participation in inclusive education.

**Methods:**

This sequential explanatory mixed-methods study included two phases. (1) The quantitative phase investigated social interaction rates among seven autistic and 10 non-autistic students at an inclusive school club in 21 45-minute club sessions over a school year, using video-based social behavior coding. (2) Based on the observed social interaction rates, we first calculated the percentages of sessions with high and low social participation in autistic and non-autistic students, as indicated by the 25<sup>th</sup> and 75<sup>th</sup>tile of the social interactions rates in the school club over time. We then identified the club sessions where each student had their highest and lowest social participation (interaction rates below the 25<sup>th</sup>tile and above the 75<sup>th</sup>tile of the student's observations, respectively). In comparison between sessions with high and low participation, we conducted video observations and thematic analysis of conversation transcripts, focusing on the environments and contexts of peer interactions, including peer behaviors and reactions, teacher interventions, as well as classroom activities and setup.

### **Results:**

All students presented varying levels of social participation across sessions. Autistic students showed high social participation in 25% and low social participation in 19% of the club sessions (as compared with 27% and 27% in non-autistic students). Table 1 shows the average cut-off of social interaction rates for high and low social participation in autistic and non-autistic students.

Thematic analysis revealed environmental three themes associated with students' social participation including (1) interpersonal similarity and openness to differences, (2) teacher intervention and classroom climate, (3) and activity and physical environments. For autistic students, similarity with peers in terms of shared interests and social styles play major roles in engaging and reciprocal social interactions. Peers' openness with social acts different from the norms allowed social connections to grow, while in other instances peers' negative reaction or rejection precluded further interactions. Teacher interventions that celebrate both autistic and non-autistic students' strengths and accomplishments fostered relationship building and a climate of peer-learning. However, exclusive interventions with autistic students may create negative framing of autistic students' challenges and, in some instances, omitted non-autistic students' needs of support. Activities and physical environments that provided opportunities for exploration and self-expression facilitated peer interactions of sharing thoughts and discoveries. For autistic students, activities that encouraged the integration of their interests provided strong support of peer connections and exchanges upon shared passion.

### **Conclusions:**

Environmental factors such as interpersonal similarity, peer openness, teacher interventions, classroom climate, and activities play meaningful roles in the social participation of autistic students. Moving beyond individual social characteristics in autistic individuals can help improve the inclusiveness of social environments.

**323.004** (Oral) Characteristics Associated with Receipt of Reproductive Health Education Among Students with Autism  
*E. K. Schmidt and G. I. Orsmond, Department of Occupational Therapy, Boston University, Boston, MA*

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### **Background:**

Youth who receive reproductive health education (RHE) are more likely to delay initiation of sex and use condoms or contraception and are less likely to experience unwanted pregnancy and sexually transmitted infections.<sup>1</sup> Receiving RHE may also decrease the risk of sexual abuse for youth with disabilities.<sup>2</sup> Research indicates that youth with autism are least likely to receive RHE compared to peers with other disabilities,<sup>3</sup> but no information is available specifically on characteristics associated with receipt of RHE for youth with autism.

### **Objectives:**

The purpose of this analysis was to examine the patterns of receipt of RHE for youth with autism using data from the National Longitudinal Transition Study-2 (NLTS-2).<sup>4</sup>

### **Methods:**

The NLTS2 dataset includes a nationally representative sample of youth with disabilities and provides information about secondary education services and supports, as well as postsecondary outcomes;<sup>4</sup> we analyzed the Wave 1 Program, Multiple Instructors, and Parent data sets. Among 617 students who received special education services for the disability category of autism, 82.3% ( $n=513$ ) were male, 17.7% ( $n=110$ ) were female, 61.3% ( $n=383$ ) were white, 38.7% ( $n=242$ ) were students of color, and 26.5% ( $n=166$ ) had co-occurring intellectual disability. All analyses were performed in SPSS and the school-program weight was applied to adjust for underestimation. We examined associations between receipt of RHE and youth gender, race, age,

family income, intellectual disability status, receipt of physical education,<sup>5</sup> and the youth's language skills and ability to understand.<sup>5</sup> We also examined the association between these variables and teacher's perceptions of the benefits of RHE for those who had not received it.<sup>4</sup> We performed Chi Square analyses for each independent variable with both dependent variables. An adjusted alpha level ( $p < .001$ ) was utilized to correct for Type I error due to multiple analyses with the same dependent variables.

### Results:

Youth with autism were less likely to receive RHE if they were female, younger than 17-18 years, a student of color, living in lower income households, and if they had co-occurring intellectual disability or had trouble speaking or understanding (see Table 1). Teachers perceived students were more likely to benefit from RHE if they were female, 16 years old, Black or Hispanic, lived in households making less than \$25,000 annually, and had no trouble speaking (see Table 2). Teachers did not perceive status of co-occurring intellectual disability as being associated with benefit from RHE. Further, they believed students who had trouble understanding would benefit most from RHE.

### Conclusions:

The findings of this study suggest the need for policies to ensure all students are receiving RHE, especially students of color, low income students, and those with intellectual disability or who have trouble speaking or understanding. Further, since teachers believed students who had little or no trouble speaking were most likely to benefit from RHE, additional education and training regarding accessibility and universal design is necessary to guarantee students receive equitable education. Future research could examine the effectiveness of techniques to improve accessibility and current RHE programs designed for students with autism.

## POSTER SESSION — EDUCATION

### Poster 417 - Education Posters

**417.001** (Poster) A National Portrait of Autism-Specific College Support Programs in the United States  
*C. Kepple<sup>1</sup>, B. E. Cox<sup>2</sup> and C. B. Francis<sup>1</sup>, (1)Florida State University, Tallahassee, FL, (2)Educational Leadership and Policy Studies, Florida State University, Tallahassee, FL*

Background: 85 postsecondary institutions across the United States have begun programs specifically designed to provide support and services to college students with autism. These autism-specific programs (ASP's) go beyond the legally mandated accommodations provided to students with disabilities. However, there has yet to be any systematic examination of how they operate or the services they provide.

Objectives: This session reports on findings from a survey of a nationally-representative sample of autism-specific college support programs. Results from the study are broken down by institutional level (2-year/4-year), control (private/public), and geographic region. The presentation will 1) highlight the most comprehensive approaches currently used to support autistic students, and 2) offer scholars suggestions for future research to assess the efficacy of these programs.

#### Methods:

In the summer of 2020, directors of each of the 85 autism-specific support programs (ASPs) identified by McDermott and Nachman (2020) were asked about their programs' size, costs, and administrative structures. These directors also identified which (if any) of 10 literature-guided support services they provided to participating students. Responses were received by a nationally representative sample of programs from 60 institutions (42 public, 18 private; 53 4-year institutions, 7 community colleges). The session will provide a descriptive summary of national findings, including a breakdown by institutional level, control, and location.

#### Results:

Most of these initiatives are relatively young, with more than half of the programs having started in just the last 6 years; the oldest responding ASP began in 2002. These programs have an average of 38 students currently enrolled while they have served 112 students since their program's inception.

Although 20 of the programs are available at no additional cost to participating students, two-thirds of the programs charge fees above and beyond institutions' tuition and fees. Annual fees average between \$2,927 and \$4,144, with 21 programs reporting student costs of \$5,000 or more per student annually.

These ASPs provide an average of seven distinctive services to their students. Nearly all offer life-skills support (93%), social skills training (88%), and peer mentors (85%). Fewer than half offer formal mental health support (47%) or tutoring services (48%).

Conclusions: Results from this study indicate that autism specific college support programs across the country are providing students critical services that go well beyond legally mandated disability accommodations. While these programs have emphasized initiatives tailored to the unique characteristics and needs of autistic college students (e.g., daily life skills, social skills) comparatively few provide direct mental health support to their students. Now, however, such mental health support may be particularly important for these students as the ongoing pandemic forces students to make rapid transitions and dramatic shifts to routines and environments. We suggest this study serve as the foundation upon which future research should examine the efficacy of the services provided by these autism specific college support programs.

**417.002** (*Poster*) A Three-Year Evaluation of Purpose-Built Centres to Promote Inclusion of Autistic Pupils in Mainstream Schools

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Background:

Over 130,000 pupils in state funded schools in England have autism as their primary Special Educational Need (SEN). Seventy percent of these pupils are educated in mainstream settings (Department for Education, 2018). Half of their parents say that their child's school place does not meet their needs. Fewer than half of children and young people on the autism spectrum say they are happy at school (National Autistic Society, 2017).

Objectives:

A national autism charity and an education authority developed and built centres in three mainstream schools for pupils aged 11 to 16. The centres were intended to provide specialist support from trained staff, such as learning in small groups, therapies, and a calm setting to retreat to. An evaluation conducted over the first three years of the centres studied (1) the impact of this model for pupils, families and the wider school (2) lessons in how to implement this approach (3) whether this approach (or elements of it) can be considered good practice for adoption more widely.

Methods:

A mixed methods approach was taken. Data was collected via questionnaires and interviews with pupils, parents, specialist staff working at the centres, staff of the charity, and mainstream peers (matched by age and gender) as well as classroom observation. Parent packs asked questions about sensory processing, language, and input into their child's schoolwork and contact with school. Teacher packs asked about pupil-teacher relationships. A range of validated measures was used in the evaluation including the Child and Adolescent Social Support Scale (Malecki and Demaray, 2002), Self-Report Coping Scale (Causey and Dubrow, 1992) and Subjective Happiness Scale (Lyubomirsky and Lepper, 1999).

Results:

Autistic pupils often experience lower education related wellbeing. However there was no evidence of such a gap for the centres' pupils. There was early evidence that the presence of the centres and their pupils is improving attitudes in mainstream pupils. Pupils were well-supported in their social development. Centre pupils were starting to act as support for each other across year groups. The centres' approach to exclusions resulted in levels of fixed term exclusions no higher than elsewhere and the complete absence of permanent exclusions. Parental satisfaction was generally high. Parents said their children were unlikely to have managed in mainstream without the centres.

Conclusions:

Avoiding inappropriate placements is key to the achieving the maximum from the centres' limited resources. Appropriate staffing is a key strength of this kind of provision. Some elements of this approach can be considered best practice for adoption more widely: the permanent availability of a familiar, quiet and calm space; the ability and willingness of centre staff to provide highly tailored support; use of space in a very flexible way for activities and transitions; allowing specialist skills and interests to develop appears to be helping pupils thrive more than they did in primary school; and having older pupils available as a source of support. Key challenges facing any autism-specific education provision remain – for example understanding and support for co-occurring conditions such as mental health problems.

**417.003** (Poster) Autism and Evidence-Based Practices: Surveying Educators' Knowledge, Training and Use  
*P. LaCava, Rhode Island College, Providence, RI*

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Background: The search for effective practices in autism spectrum disorders (ASD) has been an ongoing initiative (National Research Council, 2001; Simpson, 2005). Groups such as the National Professional Development Center ([NPDC]; Wong et al., 2014) have published critical reports on EBP, including EBP identification and practice guidelines. Despite these advances there still exists a research to practice gap (Parson et al., 2013). The overall goal of this research was to explore educators' knowledge, training, and use of EBP when working with students with ASD.

Objectives:

1. identify educator knowledge, training, and use about EBP
2. identify barriers to using EBP
3. identify professional development needs

Methods: A SurveyGizmo online questionnaire surveyed educators (teachers, related service providers, administrators) regarding their knowledge, training and use of EBP. Participants were recruited through autism related email list serves in southern New England. Survey content was validated by the review of 12 professionals and autistic people. A pilot study was conducted with 15 educators to verify technology, feasibility, and readability. Descriptive statistics were used to describe participants' demographics and survey item responses, while qualitative answers were organized into themes.

Results: 179 educators (84% female and Caucasian) completed the questionnaire. When asked, "What is evidence-based practice?" and able to choose more than one answer, over 90% agreed that EBP was a practice that has been vetted by rigorous research and review standards and shown to be effective, but only 24% agreed that EBP was a process of integrating the best evidence from research, professional judgement and student factors. Educators identified many factors that should be considered when choosing EBP including experience, student input, teacher capacity, family collaboration, etc.

Participants were asked to rate their level of awareness and use of the NPDC's 27 EBP (Wong et al., 2014). EBP used the most include: reinforcement, prompting, modeling and visual supports. EBP used the least include: parent implemented intervention, pivotal response training and discrete trial teaching. 16 of the EBP were reported being used by more than 50% of the sample. Despite these high reported levels of use, participants reported having limited EBP training. For example, while over 73% of the sample reported using reinforcement, only 25% of this group reported having been trained in this particular EBP. Other identified barriers to EBP use include time, resources, paperwork, and case load burden.

Conclusions: As this is a self-report survey, data should be interpreted with caution. Overall findings suggest that educators are aware of and use the most common EBP for students with ASD. Despite high reported use, educators shared several roadblocks to implementing EBP with limited training being the number one identified barrier. This finding was confirmed as participants also revealed that they use many EBP without having had training. How this impacts efficacy is unknown, but future research should include confirmation of EBP use along with fidelity checks and deeper investigation of how educators make decisions and evaluate EBP. Surveying autistic people and their families for their experiences and perspectives on EBP is also vital.

**417.004** (Poster) Autistic Traits and Risk Factors for Academic Performance: The Trails Study  
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Background: Youth with autism spectrum disorder (ASD) have been granted the right to be educated in inclusive schools and receive enough specific support to achieve their academic potential. However, previous studies have demonstrated that youth with ASD score below expectations. In order to improve academic performance in adolescents with ASD, a starting point would

be to investigate how protective factors for academic performance found in the general population apply to adolescents with autistic traits and whether autistic traits are predictive in themselves and interact with these protective factors.

**Objectives:** We investigated the association of autistic traits with concurrent academic performance and change in academic performance across adolescence, controlling for sex and school type, and exploring the role of potential protective factors (IQ, social skills, and student-teacher relationship quality). We also examined whether externalizing problems are a risk factor for academic performance.

**Methods:** Adolescents ( $M_{age} = 11.11$ , 48% female, at T1) from the prospective cohort study *Tracking Adolescents' Individual Lives Survey* were studied, including typically developing ( $n = 2229$ ) and clinically referred adolescents ( $n = 543$ ). We assessed whether autistic traits combined with sex, school type, social skills, IQ, student-teacher relationship quality and externalizing problems related to: (a) initial teacher-rated academic performance, and (b) change in academic performance up to age 16, using longitudinal linear mixed models.

**Results:** Academic performance decreased across adolescence, but significant variance existed in the intercept and slope, thus the initial level and course of academic performance differed between adolescents. Male adolescents had a significantly steeper decline in academic performance over time. Initial level of academic performance was significantly higher for adolescents with higher IQ-scores, more social skills, and higher student-teacher relationship quality. The positive effects of IQ and social skills decreased significantly over time, whereas the positive effect of student-teacher relationship quality increased. Externalizing behavior affected neither the intercept nor the slope of academic performance. None of the risk or protective factors interacted with autistic traits.

**Conclusions:**

Social skills in the classroom, IQ-scores, student-teacher relationship quality and female gender positively affected academic performance, more so than autistic traits and independently from whether adolescents had few or many autistic traits. The relatively low intraclass correlation coefficient combined with the absence of an interaction of autistic traits with IQ, social skills, student-teacher relationship quality or externalizing problems in our study emphasizes the importance of assessing and tailoring interventions to individual strengths and weaknesses of all adolescents.

**417.005 (Poster)** Board Certified Behavior Analysts' Experiences Teaching Sex Education  
*S. L. Curtiss and M. Stoffers, University of Delaware, Newark, DE*

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**Background:** The relationship between information and behavior is intricately woven in discussions of sex education (Kramer, 2019). Thus, it is unsurprising that Board Certified Behavior Analysts (BCBAs) are often called upon to provide sex education for individuals with developmental disabilities under the domain of supporting expressions of sexual behavior (Davis et al., 2016). It remains unclear how BCBAs navigate the social, moral, ethical, and practical concerns involved with providing sex education (Falligant & Pence, 2020).

**Objectives:** This project seeks to answer two research questions: (1) What is the nature of BCBAs sex education practice? And (2) What challenges do BCBAs face when providing instruction?

**Methods:** This study is a thematic analysis (Clarke et al., 2015) of one-hour-long interviews with nine BCBAs (see Table 1 for sample demographics). These participants were a sub-sample from a larger study on providing sex education to those with intellectual disabilities, which was developed with our research advisory board consisting of autistic adults.

**Results:** We identified three preliminary themes from interviews with BCBAs (see Table 2 for a description of themes and example quotes). In answer to our first research question, BCBAs reported an eclectic training background to prepare for the delivery of sex education services. While some BCBAs had extensive sexual education training, others described their training as “a Frankenstein's monster of experience that you accrue over the years.” Many BCBAs noted that sex education services were requested in the context of perceived problematic sexual behavior. For instance, some BCBAs were presented with caregivers who were concerned about the masturbatory activities of the individual. Other BCBAs supported individuals who were identified as sexual offenders or at risk of sexual offending. In answer to our second research question, BCBAs reported tension between compliance and autonomy, suggesting that insistence on compliance can lead to a greater risk of sexual abuse and may inhibit individuals from receiving access to sex education that aligns with their personal needs and desires.

**Conclusions:** This project provides a clearer understanding of the nature of sex education provided by BCBAs and the challenges they face. The findings suggest greater attention is needed in the area of specialized training on sex education and autism with

special attention to the role that sex education plays in reducing problematic sexual behavior. BCBA's were aware of the tension between the compliance-oriented nature of their therapy and the value of autonomy inherent in their sex education practice. In some cases, this led them to question the degree to which the behavior they were asked to address was truly problematic.

**417.006 (Poster) Compass for Optimizing Educational Outcomes and Supporting Parent-Teacher Alliance**

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**Background:**

Unlike most ASD school-based interventions that focus primarily on classroom teachers, parents are a critical ingredient of the COMPASS intervention. As a parent-teacher consultation intervention, COMPASS brings together parents and teachers for an ecological assessment of the child's risk and protective factors across areas of development. Validated in three randomized controlled trials, COMPASS doubles IEP outcomes in the crucial areas of social, communication, and learning skills. Parent-teacher alliance is particularly promising because of its association with IEP progress and student outcomes (Ruble, et al., 2019).

**Objectives:**

The purpose of this study was to determine (a) if parent-teacher alliance after receiving COMPASS was significantly different from the comparison group, after controlling for initial alliance scores and (b) whether alliance was associated with child outcomes, after controlling for group assignment.

**Methods:**

Data come from a secondary analysis of RCTs. The first two RCTs were conducted with young children ( $n = 76$ ; 6 years; Ruble et al., 2010; 2013); the third was with high school students ( $n = 20$ ; 18 years; Ruble, et al., 2019). The studies' designs and measures were identical. Student cognitive mean score was 56.4 ( $SD = 25.8$ ) and adaptive behavior score was 63.62 ( $SD = 14.6$ ).

Measures included the Parent-Teacher Alliance Questionnaire (PTAQ), a 20-item measure of parent perceptions of their relationship with their child's teacher (Krakovich, et al., 2016). The internal consistency was .95.

For outcome assessment, two approaches were applied, one from parent and teacher ratings a second from a researcher. The first one asked parents and teachers to assess IEP goal progress with a Likert-type scale questionnaire on how much progress had been made to date using a five-point scale (1 'none at all' to 5 'a great deal') for each of the three monitored IEP goals. The internal consistency for the parent measure ( $\alpha$ ) was .81 and the teacher was .69. The second was based on Psychometric Equivalence Tested Goal Attainment Scaling (PET-GAS) to evaluate IEP progress by an independent evaluator unaware of experimental condition. Each goal is scaled using a five-point rating: -2 = present levels of performance to +2 = much more than expected. PET-GAS ratings were based on video demonstrations, work samples, and/or data collected by the teacher. Two coders independently coded 65% of the goals at baseline and three coders independently rated 35% at final evaluation. Interrater agreement .86 at final evaluation.

**Results:**

Analysis of the ANOVA indicated a trend toward significance between groups ( $p = .06$ ) for alliance scores, in favor of COMPASS, after controlling for preintervention scores,  $F(1, 84) = 3.57$ ,  $p = .06$ , partial eta squared = .041. Analysis of the partial correlations indicated a significant correlation between alliance and parent report of IEP progress.

**Conclusions:**

While parent perceptions of progress made on the IEP correlated with alliance, and teacher report of progress correlated with parent report, objective assessment of goal attainment outcomes did not. The results indicate further research is needed for leveraging consultation to enhance parent-teacher alliance, and thus child progress.

**417.007 (Poster) Conducting Standardized Assessments over a Technology Platform for Children with ASD**  
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**Background:**

The COVID-19 pandemic has forced practitioners to adapt assessments that are designed for in-person implementation to be appropriate for delivery over technology in the form of a tele-assessment (Krach et al., 2020). Krach et al., (2020) refer to adapted tele-assessment as administration using telecommunication technology for an assessment that has been adapted for technology platform but was standardized for face-to-face administration. Little guidance exists for adapting assessments to be appropriately delivered as teleassessments that takes into consideration the higher risk for error when using technology to deliver a test that was standardized for face-to-face administration.

As part of a larger study examining the efficacy of the electronic delivery of a reading comprehension intervention for students with autism spectrum disorder (ASD), our research team conducted standardized language assessments over Zoom. This presentation will discuss the process of collecting pre-test standardized language assessment data over Zoom.

**Objectives:**

The purpose of this presentation is to discuss the successes and challenges of conducting reliable and valid tele-assessments and participant performance. Information will be provided about redesigning these assessments for Zoom administration format (based on guidance from professional organizations and practical considerations), the process of conducting these assessments (the spaces and people involved), and the assessment scores.

**Methods:**

Our team worked with 19 children (ages 7-9) with ASD from different geographical regions across the United States. Assessments included subtests from the WJ-IV, WISC-IV, CELF-5, EVT-3, and CTOPP-2. Trained research team members administered all assessments and double scored all test records.

**Results:**

Some assessments were redesigned to be administered via Microsoft PowerPoint and adaptations made to allow for participant mouse control when pointing was required. However, this process did not work for everything, and some exceptions included the PPVT-5, Passage Comprehension on the WJ-IV, and Block Design on the WISC-IV. Some assessments were not possible to complete over Zoom (i.e., Repeated Sentences on the CELF-5); if the test administrator was unable to repeat themselves, this typically posed a problem for the participants as there were sometimes delays or noisy backgrounds, making it difficult to hear. Another design issue we observed was associated with any assessments that were presented without visual stimuli; participants struggled to attend to material that was presented only verbally (i.e. Understanding Spoken Paragraphs on the CELF-F). The presence of parents or other specialists (i.e., behavior technicians) was sometimes positive as they could help keep their child focused on the task at hand; however, this was often a distraction to participants (e.g., participant looking to parents for answers) or an influence to the participants' answers (e.g., parents occasionally providing, hinting at, or correcting answers). All assessments are currently in the process of being scored and will be completed by INSAR 2021 to be more fully discussed.

**Conclusions:**

The redesign and adaptation of these assessments for the Zoom environment for this population of children with ASD proved to be quite challenging when relying on professional organization recommendations during the COVID-19 pandemic. Best practices, lessons learned, and guidance for future telehealth assessment will be discussed.

**417.008** (Poster) Cultural Influence on Parents-Teachers Collaboration Towards Educating Children with ASD in Nigeria and South Africa during Crises

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**Background:** People's culture has potential to shape their thinking and trigger different action, though this phenomenon is not peculiar to one region or society. Notably, parents and teachers remain primary caregivers of children with autism spectrum disorder (ASD), and they are also expected to work collaboratively to offer necessary training and care at home and school. Despite this necessity during crises such as recent COVID-19 pandemic, the nature and extent of their collaboration might have been influenced by culture of some parents, such as those who are in remote areas in Nigeria and South Africa where research and awareness are limited and thus making ASD, various available interventions, and methods of educating children with autism to be poorly understood and ineffective.

**Objectives:** This study aimed to examine what influence culture has on the collaboration of parents and schools/ teachers who are main caregivers towards educating children with ASD in Akinyele Local Government Area, Nigeria, and Zululand District, KwaZulu-Natal, South Africa.

**Methods:** The study adopted a qualitative approach, and data was collected using semi-structured interviews with the help of an interview guide. Using purposive sampling, 5 parents were recruited from 3 different areas in Akinyele Local government while 10 parents were recruited from 5 different areas in Zululand District and they were interviewed for the study. The data was analysed using thematic content analysis, and the study strictly adhered to ethical considerations.

**Results:** The findings of the study revealed that only a few parents of children of children diagnosed with ASD reached out to schools/ teachers regarding how to keep learning going at their respective homes during national lockdown due to COVID-19 pandemic. It was also found that there was notable cultural influence on the way some parents (especially male parents in Zululand) related with their schools or teachers as they acted out cultural practice of 'men don't cry' also in this situation. Some female parents also reported that such practice has affected their relationship with schools/ teachers of their children with ASD, thus they seldom asked for help about what can be done at home to continue educating their children with autism during COVID-19 pandemic. Also, the cultural belief of many parents in Nigeria restricted them to visit schools/ teachers that were even ready to help with teaching materials or some teaching guides as some participants termed COVID-19 as a deadly and contagious disease believed to be caused by extreme heat sent by a god, thus validating limited knowledge on ASD in many remote areas.

**Conclusions:** Schools and parents need to discuss and design terms of achieving more effective and productive collaboration that focuses on continuous teaching of children with ASD, especially the collaboration mostly needed by parents during pandemic, natural disaster, and curfew. Parents should review their cultural beliefs and stick to those that can help establish and maintain close relationship with schools/ teachers in order to benefit from their guide and innovation that can help parents educate their children with ASD during different crises.

**417.010** (Poster) Educational and Diagnostic Classification of Autism Spectrum Disorder and Associated Characteristics  
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**Background:**

**Research continues to highlight discrepancies between clinical diagnoses of Autism Spectrum Disorder (ASD) and the determination of special education eligibility for services within school settings.** That inconsistency may result in the absence or lack of services provided to students with ASD (Christiansen, 2016). There is limited research conducted on the impact of those discrepancies on the identification of appropriate services for students with ASD within schools. The current study examined the characteristics of students with ASD and how they relate to educational eligibility and clinical diagnoses.

**Objectives:**

The purpose of this study is to investigate if educational eligibility and clinical diagnosis of autism are associated with specific language, social-emotional, and other key characteristics. More specifically, among students with autism, what characteristics are differentially associated with their diagnosis and can therefore be targeted for evidence-based treatments? If treatments for autism

are effective in increasing peer relationships and social competence but schools do not differentiate students with autism from those with other types of disabilities, then students may not be matched with appropriate interventions to meet students' needs.

#### Methods:

The study accessed data from a four-year cluster-randomized trial of 283 students with and without reported ASD diagnosis. The following measures/indicators were used and compared in the study: special education eligibility, Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012), Children's Communication Checklist-2 (CCC-2; Bishop, 2006), School Social Behavior Scales (SSBS; Merrell, 1993). The results of the assessments were analyzed to determine the differences and overlap of the assessment tools used for determining the educational eligibility of Autism and medical diagnosis of ASD.

#### Results:

Five MANOVAs tests were run, two were significant, one was approaching significance and two were not significant. The MANOVA with dependent variables related to social competence and social relations yielded significant differences among groups with and without ADOS diagnoses  $F = 3.47, p = .001$ . Groups did not differ based on an IEP diagnosis of autism  $F = .56, p = .69$   $F = .48, p = .87$ . Tukey follow-up comparisons documented significant mean differences between the group of students with autism and the group without autism for all subscales with the group with autism having more impaired social functioning.

Conclusions: A central finding of this study includes that an educational eligibility classification was not associated with characteristics of autism but ADOS-2 classification of autism (autism, autism spectrum disorder, no autism) was associated with key ASD characteristics. More specifically, we found that the educational diagnosis of Autism did not distinguish between students with and without autism on key characteristics of language, peer and social relations and competence, or academics and other interests. It isn't clear how students with autism were determined eligible for an IEP if they did not differ from peers with other disabilities on key social and language outcomes. This can be a result of the absence of consistent standards for identifying students under the Autism category. ADOS-2 classification was found to be a more solid diagnostic measure for important and differential characteristics associated with autism.

#### **417.011 (Poster) Estimating the Prevalence of Autism Among Postsecondary Students in the United States**

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#### Background:

How many postsecondary students have autism? Although this question is seemingly simple and straightforward, the current literature does not provide a solid answer. The few studies that have attempted to do so yield dramatically different estimates, in part because they all have critical limitations that prevent them from yielding an authoritative figure. Without good data about the prevalence of autism in higher education, postsecondary policy makers and institutional administrators are unlikely to recognize the importance of this population or be persuaded to expand efforts to support these students.

#### Objectives:

In this paper we identify, analyze, and synthesize data drawn from multiple sources to estimate the prevalence of autism within postsecondary institutions in the United States.

#### Methods:

Drawing from a review of 400 publications, 16 prominent national surveys used by postsecondary institutions, and 7 federal datasets, this project 1) assesses the generalizability of estimates based on previously published literature, 2) extrapolates estimates from Eagan et al.'s (2016) study of 137,456 college freshmen attending over 184 postsecondary institutions, and 3) conducts original analyses of 3 nationally-representative datasets from the Institute of Education Sciences.

Of the 16 widely used multi-institutional surveys of postsecondary students we reviewed, only one (Eagan et al., 2016) asked explicitly about autism. Likewise, only two of the seven nationally representative data sets we examined from the Institute of Education Sciences (IES) include data necessary to estimate the preponderance of college students with autism: the Baccalaureate & Beyond (B&B, 2016-2017), the National Postsecondary Student Aid Study (NPSAS, 2016). Data from these studies were weighted to provide nationally representative estimates of the prevalence of autism in higher education.

## Results:

Without accounting for students' reluctance to self-disclose autism once in college, nationally representative data relying on student self-reports suggests there may be as few as 50,281 undergraduate college students who report having autism in the United States. Calculations from other multi-institution data sources yield higher estimates, between 83,801 and 103,748. However, when we account for the fact that some individuals with autism do not receive a diagnosis until after college (Author, 2017) and 38% of students with formal autism diagnoses do not disclose that information once in college (Newman et al., 2011), we think it more likely that there are between 81,098 (50,281 / 0.62) and 167,335 (103,748 / 0.62) total undergraduate students with autism in the US today.

## Conclusions:

These estimates may be critical to ensuring that the growing population of college students with autism receives appropriate attention, support, and resources from their postsecondary institutions. Educational administrators can use the estimates to show that college students with autism are a sizable population that warrants increased attention from postsecondary institutions. Moreover, our examination of these wide ranging data sources also revealed the paucity of empirical evidence from which researchers can currently generate plausible estimates of autism's prevalence in postsecondary education. Future research on the topic will require the development and analysis of additional large-scale, multi-institutional, representative data sets.

### **417.012 (Poster)** Examining Ethnicity As a Moderator of the Relation between Pre-Parent Factors and Actual/Perceived Knowledge of ASD

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## Background:

There is little known about parenting knowledge in pre-parents, as most studies focus on those that are already a parent. Additionally, evidence suggests there may be ethnic disparities in age of diagnosis for children with autism spectrum disorder (ASD) due to caregivers' lack of awareness of early signs of neurodevelopmental delay (Mandell et al., 2009).

**Objectives:** The present study aimed to evaluate how prior experience with children, undergraduate education, and family SES may relate to pre-parents' actual and perceived ASD knowledge and how ethnicity may moderate those relations.

## Methods:

Participants were 221 undergraduate students who identified as pre-parents (i.e., have no children but plan to have children in the future). They completed questionnaires via Qualtrics including *A Survey of Knowledge of Autism Spectrum Disorder* (ASK-ASD), assessing perceived (ranging from 1 to 3) and actual (ranging from 0 to 1) ASD knowledge, and a demographic questionnaire, which included ethnicity (coded 0 = White, 1 = Non-White), experience with children in five roles (e.g., babysitter; coded 0 = no, 1 = yes), and previous enrollment in specific Psychology undergraduate classes (coded 0 = no, 1 = yes). An experience composite (ranging from 0 to 5) and a classes composite (ranging from 0 to 16) were created by summing the items for the respective constructs.

## Results:

Zero-order correlations indicated that ethnicity related to actual and perceived knowledge of ASD and family SES, with White participants having significantly more perceived and actual knowledge and higher family SES. Both experience and family SES were significantly positively correlated with ASD knowledge.

Six moderated multiple regressions examined whether ethnicity interacted with experience, classes, or family SES (considered separately) in predicting both actual and perceived ASD knowledge. At Step 1, the significant main effects found in the zero-order correlations held, with no additional main effects emerging (Table 1). That is, ethnicity, experience, and family SES were significant unique predictors in each of their respective analyses [although ethnicity and family SES only predicted a marginal amount ( $p = .05$ ) of unique variance in perceived ASD knowledge]. At Step 2 (interaction effect), only the interaction between ethnicity and experience predicted unique variance in actual knowledge,  $b = -0.03$ ,  $SE = 0.02$ , [95% CI (-0.06, -0.003)], and perceived knowledge,  $b = -0.09$ ,  $SE = 0.04$ , [95% CI (-0.17, -0.001)]. Post-hoc plots (Figure 1) showed that the positive relation between child experience and perceived/actual ASD knowledge only emerged for White participants. Levels of experience did not predict levels of actual/perceived knowledge for Non-White participants.

## Conclusions:

Ethnicity, family SES, and child experience contributed to participants' ASD knowledge. The lack of finding of a contribution from classes suggests that Psychology curriculum may need to place a heavier emphasis on neurodevelopmental differences, and future research should evaluate if specific courses contribute to variability in ASD knowledge. The interaction between ethnicity and child experience indicated that Non-White participants may rely on other factors when acquiring ASD knowledge of ASD. The findings may provide clinical implications to how pre-parent knowledge of neurodevelopmental disabilities could enhance early diagnoses.

### 417.013 (Poster) Examining Restricted Repetitive Behaviours and Interests As Predictors of Math Ability Among Students with Autism

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**Background:** A widely held, stereotyped belief is that students with autism tend to be mathematically gifted. This stereotype has some support in the annals of autism research, but more recently, researchers have revealed that the rates of both math giftedness and math weakness and/or disability among students with autism are higher than we would expect in a typical population (Chiang & Lin, 2007; Mayes & Calhoun, 2006; Oswald et al., 2015). Although IQ and language ability are known predictors of both neurotypical (e.g. Byrnes & Miller, 2007) and neurodiverse (e.g. Oswald et al., 2015) students' math abilities, more research is needed to determine how students who share a common diagnosis can have such disparate outcomes in the same area of academic performance. It is possible that students' consistent, systematic, and uniquely autistic engagement with restricted, repetitive behaviours and interests (RRBIs), such as special interest engagement, represents an area of strength that may lead to improved math abilities.

**Objectives:** To examine the role that RRBIs have in predicting the math abilities of students with autism.

**Methods:** Forty-nine students with autism (92% male) completed standardized assessments of IQ (*Leiter-3 & Raven's Progressive Matrices*) and language ability (*Clinical Evaluation of Language Fundamentals, Fifth Edition* Formulated Sentences subtest). Scores from the *Social Responsiveness Scale, Second Edition* Restricted Interests and Repetitive Behaviours subscale were used as a measure of students' RRBI symptom severity. A standardized measure of foundational math ability (*KeyMath-3 Diagnostic Assessment, Canadian Basic Concepts composite*) was administered as the outcome measure. A hierarchical regression analysis was used to determine the unique amount of variance in math scores explained by RRBI symptom severity, above and beyond known predictors of IQ and language ability. Assumptions of multiple regression (i.e. homoscedasticity, linearity) were met according to statistical testing in IBM SPSS (v. 24).

**Results:** IQ and language ability were significant predictors of participants' math ability in the first regression model (IQ  $\beta = .647$ , language ability  $\beta = .323$ ), whereas RRBI symptom severity did not account for a significant amount of variance in participants' math ability scores when added to the second regression model ( $\Delta R^2 = .002$ ). Students with higher IQs and better language abilities had overall better math abilities, whereas the severity of students' RRBIs had no substantial influence on participants' math abilities.

**Conclusions:** Despite the lack of support for the original hypothesis that RRBIs, like special interest engagement, would strengthen students' math abilities, this study makes two critical contributions to the literature:

- (1) The results replicate previous research on the utility of IQ and language ability as predictors of math ability for students with autism; and
- (2) A deeper look at available RRBI measures reveals a need for more strength-based measures of RRBIs, given that existing measures like the *Social Responsiveness Scale, Second Edition* are both deficit-based and nonspecific—a single symptom severity score cannot adequately distinguish strength-based constructs of special interest engagement from deficit-based constructs of insistence on sameness and stereotyped movements.

**417.014** (Poster) Factors Predictive of High School Diploma Assigned to High School Students with Autism Spectrum Disorder  
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Background: For students with ASD, attainment of a standard high school diploma paves the way for the successful pursuit of employment and/or higher education. Admittance to degree-bearing college programs requires the standard diploma and employment opportunities available to individuals without a standard diploma are far more limited (Whittenburg et al., 2019). However, eligibility policies for standard diplomas vary widely across the country (Guy et al., 2000). These varying local policies serve as the de facto gatekeepers to students' postsecondary education, career options, and earning potential. Students with disabilities who spend more time in general education courses are more likely to be eligible for a standard high school diploma (Thurlow et al., 1997). Yet, student and community characteristics that factor into the decision-making process for standard diploma eligibility still remain largely unknown.

Objectives: Since earning a high school diploma can serve as an important element in closing the autism employment gap, an examination of the factors that drive diploma earning is warranted. Research questions are: 1) To what extent is the percentage of time spent in general education predictive of diploma status for students with ASD?; 2) To what extent is state of residence predictive of diploma status for students with ASD?; and 3) When controlling for the influence of percentage of time spent in general education and state of residence, to what extent do student characteristics, family profile, and/or school and community factors predict diploma status for students with ASD?

Methods: Data is derived from a randomized control trial study conducted by Center on Secondary Education for Students with Autism Spectrum Disorder, and only pretest phase (prior to intervention) was included for analysis. 60 high schools were recruited from 3 states, NC, WI and CA, and 547 students enrolled in the study.

Relationship between diploma type and percent time spent in general education and state of residence respectively were identified using chi-square tests and simple logistic regression. Next, block-wise hierarchical modeling procedure was employed with percent time in general education and state of residence held constant, with each block regressed on diploma type. Three blocks of predictors, in order of entrance, were: 1) student ability characteristics; 2) environmental characteristics; and 3) student and family demographic characteristics.

Results: Alone, percent time spent in general education, state of residence, IQ, and adaptive behavior significantly predicted whether a student with ASD receives a standard high school diploma. Together, percent time spent in general education and state of residence improved model fit by 48%, suggesting these are the 2 strongest predictors of diploma type. Students who spend a greater amount of time in a classroom that provides instruction on general education curriculum and students from WI were more likely to graduate with a standard diploma.

Conclusions: Students in WI, a state that promotes a more inclusive model, are more likely to achieve the standard diploma. This suggests that an inclusive model of education can help students achieve the standard diploma, which may then improve their chances for better postsecondary outcomes in employment and education.

**417.015** (Poster) From a "Disorder" to "a Way of Being": The Effects of an Online Training on Pre-Service Teachers' Stigma and Their Understanding of Emotional and Empathic Capacities of Autistic Students  
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Background: In light of the difficulties autistic students have in schools (Fleury et al., 2014; Hughes et al., 2011), six in 10 autistic students believe that the main thing they need is a teacher who understands autism (All-Party Parliamentary Group on Autism, 2017). Teachers' knowledge of autism has been improving over the decades (Busby et al., 2012), but teachers still tend to hold on to inaccurate ideas about the lived experiences of autistic students (Lalvani, 2015; Vincent & Ralston, 2019). The gap between knowledge and understanding suggests that factual knowledge about the diagnostic criteria should also emphasize diversity over conceptions of pathology. Online training has been associated with reduced stigma and increased understanding among undergraduates (Gillespie-Lynch et al., 2015), and this study replicates a prior training study (Saade et al., under review) because the how online training can enrich the understanding of pre-service teachers remains unknown.

Objectives: To examine if autism training is associated with improved knowledge and stigma for pre-service teachers at one university in western Canada.

Methods: Pre-service teachers ( $N=105$ , 26.7% male) participated in an online pre-test, followed by an autism training, and a post-test. The pre/post-test included open-ended questions (e.g., “what is autism?”) and questions about demographics, a ten-question measure of stigma (social distance scale), and a participatory autism knowledge measure (PAK-M). Of the PAK-M questions, the current study focused on questions relating to emotional and empathic capacities of autistic people ( $\alpha=.77$ ).

Results: Completing the online training did not significantly improve pre-service teachers’ knowledge of common myths (e.g., “Most autistic people have low intelligence”). However, the training did improve the pre-service teachers’ understanding of issues related to emotional and empathic capacities of autistic people. A paired-samples t-test was conducted to compare knowledge about emotional and social capacities of people on the spectrum before and after training. Accuracy of these answers improved from pre-test ( $M=1.84$ ,  $SD=.55$ ) to post-test ( $M=1.4$ ,  $SD .48$ );  $t(104)=9.16$ ,  $p<.001$  (effect size was large,  $d =.85$ ).

A paired-samples t-test was conducted to compare stigma towards people on the spectrum before and after the training. Stigma was reduced from pre-test ( $M=1.69$ ,  $SD=.58$ ) to post-test ( $M=1.51$ ,  $SD .56$ ) conditions;  $t(104)=5.64$ ,  $p<.001$  (effect size was small,  $d = .31$ ).

Analyses of open-ended answers (“what is autism?”) demonstrated while answers given *before* the training were generally accurate (“spectrum of disorders”), the after-training answers reflected a nuanced understanding of autism (e.g., “A way of being”). The biggest change was that after the training, pre-service teachers were more likely to say that people with autism have the capacity to feel empathy (e.g., “are empathetic towards other people”) and to contribute to their social networks (e.g., “Autistic people are valuable members of our communities”).

Conclusions: While the effect of the training on pre-service teachers was small for distinguishing non-social characteristics of autism, the effect of the training was large when it came to autistic students’ emotional and empathic capacities. These findings suggest that an online training can reduce stigma and improve understanding of the emotional and empathic capacities of autistic students.

**417.016** (Poster) How Did the Transition to Online Instruction Impact Neurodivergent Youth? It’s Developmental, My Dear Watson

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Background: The developmental impacts of the shift to online instruction due to COVID-19 remain largely unknown. Increased self-discipline is required online, which may impact younger learners disproportionately due to the continuing development of executive functioning (EF) abilities (Diamond & Lee, 2011). Autistic people often experience EF difficulties (Hill, 2004), which could hamper online learning. However, some autistic people prefer computer-mediated to in-person communication (Gillespie-Lynch et al., 2014). Indeed, some autistic students describe being happy with the transition online (Reicher, 2020).

Objectives: To examine changes in student-reported and parent-reported learning and social engagement in a summer program for neurodivergent youth from 2019 (in-person) to 2020 (remote instruction).

Methods: Neurodivergent youth (2019  $n=53$ ,  $M_{age}=10.1$ ; 2020  $n=39$ ,  $M_{age}=10.6$ ) and teens (2019  $n=49$ ,  $M_{age}=16.0$ ; 2020  $n=53$ ,  $M_{age}=16.4$ ) were surveyed on the last day of a five-day technology-themed informal educational workshop. Classrooms were split into youth (~7-13 yo) and teens/young adults (~14-21 yo). Parents completed surveys at the end of each summer. Among the 112 youth whose parents disclosed their diagnoses, 76 were autistic and 54 had ADHD (29 also had ASD). Twenty-five students attended in both 2019 and 2020.

Results: Given that some students became teenagers between 2019 and 2020, we included age as a continuous covariate in longitudinal analyses of students who attended both years. Students reported no losses in computer and social learning ( $p>.21$ ) and increased job skill learning online ( $p=.04$ ). An interaction between age and job skill learning revealed that age was positively correlated with heightened job skill learning online ( $p = .03$ ).

Cross-sectional analyses revealed that autistic students reported greater computer learning relative to peers with other diagnoses ( $p = .04$ ), as well as interactions between ASD and year ( $p = .02$ ), ASD and ADHD ( $p = .04$ ) and ASD, year and age grouping ( $p = .008$ ). The autistic advantage in computer learning was only apparent in-person ( $p< .011$ ) and not online ( $p = .79$ ).

Parent reports of autistic students' engagement with computer activities were correlated with student-reported computer learning ( $p=.02$ ). A mixed analysis of parent-reported computer engagement at the program and school indicated that computer engagement was higher at the program than at school ( $p<.001$ ). An interaction between age and year was observed ( $p=.001$ ). Parent-reported computer engagement at the program was higher for children in-person ( $M=4.6$ ) than online ( $M=3.9$ ;  $p=.002$ ). Parent-reports of teen computer engagement did not differ by year ( $p=.43$ ). An analysis of parent-reported social engagement at the program revealed another interaction between year and age ( $p = .02$ ). Parents reported *heightened* social engagement online relative to in-person for teens ( $p = .03$ ) and no change for children ( $p = .25$ ).

Conclusions: The transition online did not decrease participants' learning and engagement in most domains. Mirroring reports that some neurodivergent people prefer online learning, neurodivergent teenagers may often be more engaged online. Findings contradict the misconception that autistic people are asocial computing machines (Draissma, 2009) by suggesting that an autistic advantage in computer skill learning grows from in-person scaffolding.

**417.017** (Poster) Jasper in the Classroom: Supporting Peer Engagement for Preschool Students with Autism Spectrum Disorder  
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Background: As rates of autism spectrum disorder (ASD) continue to rise, school based services may be the most efficient way to provide early intervention. However, many teachers lack the experience or training to address the unique needs of students with ASD. Training teachers to assess and target core challenges of ASD may be a way to help address the specific needs of students with ASD. JASPER is an evidence-based intervention for children with ASD that has shown consistent improvements in engagement and social communication in the school setting for students with ASD (Lawton & Kasari, 2012; Chang, Shire, Shih, Gelfand, & Kasari, 2016; Shire, Chang, Shih, Bracaglia, Kodjoe, & Kasari, 2017). While previous research has focused on implementing JASPER within classroom routines, training teachers to effectively modify existing curriculum with JASPER strategies may be another avenue to provide support for students with ASD.

Objectives: The present study aims to train preschool classroom teachers to modify small group curriculum with JASPER strategies to address two core challenges of students with ASD, engagement and social communication.

Methods: Forty-nine preschool aged students with ASD (mean = 49 months) enrolled in mixed disability classrooms across 12 schools (19 teachers) were recruited for the study. The students, 95% male, represented diverse backgrounds (81% Hispanic or Latinx, 5% African American, 3% Asian, and 11% other/mixed). Schools were randomized to receive training to incorporate JASPER strategies into their existing curriculum or to a control group providing the standard preschool curriculum. Standardized measures of social communication (Early Social Communication Scales; Mundy et al., 1986; Seibert et al., 1982) and cognition (Mullen Scales of Early Learning; Mullen, 1995) were administered at entry and exit. Ten minute small group rotations with the classroom teacher were filmed at entry and exit and coded for student engagement based on the engagement states described by Adamson, Bakeman, and Decker (2004).

Results: Both the treatment and control groups improved in standardized measures of joint attention ( $F(1,40) = 5.53, p = .02$ ), requesting ( $F(1,40) = 8.27, p = .006$ ), expressive language ( $F(1,37) = 20.757, p < 0.001$ ), and receptive language ( $F(1,37) = 21.282, p < 0.001$ ). Furthermore both groups increased overall time engaged during small group rotations ( $F(1,40) = 10.62, p = .002$ ). However, students in the treatment group were more likely to be engaged with peers during small group rotations at exit (Odds Ratio = 2.99, Confidence Interval = 0.161, 2.03). Teachers in the treatment group achieved high fidelity in implementing JASPER strategies when compared to the control group ( $F(1,26) = 18.662, p = .0002$ ), replicating previous work training teachers in JASPER.

Conclusions: Teachers can play an integral role in supporting engagement for students with ASD. Training teachers to incorporate JASPER strategies into their preschool curriculum can help facilitate peer engagement. Peer engagement can be difficult for students with ASD, but appropriate supports from teachers can provide students more opportunities for peer socialization throughout the school day.

**417.018** (Poster) Learning about Neurodiversity at School: Key Concepts for Communicating Neurodiversity to Primary School Children, from the Leans Project Co-Design Process

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**Background:** Around the world, a large proportion of autistic children attend mainstream schools (i.e. schools that are not specialised provision for disabilities). Teachers and peers may have a poor understanding of neurodevelopmental differences in their learning and thinking, which can negatively impact children’s school experiences. Educating broadly about the concepts of *neurodiversity and neurodivergence*, just as curricula may already cover biodiversity and cultural differences, is an opportunity to teach about brain-based differences beyond diagnostic labels. Teaching separately about autism, dyslexia, ADHD etc. misses cross-condition commonalities, and may lack relevance to typically developing children, or neurodivergent children without diagnoses or supports--whether due to resourcing, attitudes, or race- and gender-related diagnostic disparities. The LEANS project proposes whole-class teaching about neurodiversity as an “umbrella” concept, in order to increase pupil and teacher understanding of differences in learning, interaction, and sensory experiences, and to promote inclusive actions and attitudes. Unlike some existing education resources focused on neurodivergence, LEANS is not an intervention for a perceived classroom “problem”, but upskills all pupils and staff members, focusing on capacity for positive future changes.

**Objectives:** Through co-design with educators, identify strategies and concepts needed to teach about neurodiversity as an “umbrella concept” in a way that is accessible and engaging for mainstream primary pupils age 8-11, and their teachers. In this project, “teaching neurodiversity” includes addressing attitudes and actions in the school community, not increased factual knowledge alone.

**Methods:** Neurodiverse teams of researchers (n=7) and experienced educators (n=8) collaborated in seven 90-minute online design workshops to elicit content ideas. These were structured around five main discussion topics: introducing neurodiversity, the classroom, other school activities (e.g. sport, the arts), friendship and social interaction, and applying neurodiversity knowledge.

**Results:** Across workshops and domains, the same concepts consistently re-appeared as essential to explaining neurodiversity and neurodivergence in school, and conveying their relevance to individuals. These included: learning to distinguish ‘needs’ from ‘wants’; understanding and adopting equity-based concepts of fairness, especially where these relate to additional supports/resources at school; and recognising the equal validity of different types of communication, sense-making, and engagement with learning. The team further identified the need to make neurodiversity education distinct from other widespread educational messaging on differences (i.e. “everyone is unique”). Neurodivergence is a *different type of difference*, both in degree and in type, than those with which children may already be familiar.

**Conclusions:** Outputs from the neurodiverse design team emphasise that teaching neurodiversity in schools is not primarily about definitions or facts; it requires attention to a surrounding ‘family’ of concepts. Grasping needs, equity, and validity issues are the necessary groundwork to justify and motivate changes in people’s attitudes and actions. The design process also highlighted the challenge of making neurodiversity information distinct from other difference-focused educational messages.

Resource development is ongoing, plus review by additional educators and community members. LEANS will be evaluated for efficacy in UK primary schools in 2021, focusing on changes in pupil and teachers’ neurodiversity-related knowledge and attitudes. The final resource pack will be available for free in late 2021.

**417.019** (Poster) Loneliness in Relation to Age and Peer Engagement in Children and Adolescents with Autism Spectrum Disorder

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**Background:**

Children and adolescents with Autism Spectrum Disorder (ASD) tend to have fewer social connections and reciprocal friendships compared to typically developing students (Dean, Harwood, & Kasari, 2014; Locke, Ishijima, Kasari, & London, 2010). Within existing relationships, individuals with ASD also report poorer friendship quality (Chamberlain et al, 2007; Kasari et al, 2011; Kasari et al, 2015). These social challenges are associated with increased loneliness, which becomes more pronounced in

adolescence (Humphrey & Lewis, 2008; Locke et al., 2010; Pisula & Łukowska, 2012). Research is needed to examine the emergence of loneliness across a wide age span, and to explore the relationship between loneliness and social engagement at school.

#### Objectives:

The primary objective of this study was to examine the emergence of loneliness in children and adolescents with ASD. A secondary aim sought to examine the relationship between participants' self-report of loneliness and observed engagement states.

#### Methods:

This is a secondary analysis of data that were collected from two large multi-site randomized control trials, in which children and adolescents with ASD participated in social skills interventions across four sites. Data were derived from baseline assessments, which were collected prior to the start of intervention.

Children and adolescents with ASD (N = 199) from elementary, middle, and high school, (6 -19 years;  $M= 10.34$ ,  $SD= 3.52$ ) had a confirmed diagnosis of ASD (ADOS, Lord, Rutter, Dilavore & Risi, 2002), average or above average intelligence ( $IQ \geq 70$ ; Stanford-Binet, Fifth Edition), and were educated in a general education classroom for a minimum of 80% of the school day. Participants were observed two times during unstructured social periods at school (recess/break and lunch) using the Playground/Teen Observation of Peer Engagement (POPE/TOPI; Kasari et al., 2016, Oti et al., 2010). Participants also completed the Loneliness Rating Scale (self-report; Asher, Hymel, & Renshaw, 1984). Correlation and regression analyses were utilized to evaluate the relationship between self-reported loneliness and age, and observer-rated social engagement.

#### Results:

There was a significant positive correlation with age and loneliness such that older children reported higher levels of loneliness ( $r= 0.29$ ,  $p= .001$ ). Similarly, children who were in middle/high schools reported significantly greater loneliness compared to children in the elementary schools ( $\beta= 16.64$ ,  $p= <0.001$ ). There was no association between loneliness and observed joint engagement ( $r= -0.07$ ,  $p= 0.38$ ) or solitary ( $r= 0.06$ ,  $p= 0.46$ ).

#### Conclusions:

The study findings highlight the complexity of loneliness in children and adolescents with ASD. Adolescents with ASD reported significantly greater loneliness compared to children with ASD. Participants who spent a majority of time jointly engaged were just as likely to report feelings of loneliness as participants who spent a majority of time in solitary. These findings suggest that one does not need to be physically alone to feel lonely. Alternatively, some children with ASD appear content with spending a majority of time in solitary. More research is needed to examine possible discrepancies between desired and actual relationships.

#### **417.020** (Poster) Measurements of Spontaneous Communication Initiations in Children with Autism in Preschool to Third Grade Classrooms

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#### Background:

We have made great strides in understanding and measuring communication in young children with autism in clinical settings. Yet, there is still much to learn about how and why elementary-age children with autism spontaneously communicate within classrooms and the developmental features that are associated with the frequency and function of their communication initiations.

#### Objectives:

We examine the frequency and function of spontaneous communication initiations ("communication initiations") within a sample of children with autism during early to middle childhood, as they engage with their teachers and peers during structured and unstructured classroom activities. We investigate the latent structure of communication initiations within the classroom and explore how children's characteristics (i.e., autism severity) influence their communication initiations.

#### Methods:

This study used archival classroom video observations (R324130350) from the beginning of the school year, in which communication initiations were coded as part of a larger project evaluating classroom active engagement (Sparapani et al., in preparation). The videos captured times when educators (teachers and paraprofessionals) and children worked together during 1 to 1, whole group, or small group contexts. Children (N=113; Mage=6.16) ranged from preschool to 3rd grade from 63 schools and 17 districts in CA (80% special education). Nine communicative functions were coded and analyzed using count and proportion metrics.

Results:

(Preliminary)

For a statistical summary of all initiating communication functions, see Table 1 below.

We observed high proportions of zeros for most of the communication functions, (43% –91%), and therefore dichotomized the variables for analysis to prevent model fitting errors. Guided by the literature, we specified and identified two models as well as a unidimensional construct to represent the most parsimonious structure of communication initiations. We evaluated the absolute and relative fit of the models using confirmatory factor analysis with the WLSMV estimator and Mplus software. We trimmed “protesting” from the model due to its very low occurrence. The unidimensional model evidenced good fit overall and the best fit to the data (RMSEA = 0.068 [0.018–0.107]; CFI = 0.950;  $\chi^2/df = 1.53$ ). All of the factor loadings were significantly different from zero ( $p < 0.05$ ).

We used structural equation modeling to examine the unique contribution of children’s age, cognitive and adaptive abilities, and severity of autism symptoms to the communication latent factor. Children’s adaptive behavior explained a significant amount of variance in children’s communication initiations ( $\beta = -0.31$ ;  $p < 0.05$ ) over and above its shared covariance with the other predictors. Age was approaching significance (0.08).

Conclusions:

This study provides a descriptive analysis of how and why school-aged children with autism initiate communication and the developmental characteristics that influence their communication. These data provide preliminary evidence for a quantitative measure of communication in the classroom. A unidimensional model of communication initiations may reflect a low occurrence rate of specific communicative functions, or it might suggest that children’s communication is more nuanced in older years.

**417.021** (Poster) Outcomes of High-Quality Training on Teacher Implementation of Ebps for ASD

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Background:

Children with autism spectrum disorder (ASD) receive a majority of services in schools. Although evidence-based practices (EBPs) for ASD exist, the research on teacher implementation of EBPs in schools indicates low usage and poor fidelity. In response the California Autism Professional Training and Information Network (CAPTAIN) was created to scale-up the use of EBPs for ASD. CAPTAIN is a statewide cross-agency collaboration with over 400 members representing school and community agencies, including 97% of Special Education Local Plan Areas in the state. Using a train-the-trainer model, CAPTAIN provides training to members annually and supports regional plans for training and implementation. Members are required to provide high quality training on ASD and EBPs as well as provide implementation coaching to at least three providers or programs annually.

Objectives:

To examine the effects of receiving high quality training and coaching from a CAPTAIN member on provider EBP knowledge and implementation outcomes of EBP fidelity and classroom quality.

Methods:

A statewide survey was sent online to providers that asked about their EBP training experiences and EBP use for the 2018-2019 school year. Respondents included 1,582 special educators, paraeducators, general educators, and direct service providers from across California. Of these 1,582 respondents, 330 had received EBP training from a CAPTAIN member. An additional online survey assessing EBP knowledge, self-rated EBP fidelity, and classroom quality was sent to 253 teachers, both to those who had received training by a CAPTAIN member (n = 60) and those who had not (n=193).

### *Measures*

**EBP Knowledge and Fidelity.** For each EBP used, teachers completed a knowledge assessment and implementation checklist from the NPDC-ASD.

**Classroom Quality.** Teachers completed the self-report version of the Autism Program Environmental Rating Scale (APERS; Odom et al., 2018), which is designed to assess the overall quality of program environments for students with ASD.

**EBP Attitude.** Respondents completed the Evidence-Based Practice Attitude Scale (EBPAS; Aarons, 2004), which measures general attitudes toward adoption of EBPs.

### *Data Analysis*

Data analysis using ANOVA, GLM, GEE, and Chi square indicated positive outcomes for providers that received training by CAPTAIN members.

### *Results:*

CAPTAIN trained providers had significantly higher EBP knowledge, reported feeling more competent implementing EBPs, more knowledgeable explaining their primary EBP, and reported higher levels of EBP openness than providers not trained by CAPTAIN. Teachers were twice as likely to self-report above 80% fidelity on EBPs if trained on the EBP by CAPTAIN than providers not trained at a trend level. Trained providers also reported using all of the components of their primary EBP to a greater extent, used their primary EBP with “most or all students” with higher frequency and reported collecting fidelity of implementation data and student data. Finally, trained teachers reported significantly higher classroom quality compared to teachers who were not trained.

### *Conclusions:*

These preliminary findings show promise for the efficacy of the CAPTAIN model to increase dissemination and effective implementation of EBP at the classroom level. Future research will involve objective assessment of teacher and student outcomes that result from CAPTAIN participation.

**417.022 (Poster)** Person-Centered IEP Transition Planning for Students with Autism Spectrum Disorders: What Are We Still Missing?

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**Background:** After exiting the school system, students with autism spectrum disorder (ASD) face challenges in post-school outcomes including low rates of employment, independent living, and post-secondary education. Engaging students and their families in transition planning early on has been identified as a way to improve post-school outcomes, which is underscored by Individuals with Disabilities Education Act (IDEA) mandates. Reauthorizations to the IDEA have also emphasized the person-centered approach, including the voices of students with ASD in transition planning. Despite such mandated policies and guidelines, person-centered transition practices are not uniformly implemented. The present study utilized a qualitative approach to investigate barriers and facilitators to the implementation of person-centered transition planning for students with ASD.

**Objectives:** The primary objective of the present study was to better understand barriers and facilitators of person-centered transition planning practices for students with ASD, from the perspective of multiple stakeholders.

**Methods:** We conducted qualitative, in-depth interviews with 22 stakeholders including four youth with ASD, ten parents of youth with ASD, and eight professionals (e.g., special education teacher, transition specialist). The average ages were 17.1 years

( $SD = 7.2$ ) for youth with ASD, 50 years ( $SD = 7.6$ ) for parents, and 51 years ( $SD = 14.5$ ) for professionals. Only three participants were male including one youth with ASD and two professionals. The semi-structured interviews ranged from 60-90 minutes. Using the interview transcripts, we coded data line by line using constant comparative analysis and emergent coding.

**Results:** Analysis of interview transcripts yielded 40 codes, and five separate themes. We used a combined Self-Determination Theory and Ecological Systems Theory to interpret the barriers and facilitators of person-centered transition planning practices (see Figure 1). First, the characteristics of youth with ASD influenced their involvement in person-centered transition planning such as self-determined motivation, balance between the dream and the reality, goal ownership, passive or active role of students, anxiety, and the severity of autism. Second, with respect to microsystem (e.g., parents and teachers), we found that person-centered transition planning was well-implemented when parents advocated for including students with ASD in the process and when teachers implemented appropriate data-driven assessment and progress monitoring. Third, with respect to mesosystem (e.g., interaction between microsystems), it was critical to have ongoing communication among stakeholders and connections with outside agencies. Lastly, we found that community resources were critical in limiting or promoting person-centered planning outcomes.

**Conclusions:** Person-centered transition planning practices for students with ASD show inconsistencies and areas needing improvement. Multiple stakeholders could support engaging students with ASD in person-centered transition planning at different levels. As efforts to improve transition services and outcomes continue, it will be important to consider and address the barriers and facilitators described by stakeholders.

**417.023** (Poster) Racial/Ethnic Disproportionality of Autism in Special Education in California  
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**Background:** Racial/ethnic disproportionality in special education for racial/ethnic minority children is a persistent issue in the field. Special education disproportionality is defined as the degree to which belonging to a given group (e.g., gender, race/ethnicity, or socioeconomic class), affects the probability of being found eligible for special education placement (Cruz & Rodl, 2018). Disproportionality can result in overrepresentation or underrepresentation of certain groups in special education eligibility and placement. While there are established issues of under-identification of Latinx families of children with autism, less is known about the interplay between over-identification and under identification by diverse racial/ethnic groups. In order to examine the over/under identification interplay, we conducted an exploratory analysis of significant disproportionality in special education of students with autism in California.

**Objectives:** RQ1: What are the characteristics of Local Educational Agencies (LEAs) identified as significant disproportionate in the special education category of autism in California? RQ2: What demographics factors (e.g., race/ethnicity, family income, English proficiency) impact disproportionality in autism?

**Methods:** To answer RQ1, we obtained data from the California Department of Education (school year 2018-2019) and identified LEAs ( $N=130$ ) with significant disproportionality in various disability categories. Risk ratios were used to calculate the probability of students in a given racial/ethnic group to be identified in a given disability category (i.e. autism) within the LEA. We used descriptive statistics (e.g., Mean, standard deviation) to analyze each LEA with overrepresentation of students in the special education category of autism (a risk ratio of 3.0 or more). Lastly, we conducted a comparative analysis of risk ratios for each of the racial/ethnic groups represented in the final sample of disproportionate districts in autism.

**Results:** From the initial 130 LEAs/districts, a total of 7 LEAs ( $N=7$ ) were identified as significant disproportionate for the over-identification of any given racial/ethnic group in with autism. Specifically, all the LEAs were identified as significant disproportionate for the over-identification of White students with autism. Hence, White students had a risk ratio of 3.00 or more in each of the 7 LEAs. This means that White students were 3 times more likely to be placed in the special education category of autism than the rest of the other racial/ethnic groups within the LEA. Preliminary analysis show that the 7 disproportionate districts are strikingly similar across 3 main demographic factors in each LEA (racial/ethnic distribution, percentage of economically disadvantaged students, and percentage of English Learners). Importantly, all the disproportionate districts also had an under-identification of Latinx students with autism.

**Conclusions:** The under-identification of Latinx students may result in the overrepresentation of White students with autism. This study sheds light into the interplay of over-identification of White students with autism and the under identification of Latinx students with autism. Additional data collection is under way to examine the experiences of parents of children with autism as they access an autism eligibility and services in the 7 disproportionate LEAs.

**417.025 (Poster)** Reviewing the Evidence for Using Video-Based Intervention to Teach Employable Skills to Transition-Age Students with ASD

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**Background:** For youth with autism spectrum disorder (ASD), finding employment after high school, particularly employment that offers hours and wages comparable to that of their neurotypical peers, is often difficult. One aspect contributing to this employment gap is students' lack of applicable vocational skills. Video-based intervention (VBI), an evidence-based practice (EBP) for teaching skills to students with ASD, may be one method to bridge this skills gap. However, given that much of the VBI literature focuses on daily living skills, rather than marketable vocational skills (i.e., a skill that one could realistically receive pay for performing), the effectiveness of VBI to teach employable skills requires further evaluation.

**Objectives:** The purpose of this study was to empirically evaluate the effectiveness of VBI to teach marketable vocational skills to transition age (14-21) youth with ASD through a synthesis of the literature. Further, we aimed to analyze (1) the effectiveness of particular facets of the VBI used, (2) the types of skills taught, (3) the characteristics of students for whom VBI was effective, and (4) the degree to which VBI has been implemented in authentic contexts. To date, there has yet to be a systematic review on this topic that goes beyond descriptive measures of the literature base.

**Methods:** A systematic search of the literature yielded 23 studies that met the inclusion criteria. Studies were assessed and coded for content, participant demographics, What Works Clearinghouse (WWC) design standards, and quality indicators (Horner et al., 2005; Gersten et al., 2005). Studies that met design standards with or without reservations were analyzed using visual analysis, success estimates, and Tau-U effect sizes.

**Results:** Overall, VBI was found to be effective in teaching marketable vocational skills to students with ASD. Of the 19 studies that met standards with or without reservations, 16 studies had success estimates of 100%. In addition, 14 studies indicated strong effects (Tau-U  $\geq$  0.93), four had medium-to-high effects (Tau-U=0.66-0.92), and only one had weak effects (Tau-U<0.66). Although the use of video modeling and video prompting was relatively equal across the total sample, studies that demonstrated strong effects were more likely to use video prompting. The use of supplemental supports such as error correction, were used among 39% of studies and did not appear to be more or less effective than studies that did not use them. Skills taught with VBI ranged across eight major content areas, with the most common being clerical and food preparation. The synthesis included 59 participants with ASD, with a mean age of 17.1 years old, and were primarily male (94%) with co-occurring intellectual disability (ID; 61%). Other demographic characteristics were rarely reported. Only 35% of studies were implemented in authentic settings, and only 26% by an authentic agent.

**Conclusions:** The findings indicate that VBI is effective in teaching employable skills to transition-age youth with ASD and could feasibly be used to address the postsecondary employment gap. However, further diversification in terms of participant demographics, types of skills, and authentic implementation contexts is needed.

**417.026 (Poster)** Specialized Training in Autism Spectrum Disorder: Characteristics of Law Enforcement Officers Who Seek Training to De-Escalate Emergency Situations

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**Background:** As the incidence rates of Autism Spectrum Disorder (ASD) continue to increase in children and adults, so do interactions between Autistic persons and law enforcement. Lack of training and knowledge of autism may result in LEOs misinterpreting ASD specific behavior as noncompliant, threatening, disorderly, or suspicious. A number of highly publicized negative encounters between Autistic individuals and LEOs have resulted in several states requiring formalized training for LEOs in ASD. However, little is known regarding the content or impact of these training programs. There is currently no empirical literature examining personal characteristics of officers who self-select to participate in specialized in-person training in autism spectrum disorder.

**Objectives:** The primary author created a bi-monthly training program for LEOs that prepares officers to respond to calls involving individuals with ASD. The present study included 234 LEOs who completed a 4-8 hour autism-specific training due to personal interest, direction from their employer, or a combination thereof. The purpose of the present study was to determine differences in personal and professional characteristics of LEOs who elected to seek specialized training in autism.

**Methods:** Two-hundred and thirty-four LEOs attended nine separate training sessions. LEOs were 63.4% ( $n = 151$ ) male with a mean age of 40.95 years ( $SD = 10.5$ ) and 13.48 years of law enforcement experience ( $SD = 9.2$ ). A total of 145 (61.97%) LEOs indicated attending the training per employer requirements, and 38.03% ( $n = 89$ ) reported attending due to personal interest. To

evaluate LEOs' prior experiences, participants completed a questionnaire that included relationships with individuals with ASD and professional experience.

Results: Findings revealed that 50.6% ( $n = 45$ ) of LEOs who self-selected to participate in the training reported a personal relationship with someone with autism, which is greater than LEOs who were required to attend the training 23.6% ( $n = 35$ ),  $\chi^2(1, N = 234) = 18.00, p < .001$ . LEOs were equally likely to have completed autism-specific,  $\chi^2(1, N = 234) = 0.34, p = .56$ , and Crisis Intervention Training,  $\chi^2(1, N = 234) = 0.43, p = .84$ , regardless of whether they were required to complete training or not. Gender was not related to LEO self-selection,  $\chi^2(1, N = 234) = 0.07, p = .79$ .

Conclusions: The results of the present study compared differences in personal characteristics of officers who chose to attend specialized in-person training in autism spectrum disorder versus those who attended per requirements of their employer. Overall, LEO characteristics including gender, years of law enforcement experience, previous autism training, or previous training in crisis de-escalation did not differ between the two groups. However, having a personal relationship with someone with autism was reported at much higher rates among LEOs who self-selected to attend the training.

**417.027 (Poster)** Supporting Autistic Adults in Postsecondary Settings: A Systematic Review of Peer Mentorship Programs  
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Background: There is an increasing number of autistic individuals attending college or university; however, graduation rates remain low, with 39% of autistic students matriculating within 8 years of study, versus 60% of the total student populace matriculating within 6 years. This is despite autistic students having strengths which lend themselves to success in academia, such as memory skills, detail orientation, and passionate interests. The failure of post-secondary institutions to support the individual needs of these students is thought to be one contributing factor. For example, it is often reported that adjustment to dormitory living, learning in larger settings, and personnel hierarchies (i.e., counselors, teaching assistants, professors) pose as challenges. As well, difficulties with social relationship formation have been cited. A promising approach is the emergence of peer mentorship programs designed to provide individualized, one-on-one support for autistic post-secondary students. However, there is no literature to date which has systematically examined such programs.

Objectives: A systematic review was conducted that described existing peer mentorship programs for autistic students in post-secondary education, as well as their effectiveness.

Methods: A search of five databases (PsycINFO, Medline, Embase, Scopus, and Web of Science) identified nine unique programs that were evaluated in 11 peer-reviewed articles.

Results: Programs existed in predominantly White, English speaking countries (United Kingdom, Canada, United States, and Australia). Most programs (78%) involved both individual peer mentor meetings and group meetings. Some of the latter were social in nature, whereas others were skills/strategy based. Programs reported various positive outcomes, some of which included social skills, academic performance, and a sense of belonging. A number of themes were identified in studies that conducted qualitative analyses, with overarching themes suggesting the importance of the peer-mentor relationship. Notably, the evidence for these programs was mostly qualitative, small in sample size, and there was considerable heterogeneity in the design, delivery, and goals of these programs, as well as the evaluation methodology used.

Conclusions: Peer mentorship programs are a promising means of addressing the needs gap of autistic students, with a variety of positive and diverse outcomes reported. This is significant considering the potential to improve post-secondary experience and increase the likelihood of graduation. Making statements about the overall effectiveness of peer mentorship programs is challenging due to heterogeneous program design and goals, however. Further research is needed to quantify program effectiveness and conduct program comparisons.

**417.028 (Poster)** Teacher Experiences of Implementing Ideas Maker Program, a Research-Based Inclusive STEM Curriculum in Public Middle Schools  
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Background: Students on the spectrum have strengths well-suited for STEM careers (e.g., cognitive traits of systemizing thinking and attention to detail) and present high postsecondary enrollment rates in STEM-related majors. However, barriers to their

success in STEM workplaces persist, including their challenges in social communication and executive functioning, as well as a lack of autism-inclusive STEM education programs. To support autistic secondary students' STEM competency in inclusive public middle schools, we developed an inclusive engineering design program called Inventing, Designing, and Engineering for All Students (IDEAS). The IDEAS program has demonstrated positive effects on STEM competency and social interaction. Understanding the experiences of school teachers leading the program would provide valuable insights on program implementation and improvement.

**Objectives:** To present teachers' perceptions and experiences running Maker clubs, their perception of its advantages and disadvantages, and their suggestions and action plan to improve the club curriculum.

**Methods:** In this qualitative study, we interviewed 10 teachers leading the program at three public middle schools in a large, urban area over two school years. Two focus groups with teachers across schools were conducted at the midpoint of the program to identify teachers' challenges and barriers of program implementation. Six group interviews were conducted with teachers at each school at the end of each school year to facilitate conversations regarding school-specific program experiences and issues. We further collected teachers' program implementation logs (n=25) and field observation notes (n=149) at the three schools. Thematic analysis was conducted to explore teacher experiences.

**Results:** Thematic analysis revealed that teachers valued the flexibility of this program, which enabled them to adjust the clubs to their schedule and learning needs. They enjoyed co-learning and co-making with their students in their new role as facilitators and cheerleaders rather than adopting their conventional role as knowledge providers. This propelled students to take charge of their making and designing, thus enabling them to become "expert makers." Furthermore, teachers new to the program appreciated their support from co-leaders as they facilitated these clubs, which enabled them to organize themselves and club sessions better. These clubs' safe and nurturing space equipped them to understand their students' abilities and interests better, and teachers incorporated them effectively in the clubs and sometimes even in the classroom. Many teachers also appreciated how the club space enabled Autistic students to manage their frustration while working, regulate emotions, and socialize organically with peers by connecting over their interests. Teachers attributed the logistical and organizational challenges they faced to the need for more exposure and practice with technology and infrastructural shortcomings. Despite facing these challenges, teachers were eager to learn, open to adopting changes, and collaborating with the research and support teams to overcome the challenges.

**Conclusions:** Involving teachers in the planning and execution of clubs resulted in developing a sustainable environment where clubs were adapted to meet student needs. Since teachers modified the curriculum plans, they felt empowered and included in the process and hence voiced their concerns and ideas to enhance these clubs.

**417.029** (Poster) Teacher-Student Interactions within Mathematics Instructional Contexts in Classrooms Serving Students with Autism

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**Background:** An increasingly robust body of literature identifies teacher-student interactions as a linchpin for student development and learning and an important intervention target for students with typical development and at-risk populations (e.g., Downer et al., 2010). Empirical evidence has documented links between teacher language and student active engagement (Connor et al., 2020) as well as predictive associations between high quality interactions and students' academic and social outcomes (e.g., Burchinal et al., 2008). Few studies have evaluated interactions between students with autism and their teachers.

**Objectives:** To examine how teachers (with a range of knowledge, skills, and practices) teach mathematics lessons, the amount and type of talk they use with students with autism, and how teacher moves (practices and language) relate to student engagement and student-level characteristics (cognitive and adaptive abilities, problem behaviors, autism symptoms).

**Methods:** Participants included 84 preschool–3rd grade students with autism and 65 teachers from general and special education classrooms across 17 districts in CA. We utilized archival video observations (R324A140005) to examine the dynamic relations among teacher instructional “moves” (instructional practices and teacher language) and student active engagement in the context of mathematics instruction. We drew from existing literature for guidance to examine teachers' instructional moves and the *Classroom Measure of Active Engagement* (CMAE; Sparapani et al., 2016) to evaluate student engagement. Trained observers coded the observations using Noldus Observer® Video-Pro Software (XT 13; 2017), achieving and maintaining high interrater agreement using occurrence agreement (>80%).

Results: We report preliminary findings from 58 students (Mage = 6 years) and their teachers (n = 36) across 90 mathematics tasks. Overall, teachers primarily delivered mathematical tasks that required low/medium cognitive demand (recall and procedural tasks), rarely provided students access to learning materials, and predominantly used language to direct student behavior (e.g., sit down; M=19.48 instances, SD = 26.66). Some teachers used very little responsive language while others were very responsive (M=11.96, SD = 17.86). We observed moderate to strong positive associations between teachers' use of responsive language and students' emotion regulation ( $r = 0.71$ ;  $p < 0.01$ ), productivity ( $r = 0.64$ ;  $p < 0.01$ ), and teacher-rated adapted behavior (VABS;  $r = 0.36$ ;  $p = 0.05$ ). Teachers used less responsive language with students who exhibited more problematic behavior (PDDBI;  $r = -0.51$ ;  $p = 0.05$ ). Finally, students' cognitive abilities and presence of problematic behavior predicted the types of tasks teachers provided to them,  $F(29) = 2.29$ ;  $p < 0.05$ .

Conclusions: Findings suggest that the nature of the mathematical task facilitates different learning opportunities for students with autism and also provides insight into salient features of teachers' practices and talk that promote (or hinder) student engagement. These data document variability in teacher language, which is in part, is due to specific student characteristics that influence their talk. The results may provide a means for teachers to reflect on their instructional moves, observing nuances of instructional practices and talk that could improve the learning experiences of students with autism and potentially create change in student learning over time (Van es et al., 2017).

**417.030** (Poster) Teaching Online during a Pandemic: Special Educators' Experiences Working with Parents  
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Background: Due to the COVID-19 pandemic, school buildings worldwide abruptly closed in Spring 2020, forcing a shift to online learning. This task was especially difficult for special educators working with children with autism, as this population often benefits from close relationships with teaching staff, direct/one-on-one instruction, and implementation of behavioral and motivational strategies to improve engagement and encourage routines. Teachers therefore had to work much more closely with parents than ever before, with many relying on parents to implement the curriculum, particularly those with younger students.

Objectives: The current study presents a qualitative investigation into elementary special educators' perspectives on and experiences with working with parents while teaching online due to COVID-19. The study aimed to answer the following questions: 1) How did teachers collaborate with parents during this time? 2) What shifts were there in teacher-parent relationships? 3) What are the implications regarding parent educational involvement going forward?

Methods: Six elementary special educators teaching in autism-only or majority-autism classrooms in districts throughout California participated. (Five additional participants are not reported herein, as their classrooms were not majority-autism.) Three teachers served students with mild-moderate disabilities; the others served students with moderate-severe disabilities. All teachers had self-contained special day classes except for one resource teacher who taught via push-in/pull-out. Four teachers taught at schools with over 60% minority students enrolled. All participants were interviewed via Zoom using a semi-structured interview guide. Interviews lasted 50 minutes on average. Interview transcripts were coded inductively and analyzed using thematic analysis.

Results: Four themes were generated: 1) Strengthening Parent-Teacher Relationships; 2) Importance of Non-Academic Support; 3) Parents as Instructional Partners; and 4) Challenges to the Teacher Role. Regarding relationships, teachers reported both they and parents appeared to have more insight into what the other was experiencing. Teachers often made reference to having a lot of empathy toward students' families and highlighted the importance of good rapport. Teachers also discussed wanting to provide socio-emotional support first and foremost, with many expressing a concern for families' safety and basic needs. Some teachers had issues with parent engagement, and though many parents tried implementing strategies at home, teachers recognized the difficulties of parents assuming the teacher role. Finally, teachers expressed dealing with challenges in terms of accountability (e.g. taking attendance) and providing feedback to parents (e.g. teaching parents to use strategies that foster independence).

Conclusions: While recognizing the challenges inherent in online teaching for students with autism, teachers in this study gained insight into their students' families and emphasized the importance of parent-teacher relationships. They also highlighted ways in which the experience teaching during the COVID-19 pandemic may positively influence their teaching in the future (e.g. by ensuring more consistent communication and emphasizing rapport-building). The findings are not only useful to special educators still navigating teaching during the pandemic but will also be of use to those teaching in-person in the future. Future research must follow-up on these findings to see if this experience changes teachers' perspectives on involving parents in their students' education long-term.

**417.031 (Poster) Teaching Students on the Autism Spectrum: Joys and Trials**

*C. M. Anderson, C. I. Wood, L. N. Franklin and A. O. Iampieri, Health Sciences, Towson University, Towson, MD*

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**Background:** Children and teenagers with autism spectrum disorder (ASD) spend a great deal of time in school, and many of the interventions they receive are delivered there. How competent, compassionate, and well supported teachers are directly impacts students with ASD and their families. Unfortunately, little is known about these teachers' day-to-day achievements and struggles.

**Objectives:** To explore the experiences of educators serving students with ASD as well as the roles played by colleagues, administrators, students' families, and larger systems.

**Methods:** Qualitative interviews addressing experiences teaching students with ASD in public schools were conducted with 19 educators, including special and general education teachers. Interview transcripts were analyzed using the constant comparative method associated with a grounded theory approach.

**Results:** Four major themes emerged from educators' narratives. **(1) "Getting Autism."** Teachers described a bond with students with ASD and pride in their ability to read and respond to them. *It's knowing that those kids can understand everything I'm saying and to not talk about them like they can't. I've always tried to talk to them...as if they can understand me because they can. And tried really hard to communicate with them in a way that they can communicate.* **(2) Allies and Adversaries.** Teachers sometimes found their best support came from involved parents or fellow professionals – people who helped them problem solve and advocate for their students. At the same time, parental denial or colleagues' misunderstanding of ASD could impede progress. *They want to send him out of the room because he is spinning in the background. "Okay. Is he disturbing anything?" If he needs to spin for a little while to get that movement and he is still...absorbing what the teacher is saying, does he really need to leave? He might need to sit in the back of the classroom and bounce on a ball while he is listening... We have to be creative with how we offer that.* **(3) Tangled Systems.** Teachers worked within bureaucracies governed by federal and state laws, district policies, and institutional beliefs. Resources were scarce; restrictions were plentiful. *The school psychologist is only allowed to say the A-word as, "We are concerned that the student is showing signs of..." Families then must go and find somebody out in the world who can diagnose which takes forever.* **(4) Taking a Toll.** Teachers were spending their days with children on the spectrum who were sometimes aggressive or emotionally labile. This, plus frustrations with larger systems, had physical and psychological consequences. *I have been sent to the hospital. They will hurt you. It's not because they're vicious or horrible people. They just lose control of themselves.*

**Conclusions:** Educators with an understanding of autism contribute a great deal to their students' progress and sense of well-being and acceptance. However, they often struggle with a wider school community that has little understanding of autism, as well as bureaucratic burdens. A deeper understanding of the issues facing these professionals may help school districts and families more effectively support them and their students.

**417.032 (Poster) The Academic Learning Experiences of Autistic University Students: Challenges with Alexithymia, Cognitive Flexibility, Social Satisfaction and Mental Health**

*B. J. Scott, J. J. Millington and S. Anns, University of Sussex, Brighton, United Kingdom*

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**Background:** The number of autistic university students has increased in recent years; however, the levels of completion and achievement are still lower for these students compared to their peers (Levy & Perry, 2011; Drake, 2014). Completion of a university degree consistently predicts positive adult outcomes and autistic graduates have more favourable long-term prospects in employability and income compared to non-autistic graduates (Hendrickson et al., 2013). As a consequence of the core traits of autism, many of the academic, social, and daily living challenges can be magnified for autistic students, making the transition to higher education challenging (e.g., Hillier et al., 2017; Jackson et al., 2018), particularly in areas such as information processing, flexible planning, and social difficulties (Anderson et al., 2017; Gurbuz et al., 2019; Anderson et al. 2019; Jansen et al. 2018).

**Objectives:** The aim of this study is to examine the academic and social learning experiences of autistic university students and to explore their relationship with cognitive flexibility, alexithymia and mental health diagnosis. Based on the current literature we expect that (i) autistic students will report relatively more challenges with academic learning experiences compared to their neurotypical peers, (ii) they will show relatively more difficulties with cognitive flexibility, alexithymia and mental health, and that (iii) these factors, with the addition of social satisfaction, will predict relatively more learning challenges.

**Methods:** The study was completed by 82 autistic and 107 non-autistic students enrolled in universities in the UK, Ireland, Australia, and New Zealand. Group membership was confirmed by the Social Responsiveness Scale-Second Edition Adult Version (SRS-2; Constantino & Gruber, 2012). An original questionnaire, the Academic Learning Experiences Questionnaire (ALE-Q) was devised, incorporating constructs such as anxiety in group learning, sensory issues in a lecture environment, group

vs. independent study, and memory and organization of learning materials. The Toronto Alexithymia Scale (TAS-20; Bagby, Parker & Taylor, 1994) and the Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995) were added to the measures above in an online Qualtrics survey and a link to the Group Embedded Figures Test (GEFT; Witkin et al., 1971) was provided at the end of the survey.

Results: Preliminary results show significant differences between groups of autistic and non-autistic students' academic learning experiences, with autistic students reporting significantly more challenges on the ALE-Q. Additionally, significant group differences were found on the CFS, the TAS-20 as well as in student social satisfaction. Furthermore, an anxiety diagnosis, low social satisfaction, lower cognitive flexibility and alexithymia significantly predicted more negative academic learning experiences for autistic students. In comparison, only an anxiety diagnosis was a significant predictor of negative academic learning experiences for non-autistic students.

Conclusions: Preliminary findings indicate that autistic students face more challenges around cognitive flexibility, alexithymia, social satisfaction and mental health, and that these are related to their academic learning experience at university. Awareness of these challenges in this growing student subpopulation is vital if universities are to provide individualised, effective support and findings from this study should contribute to informing such support.

**417.033** (*Poster*) The Experiences, Practices, and Needs of General Education Teachers Including Autistic Students in High-Poverty Schools

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Background: Inclusion of autistic students in general education classrooms is becoming increasingly common, however, teachers consistently report a lack of adequate knowledge, training, and resources to effectively educate these students. These barriers are compounded in districts where large percentages of students live in poverty, as the quality of instruction tends to be lower, teachers tend to be less qualified, and inclusion of autistic students in general education is often more common. Examining general education teachers' perceptions and experiences with inclusion and their use of evidence-based practices (EBPs) for autistic students is important for providing targeted training and support that fits the context and needs of teachers working in high-poverty schools.

Objectives: Our primary objective is to examine the perceptions, experiences, and use of EBPs for autism by general education teachers including autistic students in high-poverty schools. Research questions include: 1) What are the barriers to inclusion? 2) What are the facilitators to inclusion? 3) What strategies for supporting autistic students do these general education teachers use that are consistent with EBPs for autism?

Methods: This study utilized qualitative focus groups with 27 general education teachers working in schools with high percentages of students receiving free or reduced lunch ( $M = 68.6\%$ ,  $SD = 14.1$ ). Participants taught kindergarten through eighth grade in public and charter schools in 16 counties across California, had an average of 12.8 years ( $SD = 8.9$ ) of teaching experience, and taught at least one autistic student as the lead teacher in a general education classroom. All schools had at least 50% of students receiving free or reduced lunch. Ten focus groups each consisting of 2-5 teachers and at least one facilitator were conducted over Zoom. Groups lasted approximately 45 minutes. Researchers sent teachers fictional student vignettes for discussion, asked questions, and encouraged teachers to share their personal experiences. Thematic analysis was used to analyze focus group data. Approximately 30% of transcripts were co-scored for interobserver reliability (95.9%).

Results: Teachers reported three main barriers to inclusion: 1) characteristics of autistic students (e.g., disruptive behavior, challenges with social communication), 2) simultaneously meeting the needs of peers, and 3) negative responses to autistic student from peers. The primary facilitators of inclusion were: 1) consultation and collaboration with professionals (e.g., special education teacher, school psychologist, etc.), 2) instructional aide for student/classroom support, and 3) diverse range of peer needs (e.g., many other students also had individualized learning needs/supports). The most common strategies teachers used that are consistent with EBPs for autism were: 1) visual supports, 2) reinforcement, and 3) peer-based intervention.

Conclusions: Results can guide how general education teachers working in high-poverty schools are trained and supported. Specifically, barriers need to be addressed, facilitators need to be leveraged, and teacher training could target specific EBPs for autism that other general education teachers are using and perceive positively. This could reduce teacher burden and increase buy-in and sustainment of EBPs. This is a significant addition to the literature on promoting inclusion for autistic students in high-poverty districts.

**417.034 (Poster)** The Need for Educational Screen Time Guidelines for Children with ASD: An Exploratory Study on Clinicians' Perceptions

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**Background:** Children with ASD have a higher affinity to screen time and can benefit from technology use, yet there is a lack of literature addressing the appropriate guidelines that outline the safe and effective use of such technology. The lack of understanding may result in misuse of technology and lead to significant impacts on functional, behavioral, and physical outcomes. Much of the research currently focuses on screen time overuse in children with ASD, providing no clear strategies for limiting risk factors while still benefiting from technology use.

**Objectives:** This exploratory study aimed to explore the perceptions of clinicians around screen use for children with ASD, the current barriers to screen management and guidelines, and factors to consider in developing educational guidelines for families and other stakeholders specific to children with ASD.

**Methods:** Participants in this exploratory qualitative study were fifteen clinicians working with children with ASD for at least five years; twelve of the clinicians had the experience of 10 years and up. The participants consisted of four occupational therapists (OT), six speech language pathologists (SLP), four behavioral analysts (BA), and one participant who was a behavioral interventionist (BI) and an education assistant (EA). The participants were invited to participate in semi-structured in-depth focus groups or individual interviews to gather information about their perspectives on their clients' screen-use and their roles in supporting families of children with ASD with screen-time management. A summative content analysis ( was implemented to summarize the data. This type of analysis allowed for interpretation of the content in a qualitative approach based on quantitative data (Hsieh & Shannon, 2005). The summative content analysis allowed for meaning interpretation, as well as an exploration of the frequency of content, which enabled a stronger understanding of which clinical concerns appeared to be the most imperative.

**Results:** Four main themes emerged from the data: (A) There are existing barriers to managing screen time, including lack of knowledge and awareness of parents and stakeholders; lack of advocacy for more evidence-based interventions for screen time use among children with ASD; and Challenges observed in implementing screen-management strategies. (B) Factors impacting screen use and addiction including individual characteristics and profile; environmental factors; behavioral Factors and the nature of Screen Use (C) Clinical considerations and recommendations for screen time management including human-based activities for healthy development; strategies for managing screen time; meeting the needs of the family; the need to base decisions on reliable sources of information. (D) The nature of the ASD screen time guidelines and recommendations for their future development.

**Conclusions:** These findings inform the understanding of current challenges that clinicians face when supporting families with managing screen time of children with ASD and clinicians' recommendations for developing guidelines. The findings also point out the current barriers and opportunities to create a clear, comprehensive set of educational guidelines.

**417.036 (Poster)** Understanding the Impact of the Covid-19 Pandemic on the Education of Autistic School Age Children and Their Families

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**Background:**

Research on the experiences of U.K parents and carers of autistic children and young people during lockdown due to the Covid-19 pandemic, has shown that 'many families felt let down by the government and had to face lockdown tackling new struggles, often with significantly reduced support' (G Pavlopoulou, R Wood, C Papadopoulos – 2020)

A national autism charity conducted a survey to understand the impact of the pandemic on autistic people and their families, including the effect on the education of autistic school age children during this challenging time.

**Objectives:**

The aim of the survey was to understand the impact of the pandemic on its audiences of autistic people and families so better information, advice and support could be developed by this charity in partnership with a national mental health charity.

## Methods:

An online survey was conducted across the U.K and co-designed with autistic people and families. It was promoted across a number of channels between June and July 2020. The survey focused on the impact of the COVID-19 pandemic and was completed by 4232 respondents including 1623 parents of school aged autistic children.

**Results:** The autistic children whose parents responded to the survey were educated in a range of settings, although as would be expected, the majority were in mainstream schools. While there were some differences by type of setting, the stark reality is that overall, seven in ten parents said that during lockdown, their child had difficulty understanding or completing school work and around half said their child's academic progress suffered.

Many parents also said that having to support their children during home schooling increased their stress levels, particularly among those who were also working. While for a minority of autistic children, it was a relief to stay at home as it reduced social anxiety, for some parents the lack of contact or support with school staff, particularly in mainstream schools, further added to daily struggle of home schooling.

## Conclusions:

The lockdown due to the Covid-19 pandemic and resulting school closures in spring and summer 2020 had a significant impact on the educational experiences of school children. Autistic children who often receive extra support while at school were particularly affected due to this support not being available to help them to complete their work at home during lockdown. Consequently, some children may have now fallen behind in their education. The necessary restrictions also negatively impacted the mental health of many adults and children, among the general population, while a higher than average proportion of the autistic population already have co-existing mental health difficulties. A survey of families of disabled children during lockdown also found that the majority (70-80%) reported worsening emotional and mental health for both their children and themselves (Disabled Children's Partnership: 2020).

**417.037 (Poster)** Using Parent-Created and Parent-Implemented Video Prompting to Promote the Acquisition of Daily Living Skills for an Adolescent with ASD

*G. Yakubova and B. B. Chen, University of Maryland, College Park, MD*

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**Background:** Developing the skills to live independently in adulthood is a major goal for any young adult transitioning out of high school, but may be a particular point of focus for those with autism spectrum disorder (ASD), who often struggle to complete daily living tasks independently. Given that parents are often the most knowledgeable about their child's performance and goals related to daily living tasks, it is worthwhile to train parents to create and implement their own customizable, evidence-based intervention, such as video prompting (VP), to teach their child these tasks.

**Objectives:** The purpose of this study was to evaluate the effects of a parent-created and parent-implemented VP intervention with error correction on their child's independent completion of three daily living tasks.

**Methods:** A multiple-probe across tasks design of single-case research design (SCRD) consisting of baseline, intervention, and maintenance phases, was used to evaluate the effects of a parent-created and implemented VP intervention on the independent completion of three daily living tasks selected by the parent (confirming an appointment, flossing, and frying an egg). The parent of a 14-year-old with ASD attended a one-time training, where she learned how to select three relevant and complex daily living tasks, task analyze, record her modeling of the task, create, edit, and narrate VP clips, and implement study procedures, including error correction using a system of least prompt (SLP). Following the training, the parent created the VP clips and implemented the multiple-baseline design with her child at home, recording the sessions to send to the research team for data collection and ongoing feedback. Task completion was scored by the percent of task analysis steps completed correctly and independently per session. Social validity and fidelity of the parent's implementation were also collected.

**Results:** The child improved in his ability to complete all tasks independently with greater accuracy compared to baseline, e.g., confirming an appointment task (31% during baseline to 92-100% range during intervention), flossing (13-20% during baseline to 67-100% during intervention), and frying an egg (6-13% during baseline to 87-100% during intervention). The child maintained the acquired skills at a one-week follow-up. The parent implemented study procedures with high fidelity across phases and tasks (mean scores ranging 88-100%). The weighted average Tau-U demonstrated a strong effect between baseline and intervention and baseline and follow-up, Tau-U= 1.0, 90% CI [0.631, 1].

**Conclusions:** VP, which is an evidence-based practice that can be easily created and accessed using everyday technology, can help a person with ASD complete daily living tasks in a home setting and increase independent functioning in daily life. The findings of the current study offer implications for future research and practice on training parents on the use of evidence-based practices (video prompting and system of least prompts) to support their child's acquisition of daily living skills.

**417.038 (Poster) Varying Perspectives: Teachers & Parents on the Planning for School Transitions**

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**Background:** Students with autism spectrum disorders (ASD) often have difficulty with transitions, including school-level transitions. Major school-level transitions may increase the risk of reduction in school-based services and regression of both academic and social/emotional development progress (Nuske et al., 2019). Therefore, it is important for teachers and parents to communicate and prepare for their students' school-level transitions. Multi-informant approaches to assessment are increasingly important in capturing behaviors across contexts (e.g., home and school; De Los Reyes, 2004). For students with ASD, informant discrepancies between parent and teachers are frequently cited (Lopata et al., 2016). This could be identified as a risk factor for unsuccessful school transitions especially for students from Title 1 schools, where communication and resources are often limited for parents and teachers.

**Objectives:** Compare parent and teacher reports of satisfaction with planning transitions for students with ASD from Title 1 schools, and examine differences in satisfaction between parents and teachers of kindergarten students versus elementary school students.

**Methods:** This study utilized baseline data from a larger randomized control trial (in preparation) which examined the effects of a parent-based intervention designed to improve school-level transitions for children with ASD. A total of 45 children with ASD had both parents and teachers complete the Transition Evaluation Questionnaire (TEQ). The TEQ measures parent and teacher satisfaction with planning for the child's transition between the current and future school. Seven items were rated on a 5-point Likert scale and summed to create a total score (higher scores indicated greater satisfaction). A correlation test was implemented to measure the correlation between the parent-report and teacher-report total scores. In addition, independent samples t-tests were conducted to investigate differences in parent and teacher TEQ scores between kindergarten students transitioning to elementary school (n=23) and elementary students transitioning to middle school (n=19).

**Results:** Parent-report total scores (M = 17.52, SD = 6.43) and teacher-report total scores (M = 17.67, SD = 6.55) on the Pre-TEQ were not significantly correlated,  $r(43) = -0.01, p = 0.92$ . In addition, both parents and teachers of kindergarten students were more satisfied with transition planning than parents and teachers of elementary students. The mean parent-report total score for kindergarten students (M = 19.43, SD = 7.09) was significantly higher than that of elementary students (M = 16.47, SD = 4.15),  $t(45) = -18.42, p < .001$ . The mean teacher-report total score for kindergarten students (M = 17.91, SD = 6.19) was also significantly higher than that of elementary students (M = 17.47, SD = 7.55),  $t(45) = -16.54, p < .001$ .

**Conclusions:** Parent and teacher report discrepancies remain an issue for school-based research amongst children with ASD. Results suggest that parent and teacher reports regarding satisfaction with school transition planning also differ. Moreover, parent and teacher satisfaction with planning transitions was significantly lower for elementary students compared to kindergarten students. Overall, these findings have implications for future interventions that target communication between parents and teachers to help school transitions for students. Additionally, more support may be necessary for higher school-level transitions.

**417.039 (Poster) What Do Teachers Know about Sex Differences in Autism? Survey Study on Recognition of Autism in Girls**

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**Background:** Females with Autistic Spectrum Conditions (ASC) without intellectual disability (ID) are currently under-recognised (Van Wijngaarden-Cremers et al., 2014). Teachers have a crucial gatekeeping role to the diagnostic pathway. The literature suggests that girls with ASC without ID may superficially look and sound more like typically developing girls than boys with similar levels of impairment in social communication and interaction (Dean et al., 2017; Hiller et al., 2014; Parish-Morris et al., 2017; Rynkiewicz et al., 2016). Late-diagnosed autistic women and parents of autistic girls have cited lack of knowledge about ASC in females amongst teachers as a factor in delayed diagnosis (Bargiela et al., 2016; Cook et al., 2018; Leedham et al., 2019). Yet very little is known about knowledge of sex differences in ASC presentation amongst teachers, and their confidence in recognising autism in girls.

**Objectives:** The aim of this exploratory study was to investigate levels and sources of knowledge of sex differences in ASC presentation amongst UK teachers. A further aim was to explore differences in teachers' confidence in recognising undiagnosed ASC in girls and in boys.

**Methods:** Ninety teachers and teaching assistants in mainstream and special education settings in the UK were surveyed using a bespoke questionnaire and convenience sampling through social media. Questions covered knowledge of ASC focussing in on sex differences in ASC presentation and confidence in recognising undiagnosed ASC in boys and girls.

**Results:** Most participants (n = 66; 73.3%) thought ASC presents differently across the sexes, with 47 participants (of 68; 69.1%) citing the "ability to mask symptoms" in females as the main reason. Other reasons for sex differences in ASC presentation included: "emotional & social maturity" in females (n = 53; 63.1%), "coping skills" in females (n = 42; 50.6%), "gender-related social expectations" in females (n = 40; 47.6%), and "aggression" in males (n = 50; 60.2%). Just over half of participants (n = 46; 51.1%) thought boys were more impaired than girls in social communication and interaction. Whilst 60% (n = 54) of respondents had received training for working with children with ASC, most participants (n = 74; 83.1%) had never received training for sex differences in ASC. More participants were "confident", "fairly confident" or "very confident" in recognising undiagnosed ASC in boys (n = 73; 81.1%) than in girls (n = 49; 54.4%). Over half (56%) of participants' suggestions to support teachers in recognising ASC in girls related to increasing training, understanding and awareness.

**Conclusions:** The key finding from this study suggests that whilst respondents were aware of sex differences in ASC presentation, behaviours observed in girls were interpreted as differences and/or coping mechanisms rather than indicating concealment of similar levels of difficulties to boys, and therefore warranting referral for assessment. Furthermore, participants were less confident in their ability to recognise ASC in girls and would welcome further training and understanding of ASC in girls.

**417.040 (Poster)** Written Language Adapted Tele-Assessment Practices during COVID-19: Successes and Challenges with Elementary-Age Children with Autism Spectrum Disorder

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## **Background:**

The COVID-19 pandemic has led many researchers to adopt adapted tele-assessment practices (i.e., the use of telecommunication technology to administer face-to-face normed assessments; Krach et al., 2020). Though professional organizations have offered some best-practice recommendations, concerns remain about the use of adapted psychoeducational tele-assessments for children with autism spectrum disorder (ASD), particularly in challenging skill areas like writing (Zajic & Wilson, 2020). This presentation examines the successes and challenges of conducting written language adapted tele-assessments via Zoom to children with ASD.

## **Objectives:**

This presentation will discuss the process of collecting writing assessment data collected at pretest during a telecommunication comprehension intervention. Information will be provided about the choices made in redesigning these assessments (based on guidance from professional organizations and practical considerations), the process of conducting these assessments (including the spaces and people involved), and the participants' performance.

## **Methods:**

Fourteen verbal children with ASD (ages 7-9) from across the United States were administered the VMI-6, the WJ-IV (Sentence Writing Fluency [SWF] and Writing Samples [WS]), and an experimenter-designed assessment (Name Writing, Letter Writing, Word Writing, and Sentence Story Writing). A trained team member administered and scored all assessments, and all children completed the activities using either unlined paper with a pen or pencil, or a whiteboard and marker. All assessments were redesigned to be administered using Microsoft PowerPoint.

## **Results:**

Participants demonstrated few difficulties completing the VMI-6, but some participants frequently forgot to show their drawings or were unable to align the paper/whiteboard with the webcam. SWF appeared difficult for some participants, as some did not

write complete sample sentences following error correction ( $n = 4$ ) and others finished early due to time taken ( $n = 8$ ). Visuals and explicit directions provided for WS appeared helpful, though all participants generally scored below their in-person, age-expected scores. Participants showed minimal difficulties with Name Writing and Letter Writing but often struggled with Word Writing (auditory difficulties and no visual prompts) and Sentence Story Writing (properly understanding the task demands via Zoom). Participants often redrew the conversation bubble for Sentence Story Writing, a step not required during in-person administration.

A parent was often present ( $n = 12$ ) to help their child stay on task. While parents assisted with physically showing the child's writing to the webcam after each item, parents also often provided unintended hints to their children by sounding out words when repeating questions or assisted with idea generation (even when prompted and instructed not to). Many participants also often looked to their parents for spelling assistance and would become frustrated when they could not help them. Additional results (scores and relationships between scores and parental involvement) will be finalized before INSAR 2021.

### **Conclusions:**

Participants appeared to engage well with most of the assessments, but the role and level of parent involvement makes score interpretation difficult. Parents looked to play both supportive and adverse roles to the assessment process to obtain valid scores of child performance. Considerations for future literacy-focused telecommunication assessment research will be discussed with applications to instructional contexts.

# Emotion

## PANEL SESSION — EMOTION

### Panel 211 - Self-Regulation and Associated Clinical Features in Autism across the Lifespan

**Panel Chair:** Deanna Swain, *Virginia Polytechnic Institute and State University, Blacksburg, VA*

**Discussant:** So Hyun Kim, *Psychiatry, Center for Autism and the Developing Brain, White Plains, NY*

Self-regulation (SR) encompasses emotional, behavioral, and cognitive processes. Impairment in SR, especially as it relates to emotion dysregulation, has been well documented in individuals with ASD, which may emerge as early as one year of age. Less is known regarding the underlying mechanisms of SR development as well as outcomes associated with impairments in SR. This session directly targets possible determinants of SR (Presentation 1 and 2), co-occurring behavioral features (Presentation 3), and clinical outcomes related to SR (Presentation 3 and 4) across the developmental span from early childhood to adulthood. Specifically, the first presentation examines the caregiver role as it relates to behavioral regulation in toddlers with ASD. The second presentation explores the relationship between ASD characteristics and SR in a diverse sample of school-children. The third presentation describes the co-occurrence of emotion dysregulation and other challenging behaviors (self-injurious behavior or aggression) in an in-patient setting. The fourth presentation examines the predictive role of emotion regulation response patterns on co-occurring psychopathology and life satisfaction for individuals with ASD during emerging-adulthood. Finally, the discussant will highlight themes and future directions regarding SR studies in ASD.

**211.001 (Panel)** Exploring the Effects of Treatment and Caregiver Requests on Behavioral Self-Regulation in Toddlers with Autism

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#### Background:

Children's ability to comply with caregiver requests is considered to be the earliest indication of self-regulation processes in early childhood and is closely linked to children's burgeoning emotion regulation abilities (Kopp, 1982). This ability to comply with caregivers' requests is predictive of a host of positive future outcomes including social competence, mental health and less parenting stress (Kochanska, 2002; Kuczynski & Kochanska, 1990; Patterson 2002), and may be especially important for children with ASD, who are pre-disposed to deficits in social-communication that may make caregiver-child interactions more challenging. Although compliance to caregivers' requests has been studied in children with autism, studies have largely focused on older children. There is also a scarcity of research exploring the effect of early caregiver-mediated intervention on compliance in very young children with autism, an area that warrants more study given the importance of children's compliance for future outcomes.

#### Objectives:

Characterize the use of caregiver requests and compliance to requests among toddlers with ASD and explore the effects of treatment on children's compliance to caregiver requests.

#### Methods:

This study is a secondary data analysis of data collected as part of a randomized controlled efficacy trial of a naturalistic, parent-mediated social-communication intervention for children with ASD (JASPER; Kasari et al., 2015). Upon entry, participants were randomized to receive either JASPER (n = 39) or a caregiver psychoeducation intervention (PEI; n = 36). At three timepoints (entry, exit and follow-up), caregivers engaged their children in a video-taped clean-up task that was later coded for caregivers' use of requests and children's compliance. Baseline analyses were conducted to characterize dyadic behavior at entry and GLMMs were used to determine the effect of treatment on children's compliance to caregivers' requests over time.

#### Results:

At baseline, caregivers made an average of 8.39 requests ( $SD = 4.71$ ) of their child, averaging 2.89 direct requests ( $SD = 3.12$ ) and 5.85 indirect requests ( $SD = 3.12$ ). Children's average proportion of compliance to direct requests (compliance to direct request/total requests) was 0.48 ( $SD = 0.42$ ) and their proportion of compliance to indirect requests (compliance to indirect request/total requests) was 0.39 ( $SD = 0.35$ ). Results of GLMMs revealed a significant main effect for the interaction between treatment and time on children's proportion of compliance to direct requests over time ( $F(1,112) = 3.20, p = .045$ ). Post-hoc analyses indicate significant increases in children's proportion of compliance to direct requests at exit and 3-month follow-up for participants in the JASPER condition only. No significant main effects were found for the effect of either treatment on children's proportion of compliance to indirect requests over time ( $F(2,184) = 0.819, p = .443$ ).

#### Conclusions:

The findings of this study describe caregivers' use of requests and children's compliance behavior in young children with ASD, an area that has been largely unexplored. Findings also suggest that caregiver-mediated social-communication interventions, such as JASPER, may be effective in improving children's compliance with caregivers' direct requests, indicating the need for further exploration of the effects of intervention on behavioral and emotional regulation among young children with ASD.

**211.002 (Panel)** Examining Predictors of Emotion Dysregulation in Children with ASD and Co-Occurring Psychopathology  
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**Background:** While it is well accepted that individuals with ASD demonstrate high rates of emotion dysregulation (ED), underlying mechanisms remain unclear. White and colleagues (2014) proposed a theoretical model linking characteristics of ASD to heightened ED and co-occurring psychopathology. To date, there are mixed findings supporting the relationship between ASD symptoms and ED, with some suggesting method invariance may play an important role when interpreting findings (Uljarevic et al., 2018). The current study empirically examines the proposed link between ASD symptoms and ED in children with ASD with and without co-occurring psychopathology across a critical developmental age span.

#### Objectives:

1. Explore ED patterns across co-occurring psychopathology.
1. Examine the predictive role of ASD symptoms on ED across diagnostic groups.

**Methods:** Participants included 874 children between the ages of 1.5 and 12 years ( $M_{age} = 69.6$  months; 66% Caucasian, 15.8% Hispanic; 19.7% female) with ASD seen at ASD-specialty clinics for clinical or research purposes. Regarding diagnostic classification, 57% had a diagnosis of ASD only, 25.3% comorbid with Intellectual Disability or Learning Disorder (ID/LD), 12.8% with externalizing (Ext), 3.5% with internalizing (Int), and 1.1% with Ext and Int. Emotion dysregulation was quantified by caregiver report on the Child Behavior Checklist - Dysregulation Profile (CBCL-DP; Althoff, Ayer, Rettew, & Hudziak, 2010), which allows for categorical and continuous measurement of ED. ASD symptoms were calculated by the ADOS-2 Calibrated Severity Scores for Social Affect (CSS-SA) and Restricted and Repetitive Behavior domains (CSS-RRB). Additional demographic variables included child age, gender, observed spontaneous language from ADOS (OLANG), most recent NVIQ estimate, and maternal education. For aim 1, ANCOVAs were run to compare ratings of ED across diagnostic groups controlling for age, NVIQ, OLANG, and CSS total. For aim 2, hierarchical linear regressions were run to examine predictors of ED across diagnostic groups. Predictors were entered into two blocks: 1) age, NVIQ, OLANG, maternal education; 2) CSS-SA and CSS-RRB.

**Results:** Based on caregiver report on CBCL, 48.4% ( $n = 423$ ) of the total sample presented with heightened ED. Results from ANCOVA revealed significant differences in ED across 5 diagnostic groups ( $F[4,842]=5.91, p<.001$ ; Figure 1), which remained significant when collapsing into 2 groups (ASD/ID/LD vs. ASD/Int/Ext). When predicting CBCL-DP for those without Int/Ext comorbidities, there were no main effects for CSS-SA ( $\beta=-.03, p=.39$ ) or CSS-RRB ( $\beta=-.02, p=.65$ ) after controlling for key child and family factors. Similarly, for those with Int/Ext comorbidities, CSS-SA ( $\beta=-.16, p=.05$ ) and CSS-RRB ( $\beta=-.06, p=.46$ ) remained non-significant.

**Conclusions:** Results from the current study provide limited support for the link between core ASD symptoms and ED in children with ASD with/without co-occurring psychopathology. Past findings showing significant relationships have primarily relied on caregiver report for both constructs. Thus, the limited link observed in the present study may be a function of

methodological differences, with autism symptom severity being quantified via clinician observation and ED measured by caregiver report. Results also suggest that identification and treatment of ED in children with ASD should consider the levels of co-occurring symptoms, especially internalizing and externalizing problems.

**211.003 (Panel)** Mapping the Time Course of Emotion Dysregulation and Challenging Behaviors in Psychiatrically Hospitalized Youth with Autism Spectrum Disorder

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**Background:** Emotion dysregulation (ED) is a common and clinically significant problem in individuals with ASD associated with challenging behaviors, such as self-injurious behavior (SIB) and physical aggression. Prior research on these behaviors is limited mainly to parent reports or small case studies. How ED, SIB, and aggression present in real-time and how the timing of these behaviors relate to one another is underexplored. Understanding the time course and the relationship between ED and challenging behaviors, including individual differences in these features, is an essential step towards determining their function and predicting their onset.

**Objectives:** The present study aimed to describe the occurrence and relationship between ED, SIB, and aggression—observed and coded during everyday activities across three specialized inpatient psychiatric units.

**Methods:** Participants were 56 individuals (83% male, mean age 11.7) from the Autism Inpatient Collection. Participants were observed for an average of 6.3 hours across several sessions (mean # of sessions = 5.43). Start and stop times of ED, SIB, and aggression were coded live through a mobile phone app. Double coding performed on 20% of cases indicated good inter-rater reliability (mean kappa = .74). Temporal relations between the three behaviors were analyzed using cross-recurrence quantification analysis (CRQA), which examines whether co-occurrence and lagged associations between variables exceed chance (e.g., ED precedes SIB).

**Results:** Table 1 reports descriptive statistics showing the number of participants displaying each behavior and the rate per hour and mean duration of behaviors. Episodes of ED were the longest lasting on average (mean duration = 42.7 seconds), and ED and SIB occurred at a higher rate than episodes of aggression. As shown in the table, many of these measures had a high degree of variability amongst participants. Figure 1 displays plots of the temporal relations between behaviors. CRQA analyses revealed that only ED and SIB co-occurred at above chance levels for the sample as a whole. We observed above chance co-occurrence of ED and SIB in 67.5% of participants, ED and aggression in 51% of participants, and SIB and aggression in 27% of participants. As shown in the figures, ED occurred in the 10 seconds preceding SIB more than would be expected by chance, and this relationship was more substantial than SIB preceding ED. A similar pattern emerged for ED and aggression; however, fewer participants demonstrated these lagged relationships. Further analyses will examine individual participant profiles and potential predictors of individual differences (e.g., verbal ability, IQ, autism severity).

**Conclusions:** To our knowledge, this is the first study to examine the real-time presentation of SIB and aggression and their relation to observable emotion dysregulation. ED and SIB had the highest co-occurrence. About half of the participants did not show significant co-occurrence of ED and aggression, suggesting that aggression occurs without observable signs of dysregulation for many individuals. These results provide useful insights into individual differences in presenting challenging behaviors, and future analyses will explore predictors of these differences.

**211.004 (Panel)** The Impact of Emotion Regulation Strategies on Mental Health in Adults with Autism

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**Background:** Difficulties with effective emotion regulation (ER) are common for individuals with autism spectrum disorder (ASD) and associated with a host of poor outcomes including increased risk of psychiatric problems. Despite the link between ER impairment and increased psychopathology, limited research has identified specific ER responses that are associated with co-occurring psychopathology, particularly depression, and other mental health outcomes for emerging adults with ASD.

**Objectives:** The current study sought to identify whether specific ER response patterns were differentially related to co-occurring depression and anxiety symptoms, loneliness, and life satisfaction for emerging adults with ASD.

Methods: Fifty-one cognitively able older adolescents and young adults with ASD (M age: 19.13, 81.60% male, 91.70% White) participated in the study. They were recruited as a part of a larger randomized, controlled trial of a college transition support program for emerging adults with ASD. Participants completed a battery of questionnaires related to mental health outcomes (i.e., depression and anxiety symptoms, loneliness, and life satisfaction). Self-reported ER strategies were measured across two domains of controlled responses: approach-based voluntary engagement (i.e., cognitive reappraisal, emotion acceptance, problem-solving) and avoidance-based voluntary disengagement (i.e., avoidance, denial, distraction).

Results: A series of linear regressions were used to analyze the relationship between ER strategies and co-occurring anxiety and depression, as well as loneliness and life satisfaction. Both voluntary engagement strategies ( $\beta = -.28, p = .010$ ) and voluntary disengagement strategies ( $\beta = .61, p < .001$ ) were significant predictors of co-occurring depression symptoms, such that more frequent use of voluntary disengagement and less frequent use of voluntary engagement strategies were associated with increased depression symptoms [ $F(2, 50) = 19.98, p < .001, R^2 = .43$ ]. Voluntary disengagement strategies ( $\beta = .60, p < .001$ ) were similarly predictive of anxiety symptoms, although voluntary engagement ( $\beta = -.18, p = .112$ ) was not [ $F(2, 50) = 15.64, p < .001, R^2 = .37$ ]. Analyses revealed that increased voluntary disengagement ( $\beta = .51, p < .001$ ), but not voluntary engagement ( $\beta = -.20, p = .108$ ), predicted loneliness [ $F(2, 51) = 10.67, p < .001, R^2 = .28$ ]. Finally, unique relationships appeared between life satisfaction and the two ER domains; specifically, voluntary disengagement ( $\beta = -.36, p = .003$ ) negatively predicted life satisfaction, whereas voluntary engagement ( $\beta = .47, p < .001$ ) positively predicted life satisfaction, [ $F(2, 51) = 13.26, p < .001, R^2 = .33$ ].

Conclusions: Emerging adults with ASD experienced poorer mental health outcomes when using voluntary disengagement strategies to purposefully avoid experiencing uncomfortable emotions. In fact, adults with ASD who chose to tolerate and engage with, or alter, uncomfortable emotions via voluntary engagement strategies like emotion acceptance and cognitive reappraisal experienced more life satisfaction and better mental health outcomes. The divergent relationships between mental health and these two ER responses suggests the importance of building emotion acceptance and tolerance, instead of avoidance and distraction, when treating anxiety and depression in this population. Given the initial success of mindfulness and acceptance-based treatment protocols in ASD samples, additional research into these treatments and their impact on ER response patterns is warranted.

## POSTER SESSION — EMOTION

### Poster 418 - Emotion Posters

**418.001** (Poster) A Positive Youth Development Framework to Understand Positive Mental Health in Autistic Youth  
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Background: Positive mental health (PMH) has been conceptualized as the combination of positive psychological and social functioning, rather than just the absence of mental health problems (Keyes, 2002). This includes a continuum ranging from languishing (the absence of PMH) to flourishing (high levels of PMH). No studies have explored this continuum in autistic youth, despite support for its use in young people (Keyes, 2006). Positive Youth Development (PYD) frameworks posit that youth experience more positive outcomes when there is an alignment between an individual's strengths (e.g., adaptive behaviours) and ecological assets (e.g., environmental supports; Lerner et al., 2010), including in youth with autism (Weiss & Burnham Riosa, 2015).

Objectives: To determine the individual and ecological correlates of PMH in autistic youth.

Methods: Data were collected from 137 family caregivers of youth between 11 and 22 years of age ( $M = 16.81, SD = 3.21, 77\%$  male) with a diagnosis of autism and intellectual disability in Ontario (Canada). Caregivers completed surveys on their children's adaptive behaviours (Maenner et al., 2013; Mazurek et al., 2012), mental health problems (Goodman, 1997), and ecological resources (Byles et al., 1988; Coster et al., 2012; Emerson et al., 2006). PMH was measured using the six C's of PYD (Caring, Character, Contribution, Competence, Confidence, Connectedness; Lerner et al., 2005), and three categories were created based on the number that were endorsed, similar to strategies categorizing PMH in adults (Keyes, 2002).

Results: Adaptive behaviour and sociocommunicative and functional cognitive ability were significantly higher in the flourishing group compared to the moderate well-being group (both  $p < 0.01$ ), who in turn was higher than the languishing group (both  $p < 0.01$ ). The languishing group had significantly higher severity of mental health problems compared to the flourishing and moderate well-being groups (both  $p < 0.01$ ), though the latter two groups did not differ from each other ( $p = 0.08$ ). Similarly, the languishing group was reported to have lower rates of access to resources to enable participation in home activities (both  $p < 0.01$ ) and school (both  $p \leq 0.001$ ) compared to both other groups, who did not differ from each other ( $p > 0.05$ ). Parents of youth in the flourishing and moderate well-being groups reported higher rates of their own self-efficacy compared to parents of youth in

the languishing group (both  $p < 0.01$ ), though they did not differ from each other ( $p > 0.05$ ). The moderate well-being group had significantly greater family functioning than the languishing group ( $p < 0.05$ ), though there was no difference between the flourishing and moderate well-being groups ( $p = 0.44$ ) and flourishing and languishing groups ( $p = 0.15$ ).

**Conclusions:** For autistic youth, flourishing was associated with the highest level of adaptive behaviours, and the presence of any level of PMH was associated with fewer mental health problems, and greater parent self-efficacy, family functioning, and resources/support at home and school. Future research can investigate individual and ecological correlates of dual continua mental health outcomes in autistic youth.

**418.002 (Poster)** Adaptive Behavior and Emotion Dysregulation Profiles in Young Children with Autism Spectrum Disorder  
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**Background:** Daily functioning of children with autism spectrum disorder (ASD) is often impacted by factors beyond ASD core symptoms. Emotion dysregulation is commonly observed and significantly impacts parent stress and children's behavioral health. Up to 50% of children with ASD have co-occurring attention-deficit/hyperactivity disorder (ADHD) symptoms, which are also associated with emotion dysregulation. Despite research linking difficulties with emotion dysregulation to functional impairment, the relationship between emotion dysregulation and adaptive behavior in ASD is relatively unexplored. Additionally, the impact of co-occurring ADHD symptoms on this relationship is unknown. Elucidating the interrelationships between emotion dysregulation, ADHD symptoms, and adaptive behavior is critical because adaptive skills provide an indicator of functional impairment and are often used to measure ASD treatment outcomes.

**Objectives:** We examined whether emotion dysregulation and ADHD symptoms were associated with adaptive functioning in young children with ASD. In addition, we explored whether emotion dysregulation impacted adaptive functioning over-and-above the impact of ADHD symptoms.

**Methods:** Participants were N=185 children with ASD ages 3-7 years old (mean=4.9, std=1.2). Adaptive functioning was assessed through parent-report on the Vineland Adaptive Behavior Scales, which yields scores in the areas of Socialization, Daily Living Skills, Communication, and an overall composite score. Emotion dysregulation and ADHD symptoms were assessed through parent report on Aberrant Behavior Checklist (ABC), using the Irritability and Hyperactivity subscales, respectively. We hypothesized that lower levels of adaptive behavior will be associated with poorer emotional regulation and this will be over-and-above the impact of co-occurring symptoms of ADHD. To test these hypotheses, we employed a series of Pearson's partial correlations, controlling for both age and IQ.

**Results:** Emotion dysregulation, as reflected in the ABC Irritability subscale, was negatively correlated with communication ( $r(183) = -.20, p < .01$ ), social skills ( $r(183) = -.31, p < .0001$ ), daily living skills ( $r(183) = -.20, p < .01$ ), and overall adaptive behavior ( $r(183) = -.21, p < .01$ ). Additionally, ADHD symptoms, as reflected in the ABC Hyperactivity subscale, were negatively correlated with communication ( $r(183) = -.27, p < .001$ ), social skills ( $r(183) = -.16, p < .05$ ), and overall adaptive behavior ( $r(183) = -.26, p < .001$ ), but not daily living skills ( $r(183) = -.12, p = .12$ ). Furthermore, the ABC Irritability and Hyperactivity subscale scores were positively correlated with one another ( $r(183) = .36, p < .0001$ ). Finally, when controlling for ADHD symptoms, only difficulties with social skills ( $r(183) = -.27, p < .001$ ) and daily living skills ( $r(183) = -.17, p < .05$ ), remained negatively correlated with emotion dysregulation.

**Conclusions:** Emotion dysregulation and ADHD symptoms are separately correlated with adaptive behavior in young children with ASD. After adjusting for the effect of co-occurring ADHD symptoms, we found emotion dysregulation continued to be moderately negatively correlated with socialization and daily living skills. Understanding the relationship between emotion dysregulation and adaptive behavior is important for informing interventions for ASD and understanding treatment outcomes.

**418.003** (Poster) An Ecological Momentary Assessment (EMA) Study of Parent Emotion Regulation, BAP, and Child Behavior Problems

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**Background:**

Emotion regulation (ER) within and between family members is unique when there is a child with autism spectrum disorder (ASD). Two commonly used ER strategies are cognitive reappraisal and emotion suppression. Parents of children with ASD tend to use more maladaptive coping skills, which may increase their likelihood of exhibiting distressed parenting responses to child emotion. Furthermore, parents who exhibit features of the Broader Autism Phenotype (BAP) may also have ER deficits. It has become apparent that parents who respond in more adaptive ways fare better in terms of their own wellbeing and their child's outcomes. However, it less clear what strategies parents select in the moment their child is having a behavior problem, and how distressed parenting style and BAP affect their selection.

**Objectives:**

The current study examined how parents regulate their emotions in the moment their child is demonstrating challenging behavior, and how parenting style and genetic load affect their choice of ER strategy. The aims of this study were twofold: 1) To examine the ER strategies parents use during the challenging behavior, and 2) To understand how distressed parenting and BAP presentation (rigidity) influence strategy selection (cognitive reappraisal or emotion suppression).

**Methods:**

Participants were mothers ( $N = 20$ ) of children with ASD who were recruited for an ecological momentary assessment (EMA) study examining family patterns in ASD. Participants completed the Coping with Child Negative Emotion Scale –Distressed Parenting subscale and the Broader Autism Phenotype Questionnaire –Rigidity subscale. Parents then participated in a 7-day EMA study and answered questions about their child's behavior and what ER strategy they used. Proportion scores were calculated for each strategy summing a participant's use of that strategy over the week, and then dividing by total response opportunities (occurrence of challenging child behaviors). Two regression models were constructed to predict whether distressed parenting and BAP rigidity predicted momentary use of cognitive reappraisal and emotion suppression.

**Results:**

Parents were more likely to help or distract their child ( $M = 42.2\%$  of total responses), hold in their emotion ( $M = 27.6\%$ ), use a calming strategy ( $M = 22\%$ ), express their emotion/raise their voice ( $M = 20.2\%$ ), or reframe their thought ( $M = 14.8\%$ ) compared to other ER strategies. Distressed parenting trended toward significance ( $b = -.06, p = .10$ ) for predicting less momentary cognitive reframing, whereas BAP rigidity was nonsignificant ( $p > .05$ ). BAP rigidity was a significant predictor of momentary emotion suppression ( $b = .19, p = .03$ ), but distressed parenting was nonsignificant ( $p > .05$ ).

**Conclusions:**

Distressed parenting seems to have a negative association with using cognitive reappraisal during their child's challenging behavior, which limits their ability to effectively reframe a negative thought to a more helpful one. Likewise, parents with high BAP rigidity were more likely to suppress their emotions, which would preclude them from expressing or acknowledging their emotions (i.e., a precursor to adaptive ER). Studying momentary parent ER in response to child behavior is necessary for understanding how to best improve outcomes for both parents and children with ASD.

**418.004** (Poster) Assessing Automatic Emotion Processing in Boys with Autism Via Eye Tracking and Facial Mimicry

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**Background:** Difficulties in automatic facial emotion processing in individuals with autism spectrum disorder (ASD) might remain concealed in behavioral studies due to the use of compensatory strategies.

**Objectives:** In the present study, we wanted to overcome influences of compensatory strategies and turned to measures tapping more automatic social processing behavior. More specifically, to gain more insight in the underlying facial emotion processing mechanisms in ASD, we simultaneously investigated gaze behavior and spontaneous facial mimicry of boys with and without ASD.

**Methods:** We recorded eye tracking and facial mimicry data of 20 school-aged boys with ASD and 20 matched typically developing controls while performing an explicit emotion recognition task. We analyzed proportional looking times to specific face regions (eyes, nose and mouth) and we modeled face exploration dynamics by mapping temporal scan paths using observable Markov models. Facial mimicry was assessed using automatic video decoding via FaceReader software.

**Results:** We found that boys with ASD and controls were equally capable to recognize facial expressions and did not differ in proportional looking times, and number and duration of fixations. However, TD boys adapted their gaze behavior more in function of the displayed expression, in comparison to boys with ASD. Furthermore, both groups showed similar face exploration dynamics, although boys with ASD demonstrated smaller saccadic amplitudes. Pertaining to the facial mimicry, we found no emotion specific facial responses and no group differences in the responses to the displayed facial expressions.

**Conclusions:** Our results indicate that boys with and without ASD employ similar eye gaze strategies to recognize facial expressions. However, the smaller saccadic amplitudes in boys with ASD suggest a less exploratory face processing strategy. Nevertheless, considering the similar behavioral performances, this slightly more persistent visual scanning behavior in boys with ASD does not imply less efficient emotion information processing. Finally, results on the facial mimicry data indicate similar facial responses to emotional faces in boys with and without ASD.

**418.005 (Poster)** Associations between Objectively Measured Facial Expressions during the ADOS-2 and the Calibrated Severity Scores in 3-Year-Olds with Suspected ASD

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Background: Autism spectrum disorder (ASD) is defined by restricted, repetitive patterns of behavior, and persistent disturbances of social communication. Children with ASD tend to exhibit more negative emotion (Macari et al., 2017) and engage in less frequent eye contact than typically developing peers (Barbaro & Dissanayake, 2012). Current best practice for measuring children's ASD symptom severity is based on expert, but subjective, clinician observation during the Autism Diagnostic Observation Schedule-2 (ADOS-2). Objective, automated detection of children's facial expressions from first-person videos during the ADOS-2 may quantify child expressive behavior. The current study examined associations between objectively measured expressive behavior and ASD symptom severity during the ADOS-2.

Objectives: To investigate associations between objectively quantified facial expression and gaze behavior measured from a low-cost video camera and examiner-adjudicated ADOS-2 calibrated severity scores (CSS).

Methods: Sixty-six children (49 boys,  $M_{age}=39.97mo$ ,  $SD=10.58$ ) with suspected ASD (61 confirmed ASD) were administered the ADOS-2. A hypothesis-blind examiner provided a total CSS and subscales for Social Affect (SA CSS) and restricted/repetitive behavior (RRB CSS). Children's facial expressions during the assessment were recorded with a small camera (Pivothead or Orca) contained in eye-glasses worn by the examiner. We processed first-person video from the camera with Affectiva algorithms in the iMotions software suite to automatically detect child facial expressions. Measures included the durations of child facial action units associated with negative affect and child gaze at the examiner—all expressed as proportions of ADOS-2 duration.

Results: There were positive associations between brow furrowing and the ADOS-2 total CSS ( $r=.29$ ,  $p=.02$ ) and the SA CSS ( $r=.34$ ,  $p=.01$ ). The proportion of lip stretching was positively associated with the total CSS ( $r=.25$ ,  $p=.04$ ). Likewise a composite index of negative expression brow furrowing or lip stretching) showed positive associations with the total CSS ( $r=.35$ ,  $p=.004$ ) and the SA CSS ( $r=.38$ ,  $p=.002$ ). Finally, there was a negative association between the proportion of gaze at the examiner and the RRB CSS ( $r=-.31$ ,  $p=.01$ ).

Conclusions: The current study examined associations between automated measurements of child expressive behavior during the ADOS-2. Greater levels of facial expressions indexing higher levels of negative emotion were modestly associated with social affect and total symptom severity scores. By contrast, greater attention to the examiner was associated with lower levels of repetitive behavior symptoms. The results suggest that negative affect may index higher levels of autism symptoms, while attention to the examiner may index lower levels of repetitive behaviors or an ability to disengage from those behaviors.

**418.006 (Poster)** Characteristics Associated with Anxiety in Youth with Autism Spectrum Disorders

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**Background:** Anxiety disorders are commonly diagnosed in typically developing youth (Merikangas, et al. 2009). Research suggests that anxiety occurs at higher rates in individuals with autism spectrum disorder (ASD) (Rosenberg, et al. 2011) with estimated rates ranging between 11 to 84% (Kerns et al., 2015). Studies have investigated several factors including cognitive ability, gender, age, and severity of ASD to determine their role in the development of anxiety-related symptoms in youth with ASD (Dubin, et al., 2015; Eussen et al., 2013; Mazurek et al., 2010). However, efforts to identify correlates and risk factors for anxiety in cases of ASD have yielded inconsistent findings (Vasa et al., 2015). These variable conclusions present challenges for treatment planning (Dubin et al., 2015) as well as for researchers attempting to measure and better understand anxiety and ASD (Kerns, et al. 2017).

**Objectives:** The aim of this cross-sectional study was to extend prior research by (a) evaluating the prevalence of comorbid anxiety disorders among a well-characterized sample of youth with ASD, and (b) investigate potential correlates for anxiety disorders.

**Methods:** Data were analyzed from youth between the ages of three and 21 ( $N=685$ , 77% male,  $M$  age=8.3) who were evaluated at a specialist center providing autism specific diagnostic evaluations *and* who received a diagnosis of ASD *and* who had data recorded for all variables of interest. Data were extracted from an on-site database. Variables of interest were as follows: age, gender, verbal IQ, nonverbal IQ, ADOS-2 Comparison Score, and ADOS-2 Module. A dichotomous variable “Anxiety” was calculated. Presence of an anxiety disorder was indicated if any anxiety related diagnostic label were listed as a final diagnosis (i.e., “anxiety”, “Anxiety-disorder NOS”, generalized anxiety disorder, social anxiety, separation anxiety). Most of the sample (66%;  $n=492$ ) were administered Module 3 of the ADOS-2; thus, additional analyses were completed on that subgroup using ADOS-2 Social Communication, RRB, and Total Scores. Descriptive statistics were used to measure prevalence of anxiety diagnoses and to characterize the sample. Simultaneous logistic regression was used to investigate potential predictor variables with “Anxiety” as the outcome variable.

**Results:** In the total sample, 15.3% were provided an anxiety diagnosis and VIQ, NVIQ and age were significantly correlated ( $p<.01$ ) with the presence of an anxiety disorder. The model including the predictors was significant,  $\chi^2(5) = 99.72, p<.001$ . Age ( $p<.001$ ), verbal IQ ( $p=.05$ ), and nonverbal IQ ( $p=.02$ ) were significant predictors of an anxiety diagnosis. For the Module 3 subsample, the model was significant,  $\chi^2(7) = 45.94, p<.001$  but only age was a significant predictor ( $p<.001$ ).

**Conclusions:** Lower rates of anxiety disorders were found in this sample than expected, though prevalence in this sample was within the broad, estimated range of 11 to 84% (Kerns et al., 2015). Notably, the only reliable predictor of receipt of an anxiety disorder diagnosis was age with older individuals being more likely to receive a diagnosis. Neither gender, IQ, nor severity of ASD symptoms were reliable predictors. Implications for clinical practice and future research will be discussed.

**418.007 (Poster)** Characterizing Difficulties with Emotion Regulation in Toddlers with ASD

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**Background:** Difficulties with emotion regulation (ER) underlie emotional/behavioral problems in autism spectrum disorder (ASD), yet very little is known about the early development of emotion dysregulation. Based on parent-report of the affective characteristics of temperament, toddlers with ASD demonstrate lower positive affect, higher negative affect, and fewer regulatory strategies than toddlers without ASD (Garon et al., 2009, 2016; Macari et al., 2017). However, to date, no observational studies have *concurrently* documented how emotional reactivity and regulation strategies may differ in toddlers with ASD relative to their non-ASD peers. Prior work has indicated that initial emotional reactivity and the regulation of those emotions are best explained by a single factor (Mazefsky et al., 2018, 2020; Zelkowitz & Cole, 2016), highlighting the need to examine both domains to best understand the ER construct in early childhood.

**Objectives:** This presentation will examine how toddlers with and without ASD express and regulate their emotions during tasks eliciting joy, fear, and frustration.

**Methods:** Thirty-seven toddlers (18 ASD, 19 non-ASD; 22-28mos) were recruited from a longitudinal study focused on ASD screening and early detection; children underwent gold-standard testing for ASD. Participating children completed nine tasks from the *Laboratory Temperament Assessment Battery* (Lab-TAB). Video-recordings of these tasks were coded by undergraduate

research assistants using a behavioral coding scheme tapping facial, bodily, and vocal affect and the frequency of employed ER strategies. Profile analyses were performed to examine the mean affect and total regulation strategies across each task, with a priori pairwise comparisons by task.

#### Results:

There were significant task-by-diagnosis interactions for bodily affect and vocal affect. Additionally, there were significant main effects for facial affect, but the interaction was non-significant. A priori pairwise comparisons revealed that relative to toddlers without ASD, toddlers with ASD demonstrated more facial, bodily, and vocal distress during a task in which they were told they could not play with engaging toy (End of the Line). Likewise, toddlers with ASD displayed increased negative facial expressions when they were unable to open a clear locked box that contained a desired object (Attractive Toy in a Transparent Box). There was a differential pattern during the Modified Peek-a-Boo task, such that toddlers with ASD displayed incongruent negative facial affect whereas toddlers without ASD displayed expected positive facial affect. With regard to regulatory strategies, there was only a significant main effect for task. A priori posthoc analyses revealed that toddlers with and without ASD displayed comparable frequencies of ER strategies, except during the End of the Line task during which toddlers with ASD utilized more ER strategies than their non-ASD peers.

Conclusions: Toddlers with ASD were characterized by high negative affect and low positive affect despite frequent and age appropriate attempts to regulate their emotions. These findings provide preliminary evidence that observable indicators of emotion dysregulation are present around two years of age and map onto to findings documenting patterns of ineffective ER in older children with ASD (e.g., Jahromi et al., 2012; Mazefsky et al., 2014). Clinical implications and future research directions will be discussed.

#### **418.008** (Poster) Correlates of Anxiety in Autistic and Non-Autistic Individuals with Moderate-Profound Intellectual Disability or Those Who Speak Few or No Words

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Background: Individuals diagnosed with Autism Spectrum Disorder (ASD) are at heightened risk of experiencing mental health difficulties. More specifically, the prevalence of anxiety is estimated at 11-84% with most studies reporting a rate of approximately 40%. Individuals with intellectual disability (IQ<70) are also at heightened risk of anxiety. Sensory processing differences and repetitive behaviour have been found to be associated with anxiety in these groups. However, the majority of research has focused on autistic individuals without intellectual disability or individuals who speak in sentences. Therefore, there is a paucity of research exploring this in autistic and non-autistic children and adults with moderate-severe intellectual disability or those who speak few or no words. Identifying those individuals most at risk of experiencing anxiety will enable early and targeted intervention. Efforts towards improving mental health and developing interventions specifically aimed at reducing anxiety has been identified by autistic individuals, their families and professionals as top priorities for autism research via the James Lind Alliance.

Objectives: To explore relationships between anxiety, repetitive behaviour and auditory sensory processing differences in autistic and non-autistic children and adults with moderate-severe intellectual disability or those who speak few or no words.

Methods: Parents/carers completed an online questionnaire battery including the Wessex Questionnaire (a proxy measure of adaptive ability), the Social Communication Questionnaire (SCQ), Repetitive Behaviour Questionnaire-2 (RBQ-2), subscales from the Sensory Profile-II and the Anxiety, Depression and Mood Scale (ADAMS).

Results: To date, 44 parents/carers of autistic individuals have participated in the online questionnaire study (63.6% male;  $M_{age} = 20.07$  years ( $SD = 11.52$ ), range: 4-63). Diagnoses included individuals with idiopathic autism ( $n = 20$ ) and autistic individuals who also had a comorbid diagnosis of a genetic syndrome associated with intellectual disability ( $n = 24$ ). Repetitive behaviour and auditory sensory processing differences were significantly correlated with generalised anxiety ( $r_s = .577, p < 0.01$ ;  $r_s = .565, p < 0.01$  respectively). When adjusting for age, ability level and autism characteristics, hierarchical regression analyses indicated that higher rates of repetitive behaviour and auditory sensory processing differences predicted higher levels of anxiety ( $p < 0.05$ ). This model explained 41% of the variance in anxiety scores. By May 2021, we will present data from 100 families after additional questionnaire completions and the inclusion of individuals with a diagnosis of a genetic syndrome associated with intellectual disability and autism characteristics.

Conclusions: Preliminary analyses suggest that repetitive behaviour and auditory sensory processing differences are associated with anxiety in autistic and non-autistic individuals with moderate-severe intellectual disability or those who speak few or no words. Identifying potential pathways between repetitive behaviour, sensory processing differences and anxiety will allow us to

explore how these factors are implemented in the development and maintenance of anxiety, informing the development of tailored anxiety interventions.

**418.009 (Poster) Debunking the Myth of Autism and Empathy: Exploring Alexithymia As a Mediator**

**E. J. Adler, H. K. Schiltz, S. A. Lehman, N. Gordon and A. V. Van Hecke, Psychology, Marquette University, Milwaukee, WI**

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**Background:** The pervasive misconception that autistic people lack empathy has been perpetuated by inconsistencies in how researchers define empathy and imprecise measurement (Fletcher-Watson & Bird, 2020). Moreover, there is growing evidence to suggest that alexithymia, the diminished ability to identify and understand one's emotions, affects many autistic adults (Hall et al., 2004; Oakley et al., 2020), and may be closely related to expressions of empathy in autism (Bird et al., 2010; Mul et al., 2018). It remains unclear, however, whether the link between autistic features and empathy may be in part *explained by* alexithymia.

**Objectives:** Among a sample of autistic and non-autistic adults, the present study aimed to 1) assess the association between autism features, empathy, and alexithymia, 2) explore the role of alexithymia as a mediator of the association between autistic features and empathy, and 3) evaluate whether effects are similar in both autistic and non-autistic samples.

**Methods:** 259 young adults aged 17-29 ( $M=19.45$ ; 48.5% female) completed measures assessing autistic features (AQ; Baron-Cohen et al., 2001), alexithymia (TAS-20; Bagby et al., 1994), and empathy (EQ; Baron-Cohen & Wheelwright, 2004). Participants were combined across a study involving autistic young adults participating in a social skills intervention ( $N=99$ ) and a study of non-autistic college students ( $N=160$ ) in order to capture a wide range of autistic features, alexithymia, and empathy. Diagnoses of autism were confirmed using the ADOS-G. IQ among autistic participants was  $\geq 70$ . The PROCESS 3.5 macro on SPSS version 27 was used to estimate the direct effect of autistic features (AQ) on empathy (EQ) and the indirect effect through alexithymia (TAS-20). Bootstrapped confidence intervals were used to estimate the indirect effect.

**Results:** Bivariate Pearson correlations revealed more autistic features were significantly associated with higher levels alexithymia ( $r(257)=.519, p<.001$ ) and lower levels of empathy ( $r(257)=-.643, p<.001$ ). Alexithymia and empathy were also significantly negatively associated ( $r(257)=-.586, p<.001$ ). Mediation analyses indicated a significant indirect effect of autistic features on empathy through alexithymia (Figure 1:  $b=-.32, CI: -.44, -.22$ ). Evidence of a significant direct effect from autistic features to empathy ( $b=-.84, p<.001$ ) indicates partial mediation. There was no evidence for moderated mediation based on autism diagnosis (index of moderated mediation = 0.0562, CI:  $-.1177, .2595$ ); as such, the mediating role of alexithymia seems to be invariant across non-autistic and autistic young adults.

**Conclusions:** Findings from our study add to the emerging evidence that alexithymia and empathy are closely related among autistic individuals. Importantly, our analyses also revealed that alexithymia partially accounted for the association between autistic features and empathy in a sample of non-autistic and autistic adults. This effect was consistent across both autistic and non-autistic adults. Therefore, myth of autistic people having less empathy may be driven by the substantial percentage of autistic people with alexithymia. Future research should seek to clarify the degree to which these associations are due to measurement, as alexithymia may affect responses on measures of empathy that include questions about emotions in oneself and others.

**418.010 (Poster) Do Alexithymia Traits or Autism Traits Specifically Explain Depression in Autism?**

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**Background:** Contemplating alarming depression rates in adults with autism spectrum disorder (ASD) there is need to find factors that are associated with increased symptoms in this population. Alexithymia, assessed by difficulties in identifying and describing emotions and an externally-oriented style of thinking was found to be a prevalent condition in ASD. Beyond a possible relation with autism traits, alexithymia traits should be considered as candidate for explaining why individuals with ASD report higher levels of depressive symptoms.

**Objectives:** In this cross-sectional study we target the question to what extent autism traits on the one hand and alexithymia traits on the other hand indicate depressive symptoms in ASD and whether the pattern of association is specific to ASD.

**Methods:** Data of a large ( $N=400$ ) representative clinical referral population of adults referred to autism diagnostics have been investigated and split into cases with confirmed ASD diagnosis ( $N=281$ ) according to ICD-10 criteria and cases with ruled out ASD diagnosis ( $N=119$ ). Dominance analysis was chosen as adequate method for evaluating relative predictive power of single

predictors in a multivariate comparison within each group (ASD and non-ASD). Models contained age, gender and IQ as control variables and the three subscales of the *20-Item Toronto Alexithymia Scale (TAS-20)* and the *Autism Quotient (AQ)* as predictors.

Results: Dominance analysis revealed the alexithymia factor *difficulties in identifying feelings (DIF)* as strongest predictor for depressive symptomatology in ASD, outweighing autism traits and other alexithymia factors. This pattern of prediction was not specific to ASD and was shared by clinical controls from the referral population with ruled out ASD diagnosis.

Conclusions: Results imply that clinical interventions should take weakened abilities in assessing emotions in consideration when targeting depression in autism. As predictive patterns were similar in the non-ASD group, the association of alexithymia traits with depression may not be unique to ASD and may constitute a general psychopathological mechanism in clinical samples.

**418.011** (Poster) Emotion Dysregulation in Young Children with ASD: Exploring Individual- and Family-Level Factors  
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Background:

Emotional dysregulation (ED), or the failure to regulate emotions appropriately and effectively, occurs at increased rates in individuals with ASD. Cibralic and colleagues (2019) conducted a systematic review of determinants of ED in young children with ASD, finding mixed evidence for various individual factors (ASD symptom severity, IQ, language, and executive functioning). Family factors (parental education level, income, number of siblings, etc.) are rarely factored into this relationship. Given current literature highlighting the significance of ED and SES in neurotypical populations (Backer-Grøndahl, 2016.; Troy et al., 2017) and a call for the inclusion of family factors into ASD outcome research (Karst & Van Hecke, 2012), this study aims to explore the relationship between individual and family factors on ED in a large sample of young children with ASD.

Objectives:

1. Explore the relationship between family factors and child ED.
1. Examine the predictive nature of individual and family factors on child ED.

Methods:

Participants included 433 children between 1.5 and 5 years of age with ASD seen at ASD-specialty clinics for clinical/research purposes. Emotion regulation was quantified by caregiver report on the Child Behavior Checklist Ages 1.5-5 years - Dysregulation Profile (CBCL-DP; Achenbach, 1991), which allows for categorical and continuous measurement of ED. Individual-level factors included child age, non-verbal IQ, language level, and ASD symptoms (measured by the ADOS-2 Calibrated Severity Scores for Social Affect [CSS-SA] and Restricted and Repetitive Behavior domains [CSS-RRB]). Family factors included race, ethnicity, income, and caregiver education level; for a subsample, information regarding siblings were available. For Aim 1, chi square tests were run to examine differences in ED across family factors. For Aim 2, hierarchical linear regressions were run to examine predictors of ED. Predictors were entered into two blocks: 1) age, gender, NVIQ, observed spontaneous language level, CSS-SA and CSS-RRB; 2) highest caregiver education and family income (entered together and separately).

Results:

In the current sample, 38.3% (n = 166) presented with heightened ED, according to caregiver report on CBCL. Chi square analyses revealed significant differences in child ED across family income (X(8)=35.80,  $p < .001$ ) and highest caregiver education (X[3]=8.84,  $p = .03$ ) but not child race (X[3]=3.82,  $p = .28$ ) or ethnicity (X[1]=2.73,  $p = .10$ ). Within a subsample (n=263), child ED was not related to number of siblings (X[2]=3.82,  $p = .15$ ) or sibling with ASD (X[1]=.54,  $p = .46$ ). When predicting ED and controlling for individual-level factors, combined caregiver education level explained approximately 10% of the variance when entered as the single family factor ( $\beta = .16$ ,  $p = .04$ ). Similarly, income explained 14% of the variance when entered as the single family factor ( $\beta = -.25$ ,  $p < .01$ ). When both were entered together, only income remained as a significant predictor of child ED ( $\beta = -.21$ ,  $p = .03$ ).

Conclusions:

The current study provides supporting evidence for the inclusion of family factors (caregiver education level and family income) when examining child ED. Family factors should not only be taken into consideration in regard to assessment for ASD and co-occurring behavioral dysregulation; however, further exploring the effects of family factors on ER may be imperative for tailoring treatments and exploring outcomes.

**418.012** (Poster) Emotion Regulation Strategies, Autistic Traits and Socialisation

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**Background:** Individuals with Autism Spectrum Conditions (ASC) generally show maladaptive emotion regulation strategy use which may lead to various behavioural, emotional and mental health problems. To prevent negative and promote positive outcomes, identifying factors that predict emotion regulation strategy use is crucial. However, it is not clear whether ASC symptom severity predicts emotion regulation strategy use.

**Objectives:** Given that ASC is a multidimensional spectrum, this research examined whether severities of individual ASC traits, in addition to general ASC symptom severity, predicted emotion regulation strategy use in adults (Study 1) and children (Study 2) to extend the very sparse literature in this area. Study 2 also investigated whether parental responses to child's emotions predicted child's emotion regulation strategy use.

**Methods:** Study 1 included 172 adults (106 females) with a mean age of 26.41 years ( $SD = 6.84$  years, range = 18 – 40 years) who completed questionnaires on ASC traits and emotion regulation strategies. Study 2 included 126 parents (99 mothers, 27 fathers) who had children with a mean age of 4.29 years ( $SD = 1.06$  years, range = 3 – 6 years; 62 girls; 4 unspecified gender) and completed questionnaires on their children's ASC traits and emotion regulation strategies as well as their responses to children's emotions.

**Results:** Results suggested that emotion regulation strategy use was predicted by (1) difficulties in social skills and tendency to attend to detail in adults, (2) difficulties in mind-reading and imagination in children, and (3) parental encouragement of expression and minimizing/punitive responses. Despite different ASC traits predicted emotion regulation strategy use at different developmental stages, individuals with higher ASC traits were more likely to show maladaptive patterns of strategy use in both studies. Moreover, higher child ASC traits and greater parental responses to child's emotion predicted child's adaptive emotion regulation strategy use in opposite directions.

**Conclusions:** This research provides the first evidence that shows the impact of ASC traits on emotion regulation strategy use was present since early childhood but manifested through different ASC traits at different developmental stages. Although individuals with higher ASC traits are more likely to show maladaptive patterns of strategy use, greater parental responses to child's emotion, especially encouragement of expression, may facilitate adaptive emotion regulation strategy use in children. These findings contribute to our understanding of emotion regulation strategy use across the multidimensional spectrum of ASC and the lifespan, providing implications to parenting, educational and interventive strategies to facilitate adaptive emotion regulation strategy use and promote positive outcomes throughout the lifespan.

**418.013** (Poster) Emotional Regulation in Children with Autism: The Role of Ethnicity

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**Background:** From the 1 in 66 children diagnosed with autism spectrum disorder (ASD), up to 84% experience anxiety symptoms. In children with ASD, impaired emotional regulation (ER) may contribute to development or exacerbation of these symptoms. ER is the ability to control one's emotional experience. In neurotypical (NT) populations, ER ability is suggested to be influenced by ethnicity, as ethnicities can differ in value systems, social status, emotional socialization, and emotional expression. Ethnic differences in ER and its underlying neural correlates have been reported. Studies examining the effect of ethnicity on ER in children have had mixed results; some studies found higher levels of emotional difficulties in white populations compared to non-white populations, while others suggest the opposite. Despite these mixed results, a common finding across studies is that some non-white, NT populations use emotional suppression, a maladaptive ER strategy, more than white populations. However, in these non-white, NT groups, emotional suppression is not linked to adverse psychological effects, as it is in white, NT populations. These differences suggest that approaching ER difficulties with an ethnic lens may be critical to developing targeted interventions for ER-related psychopathology. To our knowledge, no studies have investigated the effect of ethnicity on ER ability in ASD.

**Objectives:** The goal of this study was to examine the association between ethnicity and ER ability in a sample of children with ASD. Specifically, we explored whether (1) individual differences in ER ability were associated with ethnic differences in children with ASD; and (2) differences in the effect of ethnicity on ER ability in children with ASD compared to NT children.

**Methods:** A sample of children with a diagnosis of ASD ( $n=27$ ;  $M_{age}=10.85$  years,  $SD_{age}=2.05$ ; 10 non-white; 17 white) and typical controls were recruited ( $n=36$ ;  $M_{age}=9.41$  years;  $SD_{age}=1.71$ ; 21 non-white; 15 white). Participants self-reported their ethnic backgrounds. The sample was pooled into two groups based on ethnicity: non-white (African-American, Asian/Pacific Islander, Hispanic, Native-American, Multiracial) and white (European-American/White). ER ability was measured by the Emotion Dysregulation Inventory (EDI), a caregiver report standardized for ASD. We also characterized internalizing and externalizing behaviours using the Child Behaviour Checklist (CBCL), a caregiver report assessing problem behaviour in children.

**Results:** The Wilcoxon Rank Sums Test demonstrated that children of white ethnicity had significantly higher scores on the EDI-Dysphoria subscale ( $p=0.017$ ) and the CBCL internalizing score ( $p=0.039$ ) compared to non-white ethnicities. Linear regression did not show a significant interaction effect of diagnosis and ethnicity. The effect of ethnicity on the other EDI subscales as well as the CBCL externalizing scores was not significant.

**Conclusions:** The results of this preliminary study suggest that there are ethnicity-related differences in children's ER abilities, and these differences appear similar among children with ASD and NT. If replicated in larger samples, this may suggest that ethnicity is a clinically-important variable when considering ER interventions.

**418.014 (Poster)** Investigating the Mediating Effects of Alexithymia, Intolerance of Uncertainty and Anxiety on the Relationship between Sensory Processing and Restricted and Repetitive Behaviours in Autistic Adults

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Background:

Autistic people often experience sensory processing (SP) differences that may affect homeostatic arousal leading to over- or under-responsiveness. Some restricted and repetitive behaviours (RRB) may function in response to these difficulties and serve to regulate arousal levels, and consequently ease distress and discomfort that may accompany these sensory experiences. RRB comprise insistence on sameness (IS) and repetitive motor behaviours (RMB). In autistic children, the relationship between SP and both IS and RMBs has been shown to be mediated by intolerance of uncertainty (IU; a tendency to react negatively to unforeseen/unpredictable situations and events) and anxiety together, but research has only partially explored this relationship in autistic adults. Moreover, there is evidence to suggest that alexithymia (difficulty identifying and describing emotions) may play an additional mediating role, through its impact on IU and anxiety, but this has not yet been explored.

Objectives:

This study aimed to explore the serial mediating effects of alexithymia, IU, and anxiety on the relationships between sensory processing and restricted and repetitive behaviours in autistic adults.

Methods:

Participants with an autism diagnosis were recruited from the Adult Autism Spectrum Cohort-UK, to take part in the Personalised Anxiety Treatment-Autism study. Data were available from 426 autistic adults. Participants completed four self-report questionnaires measuring: SP (Sensory Preferences Questionnaire (SPQ)); RRB (Adult Repetitive Behaviour Questionnaire-2 (subscales RBQ-2A IS and RBQ-2A RMB)); alexithymia (Toronto Alexithymia Scale-20 (TAS-20)); IU (Intolerance of Uncertainty Scale; IUS-12); and anxiety (Hospital Anxiety and Depression Scale; HADS Anxiety). Mediation models were run using serial mediation (model 6) of Hayes' (2013) PROCESS macro for SPSS, applying bootstrapped 95% confidence intervals (10,000 resamples). Age and gender were included as covariates in the models.

Results:

There was a significant direct effect from SP to IS (SPQ-->IS, B=.1881, SE=.0151, CIs=.1585-.2177) and significant indirect effects through IU alone (SPQ-->IU-->IS, B=.0215, SE=.0062, CIs=.0106-.0347) and Alexithymia and IU (SPQ-->Alexithymia-->IU-->IS, B=.0078, SE=.0025, CIs=.0036-.0132). There was a significant direct effect from SP to RMB (SPQ-->RMB, B=.1390, SE=.0107, CIs=.1180-.1600) and a significant indirect effect through all three mediators (SPQ-->Alexithymia-->IU-->Anxiety-->RMB, B=.0008, SE=.0005, CIs=.0000-.0020). The figures below illustrate significant pathways (direct: solid lines, indirect: dashed lines).

#### Conclusions:

There were two potentially distinct pathways between sensory processing and restricted and repetitive behaviours in autistic adults, indicating that different mechanisms may underpin insistence on sameness and repetitive motor behaviours although alexithymia and IU are involved in both. We did not discriminate between hyper- and hypo-sensory processing differences in this analysis, and it remains to be seen whether distinct relationships emerge when considering these subtypes in an adult sample. Difficulties with emotional processing, alongside IU and anxiety, should be considered when understanding the relationship between sensory processing and restricted and repetitive behaviours, and when offering interventions to support autistic people.

#### **418.015 (Poster)** Measuring Functional Deficits in Relation to Emotion Regulation Problems in Autism Spectrum Disorders Using the Cafas

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**Background:** Emotion regulation (ER) difficulties are common in autism spectrum disorder (ASD) and have linked to higher psychiatric symptoms. It has been suggested that ER difficulties may also contribute to poor functional outcomes in ASD, as has been shown in typically developing children (Cloitre, et al., 2005). However, measures used to establish this relationship in the general population, such as the Child and Adolescent Functional Assessment Scale (CAFAS; Hodges & Wong, 1996), have not been utilized in ASD. Further, previous research suggests that psychometric properties of valid assessments differ when used in ASD (White, et al., 2016). Better understanding and assessment of functional outcomes, in relation to ER, in ASD is important to consider for both research and clinical applications.

**Objectives:** This study investigates the measurement of functional problems as measured by clinician interview, compared to ER problems measured via clinician interview in an ASD sample.

**Methods:** A total of  $n = 57$  participants with ADOS-confirmed ASD, without intellectual disability, and selected for having ER problems. This sample was 73.7% male, 87.7% white with an average age of  $M = 15$  years ( $SD = 2.59$ ) and an average IQ of  $M = 105.31$  ( $SD = 18.49$ ). Both measures were collected through an interview with a parent by an independent evaluator within a clinical trial. The CAFAS is a valid and reliable rating scale which assesses functioning level across contexts. The Emotion Dysregulation Inventory (EDI; Mazefsky et al., 2018) is a valid and reliable measure of ER in ASD. The EDI measures Reactivity, intense negative emotion, and Dysphoria, low positive affect. Pearson correlations were conducted between EDI T-scores and the CAFAS subscales.

**Results:** Analyses indicate EDI subscales are not significantly correlated with any CAFAS subscales. When comparing the EDI Dysphoria to the CAFAS Mood/Emotion Subscale  $r = .120, p = .451$ , Self-Harm Scale  $r = .110, p = .488$ , School/Work  $r = .097, p = .542$ , Home Behavior  $r = .201, p = .193$ , Community Behavior  $r = -.188, p = .232$ , Substance Use  $r = -1.88, p = .232$ , Thinking Problems  $r = .027, p = .865$ , and Behavior Towards Others  $r = .050, p = .755$ . EDI Reactivity is not correlated to CAFAS Mood/Emotion Subscale  $r = .091, p = .568$ , Self-Harm Scale  $r = .181, p = .251$ , School/Work  $r = .256, p = .102$ , Home Behavior  $r = .058, p = .715$ , Community Behavior  $r = -.004, p = .980$ , Substance Use  $r = .004, p = .980$ , Thinking Problems  $r = .128, p = .420$ , and Behavior Towards Others  $r = -.043, p = .785$ . Additionally, CAFAS skewness = 1.634 (SE = .365).

**Conclusions:** The CAFAS did not indicate functional problems related to ER in ASD, within a sample of participants specifically selected for having problems with ER. Additionally, distribution on the CAFAS was not normal, indicating potential problems in psychometric properties in this population. Given previous research, it would have been expected that there would be functional deficits as a result of ER problems. Additionally, the Mood/Emotions subscale was not related to dysregulation, which may indicate differences in measurement of ER in ASD using the CAFAS. This work highlights the importance of the development and validation of functional outcome measures in ASD.

#### **418.016 (Poster)** Modeling Prospective Predictors of Mental Health Symptoms across the First Semester of College

**Background:** Prevalence rates suggest autistic adults are more likely than their allistic peers to experience anxiety and depression (Hollocks et al., 2019). Increased risk of social disappointment (Smith & White, 2020) and greater repetitive thinking (Rieffe et al., 2014) may contribute to this increased prevalence. Understanding these factors and their relationship with mental health over time is a key step to improving interventions for autistic adults.

**Objectives:** The current study examines negative repetitive thinking and satisfaction with social connectedness as prospective predictors of depression and anxiety symptoms in a longitudinal sample of first-semester college students. We hypothesize that (1) students who report greater capacity for social reward at baseline and lower social involvement throughout the semester will experience greater depressive symptoms over time; (2) on average, increases in negative repetitive thinking will precede increases in depressive and anxiety symptoms. While we predict no difference in the model of these mechanisms between autistic and allistic groups, we hypothesize that a higher proportion of autistic students will exhibit repetitive thinking and lack of social fulfillment.

**Methods:** We recruited incoming college students who reported either no history of autism (n=28) or suspected or previously diagnosed autism (n=15). Participants first completed a baseline survey including demographic information and constructs related to behavioral and physical health, such as Beck Depression Inventory, 2nd edition (BDI-II; Beck et al., 1996), and Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS; Gooding & Pflum, 2014), among other measures (see Table 1). Participants then completed 10-question surveys twice per week for 12 weeks; surveys included markers of negative repetitive thinking, social satisfaction, depressive and anxiety symptoms. Participants will complete a semester-end battery in mid-December.

Structural equation modeling (SEM) will be used to test explicit hypotheses about the association between hypothesized predictors (repetitive negative thinking and social engagement) and outcome variables related to emotional health. We plan to use bivariate dual change score models to evaluate reciprocal effects of the predictor and outcome variables. We will compare effect sizes for exploratory analyses (e.g., by gender).

**Results:** Preliminary results on baseline data suggest that greater self-reported social motivation (ACIPS;  $M = 82.13$ ,  $SD = 16.95$ ) was associated with lower depression (BDI-II;  $M = 11.22$ ,  $SD = 0.91$ ) scores at baseline ( $r = -0.46$ ,  $p < 0.01$ ). Additionally, repetitive behavior (RBS-R;  $M = 14.74$ ,  $SD = 15.90$ ) during the baseline was positively correlated with sadness scores five weeks later ( $M = 2.35$ ,  $SD = 1.26$ ) ( $r = 0.41$ ,  $p = 0.04$ ). After December 2020 we will be able to model the data (see Figure 1) within individuals and across groups to comment on etiological hypotheses.

**Conclusions:** This is the first known longitudinal investigation of the relationships between rumination, social fulfillment, and emotional health in autistic adults. Preliminary results suggest mechanisms related to depression risk are unlikely to be different between autistic and non-autistic adults, but autistic adults may be more likely to experience some of these psychosocial predictor variables.

**418.017 (Poster) Mothers of Autistic Children Recognize Emotions As Well As College Women**  
*A. J. Lampi* and *V. K. Jaswal*, University of Virginia, Charlottesville, VA

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**Background:**

One characteristic associated with autism is reduced accuracy in the recognition of facial emotional expressions (e.g. Uljarevic & Hamilton, 2013; but see Cook et al., 2012). Studies investigating whether parents of autistic individuals also show difficulties in emotion recognition have yielded conflicting results, with some finding lower accuracy compared to non-autistic individuals (e.g., Kadak et al., 2014; Palermo et al., 2006) and others finding no difference (e.g. Bolte & Poustka, 2003). It has also been suggested that alexithymia, a subclinical trait reflecting difficulty in identifying and distinguishing between emotions, may better explain performance on emotion-related tasks than levels of autism symptomatology (Bird & Cook, 2013).

**Objectives:**

We compared how well mothers of autistic children performed on a standard emotion recognition task with how well college women did on the same task. We additionally investigated the contribution of individual difference measures of autistic-like traits and alexithymia.

## Methods:

We recruited a sample of 24 mothers ( $M_{\text{age}} = 52.52$  years,  $SD = 5.92$ ) with an autistic child ( $M_{\text{child-age}} = 17.88$ ,  $SD = 4.72$ ) and a comparison sample of 151 college women ( $M_{\text{age}} = 19.15$  years,  $SD = 1.13$ ). Participants completed an emotion recognition task that required them to identify which of six emotions each of 72 faces showed (Ebner et al., 2010). In addition, participants completed the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994) and the Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2001). We examined group differences in overall emotion recognition accuracy in addition to accuracy within each emotion, both before and after accounting for level of alexithymia and autism symptomatology.

## Results:

Mothers correctly recognized the emotions in the emotion recognition task marginally more often than the college women, and mothers had significantly lower scores on the TAS-20 and AQ than college women (Table 1). Figure 1 shows the average accuracy for each of the six emotions. To analyze these data, we used linear mixed effects modelling. A model including group (mothers vs. college women) better fit the data than one that only included the six emotions,  $\chi^2(6) = 32.06$ ,  $p < .001$ . There were no significant main effects, but there was a significant interaction between group and emotion depicted,  $F(5,865) = 5.80$ ,  $p < .001$ . The only emotion that showed a difference between groups was sadness: Mothers were more accurate at identifying sad faces than college women,  $t(921) = 5.37$ ;  $p < .001$ . Adding AQ and TAS scores to this model did not result in an improved fit.

## Conclusions:

Although some past studies have found that parents of autistic children have reduced emotion recognition abilities, this study did not. Mothers of autistic children recognized emotions on a standard emotion recognition task at least as well as college women. Indeed, the only difference between the two groups showed an advantage for the mothers, who were better at recognizing sad faces than the comparison group. AQ and TAS-20 scores did not predict performance on the emotion recognition task above participant group alone.

### **418.018** (Poster) Multimodal and Dimensional Emotion Recognition Among Children with and without ASD: Examining the Impact of ASD Symptoms and Alexithymia

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**Background:** The unique social characteristics of persons with ASD are thought to contribute to their similarly distinctive emotion recognition (ER) abilities, as generally measured with forced-choice verbal-label ER paradigms. Alternatively, we suggest that alexithymia, a trait characterized by a difficulty in verbalizing emotions that is more prevalent among persons with ASD than those in the general population, may be a more powerful indicator of their ER abilities. In doing so, we used a multimodal and multimethod paradigm to test ER among children with and without ASD.

**Objectives:** The aim of this study was to assess the extent to which alexithymia and ASD symptoms are related both to basic ER across multiple modalities (face, voice, music) and to participant responses on either a traditional forced-choice paradigm or dimensional ratings of emotional arousal (low to high energy) and valence (negative to positive) among children with ASD as compared to TD children.

**Methods:** Fifteen children with ASD and 19 TD children aged 6-12 years (mean verbal mental age [VMA] = 9.14 years) participated in the study. A parent or teacher completed the Children's Alexithymia Measure (CAM; Way et al., 2010) and the Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012) for each child. The participants completed a task of ER in which they were asked to identify basic emotions (happy, sad, and fear) in facial, vocal, and musical stimuli, by selecting a corresponding verbal label (forced-choice condition) and by rating how energetic and positive/negative each stimulus was on 5-point Likert scales.

**Results:** Compared to the TD participants, the participants with ASD scored significantly higher on the CAM and the SRS-2. In the forced-choice condition, partial correlations controlling for VMA revealed no significant associations between CAM scores and ER accuracy overall, or at the group level. However, among the TD children, higher SRS-2 scores were correlated with less accurate identification of emotions in voices ( $r = -.59$ ,  $p = .010$ ) and of sad emotions ( $r = -.72$ ,  $p = .001$ ) across sad faces ( $r = -.66$ ,  $p = .003$ ) and sad voices ( $r = -.63$ ,  $p = .005$ ). In the dimensional condition, the participants with higher CAM scores rated happy music as more positively valenced ( $r = .502$ ,  $p = .003$ ) and sad music as less energetic ( $r = -.55$ ,  $p = .001$ ) as compared to the participants with lower CAM scores. Further, the participants with higher SRS-2 scores rated happy music as more positively valenced than those with lower SRS-2 scores ( $r = .48$ ,  $p = .005$ ).

Conclusions: These preliminary findings suggest that both ASD symptoms and alexithymia may be related to how children recognize and rate emotions across specific emotions or modalities. Alexithymia traits may play a greater role in the group differences in dimensional ratings of valence and arousal, whereas social differences appear to be more associated with forced-choice ratings of emotions, particularly in TD children. Overall, these findings highlight the importance of considering social differences and alexithymia traits in studying ER among children with ASD as well as TD children.

**418.019 (Poster)** Multisensory Perception of Expressions of Emotion in Autistic Children and Adolescents

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Background: Atypical sensory perception has been recognized in autistic individuals since its earliest descriptions, and is now considered as one of the key characteristics of autism (APA, 2013). The *integration* of sensory information (multisensory integration; MSI) may be particularly altered in autistic individuals, with research suggesting that atypical MSI may underlie the different sensory profiles seen in autism (e.g. Feldman et al., 2018) and may also have cascading effects on development (e.g. Stevenson et al., 2018).

Objectives: Our study is the first to define time-resolved discrimination of MSI expressions of emotion across development in individuals with and without autism. Using a novel gating paradigm (Falagiarda and Collignon, 2019), we demonstrated that precise discriminatory decisions are achieved at different time points during the unfolding of emotional expressions (anger, fear, happiness and sadness) across different periods of development.

Methods: Detection of dynamic emotion expressions (anger, fear, happiness and sadness) was tracked separately for auditory, visual and bimodal cues in 32 autistic ( $M_{age}$  12.13 (3.45),  $M_{IQ}$  99.96) and 56 typical participants ( $M_{age}$  11.91 (3.41),  $M_{IQ}$  = 106.4). Stimuli were separated into 10 progressively longer ‘gates’, increasing in increments of ~33ms (one frame), reaching a maximum of 400ms. Participants were grouped into children (age 6-12 years) and adolescents (age 13-18 years), and logistic psychometric curves were fitted for each group. Thresholds were extracted from each model at 0.625 proportion of correct responses, where  $p(\text{threshold}) = (1 - p(\text{chance})) / 2$ , and were analyzed using a generalized linear mixed model with group, modality and emotion as fixed effects and subjects as a random effect (marginal  $R^2 = 0.21$ ; conditional  $R^2 = 0.42$ ).

Results: An ANOVA was conducted on the model, revealing a significant main effect of group  $F = 4.33$ ,  $p < 0.01$ . Bonferroni post-hoc tests indicated that the group effect was driven by a significant difference between autistic children and autistic adolescents ( $t = 3.69$ ,  $p < 0.01$ ), with children having significantly higher thresholds. A significant overall effect of modality was also observed ( $F = 84.17$ ,  $p < 0.01$ ). Bonferroni post-hoc comparisons indicated that bimodal stimuli lead to better discrimination of emotion, compared to unimodal, and visual stimuli provided better discrimination than auditory stimuli (auditory sig. higher than visual ( $t = 8.51$ ,  $p < 0.01$ ); auditory sig. higher than bimodal ( $t = 12.82$ ,  $p < 0.01$ ); visual sig. higher than bimodal ( $t = 4.40$ ,  $p < 0.01$ ). An overall significant effect of emotion was also found ( $F = 6.10$ ,  $p < 0.01$ ), with post-hoc analyses indicating that fear thresholds were significantly lower than anger ( $t = 3.48$ ,  $p < 0.01$ ).

Conclusions: Our study is the first to define time-resolved discrimination of audiovisual expressions of emotion across development in autistic individuals. Our results support previous evidence that MSI profiles differ between childhood and adolescence in the autistic population (e.g. Feldman et al., 2019), and provides a platform for further exploration of temporal emotion discrimination across neurodiverse development.

**418.020 (Poster)** Self-Reported Outcomes of School-Aged Children at Elevated Likelihood for Autism Spectrum Disorder: Preliminary Results of a Longitudinal Study

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Background:

Autism spectrum disorder (ASD) has an estimated prevalence of about 1% (Baird et al., 2006), but several groups are at elevated likelihood (EL) to develop ASD. Children with an older brother or sister diagnosed with ASD – the so-called EL-siblings – have up to 20% chance of developing ASD (Ozonoff et al., 2011). Despite the importance of gaining insight into their longer-term outcomes, only few studies assessed EL-siblings after age three (Miller et al., 2016; Shephard et al., 2017). However, they did not include self-report measures, nor did they explore predictors of school-age outcomes. Adding these aspects to the follow-up design could significantly improve our understanding of their school-age functioning.

Objectives:

Explore self-reported outcomes and their predictors in a sample of EL-siblings and children at typical ASD-likelihood (TL).

#### Methods:

Participants were 37 EL-siblings (18 girls, mean age=11.7 years, sd=1.766) and 20 TL-children (7 girls, mean age=13.7 years, sd=.348), between 9 and 16 years old. They previously participated in this longitudinal study at six timepoints before their third birthday. Of the 37 EL-siblings, 11 (30%) received a best-estimate research diagnosis of ASD at the age of three and/or had a clinical diagnosis at follow-up (EL-ASD-siblings). At age three, Mullen Scales of Early Learning, ADOS and Child Behavior Checklist (CBCL) were administered, while at school-age social-emotional functioning was assessed: depression (Children's Depression Inventory; CDI-2), peer problems (Strengths and Difficulties Questionnaire; SDQ subscale peer problems), emotion regulation (FEEL-KJ), anxiety (SCARED-NL) and self-concept (CBSK/CBSA).

#### Results:

Internal consistency of the self-report measures was satisfactory, except for the SDQ-peer problems subscale. A factor analysis on this subscale resulted in two components: "detached/bullied" and "unpopular". Subsequently, a MANOVA was performed, with three groups (EL-ASD-siblings, EL-nonASD-siblings and TL-children), and eight dependent variables: "detached/bullied", "unpopular", total z-score for anxiety and self-concept, T-scores for adaptive/maladaptive/external emotion regulation strategies, and percentile-based-categories of CDI-2-scores. EL-ASD-siblings scored significantly higher than TL-children on "detached/bullied" ( $p=.006$ ), marginally higher on depressive symptoms ( $p=.062$ ), and significantly lower on self-concept ( $p=.034$ ). No group differences were found for EL-nonASD-siblings, except for a marginally lower score on "detached/bullied" compared to EL-ASD-siblings ( $p=.093$ ). Three linear regressions were performed to predict the variables with (marginally) significant group differences. Depressive symptoms and self-concept could not be predicted by Mullen Developmental Index, ADOS\_SA (social affect) or internalizing CBCL T-scores at 36 months. However, the model was significant for "detached/bullied" ( $F(3,38)=3.119$ ,  $p=.037$ ,  $R^2=0.198$ ), with higher ADOS\_SA being predictive for higher scores on "detached/bullied" ( $\beta=.290$ ,  $t=2.828$ ,  $p=.007$ ).

#### Conclusions:

This was the first longitudinal study in EL-siblings that included self-report measures of social-emotional functioning, which is important given that self-report does not always correspond with parent-report. Unlike in the EL-nonASD-siblings – who seemed to have no elevated social-emotional problems despite their EL-status – self-reported outcome in children with an ASD-diagnosis was poorer than in TL-children. Social-communicative functioning at age 3 predicted difficulties with peers later on. It should, however, be noted that our sample was rather small and our sibling group had average cognitive abilities (mean FSIQ=105), which might limit the generalizability of the results.

#### **418.022** (Poster) Studying How Physiological Arousal and Emotion Regulation Interact in Children Diagnosed with Autism Spectrum Disorder

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Background: Up to 84% of children with ASD experience clinically significant anxiety, which negatively impacts academic achievement, employment outcomes, and physical and mental health. Despite the prevalence and significance of anxiety, very few evidence-based interventions exist. A key challenge to developing such treatments is that the biological, physiological, and emotional factors contributing to anxiety in ASD remain largely unknown. Two mechanisms suggested to underlie anxiety in ASD are physiological arousal and emotion regulation (ER). This knowledge is critically needed to inform targeted treatment approaches for anxiety in ASD populations.

Objectives: Are physiological arousal and ER associated in children diagnosed with ASD?

Methods: The study sample consisted of 44 children (7-14 years) who were TD ( $n=24$ , median age=9.6, IQR=2, 15 male) or had a diagnosis of ASD ( $n=20$ , median age=11.4, IQR=2.2, 17 male). All children had full-scale IQ greater than 85. The experiment consisted of participants playing video games in between two baseline movie-watching sessions (BL1 and BL2). For short intervals, the video game controls were inverted/unresponsive to elicit frustration. Physiological arousal was measured via the

participants' heart rate (HR) and respiratory sinus arrhythmia (RSA), to index overall arousal and parasympathetic activity, respectively. Mean HR and RSA were calculated for BL1, BL2, and each video game. HR and RSA reactivity were calculated for each video game relative to BL1 and BL2. ER ability was measured via the Emotion Dysregulation Inventory (EDI), a 64-item parent-reported questionnaire validated in samples of children with ASD, in which a higher score reflects lower ER ability. Wilcoxon-Mann-Whitney tests and linear regression analyses were used to examine group differences and arousal-EDI associations, respectively.

Results: There were no significant differences in mean HR, RSA, or RSA reactivity between the ASD and TD groups. However, though both groups increased in HR, the ASD group had a significantly smaller increase on average in HR from BL1 to the frustrating video gameplay ( $p < 0.01$ , Figure 1) as well as from BL2 ( $p < 0.01$ ). There were no significant associations between physiological indices and the EDI totals (reactivity full or short, dysphoria), even though the ASD group scored significantly higher on each (full,  $p < 0.01$ , Figure 2; short,  $p < 0.01$ ; dysphoria,  $p < 0.05$ ).

Conclusions: While both groups' HR increased from resting state to negative modulation during video gameplay, the ASD group had a significantly smaller increase than the TD group (Figure 1). This difference was not explained by parasympathetic activity (RSA) and did not relate to ER, even though groups differed on ER difficulties (Figure 2). Future studies can investigate whether physiological arousal and ER significantly contribute to anxiety symptoms in children diagnosed with ASD.

#### **418.023 (Poster)** The Link between Emotion Regulation Abilities in Children with ASD and Depressive Symptomatology in Their Parents

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Background: Research shows that parents of children with autism spectrum disorder (ASD) have more depressive symptomatology than parents of typically developing (TD) children (Cohrs & Leslie, 2017). However, studies with TD children also show that children of depressed parents are at risk of developing low emotion regulation (ER) ability (Feng et al. 2008). Therefore, it is hypothesized that emotion regulation abilities in children with ASD and depressive symptoms in their parents are related.

Objectives: To analyze the relationship between emotion regulation difficulties in children with ASD and depressive symptomatology in their parent.

Methods: 108 parents (84% mothers) answered to questionnaires about themselves and their children. Parents were aged 26 to 53 years old ( $M = 40.47$ ,  $SD = 5.13$ ) and their children 4 to 12 years old. 19 were parents of children diagnosed with ASD with intellectual disability (ID; children's age:  $M = 8.79$ ,  $SD = 2.79$ ), 17 were parents of children diagnosed with ASD without ID (children's age:  $M = 9.28$ ,  $SD = 2.46$ ), and 72 were parents of TD children (children's age:  $M = 8.59$ ,  $SD = 2.27$ ). The Center for Epidemiologic Studies Depression Scale (CES-D scale; Radloff, 1977) was used to assess parents' depressive symptomatology; the Autism Spectrum Quotient Questionnaire for Children (AQ-Child; Auyeung et al. 2008) was used to control children's autistic traits; and the Emotion Regulation Checklist for children (ERC; Shields & Cicchetti, 1997) was used to assess children's emotion regulation ability.

Results: The analyses showed that children with ASD had less emotion regulation ability than TD children ( $t(106) = 7.68$ ,  $p < .001$ ,  $ES r = .60$ ). Analyzing parents' depressive symptomatology, no differences were found between fathers and mothers ( $t(106) = .11$ ,  $p = .92$ ). However, a significant difference was found among parents of children with ASD and TD children: the odds of having clinically significant depressive symptomatology (CES-d score  $> 16$ ) were 5 times higher for parents of children with ASD than TD ( $\chi^2(1) = 13.29$ ,  $p < .01$ ,  $OR = 5$ ). Furthermore, it was also found that children of depressed parents (CES-d  $> 16$ ) had more emotion regulation difficulties ( $t(106) = 3.18$ ,  $p < .01$ ,  $ES r = .30$ ). Regression analyses revealed that taking children's age into account, children's emotion regulation difficulties were a better predictor of parents' depressive symptomatology than children's diagnosis (Table 1).

Conclusions: As expected, it was found that children with ASD had more emotion regulation difficulties and that their parents had more depressive symptomatology than TD children and their parents, respectively. Furthermore, children of depressed parents had more emotion regulation difficulties than children of non-depressed parents. Finally, it was found that emotion regulation difficulties incrementally predicted parents' depressive symptomatology above and beyond the children's diagnostic group. These results suggest that children's difficulties with emotion regulation might be an important aspect in the understanding of depression in parents of children with ASD. However, further research is needed to better understand the

relation between the emotional difficulties of children with ASD and their parents' depressive symptomatology.

**418.024** (Poster) The Operationalisation of Uncertainty in Experimental Research in Autism and Anxiety: A Systematic Review  
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**Background:** A growing consensus in the mental health literature is that a construct known as 'Intolerance of Uncertainty (IoU)' (Carleton, 2014) represents a transdiagnostic risk-factor for anxiety disorders that are very common in autism. A limitation in this literature to date, however, is that this construct is measured almost exclusively through self-report (e.g. Maisel et al., 2016; Wigham et al., 2014.), which has led to somewhat of a theoretical vacuum regarding the precise mechanisms that link IoU to the behavioural expression of anxiety in the general population vs those with a diagnosis of ASD.

**Objectives:** The overarching aim of this review was to examine the effects of experimental manipulations of 'uncertainty' on overt behaviour, in order to derive a formal description of the construct of 'Uncertainty' and how this has been operationalised in the existing anxiety and autism literatures.

**Methods:** Six electronic databases were searched using the following terms: Uncertainty AND Anxiety; Uncertainty AND Autism OR Autism Spectrum Disorder OR ASD. Studies had to include either participants with a diagnosis of an autism disorder or an anxiety disorder, or a group of neurotypical participants for whom levels of autistic traits and/or anxiety were quantified as a continuous variable through validated instruments. Studies also had to consider the influence of experimental manipulations of 'uncertainty' on overt behaviour. The guidelines from the Centre for Reviews and Dissemination (CRD) were used to extract data and assess them for quality and risk of bias.

**Results:** The search identified 10,051 studies, of which 77 were included in this review. Data analysis is ongoing but preliminary results indicate that in both the anxiety and autism literatures uncertainty is frequently operationalised as a manipulation of the probabilities of stimulus-outcome contingencies. In both literatures, this is defined in terms of ambiguity (differing but stable probabilities), risk (smaller likelihood with higher stakes) or conditioning (with known or volatile contingencies) in tasks involving monetary gains or losses. However in autism research, the emphasis is on whether autistic people use contextual priors in order to make predictions regarding the likelihood of future events rather than on direct correlations between affect and behaviour. In anxiety research, other tasks involved interpreting ambiguous scenarios or being given delayed or deceptive feedback and then measuring self-confidence; whereas in autism research, uncertainty was manipulated by modifying physical cues (rubber hand illusion) or visual stimuli (dot-probe) and then measuring self-awareness.

**Conclusions:** Despite research pointing to the key role IoU plays in anxiety in autism, unlike in the anxiety literature, none of the included studies in the autism literature included a self-report measure alongside a behavioural measure of IoU and only four explored the relationship between autism, uncertainty and anxiety – only one of which found a correlation. Our preliminary results show, therefore, that there is a gap in the existing literature in terms of linking self-reported intolerance of uncertainty to the behavioural expression of such intolerance and the experience and expression of anxiety in autism.

**418.025** (Poster) The Recognition of Speech and Song-Evoked Emotions Among Children with ASD and Typical Development: Does Emotion Intensity Impact Performance?  
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**Background:** The commonly accepted dogma of difficulties in inferring others' emotions from various social cues among persons with ASD needs to be recast in relation to context. For example, the emotion recognition abilities of persons with ASD, like those of others, are highly influenced by factors such as the intensity to which emotions are conveyed and level of social pragmatic language skills. Emotion recognition also varies across modality. For example, persons with ASD can accurately recognize music-evoked emotions.

**Objectives:** In order to fine-tune our understanding of emotion recognition in ASD, we examined the relation between specific emotions, emotion intensity, and social pragmatic language skills on the recognition of speech and song-evoked emotions.

**Methods:** Twenty-six children with ASD (mean age = 10.9 years; VCI = 77.8) and 21 TD children (mean age = 9.0 years; VCI = 101.6) completed a computerized task in which they identified emotions of high or normal intensity from spoken or sung sentences with neutral semantic content. The Verbal Comprehension Index (VCI) of the WISC-V was administered to the

participants and caregivers completed three subscales of the Child Communication Checklist-2 measuring quality of initiating social conversations, scripted language, and adapting conversation to different contexts.

Results: A repeated-measures ANOVA with stimuli modality (speech vs. song), emotion (happy, sad, angry), and intensity (high vs. normal) as within-subject factors, participant group (ASD vs. TD) as a between-subject factor, VCI as a covariate, and emotion recognition accuracy as the dependent variable revealed a significant main effect of emotion ( $p = .046$ ), in which anger was the most easily recognized emotion. VCI, and not participant group, had a significant effect on emotion recognition accuracy. A significant group X intensity interaction ( $p = .035$ ) indicated that children with ASD, but not those with TD, responded more accurately in recognizing high intensity as compared to normal intensity emotions. A separate repeated-measures ANOVA with response time as the dependent variable revealed a marginally significant group X intensity X stimuli interaction ( $p = .05$ ) such that the ASD group showed faster response times for high (vs. normal) intensity emotions conveyed in speech but not in song, while the response times of the TD group showed similar response times across intensity and modalities. A regression analysis revealed that a component of social pragmatic skills (i.e., quality of initiating social conversations) was associated with emotion recognition accuracy for the TD group but not for the ASD group.

Conclusions: These findings suggest that emotion recognition among children with ASD is impacted by intensity, particularly for speech-evoked emotions, while an effect was not observed among the children with TD, who performed comparably across intensity conditions and modalities. Findings replicate previous work showing associations between verbal skills and emotion recognition of children with ASD. In contrast, social pragmatic language skills were not related to emotion recognition of children with ASD. These findings suggest that interventions targeting emotion recognition of children with ASD may be ameliorated by first teaching emotions that are intensely conveyed followed by those that are more subtle.

**418.026** (Poster) Two Pathways: The Contribution of Autistic and Alexithymic Traits to Emotion Recognition Difficulties  
*C. T. Keating and J. L. Cook, School of Psychology, University of Birmingham, Birmingham, United Kingdom*

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Background:

Recent developments suggest that alexithymia, and not autism, is responsible for the difficulties with emotion recognition that are often documented in the autistic population. Whilst research has not yet elucidated the mechanisms behind its involvement, there are speculations that being high in alexithymic traits results in more variable representations of emotion, thus leading to poorer emotion recognition accuracy.

Objectives:

We aimed to investigate variability of emotion representations and emotion recognition accuracy in a sample of autistic and non-autistic adults. We hypothesised that alexithymic, and not autistic traits, would be linked to increased variability and reduced accuracy.

Methods:

25 autistic and 25 non-autistic controls, matched on age, gender, non-verbal reasoning (NVR) and alexithymia, completed two emotion-based tasks which employed dynamic point light displays (point light faces; PLFs) of happy, angry and sad facial expressions. In the first of these tasks, on each trial, participants viewed a PLF and rated the extent to which the expression looked angry, happy and sad. Emotion recognition accuracy was calculated as the correct emotion rating minus the mean of the two incorrect emotion ratings. In the second of these tasks, on each trial, participants viewed a PLF stimulus (that looped such that it played continuously) and were required to manipulate its speed (by moving a slider) until the PLF moved at the speed of a typical angry, happy or sad expression. Variability was calculated as the standard deviation of the speeds attributed to angry, happy and sad PLFs. The Autism Quotient (AQ) and the Toronto Alexithymia Scale (TAS) were used to index autistic and alexithymic traits respectively.

Results:

First, we constructed a linear mixed effects model of accuracy as a function of mean variability with subject, age, gender and NVR as random intercepts. This revealed that mean variability [ $t(72.54) = -3.42, p < .01$ ] was a significant predictor of accuracy. Next, we constructed two linear mixed effects models with accuracy and variability as the outcome variables respectively. Whilst accuracy was negatively predicted by total AQ score [ $t(95.13) = -2.56, p < .05$ ] (and not total TAS score), variability was not predicted by total AQ or TAS scores [all  $p > .05$ ]. We ran these analyses again, entering all of the AQ and TAS subscales as potential predictors. Whilst accuracy was not predicted by any of these subscales [all  $p > .05$ ], variability was predicted by scores

on the TAS Externally Oriented Thinking (EOT) subscale [ $t(51.04) = 3.148, p < .01$ ]. Finally, we ran a mediation analysis (see Figure 1), which revealed that TAS EOT exerted an indirect effect on emotion recognition accuracy by influencing variability [standardized beta =  $-.19, z(50) = -9.50, p < .001$ ].

#### Conclusions:

Our results illuminate the presence of two ‘pathways’ to emotion recognition difficulties. On one hand, being high in autistic traits *directly* contributes to lower emotion recognition accuracy. On the other hand, being high in certain alexithymic traits (specifically externally oriented thinking) contributes to greater variability, which in turn results in lower accuracy (thus partially supporting our hypothesis).

**418.027 (Poster)** Understanding the Influence of Social Interactions on Negative Affect in Autistic Adults with Social Anxiety  
**D. L. Limon<sup>1</sup>, D. Gifford<sup>2</sup>, D. Melanson<sup>3</sup>, K. M. Normansell-Mossa<sup>3</sup>, J. A. Nielsen<sup>1</sup> and M. South<sup>4</sup>,** (1)Brigham Young University, Provo, UT, (2)Neuroscience, Brigham Young University, Provo, UT, (3)Clinical Psychology, Brigham Young University, Provo, UT, (4)Psychology & Neuroscience, Brigham Young University, Provo, UT

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Background: Social anxiety disorder affects approximately 15 million American adults and is common among autistic individuals alongside differences in social communication. Studies using ecological momentary assessment methods (EMA) have shown that individuals with elevated social anxiety show increased benefit from close social interactions, including reduced levels of daily negative affect (NA). However, little is known about how types of social interactions affect individuals with autism and concurrent social anxiety, who may show varying levels of social motivation.

Objectives: To examine how daily social interactions--including both face-to-face and digital interactions--are associated with daily NA in adults with combined autism and social anxiety relative to non-autistic socially anxious adults and autistic but non-anxious adults.

Methods: Participants included adults (18+ years) who are participating in an on-going mental health longitudinal study. Participants consisted of 100 adults evenly split across non-clinical (NOCLIN), autistic (AUT), and socially anxious (SOCANX) groups. Social anxiety was measured using the Liebowitz Social Anxiety Scale (LSAS). We leveraged smart-phone based EMA surveys to examine daily NA and data about the individual’s social interactions. EMAs are collected in real-time, limiting retrospective reporting bias which allows us to track fluctuating emotional experiences that contribute to risks for potential and/or worsened mood disorders.

Results: One-way ANOVA showed a significant effect for total score on the LSAS, as both clinical groups scored higher than the NOCLIN control group. There was no significant difference in mean LSAS score between the AUT (mean = 67.82, SD = 28.4) and SOCANX group (mean = 73.71, SD = 24.09). The same pattern of (AUT = SOCANX) > NOCLIN was true for the daily measures of negative affect and positive affect. We specifically analyzed SOCANX and AUT participants with moderate- to high-scores on the LSAS. For both autism and non-autism socially-anxious groups, a decrease in negative affect was significantly correlated with increased feelings of face-to-face social connectedness, although NA was *positively* correlated with the *number* of daily interactions in the SOCANX group.

Conclusions: Results indicate that social interactions, particularly face-to-face connectedness, help socially anxious autistic individuals in the same way as non-autistic individuals. Interventions based on improving opportunities for social interaction and reducing associated anxiety may improve mental health for autistic and socially anxious individuals.

### PANEL DISCUSSION — EPIDEMIOLOGY/POPULATION STUDIES

#### Panel 204 - Insights into Autism from Longitudinal Studies Spanning Infancy to Adulthood

**Panel Chair:** Jessica Girault, *Carolina Institute for Developmental Disabilities, University of North Carolina, Chapel Hill, NC*

**Discussant:** Alycia Halladay, *Autism Science Foundation, New York, NY*

Longitudinal studies have revealed that changes over time in symptomology, behavior, and neurobiology represent a fundamental aspect of autism spectrum disorder (ASD). In this panel, we discuss findings from four longitudinal studies spanning infancy through adulthood that highlight the dynamic nature of ASD and emphasize the importance of longitudinal research in clarifying our understanding of etiology and the natural history of ASD. Presenters discuss key early predictors of later outcomes, transition points in trajectories, and the individual, family, and contextual factors that contribute to intra- and inter-individual variability in ASD.

**204.001** (*Panel Discussion*) The Infant Brain Imaging Study: Exploring the Role of Family Traits  
**J. B. Girault**, *Carolina Institute for Developmental Disabilities, University of North Carolina, Chapel Hill, NC*

**Objective:** The Infant Brain Imaging Study (IBIS) is a prospective longitudinal study of infant siblings of children with autism who are at increased likelihood of developing autism themselves. The overarching goal of the project is to identify the developmental precursors of autism in order to improve early detection and inform intervention targets. The infant sibling study design provides a powerful framework to determine what is “familial” in autism by placing the infant sibling in the context of the family and family genetics. Here we discuss findings demonstrating that the phenotypic severity of older siblings with autism (probands) can inform behavioral and neurodevelopmental trajectories in their younger siblings.

**Methods:** The sample consists of 384 proband-sibling pairs. Infant siblings (60% male) were assessed with a neuroimaging (structural, diffusion, functional) and behavioral battery (direct assessment, parent interviews and questionnaires) at 6, 12, and 24 months; siblings are currently being followed-up at school-age. Siblings received a clinical best estimate diagnosis at 24 months using DSM-IV-TR criteria. Probands (mean age 5.5 years; 86% male) were phenotyped using parent interviews and questionnaires; autism diagnosis was confirmed with clinical records. A total of 89 proband-sibling pairs (23%) were concordant for a diagnosis of autism. Two main aims were addressed: (1) to determine whether proband characteristics are predictive of autism diagnosis in siblings, and (2) to assess associations between proband traits and sibling (a) behavior and (b) brain development from 6 to 24 months of age.

**Results:** Proband autism severity was a significant predictor of diagnosis in younger siblings at 24 months. Quantitative variation in proband adaptive behavior, communication, and language was significantly associated with sibling behavior in the same domains at 24 months, but not at earlier ages. Proband autism severity explained significant variation in cerebral volume and cortical surface area from 6 to 24 months and white matter microstructure of the splenium at 6 months among infants who were later diagnosed with ASD. Neuroimaging results linking proband traits to sibling brain development converged around cortical regions, fiber pathways, and functional networks involved in visual attentional behaviors.

**Conclusions:** The family study design revealed that autistic traits in probands can inform: (1) likelihood of later diagnosis, (2) adaptive, communicative, and language behaviors at 24 months, and (3) neurodevelopmental trajectories from 6 to 24 months in younger siblings. This suggests that quantitative autistic traits in first-degree family members may serve as important markers of genetic liability for ASD in infants and toddlers. The family study design coupled with prospective longitudinal follow-up could serve as a framework to elucidate pathways from familial genetic liability, to early brain development, to the emergence of autism.

**204.002** (*Panel Discussion*) The Canadian Pathways Study  
**P. Szatmari**, *The Hospital for Sick Children, Toronto, ON, Canada*

**Objective:** The Canadian Pathways in ASD prospective study focuses on identifying factors associated with good outcomes in an inception cohort of children with ASD. The objectives of this presentation are to provide a summary of the study, its design and some key findings.

**Methods:** Sampling occurred through autism services in 5 Canadian provinces (N=421) soon after an ASD diagnosis was made (mean age 41.17 months). Follow-up assessments occurred approximately yearly; the participants are now in late adolescence. Aspects of developmental health, highlighted as outcome domains, include communication, socialisation, activities of daily living and mental health. Multiple measures of autism symptoms and other behaviour were also obtained. Attributes associated with developmental health trajectories and outcomes included both child-level factors such as sex, IQ and language skills, as well as contextual factors such as family income, ethnicity, and functioning, and some data on services received.

**Results:** Individual children with ASD follow different developmental trajectories. Specific outcome domains have heterogeneous, independent trajectories. The shape of these trajectories may shift at key transition points such as entry to school. A substantial number of children are 'doing well' by mid to late childhood in at least one developmental health domain. Importantly, many parents report strengths seen in their children both at home and at school. Doing well is associated with both child-level and contextual-level factors such as language skills and family functioning. In this cohort, measures of the timing, type and duration of services received did not have a large impact on outcomes.

**Conclusions:** Prospective studies of autism reveal a greater degree of heterogeneity than expected. No single 'good' outcome should be expected, as this is inconsistent with the natural history of the condition. Youth with ASD have many strengths that are as important to appreciate as the challenges they may face. The Pathways study can assist us in understanding what contexts are most supportive of youth with ASD and their families, whatever trajectories they follow.

**204.003 (Panel Discussion) The Early Diagnosis Longitudinal Study**  
**C. Lord, University of California, Los Angeles, Los Angeles, CA**

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**Objective:** The Early Diagnosis Longitudinal Study is a prospective study of children referred for possible autism or neurodevelopmental delays at age 2 and an additional group of children of the same age, but who entered the study about age 9. All have been followed up to age 30. The initial goal of the project was to determine if clinical diagnoses of autism in 2 year-olds were reliable and stable. Years later, our goals are to better describe the various outcomes of the participants, map different trajectories to adulthood and identify factors that may support or create barriers for more positive outcomes.

**Methods:** The sample consists of two cohorts of consecutive referrals of all children under age 3 to 4 TEACCH clinics in North Carolina and a similar autism clinic in Chicago (n=192, mean age = 29 months), 21 children with developmental delays from the sources of referral for the preceding group for whom no one suspected autism (mean age = 30 months) and 54 children from Michigan referred for an autism evaluation who joined the study at approximately age 9. Face to face follow up assessments occurred by blinded teams at 3, 5, 9, 19, 25 and 30, with a long phone interview at 14 and questionnaire packets (now online) mailed approximately twice a year over the entire period. Data about demographic, child factors and family variables have been collected, as well as treatment logs.

**Results:** There is tremendous heterogeneity in outcomes, with a number of health and behavioral characteristics still changing as the participants moved from emerging adulthood into their late 20's. Factors such as language level (even as early as age 3), adaptive skills, and autistic symptoms each had different trajectories from toddler to adult years with predictability for objective outcomes quite high, though subjective outcomes and more general mental health concerns much more difficult to predict. We propose factors that operationalize positive outcomes for individuals with autism with intellectual disability and those without intellectual disability and show that subjective outcomes, self-reported by those who had sufficient language and reported by parents for those who could not, were definable in terms of positive and negative feelings, well-being and absence of mental health problems.

**Conclusions:** We have much more to learn about the various trajectories of development and learning that occur within the heterogeneous group of adults referred at early ages for autism. Although some early predictive factors are very powerful, other aspects of development continue to change in major ways into adulthood. If we can understand these changes, we hope we can help more individuals achieve outcomes that they desire.

**204.004 (Panel Discussion) The Special Needs and Autism Project Cohort**  
**E. Simonoff, King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom**

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**Objectives:** Conceptualizations and definitions of autism have changed markedly over the past 30 years, leading to prevalence rates in register-based and epidemiological studies increasing substantially. Does this mean that we are identifying less severely affected individuals who have overall better outcomes in adult life? At the same time, there has been an increasing appreciation of heterogeneity within autism, the role of mental health problems in the experiences of the autistic person and the need to consider outcomes from the perspective of the autistic person.

**Methods:** The Special Needs and Autism Project cohort comprises 158 autistic participants born in 1990-91 and residing in south-east England when the sample was drawn in 2000 from those either with a clinical diagnosis of autism or who were registered as having special educational needs (SEN). The sample was drawn with the original aim of accurately identifying the prevalence of autism and therefore a sample of 255 participants were selected at high, moderate and low probability of having autism based on parent-reported SCQ scores, along with clinical diagnosis. Of those receiving a gold-standard research autism diagnosis, only 58% had received a local clinical diagnosis (although most had an alternative clinical diagnosis) and the sample is particularly pertinent in taking a wider-population approach. Assessments have taken place at ages 12, 16 and 23 years.

**Results:** From the original sample, 126 (80%) have been followed up to age 23 years. Longitudinal findings show significant growth in IQ but little change in reported autistic symptoms. Although mental health symptom scores declined with age, 37% and 21% met suggested cutoffs for likely emotional disorder or ADHD at 23 years, respectively. Stability in symptom domains is particularly strong for emotional problems and ADHD, with longitudinal symptom correlations over 11 years of 0.43 and 0.44. Finally, we will endeavor to take the autistic persons perspective, examining their self-reported quality of life and the factors influencing this.

**Conclusions:** The SNAP longitudinal cohort differs from other longitudinal autism studies in being population-derived, although it is still likely to under-represent those without cognitive impairment and/or behavioral problems. Comparing findings across cohorts may help to identify additional factors that influence presentation and outcome, as well as clarifying the most robust predictors. Future research will benefit from more direct comparison and calibration across samples.

## ORAL SESSION — EPIDEMIOLOGY/POPULATION STUDIES

### Oral 309 - Early Determinants of Autism Risk

**309.001 (Oral)** Prenatal Exposure to Air Pollution and Children's Autism Spectrum Disorder: Identifying Sensitive Windows and Sex Differences

*M. M. Rahman<sup>1</sup>, Y. H. Shu<sup>2</sup>, T. Chow<sup>2</sup>, F. W. Lurmann<sup>1</sup>, M. P. Martinez<sup>2</sup>, S. P. Eckel<sup>1</sup>, J. C. Chen<sup>1</sup>, Z. Chen<sup>1</sup>, J. Schwartz<sup>4,5</sup>, R. McConnell<sup>1</sup> and A. H. Xiang<sup>2</sup>, (1)Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, (2)Department of Research & Evaluation, Kaiser Permanente Southern California, Pasadena, CA, (3)Sonoma Technology, Inc., Petaluma, CA, (4)Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, MA, (5)Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA*

**Background:** A growing number of studies have reported associations between prenatal particulate matter with aerodynamic diameter < 2.5  $\mu\text{m}$  (PM<sub>2.5</sub>) exposure and increased risk for autism spectrum disorder (ASD). However, susceptibility based on gestational time of exposure and sex is uncertain. ASD is four times more likely in boys than girls. Emerging data from animal and human studies support the sexual dimorphism in the neurotoxicity of prenatal PM<sub>2.5</sub> exposure, as well as heterogeneous exposure effects across gestational windows. The fetal brain develops in stages beginning in utero; thus, the effect of air pollution on the subsequent development of ASD may differ by sex, dose, and exposure timing.

**Objectives:** We aimed to identify sensitive time windows for the effects of prenatal exposure to ambient PM<sub>2.5</sub>, NO<sub>2</sub>, and O<sub>3</sub> on ASD risk separately in boys and girls of a large pregnancy cohort.

**Methods:** This population-based retrospective birth cohort study included 294,937 mother-child pairs with singleton deliveries at  $\geq 37$  weeks gestation in Kaiser Permanente Southern California (KPSC) hospitals between January 1, 2001, and December 31, 2014, all had complete residential addresses during pregnancy. Children's follow-up times were accrued from age one until a clinical diagnosis of ASD, last date of KPSC health plan membership, death, or December 31 of 2019, whichever occurred first. Incident ASD cases were ascertained by ICD codes in electronic medical records from at least two separate visits. Weekly mean PM<sub>2.5</sub>, NO<sub>2</sub>, and O<sub>3</sub> exposures at the maternal residential addresses, were estimated using validated satellite-based spatio-temporally resolved high-resolution (1km x 1km) land use regression models. Cox proportional-hazard models with distributed lags estimating the independent effect of each week's exposure with ASD risk were constructed to assess the time windows of increased vulnerability, separately for boys and girls and adjusting for covariates.

**Results:** Over a median of 9.04 (IQR = 5.93 –13.15) years of follow-up after birth, 5,694 children (4,636 boys and 1,058 girls) had ASD. We found that elevated weekly PM<sub>2.5</sub> exposure in the first two trimesters (1-27 weeks) of pregnancy was significantly associated with increased ASD risk (Figure). The cumulative hazard ratio over the first two trimester was 1.20 (95% CI= 1.09 – 1.32) per 10  $\mu\text{g}/\text{m}^3$  increase in PM<sub>2.5</sub>, after adjusting for child sex, maternal race/ethnicity, maternal age at delivery, parity, education, maternal comorbidities, medical centers, household income, birth year, and season. No associations were observed with NO<sub>2</sub>. For O<sub>3</sub>, exposure during 34-37 gestational weeks was associated with ASD risk [cumulative HR=1.03, 95% CI=1.01–

1.06; per 10 ppb increase]. When stratified by sex, the significant ASD risk associated with PM<sub>2.5</sub> exposure in the early gestational weeks were stronger for boys, and O<sub>3</sub> exposure in the later gestational weeks were observed only in boys (Figure).

**Conclusions:** Exposures to higher levels of PM<sub>2.5</sub> in the first two trimesters and O<sub>3</sub> in the late 3<sup>rd</sup> trimester may increase ASD risk in children, especially among boys. Further studies are needed to delineate the underlying mechanisms of the vulnerable window of susceptibility and sexually dimorphic effect of air pollution neurotoxicity on ASD risk.

**309.002 (Oral) Optimal Interpregnancy Interval in Autism Spectrum Disorder: A Multi-National Retrospective Cohort Study of a Modifiable Risk Factor**

**D. Schendel**<sup>1,2</sup>, G. Pereira<sup>3</sup>, M. Gissler<sup>4</sup>, S. Hansen<sup>5</sup>, A. Kodesh<sup>6</sup>, H. Leonard<sup>7</sup>, S. Levine<sup>8</sup>, V. Mitter<sup>9</sup>, E. Parner<sup>10</sup>, A. K. Regan<sup>11</sup>, A. Reichenberg<sup>12</sup>, S. Sandin<sup>13</sup>, A. Suominen<sup>14</sup> and R. Francis<sup>15</sup>, (1)Aarhus University, Aarhus, Denmark, (2)AJ Drexel Autism Institute, Drexel University, Philadelphia, PA, (3)School of Public Health, Curtin University, Perth, WA, Australia, (4)National Institute for Health and Welfare, Helsinki, Finland, (5)Aarhus University, Aarhus C, Denmark, (6)Department of Community Mental Health, University of Haifa, Haifa, Israel, (7)Disability, Telethon Kids Institute, West Perth, Western Australia, Australia, (8)University of Haifa, Haifa, Israel, (9)Centre for Fertility and Health (CeFH), Norwegian Institute of Public Health, Oslo, Norway, (10)University of Aarhus, DK-8000 Århus C, Denmark, (11)School of Nursing and Health Professions, University of San Francisco, San Francisco, CA, (12)Seaver Autism Center, Department of Psychiatry, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, (13)Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, (14)University of Turku, Turku, Finland, (15)Telethon Institute for Child Health Research, Subiaco, Australia

**Background:** Several studies report elevated autism spectrum disorder (ASD) risk at both short and long interpregnancy intervals (IPI) which is biologically plausible. Empirically-derived estimates of the IPI associations with ASD, however, have not been established in large-scale studies controlling for shared family factors, or contrasted in multinational settings.

**Objectives:** Quantify associations between IPI and ASD in three high-income countries with similar health care and parental leave systems, using a common protocol and controlling for family-level factors, to identify the optimal IPI at which ASD risk might be minimized.

**Methods:** Our retrospective cohort study population comprised all singleton, non-nulliparous live births, 1998-2007 inclusive, in Denmark, Finland, and Sweden with a minimum 5-year follow-up for ASD through 2012 (N = 925,523 births). IPIs were derived as the time between the conception date of the index birth and date of the preceding live birth. Optimal IPIs were defined as the IPI (continuous variable) at which minimum risk was observed, and used as the reference level. Generalized additive mixed effects log-binomial regression was used to estimate unadjusted and adjusted relative risks (RR) of ASD and their associated 95% Confidence Intervals (CI). Adjustment was made for parental and demographic factors and maternal mean IPI as a proxy for unmeasured confounding at the family level. Population attributable fractions (PAF) and potential impact fractions (PIF) for ASD were estimated under different scenarios for shifts in the IPI distribution.

**Results:** The association between ASD (n=9302) and IPI was U-shaped across all countries. ASD risk was lowest (optimal IPI) at 35 months, all countries combined. By country, optimal IPI was 30, 33 and 39 months in Denmark, Finland and Sweden, respectively, although there was negligible difference in risk across IPIs of 30 - 39 months. All countries combined, fully adjusted RRs at IPIs of 6, 12, 24, 48 and 60 months were 1.41 (95% CI: 1.08, 1.85), 1.26 (95% CI: 1.02, 1.56), 1.06 (95% CI: 0.95, 1.18), 1.08 (95% CI: 0.95, 1.22), and 1.24 (95% CI: 0.98, 1.58) compared to an IPI of 35 months. RRs for short IPIs in Sweden were higher than in Denmark and Finland, but RRs for long IPIs were similar across countries. PAFs for ASD from non-optimal IPIs were 9.27% (95% CI: 2.95%, 15.48%) for Denmark, 18.85% (95% CI: 11.11%, 26.13%) for Finland, and 18.26% (95% CI: 11.89%, 24.44%) for Sweden. Under the most conservative IPI shift scenario, PIFs were 4.50% (95% CI: 1.23%, 7.64%) for Denmark, 8.28% (95% CI: 4.62%, 11.62%) for Finland, and 8.80% (95% CI: 5.74%, 11.72%) for Sweden.

**Conclusions:** Minimum ASD risk followed IPIs of 30-39 months across three countries with similar health care and family leave policies. Although 9% to 18% of ASD cases may be attributable to sub-optimal IPI and 5% to 9% may be potentially preventable by modifying IPI, these results reflect both direct IPI effects and other, closely related social and biological pathways. Limiting non-optimal IPI via family counselling, health and family leave practices may reduce risk of ASD and other adverse reproductive and child outcomes.

**309.003** (Oral) Establishing Developmental Milestone Norms in 20,000 Individuals with Autism Spectrum Disorder: Associations with Skill Regression and Early Diagnosis

**S. S. Kuo**<sup>1,2</sup>, **C. van der Merwe**<sup>3</sup>, **C. E. Carey**<sup>3</sup>, **S. Bishop**<sup>4</sup> and **E. B. Robinson**<sup>5</sup>, (1)Stanley Center for Psychiatric Research, Broad Institute of MIT and Harvard, Cambridge, MA, (2)Analytic and Translational Genetics Unit, Massachusetts General Hospital, Boston, MA, (3)Broad Institute of MIT and Harvard, Cambridge, MA, (4)University of California San Francisco, San Francisco, CA, (5)Department of Epidemiology, Harvard School of Public Health, Boston, MA

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**Background:** Autism spectrum disorder (ASD) is characterized by substantial heterogeneity in motor, communication, and physiological development, challenging efforts towards developmental screening and early detection. Although an important step to parse this heterogeneity is creating autism-specific developmental milestone charts, few investigations that may inform these norms have been adequately powered.

**Objectives:** We aimed to characterize the ages at which individuals with ASD attain developmental milestones and to determine whether delays in milestone attainment are associated with skill loss (regression) and earlier ages at autism detection.

**Methods:** We aggregated four cohorts from clinic and community settings across the United States: The Autism Simplex Collection (N=1,514), Autism Genetics Research Exchange (N=3,675), Simons Simplex Collection (N=2,726), and Simons Foundation Powering Autism Research (N=12,127), yielding a total sample of 20,042 participants with ASD (80.8% male), aged 1.1 to 25.0 years (mean=9.3, sd=4.6 years). During clinical interview, caregivers recalled the ages at which participants first acquired ten foundational skills and whether participants later lost any skill. We conducted multivariate ANOVAs to model associations with regression status and age at diagnosis for all milestones, covarying age, sex, and cohort. From the largest cohort, comprising 60% of this sample, we separately characterized milestones for 5,029 biological siblings without ASD to evaluate possible reporting bias (telescoping).

**Results:** Of those who attained a given milestone by age 7, participants on average attained motor milestones with little delay, including smiling (3m), sitting (7m), crawling (9m), walking (14m), and spoon-feeding (20m). However, they showed on average marked delays in attaining communication milestones such as saying their first word (23m), phrase (35m), and phrase combination (39m), a sequence that typically progresses from 12 to 24 months. Participants also demonstrated substantial delays in attaining physiological milestones of sustaining bladder control (44m) and bowel control (46m), and 9-16% of those older than age 4 had not yet attained these milestones. Notably, participants who had experienced regression attained later milestones (first phrase, first phrase combination, bladder control, and bowel control) 4 to 6 months later than those who had not experienced regression. Furthermore, compared to participants diagnosed after age 5, participants diagnosed before age 3 demonstrated delays ranging from 4 to 10 months for spoon-feeding, first word, and subsequent communication and physiological milestones. Siblings without ASD were reported to attain milestones on average within age-expectation, suggesting that caregivers were unlikely to consistently overestimate delays in milestone attainment.

**Conclusions:** As one of the largest studies to date investigating developmental milestones in ASD, our findings indicate that individuals with ASD generally attain motor milestones on par with neurotypical individuals throughout their first year but then show significant delays in attaining communication and physiological milestones. These delays are especially pronounced in individuals who ultimately show regression or receive an early diagnosis, such that late diagnosis overlaps substantially with attaining early skills on time and without noticeable losses. Overall, our autism-specific developmental milestone charts can provide caregivers and clinicians alike with key reference points for seeking diagnostic evaluation and for recalibrating expectations regarding developmental progress after receiving an ASD diagnosis.

**309.004** (Oral) Predictors of Autism Diagnosis Age in a Community Sample of Australian Adults

**Y. Huang**<sup>1,2</sup>, **S. Arnold**<sup>1,2</sup>, **K. R. Foley**<sup>3,4</sup> and **J. N. Trollor**<sup>1,2</sup>, (1)Department of Developmental Disability Neuropsychiatry, UNSW, Sydney, NSW, Australia, (2)Cooperative Research Centre for Living with Autism (Autism CRC), Brisbane, QLD, Australia, (3)Department of Developmental Disability Neuropsychiatry, The University of New South Wales, UNSW Sydney, NSW, Australia, (4)Southern Cross University, Bilinga, QLD, Australia

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**Background:** The prevalence of autism diagnosis has increased across all age groups over recent decades, including first-time diagnosis in adulthood. Although adulthood diagnosis has been attributed to older birth cohort, subtler autistic traits, and lower support needs, researchers have also identified late-diagnosed adults who did not meet these criteria. Previous studies examining autism diagnosis age in children identified greater developmental delays, higher socioeconomic status, and absence of specific co-occurring conditions as predictors of earlier diagnosis. Predictors of diagnosis age in adults has not yet been examined.

**Objectives:** To examine demographic and autism-related predictors of diagnosis age among Australian autistic adults, and whether these predictors explain additional variance after controlling for current age and autistic traits.

**Methods:** Demographics and autism-related data was combined cross-sectionally from three Australian survey-based studies. The Australian Longitudinal Study of Autism in Adulthood (ALSAA) and the Study of Australian School-Leavers with Autism were longitudinal questionnaires of autistic and non-autistic Australians in the  $\geq 25$  and 15-25 age groups respectively. The *Pathways* study was a cross-sectional self-report online survey of Australian adults' (age  $\geq 18$ ) experiences of autism diagnosis. Participants in the combined data ( $N=619$ , 40.7% male) ranged in current age from 15 to 80 years with a mean reported diagnosis age of 29.60 years. Hierarchical multiple regression modelling was performed with data source as Step 1, current age and self-reported autistic traits as Step 2, and gender, diagnosis subtype, intellectual disability, language, ethnicity, family autism history, and other psychiatric diagnoses as Step 3.

**Results:** Each step of the hierarchical regression model significantly improved model fit. Older age and higher autistic traits significantly predicted older diagnosis age after controlling for data source. In the final model, female gender, lack of reported intellectual disability, and speaking a non-English language predicted older diagnosis age after controlling for data source, current age, and autistic traits. Interestingly, Asperger's diagnosis predicted younger diagnosis age in the final model. Co-occurring psychiatric conditions were not significant predictors. Analysis of possible mediation and moderation effects are in progress.

**Conclusions:** Predictors of diagnosis age in adults were mostly consistent with previous research involving children, with some exceptions. That higher self-reported autistic traits predicted later diagnosis was counterintuitive and may be due to characteristics of the tool used, biased self-evaluation, and/or camouflaging strategies. Later diagnosis of women is consistent with existing research into under-detection of autism in girls and women. People from linguistically diverse backgrounds may have reduced access to autism information, healthcare, and culturally appropriate assessment. Our study has important implications not only on providing early diagnosis to disadvantaged demographics, but also on recognition and diagnosis of adults who may need support to navigate everyday life.

## ORAL SESSION — EPIDEMIOLOGY/POPULATION STUDIES

### Oral 324 - Effects of Sex and Environment on Autism Phenotypes and Trajectories

**324.001** (Oral) The Relationship between Greenspace, Greyspace and Positive Developmental Screening in Children with Autism, Children with Special Health Care Needs (CSHCN), and Typical Children

**B. Barger**<sup>1</sup>, **L. Larson**<sup>2</sup>, **J. Torquati**<sup>3</sup>, **E. Moody**<sup>4</sup> and **S. Rosenberg**<sup>5</sup>, (1)Georgia State University, Atlanta, GA, (2)LR.Larson@ncsu.edu, NC State, Raleigh, NC, (3)U of Nebraska, Lincoln, NE, (4)Wyoming Institute for Disabilities, University of Wyoming, Laramie, WY, (5)University of Colorado Anschutz Medical Campus, Aurora, CO

**Background:** There is a large body of evidence showing that natural environments have positive physical and mental health impacts on typical populations of youth and children with ADHD. Recent research suggests the mental health impacts of natural environments on children with ASD may be mixed: greenspace may be associated with decreased conduct problems and increased anxiety in children with ASD. Notably, developmental outcomes of infants and toddlers are rarely considered in the natural environment and health literature for either typical children or children with ASD.

**Objectives:** This study investigated the effects of greenspace and greyspace (i.e., constructed non-natural surfaces) on the odds of whether children with and without an ASD screen positive on the Parents Evaluation of Developmental Status (PEDS).

**Methods:** The 2012 NSCH is a large cross-sectional public health survey of U.S. children birth to 17 years old. It includes data on the ASD status of children and caretakers of children 5 and under received PEDS items. Greenspace and greyspace metrics were derived from the National Land Cover Database (NLCD). Data from the 2012 NSCH and the NLCD were merged at the zip-code level and data were analyzed with survey weighted and stratified logistic regression models using R's survey package. Co-variables included children with special healthcare status; whether they had anxiety or conduct problems; sex, age, race/ethnicity, socio-economic status, maternal education, insurance status, and metropolitan size.

**Results:** The study sample includes 21,240 typically developing children, 226 children with autism, and 2,963 non-autistic children with special healthcare needs (CSHCN) ages 10 months to 5 years. Multi-variate models with just greenspace and greyspace showed that greenspace was unassociated ( $p = 0.50$ ) and greyspace predicted increased odds of PEDS indicating developmental concerns ( $p = 0.002$ ). Inclusion of covariates did not change the relationship between greyspace and developmental concerns ( $p = 0.024$ ) and revealed that children with ASD and CSHCN had greater odds of positive PEDS screens than typical children; older children had greater odds of positive screens than younger children; males had greater odds than females; Black children had greater odds than White children; children with conduct problems had greater odds than those without; and privately insured children had greater odds than those without insurance. A greenspace X clinical group interaction

indicated that the relationship between greenspace and positive PEDS scores was lower in children with ASD compared to typical children ( $p = 0.003$ ) suggesting that greenspace is associated with fewer developmental concerns in children with ASD.

**Conclusions:** This is the first analysis investigating the effects of green and built environments on developmental outcomes using a general developmental screening tool (i.e., PEDS) and a nationally representative sample. The findings suggest that built space is associated with increased odds of developmental concerns and greenspace is associated with decreased odds of developmental concerns for children with ASD only. While intriguing, findings are limited as environmental metrics are measured at the zip-code level. Future research should seek to replicate these findings with greenspace measures in children's immediate environments.

**324.002 (Oral)** Caregiver and Neighborhood Factors Associated with Treatment Outcomes for School-Aged Children with ASD and Co-Occurring Mental Health Needs in a Community Effectiveness Trial of AIM HI.

**B. Caplan**<sup>1,2</sup>, **T. Lind**<sup>3,3</sup>, **K. Martinez**<sup>4,5</sup>, **G. May**<sup>6</sup>, **C. Gomez Alvarado**<sup>7</sup>, **C. Chlebowski**<sup>1,2</sup> and **L. Brookman-Frazee**<sup>1,2,8,9</sup>, (1)Psychiatry, UC San Diego, La Jolla, CA, (2)Child and Adolescent Services Research Center, San Diego, CA, (3)Child and Family Studies, San Diego State University, San Diego, CA, (4)Child and Adolescent Services Research Center (CASRC), San Diego, CA, (5)Clinical Psychology, San Diego State University / University of California, San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA, (6)Psychology, University of Nebraska-Lincoln, Lincoln, NE, (7)Psychology, UCLA, Los Angeles, CA, (8)UC San Diego Dissemination and Implementation Science Center, La Jolla, CA, (9)Autism Discovery Institute, Rady Children's Hospital-San Diego, San Diego, CA

**Background:** Caregiver and neighborhood factors (e.g. income, education, household composition) are associated with developmental and mental health outcomes for children with or without autism spectrum disorder (ASD; Garner et al., 2012). High levels of social adversity are also associated with decreased engagement in children's mental health treatment (Haine-Schlagel & Walsh, 2015), and higher levels of caregiving strain have been linked to poorer treatment response in parent-mediated interventions in ASD (Stadnick et al., 2015). AIM HI ("An Individualized Mental Health Intervention for ASD") is an evidence-based intervention that is designed to target co-occurring challenging behaviors in school-aged children with ASD served in publicly-funded mental health settings (Brookman-Frazee et al., 2019). The present study will assess whether caregiver and neighborhood factors are associated with changes in child behaviors when therapists were trained to deliver AIM HI within a community effectiveness trial.

**Objectives:** The present study seeks to assess caregiver and neighborhood-level factors that are associated with treatment outcomes for children with ASD whose community therapists received AIM HI training. The objectives are to identify: (1) whether caregiver demographic factors (e.g. income, education level), caregiving strain, and neighborhood factors are associated with parent reported child behavior problems at baseline, and (2) which factors predict trajectories of behavior problems over 18 months.

**Methods:** Data were obtained from the caregivers of 156 children with ASD receiving care from mental health programs randomized to the AIM HI training condition within the community effectiveness trial of AIM HI. Participant children were 57.7% Latinx; 92.3% male, with a mean age of 9.1 years ( $SD = 2.4$ ). Parents reported family demographics and caregiver strain (CGSQ) at baseline as well as child behavior problems (ECBI) at the baseline, 6-month, 12-month and 18-month assessments. A caregiver score and neighborhood score were calculated based on the following demographic characteristics at the participant and zip code level: income/poverty, education, household composition (both); foreign born population, population density (neighborhood only).

**Results:** Higher levels of caregiver strain, but not caregiver demographic or neighborhood scores, were positively associated with ECBI Problem ( $B = 6.23$ ,  $p < .001$ ) and Intensity ( $B = 6.31$ ,  $p < .001$ ) scores at baseline. Results of three-level models (time, child, program) revealed that higher caregiver demographic risk scores ( $B = 1.66$ ,  $p = .02$ ) and caregiving strain ( $B = 2.13$ ,  $p < .001$ ), but not neighborhood score, were associated with relatively less decline on ECBI Problem scores across 18 months. Only higher caregiving strain ( $B = 1.78$ ,  $p < .001$ ) predicted relatively less decline on ECBI Intensity scores over time.

**Conclusions:** Results are consistent with prior work suggesting a strong relationship between caregiving strain and behavior problems for this population (Estes et al., 2009), as well as the association between caregiving strain and treatment outcomes within parent-mediated interventions for ASD (Stadnick et al. 2015). Overall, findings suggest that factors more proximal to the caregiver and family (caregiving strain, caregiver demographics) may be more closely linked to treatment response than neighborhood factors, and should be considered in tailoring and implementing parent-mediated interventions in ASD.

**324.003 (Oral)** Sex Differences in Trajectories of Language Development in Autism Spectrum Disorder and Typical Development

**D. Parmaksiz<sup>1</sup>, S. Koirala<sup>2</sup>, S. Yuan<sup>3</sup>, E. Kushner<sup>4</sup>, S. Shultz<sup>5</sup>, A. Klin<sup>5</sup>, C. Klaiman<sup>5</sup>, W. Jones<sup>6</sup> and L. A. Edwards<sup>5</sup>, (1)Marcus Autism Center, Atlanta, GA, (2)Department of Pediatrics, Emory University School of Medicine, Marcus Autism Center, Atlanta, GA, (3)Emory University School of Medicine, Marcus Autism Center, Atlanta, GA, (4)Emory University, Marcus Autism Center, Atlanta, GA, (5)Marcus Autism Center, Children's Healthcare of Atlanta and Emory University School of Medicine, Atlanta, GA, (6)Pediatrics, Emory University, Atlanta, GA**

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**Background:** Autism spectrum disorder (ASD) diagnoses are more common in males than females. This skewed sex ratio in autism, ranging from 3:1 to 4:1, suggests increased risk for ASD in males and a possible protective effect in females (Robinson et al. 2013, Werling and Geschwind 2013). However, diagnostic criteria for ASD were established based on predominantly male populations (Kirkovski et al. 2013) and the female phenotype of ASD remains poorly understood (Head et al., 2014). Camouflaging, or use of (un)conscious compensatory strategies to overcome social and behavioral difficulties in females may be contributing to under-detection of ASD in females (Hull et al., 2017a; Livingston et al., 2019). For example, females with ASD have been found to have higher levels of social motivation, restricted interests in more “normative” content areas (Hiller et al. 2014), and more developmentally appropriate vocabulary and core language skills than their male counterparts (Messinger et al., 2015). Also, in typical development, females acquire language faster and have larger vocabulary than males (Barel and Tzischinsky, 2018; Fenson et al., 1994). Precocious language development in females across typical and atypical development may hence not only function as a compensatory developmental mechanism, but may also contribute to differential diagnosis of ASD in females.

**Objectives:** This study examines sex-based differences in trajectories of language development across the first two years of life in a longitudinally-followed cohort of ASD and TD infants.

**Methods:** Typically developing (TD) infants (N=268;121 female) and those later diagnosed with ASD (N=42;9 female), were followed longitudinally over the first 2 years of life. Language development was measured using the Mullen Scales of Early Learning (MSEL) at a maximum of 5 time points between 6 and 24 months of age. A MATLAB implementation of the Principal component Analysis by Conditional Expectation (PACE) package for Functional Data Analysis and Empirical Dynamics (Yao et al., 2005) was used to analyze trajectories of MSEL Expressive and Receptive age equivalent scores, separated by sex and diagnostic group. Mean curves were quantified using Functional Principle Components Analysis and contrasted using Functional Regression.

**Results:** In the TD group, trajectories of MSEL expressive (EL) and receptive language (RL) scores were significantly different by sex, with females acquiring skills more rapidly than males ( $F_{EL}=8.51, p_{EL}=0.004; F_{RL}=15.74, p_{RL}<0.001$ ). In the ASD group, both EL and RL score trajectories significantly differed by sex as well ( $F_{EL}=8.96, p_{EL}=0.005; F_{RL}=5.40, p_{RL}=0.025$ ). Diagnostic comparisons revealed significant differences between trajectories of EL and RL development in males with ASD and TD males ( $F_{EL}=27.15, p_{EL}<0.001; F_{RL}=37.38, p_{RL}<0.001$ ), whereas females with ASD significantly differed from TD females in the trajectories of their RL scores only ( $F_{EL}=0.77, p_{EL}=0.382; F_{RL}=6.55, p_{RL}=0.012$ ).

**Conclusions:** Our longitudinal analyses indicate that language development varies by sex and diagnosis, with females across diagnoses maturing more rapidly in language abilities and the TD group as a whole developing language ability more quickly. These findings support the notion that females with ASD display a unique narrative profile that overlaps with males with ASD and TD females/males (Boorse et al., 2019). This feature may contribute to reduction of perceived symptom severity in females.

**324.004 (Oral) Sex-Differences in Pain Behaviors and Related Health in Autistic Children and Adults in the SPARK Cohort**  
**M. D. Failla<sup>1</sup>, J. I. Feldman<sup>2</sup>, C. J. Cascio<sup>3</sup> and T. G. Woynaroski<sup>2</sup>, (1)College of Nursing, The Ohio State University, Columbus, OH, (2)Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN, (3)Department of Psychiatry and Behavioral Science, Vanderbilt University Medical Center, Nashville, TN**

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**Background:** Clinicians have noted “reduced pain sensitivity” from the earliest clinical reports of autism. Yet, recent data suggest that autistic children experience a greater number of painful medical conditions compared to their peers and that autistic adults have altered neural processing of pain, higher reports of pain, and increased pain anxiety. However, these studies come from relatively small samples, which are unlikely to represent the broader population of persons affected by autism. Further, no prior investigations have explored the extent to which pain varies in males versus females with autism, a pressing question given growing literature highlighting phenotypic variations by biological sex.

**Objectives:** To characterize pain, pain behaviors, and health outcomes related to pain for autistic children and adults, with a focus on sex differences.

**Methods:** Using the US research cohort SPARK, we recruited three groups of autistic individuals for short surveys regarding pain behaviors and related health: 1) independent adults (n=482, 298 females and 183 males, age 18-78), 2) jointly reporting dependents (parent and self-report, n=589, 135 females and 454 males, age 13-49) and 3) dependents (with parent report, n=882, 150 females and 732 males, age 2-64). Data were collected electronically, using the Pain and Health Questionnaire and Pain Behavior Short version from the Patient-Reported Outcomes Measurement Information System (PROMIS). Self- and proxy-report versions were used as appropriate.

**Results:** Most independent autistic adults reported pain within the last week (72.6%), with 46.2% of women reporting daily pain compared to 28.4% of autistic men  $\chi^2(6) = 33.1, p < .001$ . Over the last year, more autistic women than men missed work due to pain (59.4% compared to 38.0%,  $\chi^2(4) = 17.2, p < .01$ ). A Wilcoxon test indicated that, on the PROMIS Pain Behavior Scale, women reported more pain behaviors than men (mean=18.2 versus 16.4,  $W = 23686, p < .001$ ). In the jointly reporting sample, 55.1% of dependents self-reported pain in the last week while only 40% of parents reported their dependent had pain in the same timeframe. Parents reported more daily pain in girls (17.2%) than boys (5.9%,  $\chi^2(6) = 25.2, p < .001$ ), and indicated that girls were more likely to miss school for their pain (57.4% versus 44.9% of boys,  $\chi^2(4) = 15.7, p < .01$ ). There were no significant self-reported sex differences on the PROMIS Pain Behavior Scale in the joint reporting cohort. In the dependent cohort, 28.9% of parents reported that their dependent experienced pain within the last week, with no significant differences by sex.

**Conclusions:** Findings suggest females on the spectrum may experience more pain that produces a functional impact on their daily life relative to their male peers, at least in adolescence and adulthood. Additional research is needed regarding the frequency and nature of pain in autistic individuals across the lifespan, in particular to understand differences in pain and pain management in autistic women and to elucidate the nature of pain experiences for younger and/or dependent individuals who may not be capable of clearly articulating their pain.

## POSTER SESSION — EPIDEMIOLOGY/POPULATION STUDIES

### Poster 419 - Epidemiology/population studies Posters

**419.001** (Poster) Age at First Maternal Concern about Development and Time to Services Among Children with Autism Spectrum Disorder

**J. Van Dyke<sup>1</sup>, C. DiGuseppi<sup>2</sup>, T. Crume<sup>3</sup>, N. Reyes<sup>4</sup>, A. Alexander<sup>5</sup>, B. Barger<sup>6</sup>, R. Fitzgerald<sup>7</sup>, K. Hightshoe<sup>8</sup>, E. Moody<sup>9</sup>, K. Pazol<sup>10</sup>, C. Robinson Rosenberg<sup>11</sup>, E. Rubenstein<sup>12</sup>, L. Wiggins<sup>13</sup> and S. Rosenberg<sup>8</sup>,** (1)University of Colorado, Aurora, CO, (2)Colorado School of Public Health, University of Colorado Anschutz Medical Campus, Aurora, CO, (3)Epidemiology, University of Colorado Anschutz Medical Campus, Aurora, CO, (4)JFK Partners, University of Colorado Anschutz Medical Campus, Aurora, CO, (5)NCBDDD, Centers for Disease Control and Prevention, Atlanta, GA, (6)Georgia State University, Atlanta, GA, (7)Washington University School of Medicine, St. Louis, MO, (8)University of Colorado Anschutz Medical Campus, Aurora, CO, (9)Wyoming Institute for Disabilities, University of Wyoming, Laramie, WY, (10)Division of Human Development and Disability, Centers for Disease Control and Prevention, National Center on Birth Defects and Developmental Disabilities, Atlanta, GA, (11)University of Colorado / JFK Partners, Aurora, CO, (12)Waisman Center at UW Madison, Madison, WI, (13)Centers for Disease Control and Prevention, Atlanta, GA

**Background:** Early diagnosis and treatment of autism spectrum disorder (ASD) has been shown to improve developmental outcomes. Children from non-white families or families with limited educational attainment are often diagnosed with ASD later than others and tend to have poorer access to services. Some evidence suggests that these disparities might result in part from differences in awareness of developmental milestones or symptoms to be aware of, but research about the relationship between sociodemographic characteristics and age of first maternal concern about child development is inconsistent. Further, factors that delay maternal recognition of developmental problems may also delay initiation of services.

**Objectives:** To explore child and sociodemographic factors potentially related to child age at first maternal concern about development and subsequent time to initiation of services after this first concern among children with ASD.

**Methods:** Data came from the Study to Explore Early Development (SEED), a multi-site case-control study of ASD in preschool aged children in the US. The current study is a cross-sectional analysis of 759 children classified as having ASD after a comprehensive evaluation. Factors associated with age of first maternal concern were investigated using multiple linear regression. Factors associated with time to initiation of services were investigated using a Cox proportional-hazards model.

**Results:** Factors associated with earlier maternal concern about child development were higher maternal parity, the child having at least one chronic condition, more externalizing behaviors of the child, and younger gestational age. Although maternal non-

white race was not associated with earlier concern, it was associated with longer time to initiation of services, along with a higher developmental level and absence of a chronic condition in the child.

Conclusions: Maternal parity, gestational age, and child characteristics, such as behavior and health status influenced age at first maternal concern, which did not vary by race/ethnicity. Maternal non-white race, higher child developmental level, and absence of a chronic condition in the child were associated with later initiation of services. A difference by race in time to initiation of services despite similar age of maternal concern highlights the need to improve access to services among non-white children.

**419.002** (Poster) Are People with Autism over-Represented in Homelessness? - Report from a Prevalence Estimation in the Republic of Ireland.

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Background: The prevalence of Autism in the general population in Ireland is estimated to be in the region of 1 - 1.5% (Boilson *et al*, 2016) of the population. Recent research by Churchard *et al*, (2019) estimated the prevalence rate of Autism among a cohort of long-term homeless people in the UK at around 12%. No previous study has examined the prevalence of autism in the homeless population in Ireland.

Objectives: This research was conducted to explore the number of people with autistic traits (as a measure of autism prevalence) among a representative sample of a homeless population, in a defined geographical area of Dublin, Ireland.

Methods: Using the same methodological approach as the UK study, we partnered with one of Ireland's leading not for profit homeless service providers - the Dublin Simon Community. Dublin Simon keyworkers acted as proxy informants for the clients in their caseload and completed researcher administered structured screening interviews on behalf of their entire caseloads of clients, across a representative range of homeless service provision areas - emergency accommodation, supported housing, treatment and recovery. The *Diagnostic Statistical Manual v5 (DSM-5) Autistic Traits in the Homeless Interview* (DATHI) screening instrument was used. Two additional questionnaires were also administered by the researcher which captured demographics, health and behaviour history and client characteristics and needs.

Results: Of the 106 individuals screened by proxy in this study, 3 individuals (2 males and 1 female) screened "present" for autistic traits on the DATHI screening questionnaire, giving a prevalence estimate of 2.8%. A further 7 clients (6 males, 1 female) screened "possibly present" for autistic traits. This gives a combined estimate of 9.4% (95% CI: 5% ± 16% (3 + 7/106) for those who screened "present" and "possibly present".

Conclusions: This study reports a higher autism prevalence estimate than previous Irish studies of autism prevalence in the general population but a lower prevalence estimate than the recent UK study (Churchard *et al*, 2019) in a homeless context. This study supports the emerging evidence that people with autism are overrepresented in the homeless population compared with the housed population. Autism may be a risk factor for entry into homelessness and an added challenge to exiting from homelessness.

**419.003** (Poster) ASD Traits, Social Capital, and Depression Among School-Aged Children

**H. Mori<sup>1</sup>**, M. Adachi<sup>2,3</sup>, M. Takahashi<sup>2,3</sup>, H. Shinkawa<sup>1</sup> and K. Nakamura<sup>1,4</sup>, (1)Research Center for Child Mental Development, Graduate School of Medicine, Hirosaki University, Hirosaki, Japan, (2)Department of Clinical Psychological Science, Hirosaki University, Hirosaki, Japan, (3)Research Center for Child Mental Development, Graduate School of Medicine, Hirosaki University, Hirosaki, Japan, (4)Department of Neuropsychiatry, Graduate School of Medicine, Hirosaki University, Hirosaki, Japan

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Background:

ASD are approximately 4 times more likely to experience depression (Hudson *et al.*, 2019). Depression in ASD may be associated with severe consequences including suicide attempts or complete suicide. (Cassidy and Rodgers 2017; Richa *et al.* 2014, Magnuson and Constantino 2011). In general population, previous studies have reported that high ASD traits were associated with severer mental health problems (e.g. Lundström *et al.*, 2011), and were more likely to attempt suicide (Pelton and Cassidy, 2017). ASD traits are also associated with a lower school belonging and increase loneliness and lack of social connectedness. However, little has been known about the association between the social environment (referred to as "social capital"), ASD traits, and mental health in a general population sample of school-age.

#### Objectives:

To clarify the associations between social capital, ASD traits, and depression in children with ASD traits.

#### Methods:

We distributed a set of questionnaires to all 9 to 15 year-old children who attend public school in Hirosaki City, Japan.

Data analysis was performed on 6,522 children. Social Capital was measured using the Japanese version of Social Capital Questionnaire-Adolescent Student (SCQ-AS) subscale "School trust and cohesion". ASD traits was measured using ASSQ. Depression was measured using DSRS-C.

#### Results:

ANOVA results showed significant differences in all groups (all  $p < .01$ ). Our findings indicate that a higher level of social capital is associated with lower depressive symptoms even regardless of the level of children's ASD traits (ASD-H\_SC-L vs. ASD-H\_SC-H:  $d = 1.63$  [1.51, 1.74],  $p < .001$ ; ASD-L\_SC-L vs. ASD-L\_SC-H:  $d = 1.48$  [1.37, 1.60],  $p < .001$ ; ASD-L\_SC-H vs. ASD-H\_SC-H  $d = -.187$  [-0.29, -0.09],  $p < .01$ ).

#### Conclusions:

Previous research has shown that children with high ASD traits have a higher probability of exhibiting high depressive symptoms (e.g. Lundström et al., 2011). However, the present study suggests that a high perception of SC may prevent depressive symptoms even in the presence of high ASD traits. The findings suggest that strengthening the level of social capital in school may benefit all students and especially students with high ASD traits. Further research on how strengthening social capital in school in children with high ASD traits should be conducted.

#### **419.004 (Poster)** Association between Prenatal Exposure to Pesticide Residues in the Diet and Child Autism-Related Traits in a High-Risk Cohort

**E. Joyce<sup>1</sup>**, R. J. Schmidt<sup>2</sup>, A. Y. Song<sup>3</sup>, H. E. Volk<sup>4</sup>, L. A. Croen<sup>4</sup>, M. D. Fallin<sup>5</sup>, I. Hertz-Picciotto<sup>5</sup>, C. J. Newschaffer<sup>6</sup>, J. Chavarro<sup>7</sup> and K. Lyall<sup>8</sup>, (1)*Epidemiology and Biostatistics, Drexel University, Philadelphia, PA*, (2)*Public Health Sciences, University of California Davis, Davis, CA*, (3)*Wendy Klag Center for Autism and Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*, (4)*Division of Research, Kaiser Permanente, Oakland, CA*, (5)*University of California at Davis, Davis, CA*, (6)*College of Health and Human Development, Pennsylvania State University, University Park, PA*, (7)*Departments of Nutrition and Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA*, (8)*A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

**Background:** Prior work has suggested associations between prenatal exposure to several classes of pesticides and autism spectrum disorder (ASD), but results have not been fully consistent, and combined effects across chemicals have not been sufficiently considered. Recent work has developed a cost-efficient measure of diet-based pesticide exposure through residues on fruit and vegetables, the pesticide residue burden score (PRBS), that captures a wider range of pesticides than considered in any single study for associations with neurodevelopment, suggesting it may be a useful metric towards estimating potential combined effects.

**Objectives:** To examine associations between the PRBS and ASD-related traits in our study population.

**Methods:** Participants were drawn from the Early Autism Risk Longitudinal Investigation (EARLI), a high-familial risk cohort that enrolled mothers with a child diagnosed with ASD and followed them through a subsequent pregnancy and that child's early life. Information on food intake was collected through a modified version of a previously validated Food Frequency Questionnaire. ASD-related traits were measured according to the Social Responsiveness Scale (SRS) at 36 months. The PRBS was developed following published methods, using data from the USDA Pesticide Data Program (PDP) to estimate the burden of pesticides for food items across EARLI study years (2009-2012). Food-specific PRBS were multiplied by reported food intake, and combined to create an overall PRBS. Higher PRBS indicates greater contamination. Validity of the PRBS in this cohort was examined by comparing quartiles of the PRBS to available levels of organochlorine pesticides measured in mid-pregnancy samples. Variations of the PRBS tested here included incorporating fatty food sources of organochlorine pesticides (e.g., meat, dairy) and organic intake of foods. Multivariable linear regression models, accounting for maternal body mass index and demographic factors, were used to examine associations between quartiles of the PRBS and SRS scores.

Results: 158 EARLI participants were included. We observed a significant positive trend between measured levels of the organochlorine pesticide p,p'-DDE and PRBS ranks ( $p = 0.04$ ). Counter to our hypothesis, higher PRBS ranks were associated with a reduction of SRS scores, though this relationship was only statistically significant for the PRBS score incorporating organic intake ( $Q4$  vs  $Q1$ ,  $b = -21.49$ , 95% CI:  $(-35.01, -7.98)$ ). Associations with the PRBS differed somewhat when stratifying by overall fruit and vegetable intake, with significant decreases in SRS scores only for those below the median fruit intake. Incorporation of fatty foods into the PRBS yielded results similar to the original PRBS. Results were also similar when adjusting for overall fruit and vegetable intake, or key nutrients with prior associations with ASD, including folic acid and vitamin D.

Conclusions: Results from this high-familial risk study suggested an unexpected inverse association between an index of pesticide residues in the diet and ASD-related traits. Future work should further consider the potential influence of overall healthful eating and other food sources of pesticides, while also seeking to replicate findings and consider whether familial risk may influence these relationships.

**419.005 (Poster)** Association between Prenatal Nutrients and Autism-Related Traits in the EARLI Study Using a Mixtures Approach

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**Background:**

Maternal diet during pregnancy is critical to fetal development, as demonstrated by established relationships between folate deficiency and neural tube defects and nutrient deprivation and schizophrenia. Research has also linked certain individual nutrients with autism spectrum disorder (ASD), yet examination of combined effects of nutrients and dietary factors is lacking, despite knowledge of nutrients acting together in pathways.

**Objectives:**

The goal of this work was to utilize Bayesian analyses, capable of estimating combined or “mixture” effects for a large number of correlated variables, to examine the association between prenatal maternal diet in association with ASD-related traits.

**Methods:**

Study participants were drawn from the Early Autism Risk Longitudinal Investigation (EARLI), a high-familial risk cohort that enrolled pregnant mothers who already had a child diagnosed with ASD. Pregnant women were followed until the subsequent child was age 3 years. The Social Responsiveness Scale (SRS), which measures social aspects of ASD, was assessed at 36 months. Nutrient values covering diet since becoming pregnant were determined from dietary information collected during mid-pregnancy using a Food Frequency Questionnaire. Bayesian Kernel Machine Regression (BKMR) was used to examine a range of nutrients involved in immune, one-carbon metabolism, and oxidative stress pathways, and to determine their combined effects in association with raw SRS scores. These included: folic acid and other methyl-donor nutrients, vitamin D, iron, n-3 and n-6 polyunsaturated fatty acids, as well as others. Nutrients values were first standardized using Z scores prior to BKMR.

**Results:**

Results from BKMR were not suggestive of significant mixture effects of a group of a priori-selected nutrients, based on FFQ-based intake covering the first half of pregnancy, on child SRS scores at 36 months. Some potential differences in key nutrients were suggested, including modest increases in SRS scores (indicating greater ASD-related traits) with higher levels of vitamin B12 at mid-pregnancy, and minor decreases in SRS scores with higher levels of iron, vitamin A, and carotenoids, accounting for all other nutrients examined at mid-pregnancy. However, confidence bands were wide in these analyses, and additional adjustment for total calories, maternal age and BMI, and child's sex, yielded mostly null trends. No significant associations with folic acid specifically were observed. Additional analyses planned include conducting BKMR analyses with foods, rather than nutrients, to capture associations that may more readily translate to usual intake and public health messaging, and examining associations adjusted for potential confounders, and in association with other ASD-related outcomes.

## Conclusions:

Preliminary results from this high-familial risk study did not identify strong mixture effects of nutrients in pathways with suspected relevance to ASD in association with ASD-related traits. Strong novel associations with individual nutrients were not identified with this approach, though modest signals suggest future work should consider these and other nutrients for potential associations with ASD. Because EARLI is a small high-familial risk study, future work should also replicate these analyses in other high familial risk cohorts and in other populations in which the relative contributions of genetic and environmental factors may differ.

**419.006 (Poster)** Association of Maternal Thyroid Hormones with Autism-Related Traits in the EARLI and HOME Studies  
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## Background:

Thyroid hormones (TH) are essential for neurodevelopment. Previous work examining the link between maternal TH during pregnancy and Autism Spectrum Disorder (ASD) has not yielded consistent findings. Further, few studies have considered associations with quantitatively measured ASD-related traits, which may help elucidate associations for a broader population.

## Objectives:

To examine whether maternal TH during pregnancy are associated with ASD-related traits in two birth cohorts.

## Methods:

Participants were drawn from two prospective pregnancy cohorts: The Early Autism Risk Longitudinal Investigation (EARLI) and the Health Outcomes and Measures of the Environment (HOME) Study. EARLI enrolled pregnant mothers across four US sites who had already had a child with ASD, and HOME enrolled typical pregnant women from the greater Cincinnati, OH area. Maternal TH levels, including thyroid-stimulating hormone (TSH) and free thyroxine (FT4), were measured in mid-pregnancy serum samples using standard immunoassays. ASD-related traits were measured with the Social Responsiveness Scale (SRS) in both cohorts at age 3-8 years. TSH was log-transformed (base e) to meet linear regression assumptions and reduce the influence of outliers, while z-scores were used for FT4 to account for slight differences in distributions across cohorts. In each cohort, quantile regression models were used to examine the association between TH levels and SRS total raw scores, adjusting for maternal and sociodemographic factors. Associations were also examined using linear regression models and stratified by cohort.

## Results:

278 participants (132 from EARLI and 146 from HOME) were included in these analyses. TSH distributions were similar in both cohorts, while FT4 was higher in EARLI compared to HOME. In pooled analyses, quantile regression analyses suggested associations between TH levels and SRS scores for those in the highest quantile of SRS, but not in lower quantiles (25<sup>th</sup> or below; Figure 1). In particular, higher FT4 was significantly associated with increasing SRS scores for those in the highest quantile (adjusted  $\beta$  for 95<sup>th</sup> percentile=10.3, 95%CI=1.5, 19.2). In addition, higher TSH was significantly associated with decreasing SRS scores for those in the same highest quantile (adjusted  $\beta$ =-14.9, 95%CI=-25.3, -4.6). When stratified by cohort, the adjusted association between TSH and SRS remained significant in HOME ( $\beta$ =-20.0, 95%CI=-37.4, -2.6), but not EARLI ( $\beta$ =-3.2, 95%CI=-27.3, 21.0). Analyses using standard linear regression also suggested an association between TSH and SRS scores in the pooled analysis (adjusted  $\beta$ =-5.3, 95%CI=-9.6, -1.0).

## Conclusions:

Results from these prospective pregnancy cohorts suggested that maternal thyroid hormones during pregnancy may be related to children's ASD-related traits. These associations were observed in the highest quantile of SRS scores, suggesting aberrations in

TH influence traits consistent with clinical impairment. Given associations appeared to be driven by the general population cohort, the role of maternal TH may be stronger in those without high genetic liability, or could be related to other factors that differ across these cohorts. Future work should continue to address these relationships, as well as exposure to thyroid disruptors, which may have influenced associations observed here.

**419.007 (Poster) Autism Spectrum Disorder (ASD) in West Africa – a Review**

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**Background:**

West Africa consists of sixteen (16) countries of Benin, Burkina Faso, Cape Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, the Niger, Nigeria, Senegal, Sierra Leone and Togo according to United Nations. We explored research studies on the subject of Autism Spectrum Disorder (ASD) in the region.

**Objectives:**

The review explored history of ASD and looked at various pockets of studies reporting prevalence of ASD in the region. It also explored the characteristic features of West African children with ASD and socio-cultural factors associated with diagnosis and help-seeking behavior. The review offered suggestion on appropriate educational model that should be adopted in the region.

**Methods:**

Literature search was done of research related to ASD coming from West African sub-region using Pubmed, Google Scholar and Google search. Data were extracted from these studies focusing on history, diagnosis, help-seeking behavior, characteristics of children with ASD and peculiar socio-cultural beliefs and practices in the region.

**Results:**

ASD was first reported in West African sub-region in 1972. The prevalence of ASD ranges between 0.8 to 34.5% depending on the population base / environment of the children studied in the region. Period of onset of ASD symptoms coincides with period of high prevalence of childhood infectious diseases with neurological complications in the region. Late diagnosis characterized ASD and help-seeking behavior, which is often tortuous is influenced largely by socio-cultural beliefs and practices in the region. Inclusive education model is suggested for providing intervention for children with ASD in the region.

**Conclusions:**

Further research is needed in the region and more advocacy and capacity development is required to ensure formulation and implementation of appropriate policies.

**419.008 (Poster) Concentrations of Lead, Mercury, Arsenic, Cadmium, Manganese, and Aluminum in the Blood of Pakistani Children with and without Autism Spectrum Disorder and Their Associated Factors**

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**Background:** The prevalence of Autism Spectrum Disorder (ASD) in Pakistan is unknown, but a school-based study reported a prevalence of 1 in 500 for students with special needs that included children with ASD; however, this could be a severe underestimate because many children with ASD are kept from attending school due to social stigma. The etiology of ASD is believed to be multifactorial and researchers believe that ASD is associated with environmental factors, either directly or interactively with genes. Exposure to environmental contaminants greatly contributes to the burden of disease in Pakistan. Elevated blood lead (Pb) concentrations in Pakistani children has been a concern for more than three decades. Studies also reported elevated levels of arsenic (As), manganese (Mn), cadmium (Cd), mercury (Hg), and aluminum (Al) in children and adults in some communities in Pakistan.

**Objectives:** To estimate mean blood concentrations of six metals (Pb, Hg, As, Cd, Mn, Al) and identify associated factors for children with and without ASD in Pakistan.

**Methods:** From an existing database of children already diagnosed with ASD based on the Childhood Autism Rating Scale (CARS) in the Child Development Program at Aga Khan University (AKU) in Karachi, Pakistan, we enrolled 30 children, age 2-12 years old. Children were re-evaluated based on the Urdu-translated versions of Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) and Autism Diagnostic Interview-Revised (ADI-R). For each of 30 ASD cases, we enrolled an age-, and sex-matched typically developing (TD) control child, while maintaining an overall male to female ratio of 4:1. Assessment of the six blood metals concentrations was done using blood samples of 2-3 mL by a CDC-certified Trace Metals Laboratory in Lansing, Michigan, USA. Concentrations below the Limits of Detection (LoD) for each metal were replaced by  $(LoD/\sqrt{2})$ . The percentage of concentrations below LoD for the six metals are reported in Table 2.

We compared the ASD cases and TD controls groups with respect to distribution of demographics, socioeconomic characteristics, dietary factors, and environmental factors using conditional logistic regression (CLR) models and for blood metal concentrations using univariable and multivariable General Linear Models (GLMs).

**Results:** Mean ages of ASD cases and TD controls were 78.3 and 78.5 months, respectively. ASD cases had lower SES than TD controls. More than half of ASD cases and TD controls (53.3%) reported "Urdu speaking" ethnicity. (Table 1) Geometric mean (GM) blood concentrations of Pb were nearly different between ASD and TD control groups ( $P = 0.05$ ), in the univariable GLM, but when adjusted for four covariates (Table 2), this difference was no longer significant, ( $P = 0.16$ ). For the other 5 metals, the difference was not significant in any of the GLMs. (Table 2).

**Conclusions:** This is the first study that provides information about concentrations of the six metals in the blood of Pakistani children with ASD. The factors associated with higher levels of Pb, Mn, and Al also provide essential information for designing future epidemiologic studies for investigating the role of these six metals in children with ASD in Pakistan.

**419.009 (Poster) COVID-19 and Alterations in Behavioral and Dietary Outcomes in Children with Autism Spectrum Disorder: Disparities By Income and Food Security Status**

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**Background:** Recent reports demonstrate differential negative impacts of COVID-19 on the autism community; however, specific research is lacking on the impact on behavioral and food-related outcomes among children with autism spectrum disorder (ASD).

**Objectives:** The objective of this study is to investigate the relationship of COVID-19 on overall behavior and specific behaviors, including changes in eating patterns, of children with ASD and their families.

**Methods:** Parents and caregivers (n=200) across the United States participated in an online survey that queried changes in overall behavior, eating behaviors, and specific behavioral domains during the COVID-19 pandemic. Food security was assessed based on a two-question method validated against the United States Department of Agriculture 18-item Household Food Security Survey. Logistic regression was used to assess the associations of moderate-to-large impact on overall behavior and eating behaviors with income and food security status.

**Results:** A majority of respondents reported a moderate to large impact on the child's overall behavior (74%) as well as eating behaviors (57%) due to COVID-19. Increases in specific behaviors were also reported, notably in distractibility (69%), arguing or stubbornness (69%), and hyperactivity (65%). Increased food intake by the child was reported by 42% of respondents while 36% reported decreased intake. Frequency of consumption of meat, seafood, vegetables, and 100% fruit juice decreased overall while frequency of sweets consumption significantly increased. Household food insecurity increased by 8% compared to the past 12

months prior to COVID-19. Stratifying by income level and food security status revealed disparities in the impact on overall behavior, eating behaviors, and most specific behaviors. Compared to a household income  $\geq$ \$100K, an income  $<$ \$50K was associated with an increased risk of moderate to large impact on the child's overall behavior (odds ratio (OR): 4.07, 95% CI: 1.60, 10.38) and eating behaviors (OR: 2.33, 95% CI: 1.02, 5.29). Food insecurity also significantly impacted the risk of moderate to large impacts on overall behavior and eating behaviors (OR: 3.82, 95% CI: 1.95, 7.49, and OR: 2.60, 95% CI: 1.45, 4.67, respectively).

Conclusions: Our findings show a large proportion of caregivers reporting moderate to large changes post-COVID-19 in the behaviors of children with ASD, particularly in families with low income and/or food insecurity. This study highlights the effects of existing disparities on children with ASD and their families during this unprecedented time.

**419.010 (Poster) Cumulative Incidence of Autism Spectrum Disorders in Tennessee**

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Background: The prevalence of Autism Spectrum Disorder (ASD) has significantly increased over time, and the most recent prevalence estimate is 1.85% among 8 year old children. Currently, in the US the CDC reports the prevalence of ASD biannually based on the identification in 8-and 4-year-old children in 11 states using cross sectional methods. However, comprehensive longitudinal data identifying ASD diagnosis across time has not been available for the US with those purporting such estimates usually based on self-report methods. Standard ASD surveillance methods often require time and labor intensive strategies that result in a significant time delay when reporting statistics.

Objectives: Our objective was to utilize electronic health record (EHR) data for patients seen at Vanderbilt University Medical Center (VUMC) to estimate the cumulative incidence of ASD diagnosis over time in children in Tennessee born during 1997-2018.

Methods: Our data source was Vanderbilt's Research Derivative clinical informatic platform which contains the electronic health record (EHR) data for all patients seen at VUMC including ICD codes used at each visit. Children were included as an ASD case if they were born between the years of 1997-2018; had at least one ICD code of ASD; last address in the EHR was listed in TN; and were not listed as deceased in the EHR. Incidence curves were calculated per birth cohort year dividing the number of cases of ASD per year by the total number of same aged-children living in Tennessee in the year of interest.

Results: A model for cumulative incidence curves for children living in Tennessee during birth cohort years 1997-2018 was successfully created using EHR data as shown in the figure. Final incidence estimates for ASD varied by birth cohorts with the lowest incidence of 0.42% in 18 year olds born in 1997/1998 with the highest of 1.01% in 3 and 4 year olds born in 2013/2014. Our methods yielded lower estimates than current CDC estimates. This figure shows an increase in autism incidence over time and across birth cohort years that has not yet flattened. *Importantly*, data for this study were extracted from the EHR over a 6 week period. Quantifying and creating the cumulative incidence curves took less than two weeks.

Conclusions: Utilizing EHR based ASD identification might provide an efficient way to rapidly model ASD incidence. Future directions include linking these methods to statewide educational data and Medicaid data. This strategy could potentially provide a new method to model ASD incidence in real time in a cost effective manner.

**419.011 (Poster) Developmental Profiles of Children at Risk for Autism Spectrum Disorder at School Entry: A Population-Based Cohort Study in British Columbia, Canada**

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Background: Children with autism spectrum disorder (ASD) are highly heterogenous in their functional abilities and changes in the definition of ASD over time may be leading to decreased differences among individuals with and without ASD. In British Columbia (BC), the BC Autism Assessment Network (BCAAN) conducts all publicly funded ASD assessments in children. Their clinical database allows us to identify a unique cohort of children with overlapping impairments but differing diagnoses.

Objectives: The purpose of this study was to compare the developmental profiles at school entry of children assessed for ASD using population level linkage data.

**Methods:** This is a retrospective cohort study using administrative datasets of children born in BC from 2000 to 2009. The study sample included 101,739 children in 5 comparison groups: children (1) assessed by BCAAN and diagnosed with ASD (n = 1,583), (2) assessed by BCAAN and not diagnosed with ASD (n = 1,131), (3) not seen by BCAAN but identified by the ministry of education as having ASD (n = 654), (4) identified by the ministry of education as having a special need other than ASD (n = 11,663), and (5) typically developing children (n = 86,708). Developmental profiles were assessed using the Early Development Instrument (EDI), a kindergarten teacher completed measure. The EDI measures 5 core domains: physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication and general knowledge. Scores range from 0 to 10; lower scores represent more vulnerable children. Group differences was examined using one-way ANOVA and Tukey's HSD to adjust for multiple comparisons ( $p < 0.05$  for statistical significance).

**Results:** Overall, children who were assessed for ASD, regardless of diagnosis, had mean domain scores that were lower than children identified by the ministry of education as having a special need and typically developing children. These differences were most prominent in the social competence, emotional maturity, and communication and general knowledge domains. For example, in the social competence domain, children with ASD scored on average 1.75 (95% CI 1.61, 1.88) points lower than children with other special needs, and 3.96 (95% CI 3.84, 4.08) points lower than typically developing children; children assessed for ASD, but not diagnosed with ASD, scored on average 0.89 (95% CI 0.75, 1.04) points lower than children with other special needs, and 3.1 (95% CI 2.96, 3.24) points lower than typically developing children.

**Conclusions:** The results highlight the importance of ongoing monitoring and support of children for whom there are developmental concerns, particularly for ASD. Even when these children are not diagnosed with ASD, they present with an early developmental profile that is distinct from children with other special needs and typically developing children.

**419.012 (Poster)** Disability Eligibility Patterns in Head Start Programs: A Comparison of Puerto Rico and Mainland United States of America

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**Background:** Population-based research is needed in order to identify eligibility patterns arising from diverse disabilities in diverse communities and countries. However, this has been a difficult process in part arising from challenges in collecting and accessing comparable data that are stable across communities. The Head Start Program, both in the mainland US and in Puerto Rico, is a resource that gathers yearly information service eligibility that can be compared across samples using similar criteria across sites.

**Objectives:** To analyze special education referral patterns for three to five-year-old preschool low-income Head Start populations to better understand eligibility patterns across cultures: mainland USA and Puerto Rico.

**Methods:** Database was retrieved from the Head Start ECKLC enterprise system on three consecutive years (2016-2018) of Program Information Reports, which provided information on enrollment and eligibility classification. We compared the proportions of the two countries' eligibility categories for ID and related eligibilities (e.g., Speech/Language Impairment, Autism Spectrum Disorder, Developmental Delay).

**Results:** Contrary to patterns reported in the literature on Latinx samples in the US, we observed higher incidence of Autism Spectrum Disorder in Puerto Rico when compared to mainland US. Bu there was a significant discrepancy between Developmental Delay and Speech/Language Impairment, with a much higher identification for Speech/Language Impairment and much lower identification for Developmental Delay in Puerto Rico relative to these categories in the mainland US.

**Conclusions:** Higher incidence of ASD in PR suggests that there might be an increase of awareness and education towards this diagnosis in terms of evaluation and treatment procedures. Differences in Developmental Delay and Speech Impairment could arise from cultural differences in how these typologies are viewed and defined. Expansion of the sample and in depth analysis of cultural impacts, perspectives, and screening methods need to be examined in order to validate speculations herein.

**419.013 (Poster)** Effects of the COVID-19 Pandemic on Parent-Reported Stress and ASD Symptoms in Toddlers in a Community Sample

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**Background:**

Child behavioral problems and family stress have been reported during the COVID-19 pandemic. To date, studies have not examined the impact of the pandemic on ASD symptoms in very young children. In addition, little is known about the stress of parenting toddlers during the COVID-19 pandemic.

**Objectives:** 1) To compare ASD-related symptoms, other behavior problems, and parenting stress in a cohort of toddlers recruited before the COVID-19 pandemic with a comparable cohort recruited during the pandemic. 2) To explore whether race and ethnicity differentially impacted group differences in these behavioral factors.

**Methods:**

Participants were drawn from a sample of N=1416 toddlers (mean age = 19.9 months) recruited from pediatric clinics as part of a community-based study. The sample was divided into two cohorts based on study enrollment during the same 6-month period (April 1 to October 30) in 2019 (pre-COVID-19 pandemic) and 2020 (during the pandemic). Rates of study participation and enrollment were examined between the cohorts. Parent-reported ASD symptoms were assessed with the Modified Checklist for Autism in Toddlers [M-CHAT] and Autism Spectrum Problems subscale of the Child Behavior Checklist (Aut-CBCL). General behavior problems were assessed on the CBCL Total Problems subscale (Tot-CBCL). Parent stress was examined using the Parental Stress Scale (PSS). Outcomes across the two cohorts and the effects of child race and ethnicity were examined.

**Results:** A lower proportion of eligible families consented to participate during the pandemic (N=142/1481; 9.6%) compared to pre-pandemic (N=803/1480; 54.3%) ( $\chi^2 = 361.1, p < 0.001$ ). Parental stress was significantly higher in the pandemic cohort compared to the pre-pandemic cohort ( $t = 3.8, p < 0.001$ ) for all participants, with particularly higher stress reported for White respondents during the pandemic. No difference was found between the cohorts on the M-CHAT. A nonsignificant increase was observed in the number scores above the M-CHAT cut-off (i.e., score  $\geq 3$ ), and Black children showed statistically insignificant increases in the proportion of clinical cases (8.2% to 14.3%). The cohorts did not differ significantly on the Autism Spectrum Problems scale, but there was a trend for higher scores for Hispanic families during the pandemic ( $p = 0.07$ ). Statistically insignificant cohort differences were found in the proportion of elevated scores (defined as T-score  $> 60$ ) for Black (pre-pandemic 7.6%; pandemic 15.2%) and Hispanic children (pre-pandemic 10.5%; pandemic 16.7%) while White and Non-Hispanic children showed decreases. Lastly, cohorts did not differ in total behavior problems. However, trend-level findings on the Tot-CBCL showed increased problems for non-White versus White children during the COVID-19 pandemic ( $F = 3.73, p = 0.05$ ) and for Hispanic versus non-Hispanic children ( $F = 3.91, p < 0.05$ ).

**Conclusions:**

Higher levels of parenting stress were reported in a cohort of toddlers enrolled during the COVID-19 pandemic compared to pre-pandemic participants. Although ASD symptoms and general problem behaviors did not increase during the pandemic for the full sample, group differences emerged when considering race and ethnicity. Findings suggest possible differential impact of the COVID-19 pandemic on behavioral functioning in toddlers. Future research will examine associations between parenting stress and child behaviors, as well as developmental changes over time between the cohorts.

**419.014 (Poster)** Exploring a Role for Parental Mental Health in Perception and Reports of Pain on Behalf of Children with Autism Spectrum Disorder

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**Background:** In addition to social communication impairments and repetitive behaviors, children with autism spectrum disorder (ASD) have higher prevalence of pain compared to controls and may experience altered tactile perceptions. However, increased reports of pain may be a function of differences in parental interpretation among children with ASD. Parents of children with ASD experience high rates of stress, depression and anxiety, which may affect how they report pain symptoms on behalf of children. Since pain is a leading cause of morbidity and disability worldwide and may contribute to adverse health outcomes in people with ASD, further work regarding pain experiences in ASD is warranted.

**Objectives:** We sought to explore a relationship between ASD and parental reported child pain, with further consideration of the presence of maternal mental health conditions (MMHCs) as a contextual factor.

**Methods:** Data from 1,423 children with ASD, 46,145 children without ASD and their mothers were used from the combined 2016-2017 National Survey of Children's Health (NSCH). Mothers reported child pain and ASD status and their own mental health status ("Excellent or Very Good," "Good," or "Fair or Poor"). A status of "Fair or Poor" was coded as having MMHCs. Weighted prevalence estimates of ASD, pain and MMHCs were calculated for four levels of one main exposure variable (group 1: No ASD/ No MMHCs (reference group; N= 44,327); group 2: No ASD/Yes MMHCs (N= 1,818); group 3: ASD/No MMHCs (N= 1,277); and group 4: ASD/Yes MMHCs (N= 146)). Logistic regression models were used to explore the relationship between pain and this main exposure variable, adjusting for co-occurring neurological conditions (CNC).

**Results:** Frequent or chronic pain was reported for 8.5% of children without ASD and 14.1% of children with ASD. MMHCs were reported by mothers in 3.9% of children without ASD and 10.3% with ASD. Pain was prevalent in 7.4% [95% CI= 6.9-7.8] of children in group 1, 22.8% [95% CI= 18.7-26.8] of group 2, 16.1% [95% CI= 9.8-22.4] of group 3, and 25.4 % [95% CI= 12.3-35.8] of those in group 4. In a model fully adjusted for CNCs and sociodemographic factors, the odds of pain for group 2 (No ASD/Yes MMHCs ) compared to no ASD and No MMHCs was 3.59 [2.65-4.88], for group 3 (ASD/No MMHCs) was 2.31 [1.21-4.42], and for group 4 (ASD/MMHCs) was 3.86 [1.70-8.78] (Table 1). Tests for contrasts between groups revealed that they did not differ from each other, but each significantly differed from the reference group.

**Conclusions:** Children with and without ASD who had mothers with MHCs had higher odds of pain compared to children with mothers without MHCs. Increased odds did not attenuate as a result of controlling for CNCs, which have been associated with increased pain in children with ASD. Parental MHCs may alter perception and/or reports of pain on behalf of children with and without ASD. Future research should include detailed assessments of parental mental health in order to further explore its role in the experiences of pain and other pathophysiological symptoms present in children with ASD.

#### **419.015 (Poster)** Factors Associated with Knowledge, Attitude, and Practices of Physicians Related to Autism Spectrum Disorder in Romania

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**Background:** An inadequate level of general knowledge of physicians regarding mental health, including Autism Spectrum Disorder (ASD), could have adverse effects on affected individuals' health and quality of life in a variety of ways. For example, an inadequate level of knowledge of physicians about ASD could further delay its diagnosis and initiation of timely and appropriate interventions, particularly in communities in which mental health is considered a stigma.

**Objectives:** The purpose of this survey is to assess the level of knowledge, attitudes, and practices (KAP) of physicians regarding ASD in Romania and identify their associated factors.

**Methods:** For this cross-sectional survey, investigators at the University of Texas Health Science Center at Houston and "Carol Davila" University of Medicine and Pharmacy (UMF) collaborated to develop a questionnaire by modifying a previously established similar questionnaires used in Pakistan and Turkey, to assess KAP of physicians and specialists regarding ASD in Romania. The Questionnaire was administered to a convenient sample of 383 practicing physicians or specialists recruited from the 2017 National Conference of Family Medicine in Bucharest, Romania. We conducted confirmatory factor analysis that resulted in identifying five composite ASD knowledge sub-scores derived from 12 questions described in Table 1. Using each of these sub-scores as dependent variables in univariable and multivariable General Linear Models, we determined the variables associated KAP related to ASD as well as their potential interactions.

**Results:** Approximately 75% of the responding physicians were female and more than 80% were over the age of 30 years. About 88% of physicians correctly responded that, "impaired social interaction" was necessary for the diagnosis of ASD. The majority (73%-94%) of physicians in Romania have correctly responded to some basic questions regarding knowledge about ASD. We also found that younger physicians (age < 35 years) were more knowledgeable about potential causes of ASD than older physicians, age ≥ 35 years, (adjusted mean sub-scores: 2.70 vs. 2.13,  $P = 0.04$ , adjusted for the "type of medical school attended" and "city where the clinic is located"). The five sub-scores obtained from factor analysis explained about 64% of the variance in

all 12 questions entered into the factor analysis as shown in Table 1. We found a significant interaction between source of ASD knowledge (SAK) and (city where the clinic is located) in relation to knowledge of the physicians' regarding stigma related to ASD. We also found a marginally significant interaction between SAK and completing a master's level training after medical school in relation to knowledge of the physicians' regarding potential causes of ASD ( $P = 0.06$ ). There were no significant interactions in relation to the physician's knowledge of behaviors of children with ASD.

**Conclusions:** Though physicians in Romania have general knowledge about ASD, greater focus is needed on increased awareness of stigma and misconception surrounding ASD, as well as its symptoms and potential causes. Our study also emphasizes the importance of testing for interactions among similar studies, which may help identify associations between ASD knowledge and other covariates that effect physician's knowledge in this area.

**419.016 (Poster) First Trimester Maternal Serum Folate and Child Autism Spectrum Disorder**

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**Background:**

Many studies have reported associations between prenatal supplemental folic acid (FA) intake and reduced risk for autism spectrum disorder (ASD) in the child. Some found a critical window for protection near conception. Although studies of measured maternal serum folate have not shown an association with reduced ASD risk, none measured serum folate metabolites in early pregnancy.

**Objectives:**

We examined maternal first trimester serum folate status in association with the child's later development of ASD.

**Methods:**

In a pooled study of younger siblings of children with autism enrolled in the MARBLES (n=75) and EARLI (n=24) prospective pregnancy cohorts, serum 5-methyltetrahydrofolate (5-meTHF) and FA were quantified in up to two samples in the first trimester using LC-MS/MS stable-isotope dilution methods. Assay imprecision was calculated using in-house quality-control samples that were included with each extraction batch. ASD was clinically assessed for all children using the Autism Diagnostic Observation Schedule (ADOS) at 3 years old. Typically developing (TD) was defined using an algorithm based on the ADOS and the Mullen Scales of Early Learning at age 3 years. Relative risks for ASD were calculated using a SAS macro, %RELRIK8.

**Results:**

First trimester serum folate metabolites were available for 36 children who were diagnosed with ASD, and 63 TD children. Intra-assay and inter-assay CVs were 1.8% and 1.9% for 5-meTHF; and 4.9 and 8.5% for FA. 91% of the women had elevated 5-meTHF (above 20 ng/ml) and 0 were deficient or possibly deficient.

When examined as continuous exposures, there were no significant associations observed between ASD and averaged first trimester ln-transformed FA (RR= 0.89, 95%CI 0.71, 1.13) or 5-meTHF (RR for 10ng/mL increase=1.10, 95%CI 0.84, 1.43). There was a significant association between higher late first trimester serum 5-meTHF and increased ASD (RR=1.29, 95%CI 1.05, 1.59) that was not observed for early first trimester (**Table 1**). Additionally, when examining first trimester averages as categories given evidence for a U-shaped association with ASD, having less than elevated 5-meTHF (20 ng/ml or less) was associated with borderline significant higher risk for ASD (RR=2.22, 95%CI 0.90, 5.50), and the highest category of 5-meTHF (32 ng/mL or above) was non-significantly associated with higher risk (RR=1.76, 95%CI 0.81, 3.81) compared to having 26-32 ng/mL (**Table 2**).

**Conclusions:**

In this pooled study of high familial risk families, maternal serum folate status in the first trimester was not associated with decreased risk for ASD. There were differences in the directions of associations by timing, in which lower risk was observed for increasing concentrations of both folate metabolites in early first trimester compared to late first trimester. Further, as found in previous studies, we found evidence of a U-shaped association, with non-significantly higher risk associated with the lowest and highest categories of 5-meTHF. Additional, larger studies should confirm these findings especially for the first month of pregnancy and before. Further, population-based cohort studies should assess the generalizability of these findings to families unaffected by autism. Finally, studies in populations without elevated folate should be conducted to investigate associations of deficient serum folate concentrations.

**419.017 (Poster) Higher Than Expected ASD Prevalence in Toms River, New Jersey in 2016**

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### **Background:**

Though accurate information about the prevalence and expression of Autism Spectrum Disorder (ASD) may be useful for planning educational and health services, there is scant information from population-based studies on the prevalence and expression of ASD at the county or local level. ASD prevalence in the New Jersey was 3.1%, nearly double the Autism and Developmental Disabilities Monitoring (ADDM) Network average, during the most recent monitoring period.

### **Objectives:**

Our objective was to provide reliable, population-based, information on ASD prevalence at the school district level in the New Jersey ADDM surveillance region, leading to identification of districts with higher-than-expected and lower-than-expected ASD prevalence.

### **Methods:**

A cross-sectional study was implemented using data from the 2016 New Jersey surveillance site - a multiple source public health monitoring system that analyzes data from educational and health care sources to determine the number of 8-year-old children with ASD in defined populations. In this study, ASD cases were restricted to include children in public education, in 2016. District level denominators were based on public school enrollment data. Wilson score method was used to calculate 95% confidence intervals.

### **Results:**

ASD prevalence across 74 New Jersey districts ranged from 0 to 10.8%. Average prevalence was 3.6%. More than a quarter of the districts had ASD prevalence greater than 4%, including 3 of the 4 largest school districts. Highest ASD prevalence was identified in Toms River, wherein 78 children served by the public school system were identified with ASD (7.3%; 95% CI: 5.9-9.0). Most were boys (n= 66; 85%), from White (Non-Hispanic) (n=60; 77%), middle income families (median household income range \$45,000-\$100,000) (n=70; 90%). Most were born in New Jersey (n=65; 83%). Eighty-eight percent (n=53) with cognitive testing data had a documented Intellectual Quotient (IQ) above 70. Most of the Toms River ASD-confirmed students (n=68; 87%) received special education services during 2016, including (n=29) 38% under an Autism classification, 20% (n=5) under Other Health Impaired and 9% (n=7) under Multiply Disabled classifications. Approximately 13% (n=10) were in general education or received 504 Plan services (n=3). Thirty-seven percent (n=29) of the Toms River ASD-confirmed cases received professional evaluation before 36-months and 45% (n=35) were diagnosed with ASD by 48-months, even though 80% (n=62) had indication of delays before 36 months.

### **Conclusions:**

ASD prevalence in many areas and districts may be higher than indicated by aggregate (state or system-level) estimates. Approximately one in four New Jersey school districts had ASD prevalence greater than 4%, in 2016. In Toms River, New Jersey's largest suburban public school district, 1-in-14 8-year-olds was identified with ASD (7.4%). Higher-than-expected rates of ASD in Toms River and other New Jersey school districts point to the importance of utilizing local-level population-based ASD estimates for the development of strategies to meet the needs of children with ASD and to determine the future needs of adults with ASD. Additional inquiry is needed to identify the factors responsible for higher-than-expected ASD prevalence in New Jersey. Ongoing ASD surveillance by the same method, going forward, is recommended.

**419.018** (Poster) Impact of Belgian COVID-19 Lockdown Restrictions on Autistic Individuals' Behaviors and Their Parents' Quality of Life

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**Background:** Due to the rapid spread of the COVID-19 virus, Belgian citizens were required to stay at home between the 18th of March and 10th of May 2020. Belgium's National Security Council only allowed to go out for errands of prime necessity or outdoor physical activity within a limited distance of one's home. There are good reasons to believe that this situation affected families living with an autistic individual. First, work arrangement such as homeworking, financial uncertainty and restriction of movements could add to the challenge in parenting, possibly increasing stress and reducing quality of life. Second, social isolation, changes in routines, closing of schools, restriction of outdoor activities, lack of professional support could increase the amount of behavioral difficulties in autistic individuals.

**Objectives:** The primary aim is to investigate the impact of Belgium's lockdown restrictions on autistic individuals' communicative behaviors and their parents' quality of life. The second aim is to assess the influence of the autistic individual's characteristics, the home characteristics, and the support, resources and implementation of ASD strategies during lockdown on the changes in behaviors and quality of life.

**Methods:** A 125-question on-line survey was shared via LimeSurvey during the second month of lockdown with French-speaking Belgian parents living with an autistic individual. Three main domains were addressed in the questionnaire: family and household characteristics, the autistic individual's characteristics and behaviors, and global quality of life during lockdown. Five-point Likert items (much less than usual/a little less than usual/as usual/a little more than usual/much more than usual) measured the presence of nonfunctional communicative behaviors in the autistic individuals and the changes in their parents' quality of life — higher scores indicating a deterioration and lower scores indicating an improvement.

**Results:** 209 parents completed the survey. Answers on the Likert scales were significantly higher than "as usual" for the autistic individual's nonfunctional socio-communicative ( $t(208) = 10.57, p < .001$ ) and challenging behaviors ( $t(208) = 6.24, p < .001$ ), and for the parents' quality of life ( $t(208) = 10.41, p < .001$ ) and emotional well-being ( $t(251) = 10.54, p < .001$ ) (see Figure 1). Preliminary results indicated that at least two external factors influenced the impact of lockdown on the families. First, there was a significant main effect of the autistic individuals' amount of comorbidities on the presence of nonfunctional socio-communicative ( $F(1,203)=7.49, p=.007$ ) and challenging behaviors ( $F(1,203)=4.09, p=.044$ ), and their parents' emotional well-being ( $F(1,203)=5.86, p=.016$ ). There was also a significant main effect of parents' access to respite care on the presence of nonfunctional socio-communicative ( $F(1,207)=18.88, p < .001$ ) and challenging behaviors ( $F(1,207)=17.12, p < .001$ ), and the parent's quality of life ( $F(1,207)=32.48, p < .001$ ) and emotional well-being ( $F(1,207)=34.98, p < .001$ ).

**Conclusions:** Belgium's governmental lockdown restrictions had a negative impact both on the autistic individuals' communicative behaviors and their parents' global quality of life. Nonfunctional socio-communicative behaviors increased and parents' quality of life declined. Moreover, the impact of lockdown was worse for autistic individuals who have more comorbidities and for parents who could not access some kind of respite care.

**419.019** (Poster) Maternal Prenatal Perceived Stress in Relation to Autism-Related Symptoms at Age Three

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**Background:** Maternal exposures during pregnancy have been shown to be associated with elevated risk of ASD in her child. One exposure that warrants more inquiry is prenatal stress. Existing literature has explored the association between maternal prenatal stress and risk of ASD,<sup>1-7</sup> but their methods for measuring stress were either too narrow (i.e., one mass trauma event) or broad (i.e., open-ended recall of events). This will be the first prospective study to consider perceived stress, which accounts for all stressors and how they impact the mother, and ADOS comparison score to determine if there is an association between prenatal stress and later risk of exhibiting ASD-related symptoms. Moreover, a mother's stress during pregnancy may be even more of a concern for her child if she is at high familial risk due to having an older child already diagnosed with ASD.<sup>8</sup> This will also be the first study to examine perceived stress and ASD-related symptoms in a high familial risk population.

**Objectives:** The objective of this study is to examine the association between maternal prenatal perceived stress and the child's ADOS comparison score at age three in a high familial risk cohort.

**Methods:** This prospective cohort study includes 148 high familial risk pregnant women that already have at least one child with ASD and are at an increased risk of having another child with ASD. The exposure of interest was maternal prenatal perceived stress, and the outcome was child Autism Diagnostic Observation Schedule (ADOS) comparison score. Perceived stress was measured during each trimester of pregnancy by using Cohen's Perceived Stress Scale, which is the most widely used psychological instrument to measure perceived stress.<sup>9</sup> The ADOS is the gold-standard assessment for diagnosing autism. Trained psychologists administered the ADOS to every child at age three. The ADOS comparison score, computed through an algorithm, measures the severity of autism-related symptoms. Linear regression models were fitted to determine the relationship between maternal prenatal perceived stress and ADOS comparison score.

**Results:** Findings in the first trimester were not significant. In the second trimester, a one point increase in the mother's prenatal perceived stress score resulted in an 8% increase in the child's ADOS comparison score (*p*-value 0.0244, 95% CI (0.01, 0.15)). In the third trimester, a one point increase in perceived stress score resulted in an 11% increase in the child's ADOS comparison score (*p*-value 0.0006, 95% CI (0.05, 0.17)).

**Conclusions:** This prospective longitudinal study in a high familial risk cohort is the first to explore associations between maternal prenatal perceived stress and the child's ADOS comparison score at three years. Significant findings show that increased perceived stress during pregnancy can lead to higher risk of the child exhibiting autism-related symptoms. These findings are important because understanding prenatal risks can help us design stress interventions and preventative measures that will lead to the optimization of the child's long term health. This is especially true for mothers at high familial risk that have the added stressors from raising at least one other child with ASD.

**419.020 (Poster) Maternal Supplemental Nutrient Mixtures across Pre-Conception and Pregnancy in Relation to Autism Spectrum Disorder in the Child**

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**Background:**

Maternal pre-pregnancy and prenatal intake of vitamin supplements and certain individual nutrients have been associated with reduced risk for autism spectrum disorder (ASD) in the child. Some found a critical window for protection near conception. Because nutrients are often delivered together in supplements, their intake dose and timing are often correlated. Nutrients also influence overlapping biologic pathways, making nutrient interactions plausible.

**Objectives:**

We used mixtures analysis to examine joint and separate effects of multiple nutrients from supplements mothers reported consuming before and across pregnancy in association with the child's development of ASD.

**Methods:**

In the MARBLES prospective cohort of younger siblings of children with autism, interviews collected information on vitamins and supplements mothers consumed in each month from 6 months before through the end of pregnancy; total average daily intake of many key nutrients was calculated based on supplement brands, frequencies and doses reported in each month.

Children were clinically assessed using the Autism Diagnostic Observation Schedule (ADOS) and the Mullen Scales of Early Learning at 3 years old, and algorithmically classified as typically developing (TD, n=182) or having ASD (n=65).

Bayesian Kernel Machine Regression (BKMR) was used to assess relationships between ASD and maternal supplemental nutrient intake using groupings of 11 nutrients across time points (pre-pregnancy, pregnancy months 1, 2 and 3, trimester 2, and trimester 3) and groupings of time points across nutrients. Group Posterior Inclusion Probabilities (PIPs) were multiplied by conditional PIPs, and all variables with product PIPs > 0.10 were selected for visualization and included in unconditional logistic regression models. Trimmed nutrients were standardized using z-scores prior to BKMR.

**Results:**

When grouped by nutrient, the following had product PIPs > 0.10: calcium in trimester 2, folic acid in months 1 and 2, iron in month 2, vitamin A in months 1 and 2, vitamin C in trimester 3, vitamin E in months 2 and 3, and zinc in trimester 3 (**Figure 1**). Together, these nutrients statistically significantly predicted ASD (C-statistic: 0.70, 95%CI: 0.63, 0.77, p=0.002). Only folic acid in month 1 was statistically significant (OR = 0.32; 95% Confidence Interval (CI): 0.13, 0.79) in the logistic model. When nutrients were grouped by time, the following had product PIPs > 0.10: calcium in trimester 2, folic acid in months 1 and 2, iron in month 1, vitamin C in trimester 3, and vitamin E in months 2 and 3 (**Figure 2**). Together these nutrients statistically significantly predicted ASD (C-statistic: 0.69, 95%CI: 0.62, 0.77, p=0.003). None of these nutrients were statistically significant in the logistic model.

## Conclusions:

This first study to simultaneously evaluate a number of correlated and combined nutrient exposures before and across pregnancy in relation to the child's development of ASD found the strongest evidence for a protective association of supplemental folic acid in month 1. Calcium in trimester 2, folic acid in month 2, vitamin C in trimester 3, and vitamin E in months 2 and 3 and iron in months 1 or 2 also consistently contributed to ASD, with mostly inverse associations.

### 419.021 (Poster) Positive and Negative Impact of Initial Covid-19 Home-Quarantine Period on Children with ASD and Their Families

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**Background:** In mid-March 2020, due to the Covid-19 outbreak, the Israeli government imposed an unprecedented nation-wide home-quarantine period for ~6 weeks. During this period all education services, including special education services, were closed and the population was instructed to stay at home. To the best of our knowledge, the impact of home-quarantine on the well-being of children with ASD and their parents has not been assessed to date.

**Objectives:** To assess the impact of the 6-week home-quarantine period on children with ASD and their parents using an online parent questionnaire.

**Methods:** Parents of 268 children with ASD ages 2-18 years old (mean age = 7.6 ± 4.3) completed the questionnaire. The questionnaire included several background questions regarding the child's age, the level of support that the child required before the covid-19 outbreak, and the financial impact of the quarantine. These were followed by 9 questions where parents rated the impact of home-quarantine on their general mood, sleep, family relationships, and parenting skills, as well as 12 questions where parents rated the impact of home-quarantine on the severity of ASD symptoms, anxiety, tantrums, and sleep disturbances of their child. We used one-sample two-tailed t-tests to identify domains where the home-quarantine period had significant positive or negative impact on children with ASD and their parents. We used one-way ANOVA analyses to compare ratings across children with different levels of required support, ages, and sex as well as across families who experienced different levels of income loss during the home-quarantine period.

**Results:** While home-quarantine had a significant negative impact on the mood and sleep of parents (t(265)=-3.2, p=0.002), many reported improvements in the quality of their relationships with spouse (t(250)=4.1, p<0.0001) and child with ASD (t(265)=11.9, p<0.0001), as well as improvements in their parenting skills (t(266)=5.3, p<0.0001). Furthermore, while parents reported an increase in the severity of tantrums (t(263)=-3.3, p=0.0007), anxiety (t(264)=-3.9, p=0.0001), and restricted and repetitive behavior symptoms (t(263)=-3.5, p=0.0006), they also reported improvements in social and communication abilities of their child (t(263)=4.2, p<0.0001). Ratings were significantly lower in families of children with more severe ASD symptoms (F(2, 263)>3.2, p<0.04) and in families that experienced economic hardships (F(3,262)>3.2, p<0.02). There was no difference across ratings of boys and girls with ASD in any of the examined domains.

**Conclusions:** The initial home-quarantine period in Israel created numerous difficulties and challenges for families of children with ASD. Nevertheless, this period also offered a unique opportunity for improving family relationships, developing parenting

skills, and enhancing children's social communication abilities, particularly in families that were not impacted financially and families with children who required relatively low levels of daily support.

**419.022** (Poster) Prenatal Exposure to a Mixture of Persistent Organic Pollutants and Autism-Related Outcomes in Children  
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**Background:** Persistent organic pollutants (POPs) include compounds that have long-term persistence in the environment and have established adverse effects on neurodevelopmental outcomes. Past studies have examined prenatal exposure to POPs as a potential risk factor for autism spectrum disorder (ASD) and observed associations with specific congeners and/or classes of POPs. However, the findings of previous studies have been inconsistent and many of those studies have not considered the potential for mixture effects of POPs.

**Objectives:** In this study, we sought to examine the association between prenatal exposure to a mixture of POPs and ASD-related quantitative traits in children at high familial risk for ASD, using data collected from the Early Autism Risk Longitudinal Investigation (EARLI).

**Methods:** A total of 155 participants from the EARLI cohort, a high-familial risk cohort that enrolled pregnant mothers with a child diagnosed with ASD, were included in this analysis. Concentrations of 11 polychlorinated biphenyls (PCBs), 4 polybrominated diphenyls (PBDEs), and 2 persistent pesticides (hexachlorobenzene [HCB], 2,2-bis(4-chlorophenyl)-1,1,1-dichloroethene [*p,p'*-DDE]) were measured and imputed in maternal serum samples collected during pregnancy. Adjusted multivariable linear regression models were used to evaluate the independent effects of log-transformed POPs on ASD-related quantitative traits at 36 months, including Social Responsiveness Scale (SRS) scores, Mullen Scales of Early Learning (MSEL) scores, and Vineland Adaptive Behavior Scales version 2 (VABS-II) scores. Higher SRS scores indicate higher ASD-related traits, whereas higher MSEL and VABS scores indicate lower cognitive and adaptive functioning. We further applied weighted quantile sum (WQS) regression model and Bayesian kernel machine regression (BKMR) model to account for correlations among POPs and evaluate the mixture effect of POPs.

**Results:** In models examining chemicals independently, we observed significantly higher SRS scores among subjects exposed to higher log-PBDE47 ( $\beta=2.17$ , 95% CI: 0.08, 4.26 for 1 unit increase) and lower SRS scores among those exposed to higher log-*p,p'*-DDE ( $\beta=-2.97$ , 95% CI: -5.87, -0.07 for 1 unit increase). No significant associations were observed between POPs and MSEL scores. VABS scores were positively associated with PCB170, PCB180, PCB187, and PCB196/203. In mixture analyses, using WQS, we observed a 2.3% decrease in SRS score, a 2.1% increase in MSEL score, and a 4.7% increase in VABS score for one quartile increase in mixed POP index. PCBs were identified as the most important factor contributing to the joint effect of the mixture on ASD-related traits. Results from the BKMR models suggested a positive linear association of PBDE47 and HCB with SRS scores, a negative linear association of PBDE47 and HCB with MSEL and VABS scores, and a suggestive positive overall trend between POP mixture and higher VABS scores.

**Conclusions:** We observed independent associations between PCB180, PBDE47, HCB, and *p,p'*-DDE with ASD-related traits. Contrary to expectation, higher PCBs were associated with higher cognitive functioning. Our mixture analysis showed a degree of consistency across different methods, where we observed an overall positive mixture effect of POPs on cognitive function. Continued exploration and confirmation of our findings in non-high risk cohorts is warranted.

**419.023** (Poster) Prevalence and Characteristics of Autism Spectrum Disorder Among Low Income Children and Adolescents in Wisconsin: Results from a Statewide Population-Based Study

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**Background:** Epidemiologic studies of autism spectrum disorder (ASD) in the U.S. have reported persistent socioeconomic and racial disparities, with unexpectedly low prevalence counts for socioeconomically disadvantaged populations. These findings suggest the possibility that low income populations are under-represented in epidemiologic studies that rely on parent reporting and/or recruitment and record review of individuals served by selected healthcare systems and autism treatment services.

**Objectives:** The aims of this study were to (a) describe the prevalence of ASD among children and adolescents (ages 3-21 years) enrolled in Wisconsin's Medicaid program (public insurance program serving low income families and individuals) in 2018; and (b) the sociodemographic characteristics and frequency of co-occurring conditions in this population.

**Methods:** Functional assessment and other data were reviewed for all children and adolescents enrolled in Wisconsin's Medicaid program with International Classification of Disease diagnostic codes for ASD in 2018. The overall prevalence of ASD among children and adolescents enrolled in Medicaid was calculated by dividing the number with Medicaid claims for ASD by the total number of children and adolescents enrolled. 95% confidence intervals were calculated using Wilson's method. Sociodemographic characteristics and the frequency of co-occurring conditions are also described. For a sub-sample of counties included in the Wisconsin Autism and Developmental Disabilities Monitoring (ADDM) Network site, we estimated the percentage of 8 year-old children with ASD and enrolled in Medicaid who would be included in ADDM Network ASD surveillance counts.

**Results:** In 2018, among approximately 446,600 low income children and adolescents in Wisconsin enrolled in Medicaid, 8,769 had been diagnosed with ASD, corresponding to a prevalence of 19.6 (95% confidence interval 19.2, 2.0) per 1,000, or nearly 2% of the population. 38% of low income children and adolescents with ASD diagnoses received long-term care services, and among this population, the ratio of males to females was 3.5:1, the racial/ethnic composition was 72% White, 9% Black, 14% Hispanic, 3% Asian/Pacific Island and 2% American Indian, 95% were residing at home with parents, serious self-injurious behavior was reported for 14.2% and injurious behavior toward others for 31.8%, and 66% had co-occurring psychiatric and/or neurological conditions, with the most frequent being intellectual disability (28.3%), ADHD (25.9%), seizure disorders (10.5%) and mood disorders (5.0%). Within Wisconsin counties included in the ADDM Network ASD surveillance system, we estimate that 25% of 8 year-old children with ASD would not be counted and included in prevalence estimates without review of Medicaid claims and enrollment data.

**Conclusions:** Low income children and adolescents may be under-represented in surveys and public health surveillance systems designed to estimate the prevalence of ASD in the overall population. This study focused specifically on low income children and adolescents receiving services and supports provided by Wisconsin's Medicaid program and found the prevalence of ASD to be comparable to prevalence estimates for higher income populations. The high percentage of low income children and adolescents with ASD who have co-occurring psychiatric and neurological conditions points to the importance of including this population in future public health surveillance of ASD and its impacts.

**419.025 (Poster)** Role of Metabolic Genes (GSTT1, GSTP1, GSTM1) in Blood Mercury Concentrations of Jamaican Children with and without Autism Spectrum Disorder

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**Background:** Mercury (Hg) is a toxic metal that exists in elemental, inorganic and organic chemical forms. Exposure to the most toxic organic form of Hg occurs primarily through consumption of fish. Several studies have investigated the possible association between exposure to Hg and autism spectrum disorder (ASD), though findings conflict. These inconsistent findings could be related to potential confounding effects of dietary practices including fish consumption. In addition, there is evidence that single nucleotide polymorphisms (SNPs) in glutathione S-transferase (GST) genes can influence susceptibility to the cytotoxic consequences of Hg due to variation in Hg detoxification capacity.

**Objectives:** We investigated interactive association of three metabolic GST genes (*GSTP1*, *GSTM1*, and *GSTT1*) and ASD in relation to blood Hg concentrations of Jamaican children with and without ASD.

**Methods:** We compared characteristics of 262 children with ASD and 262 typically developing (TD) controls (2-8 years old) using conditional logistic regression models with respect to demographics, socioeconomic status (SES), foods consumed, and genotypes for *GSTP1*, *GSTM1*, and *GSTT1*. In addition, we used multivariable General Linear Models (GLMs) with the log-

transformed blood Hg concentrations as the dependent variable to investigate the interaction between each of the three GST genes and ASD status in relation to blood Hg concentrations. We also adjusted the multivariable GLMs for covariates that have been previously associated with ASD status and blood Hg concentrations. In all GLMs, we also controlled for the potential clustering effect of matched pairs of ASD cases and TD controls.

Results: At the time of enrollment 77.8% of ASD cases and 80.1% of the TD controls were 48 months or older. About 81% of the ASD cases and TD controls were male. Nearly all of the ASD cases (95.5%) and TD controls (97%) were Afro-Caribbean. After adjusting multivariable GLMs for SES, consumption of leafy vegetables, fried plantain, canned fish, and the interaction between *GSTT1* and *GSTP1* (*GSTT1*\**GSTP1*), the interaction between *GSTP1* and ASD status was significant in relation to blood Hg concentrations either in a co-dominant or dominant genetic model for *GSTP1* ( $P < 0.001$ ,  $P = 0.006$ , respectively). The genetic variant in *GSTP1* is a SNP that results in an amino acid change at position 105 of the encoded protein (Ile105Val). In the co-dominant model for *GSTP1*, geometric mean (GM) blood Hg concentrations in ASD cases with genotype Ile/Ile were significantly higher than in those with genotype Ile/Val (0.66 vs. 0.43  $\mu\text{g/L}$ ,  $P = 0.01$ ). In contrast, in TD controls with the Ile/Val genotype GM blood Hg concentrations were significantly higher than in those with the Ile/Ile genotype (0.64 vs. 0.43  $\mu\text{g/L}$ ,  $P = 0.03$ ) or the Val/Val genotype (0.64 vs. 0.44  $\mu\text{g/L}$ ,  $P = 0.04$ ).

Conclusions: Findings suggest an interactive association between ASD and *GSTP1* in relation to blood Hg concentrations that is consistent with a possible role for *GSTP1* in detoxification of Hg. Although replication in other populations is warranted, these results support development of targeted interventions focused on dietary and environmental factors that could help to moderate exposure to Hg in Jamaican children.

#### **419.026 (Poster)** Screen Time and Obesity in Children with and without Autism Spectrum Disorder

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#### Background:

Children with autism spectrum disorder (ASD) are more likely to have overweight/obesity compared to children without ASD. Screen time is associated with obesity in typically developing children, but less is known about patterns of screen use in association with obesity in children with ASD.

#### Objectives:

We examined detailed information on screen use in children with and without ASD, using baseline measures from the Adolescent Brain Cognitive Development Study.

#### Methods:

ASD was defined by parental response to “Has your child ever been diagnosed with autism spectrum disorder?” From measured heights and weights, we calculated overweight/obesity using U.S. Centers for Disease Control BMI-for-age percentiles. Researchers surveyed children about daily hours of screen time, which we classified as either “passive” (watching shows/movies/videos/YouTube, gaming on computer/console/phone, or texting on phone/tablet/computer) or “social” (using Facebook/Twitter/Instagram/ Skype/Facetime). More than 2 daily hours of screen time of all types was considered “excessive,” based on American Academic of Pediatrics guidelines.

#### Results:

In 11,875 children aged 10 y (range 9-11), 52% were male, with 52% White, 15% Black, 20% Hispanic, 2% Asian, and 11% other. 2.8% (1 in 38) of boys and 0.5% (1 in 200) of girls had ASD. 32% of children had overweight/obesity. 36% of boys with ASD had overweight/obesity, compared to 32% of boys without ASD (chi-square test,  $p=0.249$ ). 34% of girls with ASD had overweight/obesity, compared to 31% of girls without ASD (chi-square test,  $p=0.69$ ). 79% of children with ASD had excessive screen time on weekdays, compared to 62% of children without ASD (chi-square test,  $p<0.001$ ). 85% of children with ASD had excessive screen time on weekends, compared to 78% of children without ASD (chi-square test,  $p=0.02$ ). On average, boys with

ASD had 7 more hours/week of passive screen time compared to boys without ASD (t- test,  $p<0.001$ ); girls with ASD had 9 more hours/week of passive screen time compared to girls without ASD (t- test,  $p<0.001$ ). In logistic regression models, higher levels of passive screen time were associated with increased risk of overweight/obesity, for both boys and girls: each additional hour of weekly passive screen time was associated with a ~2% increase in risk of overweight/obesity ( $p<0.001$ ). Boys with ASD did not have significantly higher social screen time than boys without ASD (Wilcoxon rank-sum test,  $p=0.55$ ); there also was no difference in social screen time between girls with and without ASD (Wilcoxon rank-sum test,  $p=0.41$ ). There is no evidence that the effect of screen time on overweight/obesity differed between children with and without ASD for boys or girls (interaction term in each model,  $p>0.05$ ).

#### Conclusions:

Screen time – a powerful, modifiable health behavior – is a concern for the health and development of all children. Youth with ASD may be particularly susceptible to the deleterious effects of excessive screen time. Appropriate use of screens is important not just for obesity risk, but for cognitive, behavioral, and other health-related sequelae.

#### **419.027 (Poster) Service and Support Needs for Families of Children with a Neurodevelopmental Disability in Canada during the COVID-19 Pandemic: Caregivers' Perspectives**

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Background: The COVID-19 pandemic and the public health measures (e.g., closing or modification of support services) taken to manage it have disrupted the lives of Canadian children with disabilities and their families worldwide. The greater healthcare needs and dependency on community-based services of these children make them particularly vulnerable during the pandemic's preventative measures. However, insufficient attention has been paid to documenting service and support needs for this segment of the population during the pandemic. Understanding unmet needs for these families is a first step to informing immediate and long-term supports.

Objectives: To examine the impact of the COVID-19 pandemic on service and support needs for families of children with a neurodevelopmental disability in Canada.

Methods: The Global Report Survey, developed as part of The Global Report on Developmental Delays, Disorders and Disabilities, was designed to document the experiences of caregivers of children with neurodevelopmental conditions during and prior to the COVID-19 pandemic. The online survey was developed, tested, and disseminated in collaboration with caregivers of children with disabilities. Survey questions were based on COVID-19 policy guidance recommendations for persons with disabilities and included topics such as response to the pandemic and access to care and supports. The survey was active from June- July 2020 and collected information from a non-random, convenience sample of caregivers from across Canadian provinces and territories. Descriptive analysis was conducted to illustrate families' needs.

Results: A sample of 883 caregivers of children with disability ranging from 0 to 41 years (57.8% males and 42.1% females) completed the survey. A third of the sample (34%) reported having a child with an autism diagnosis. Close to half of the caregivers who completed the survey indicated that during the pandemic it had been difficult to: get their regular helpers or caregivers to come if they needed them (43%), get help from their family or community for the person with the disability in their home (41.1%), and get schooling (daycare, pre-school, or school) for their child (48%). Almost half reported no access to services in a clinic for their child's physical health (44.4%) or mental health (46.1%). Over a third of caregivers reported having no access to telehealth services for their physical health (35%) or their mental health (34%). Only 30% reported having access to educational plans for schooling their child at home and 21% reported having access to accessible COVID-19 information for their children.

Conclusions: Challenges faced by these families include difficulties: (1) maintaining their formal and informal support networks (regular helpers, family, community), (2) accessing regular or telehealth services for their children or themselves, (3) obtaining educational plans for schooling their children at home, and (4) accessing accessible information for their children. Optimizing access to services and supports during the pandemic is critical to mitigating potential long-term adverse impact on health and wellbeing for these children and their caregivers. Findings will be shared with relevant stakeholders at the local, provincial, and federal levels to inform decisions, policies, and programs to support families' needs.

#### **419.028 (Poster) Symptom Severity Outcomes of COVID-19 Confinement Among Youth with Autism**

### Background:

The 2019 novel coronavirus disease (COVID-19) pandemic is a rapidly evolving global emergency. Shelter-in-place and social distancing orders in response to the COVID-19 outbreak have disrupted routines, removed social outlets, and decreased or eliminated specialized support. While most research has focused on investigating the social and psychological impacts associated with stay-at-home orders in the general population, very little is known regarding mental health outcomes in vulnerable developmental populations. Youth with autism spectrum disorder (ASD) are particularly at increased risk for adverse consequences due to the higher prevalence of depression and anxiety disorders in individuals with the disorder.

### Objectives:

To explore the psychosocial effects on youth with ASD during the COVID-19 outbreak in order to constructively inform responses across communities.

### Methods:

The present study sought to examine the impact of COVID-19 in 56 youth between 10 and 16 years of age ( $n_{ASD} = 25$ ,  $n_{TD} = 31$ ). Participants underwent neuropsychological assessments before the onset of the pandemic including the Wechsler Abbreviated Scale of Intelligence (WASI II), Autism Diagnostic Observation Schedule (ADOS-2), and Behavior Assessment System for Children (BASC-2), used to pre-screen youth for major psychopathology. Measures collected during the enforced lockdown period in South Florida include the Social Psychological Measurements of COVID-19, used to assess parental perceived threat and personal experience of the COVID-19 pandemic, The Perceived Stress Scale for Children (PSS-C), Screen for Child Anxiety and Related Emotional Disorders (SCARED), Mood and Feeling Questionnaire (MFQ) and The Child and the Youth Resilience Measure (CYRM). One-way ANOVAs were performed to examine if there is a significant difference in pre-pandemic and lockdown symptom severity scores between diagnostic groups. Additionally, multiple linear regressions were performed to investigate if any clinical characteristics among children with ASD would predict a greater intensity of anxiety and depressive symptoms following the COVID-19 outbreak. In each regression, the covariates of age, IQ, and SES were entered in the model as fixed effects.

### Results:

Examination of baseline symptom levels of anxiety and depression in youth with ASD, compared with matched controls using the BASC-2 parent rating scales demonstrate significantly elevated depression symptoms for children with ASD (**Figure 1**). Additionally, children with ASD experienced significantly elevated anxiety ( $F(1,54) = 14.42$ ,  $p = 0.003$ ) and depressive symptoms ( $F(1,54) = 7.45$ ,  $p = 0.009$ ) in the context of confinement as compared with their TD peers (**Figure 2**). Pre-pandemic depressive symptoms and perceived parental threat of COVID-19 explain a significant amount of variance in depressive symptoms during lockdown ( $F(2,19) = 25.13$ ,  $p < 0.001$ ).

### Conclusions:

The COVID-19 outbreak has undoubtedly resulted in increased difficulties among ASD individuals. In line with previous research indicating that pre-existing psychological difficulties predict poorer outcomes following lockdown, we provide novel evidence that youth with ASD with depressive symptoms predating the COVID-19 outbreak are more likely to exhibit more severe outcome scores. Among vulnerable populations, youth with ASD are of particular concern for the impact that the COVID-19 outbreak may have on their wellbeing, and thus require special attention.

**419.029** (Poster) The Relationship between Childhood Weight Status and Autism Spectrum Disorder Varies By Age in a Sample of Sibling Dyads

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**Background:**

Several studies, conducted in both clinical and community-based samples, report that children with autism spectrum disorder (ASD) are more likely have overweight or obesity compared to children without ASD. These studies may provide biased estimates because they are limited in their ability to account for potentially important socio-demographic, familial, environmental, and community characteristics that may differ between these two groups of children. Studies of siblings in “simplex” families (i.e., families that include only one offspring with ASD) avoid these potential pitfalls.

**Objectives:**

The aim of the present study was to estimate the prevalence of overweight/obesity among children with and without ASD across childhood ages from a sample of sibling dyads.

**Methods:**

The Simon Simplex Collection Version 15.3 was used to create sibling dyads comprising of a child with a clinically confirmed diagnosis of ASD and a full sibling without ASD within the same family, all between the ages of 4-18 years. The full sibling without ASD was chosen to be closest within 5 years of age to the child with ASD. Body mass index (BMI) z-scores and corresponding percentiles were calculated using World Health Organization (WHO) growth references from measured heights and weights. Children who were underweight ( $< 5^{\text{th}}$  percentile) were excluded from the present study. The remaining children were classified as healthy weight ( $\geq 5^{\text{th}}$  to  $< 85^{\text{th}}$  percentile), overweight ( $\geq 85^{\text{th}}$  to  $< 95^{\text{th}}$  percentile) and obese ( $\geq 95^{\text{th}}$  percentile). Prevalence of overweight/obesity ( $\geq 85^{\text{th}}$  percentile) across six age strata was estimated from a log-binomial model using a generalized estimating equations approach to account for the correlation between children with ASD and their full siblings, and to adjust the estimates for age and sex.

**Results:**

A total of 1608 sibling dyads were available for analysis. The mean (standard deviation) age of the children with and without ASD was 9.3 (3.2) years and 9.2 (3.6) years, respectively ( $p = 0.37$ ). Children with ASD were significantly more likely to be male than their siblings (86% vs 46%,  $p < 0.001$ ). Eighty percent were of white race. Overweight/obesity rates varied significantly across the age strata ( $p < 0.001$ ), with higher rates and larger differences observed between children with ASD and their full siblings at older ages. At 4-7 years, 28% vs 30% ( $p = 0.61$ ) had overweight/obesity?, 7-9 years 36% vs 33% ( $p = 0.37$ ), 9-11 years 46% vs 42% ( $p = 0.38$ ), 11-13 years 50% vs 39% ( $p = 0.031$ ), 13-15 years 49% vs 37% ( $p = 0.056$ ), 15-18 years 48% vs 31% ( $p = 0.031$ ).

**Conclusions:**

From this unique data resource that accounted for shared family environments by analyzing sibling dyads, the prevalence of overweight/obesity diverged significantly at older ages between children with ASD and their full siblings without ASD. For children with ASD, the prevalence of overweight/obesity leveled off at approximately 50% at 9 years of age but declined for their siblings without ASD, from 42% to 31% from ages 9 through 18 years. Recognizing these age-related differences has important implications for targeting preventive interventions.

**419.030 (Poster)** Understanding Sex-Specific Autism Spectrum Disorder Phenotypes: Total Population Study on Korean School-Aged Children

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**Background:** Male:female prevalence in ASD ranges from 2.7:1 to 6:1 and is more pronounced in “clinical populations” ascertained from clinics, disability registries, or special schools. Variable sex ratios suggest possible underdiagnosis of females with ASD due to the sex-specific ASD phenotypes or camouflaging in females. Representative, community cohorts of individuals

diagnosed with ASD including both clinical and “non-clinical” (never received any services) populations can address this concern. Therefore, this study compares clinical presentations in children ascertained from both populations.

**Objectives:** Using a representative, epidemiologically-ascertained populations, we examined current cognitive abilities and ASD symptom severity between males and females diagnosed with ASD, as well as types and ages at initial caregiver concerns during early development.

**Methods:** Using the total population-based ASD prevalence study in Korean school-aged children (Male=158, Female=46), we examined the “clinical” and “non-clinical” ASD populations. We extracted the information from ADI-R (Autism Diagnostic Interview-Revised) questions to determine age of symptom onset, along with qualitative analysis of caregiver responses. We compared mean age of initial concerns, performance IQ from Korean WISC-III, and Leiter International Performance Scale-Revised, domain-level calibrated severity scores (CSS) from Autism Diagnostic Observation Schedule (ADOS), and raw scores from ADI-R, Autism Spectrum Screening Questionnaire (ASSQ), Social Responsiveness Scale (SRS), Behavioral Assessment System for Children-2 (BASC-2) between males and females in clinical and non-clinical populations.

**Results:** While the mean age of initial concerns was younger in females (N=5, 8 months) than males (N=29, 20 months), it was not statistically significant due to the small female sample size in the clinical population ( $p=0.09$ ). In the non-clinical population, there was no significant difference between males (N=129, 40 months) and females (N=41, 43 months) ( $p=0.5$ ). Sex differences in the most common parental concerns in both clinical and non-clinical populations were not significant. Lower performance IQ for clinical population females (44.2) compared to males (68.5) was a trend ( $p=0.08$ ); there were no IQ differences between non-clinical females (92.3) and males (89.5) ( $p=0.5$ ). Phenotypically, clinical population males and females had similar scores for the ADOS, ADI-R, ASSQ, and SRS. However, non-clinical males showed higher ADOS CSS and ADI-R Restricted and Repetitive Behaviors index raw scores than females ( $p<0.01$ ). On the BASC-2, clinical females showed higher somatic problem scores than males ( $p<0.01$ ). Non-clinical females had higher withdrawal problem scores than males ( $p<0.01$ ), while males trended toward higher aggressiveness ( $p=0.02$ ), hyperactivity ( $p=0.07$ ), inattention ( $p=0.05$ ), and conduct problem ( $p=0.08$ ) scores than females.

**Conclusions:** Consistent with previous studies, we found that clinical females were more severely impaired, exhibited earlier initial signs of ASD, and had lower cognitive scores than males. However, non-clinical females were less impaired, had milder ASD symptoms, and showed fewer behavioral problems than males. Results from this small sample suggest that the clinical presentation of females make them less likely to be identified and diagnosed. Future studies in large, diverse communities are necessary to replicate the findings which will inform families, educators, and clinicians for early identification and intervention, especially for females with ASD.

## ORAL SESSION — EPIGENETICS

### Oral 310 - An Update on Autism Genetics and Gene-Environment Interactions

**310.001** (Oral) New Insights into the Genomic Architecture Underlying Autism Spectrum Disorder from a Comprehensive Analysis of over 20,000 Whole-Genome Sequences

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#### Background:

Autism spectrum disorder (ASD) is a heterogeneous condition in both clinical presentation and genetic architecture. There are ~100 known high-impact copy number variations (CNVs) or single genes already associated with ASD, and others still to be found. There are also mounting data of more complex combinations of rare and common genetic variants contributing to baseline susceptibility to ASD. To fully understand the genetic basis of ASD at the level of the individual and/or family, whole-genome sequence (WGS) data are therefore necessary.

#### Objectives:

We aim to: (1) further build a massive WGS and accompanying phenotype data resource from ASD-affected individuals and their family members and make it as openly available for research as possible; and (2) better define the relationships between genotype and clinical expression to further advance clinical management and improve the health of individuals with ASD.

#### Methods: N/A

#### Results:

Firstly, we have developed the Autism Speaks MSSNG project, a controlled-access resource which is available to qualified researchers with a valid ASD-related research question. Hosted on the Google Cloud Platform (GCP), MSSNG can be accessed through a web-based portal or, for advanced users, via GCP interfaces. The latest release of MSSNG, termed DB6, contains 11,359 whole-genome sequences (DB7 coming in 2021). Alignment data (GRCh38/hg38) are available in CRAM format, along with single nucleotide variant (SNV) and indel calls. Additionally, we employed a highly accurate workflow to detect CNVs and have uniquely made these sample-level CNV calls available.

Secondly, we have performed a comprehensive analysis of the MSSNG WGS data, taking into consideration all sizes, types, and frequencies of genetic variants. Along with SNVs, indels and CNVs, we considered tandem repeat expansions, which we recently showed for the first time to be involved in ASD susceptibility, as well as structural variants (SVs) such as inversions and insertions, and mitochondrial mutations. In addition to clinically-relevant rare or *de novo* variants, we assessed common variants risk. Specifically, we calculated a polygenic risk score (PRS) for all individuals of European ancestry in MSSNG using summary statistics from the European iPSYCH association study (p-value threshold  $\leq 0.1$ ) comparing ASD-affected individuals with unaffected relatives. We demonstrated that the average PRS was higher in ASD-affected individuals compared with unaffected individuals ( $p = 1.2E-3$ ,  $R^2 = 0.15\%$ ), and that in ASD-affected individuals not harbouring a clinically significant rare or *de novo* variant, PRS was correlated with the severity of ASD-related traits. To validate any of our genome-wide findings from MSSNG,

we used WGS data from 9,205 ASD-affected individuals and their family members from the Simons Simplex Collection, and tested thousands of controls.

Conclusions:

We contextualize comprehensive rare variant data with PRS scores for the first time to provide a more complete view into the genomic architecture in ASD. The project has also enabled hundreds of deep phenotyping queries and the return of results to specific families. Ongoing functional experiments are underway including the development of induced pluripotent stem cells from individuals carrying variants of interest, integrated epigenetic analyses, and long-read sequencing in families with multiple affected individuals.

**310.002** (Oral) Development and Implementation of a Framework for an Evidence-Based Gene List Relevant to Autism Spectrum Disorder

**O. Rennie<sup>1</sup>, C. Schaaf<sup>2</sup>, N. Hoang<sup>1</sup>, J. Howe<sup>1</sup>, S. W. Scherer<sup>1</sup> and J. Vorstman<sup>1</sup>, (1)The Hospital for Sick Children, Toronto, ON, Canada, (2)Baylor College of Medicine, Houston, TX**

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**Background:** At present, there is no standardized approach for evaluating a gene's relevance to autism spectrum disorder (ASD). Consequently, substantial variability exists between various proposed lists of "ASD susceptibility/risk" genes. Given the increasing use of genetic testing for patients with ASD and other neurodevelopmental disorders, this limitation hampers uniform interpretation of genetic results. Here, we implement and expand on a systematic framework for the evaluation of ASD susceptibility genes, aimed at developing a comprehensive, transparent, and evidence-based gene list. The approach, first presented in Schaaf *et al.* (2020), was developed by an international team of multi-disciplinary experts and consists of a standardized evaluation of available genetic associations as well as the quality of the presented phenotypic data.

**Objectives:** To implement a multi-disciplinary consensus-based method for the curation of genes putatively associated with ASD risk and to compare concordance and discrepancies between our results and existing classifications.

**Methods:** Briefly, this framework curates published genetic, phenotype, and experimental ASD data. Using the Clinical Genome (ClinGen) Gene-Disease Validity framework as a starting place, points are awarded to each clinical/experimental case. Points are summed across all studies for a given gene, with the total dictating the gene classification (limited, moderate, or definitive relationship to ASD). See PMID: 32317787 for full methodology details. Using this framework, we have thus far evaluated 53 genes with a broadly assumed relevance to ASD. We compared these results with two existing standards: SFARI and ClinGen. Here we report how top scored genes by SFARI (n=42) and ClinGen (n = 11) compared to our method.

**Results:** Of the 53 genes we curated, 22 were definitive, 8 moderate, 22 limited, and one with no evidence. Of the 42 "high confidence" genes scored through SFARI, 20, 6, and 16 were evaluated as definitive, moderate, and limited by our method, respectively. Note that most genes evaluated by the ClinGen ASD/ID expert groups are not curated specifically for ASD, but rather for broader NDD phenotypes or specific syndromes that may or may not include ASD. Of the 11 genes classified as "definitive" by ClinGen for a disorder/syndrome associated with ASD, 7 were definitive, 2 moderate, and 2 limited for ASD by our method. The Venn diagram shows the comparison of the top scored genes using the three methods.

**Conclusions:** We present results from our initial work developing an evidence-based gene list relevant to ASD. Through the initial phases of this process, we provide further evidence illustrating differences that exist regarding reported gene relationships to ASD. Ideally, with continued expansion of our list of genes relevant to ASD and updates as more evidence becomes available, steps could be made to increase consistency across lists of genes used to interrogate the exome/genome in ASD patients. Evidence from our framework will not only increase discussion about this issue in the ASD research community, but ultimately, contribute to a broader agreement on the contribution of different genes to ASD. This will directly feed into genotype-phenotype research, patient care, and interpretation of genetic findings in the clinical sphere.

**310.003** (Oral) Genetic Risk on the Association of Maternal Smoking and Drinking in Pregnancy with Autism Spectrum Disorder

**J. Daniels<sup>1</sup>, K. S. Benke<sup>2</sup>, E. M. Howerton<sup>3</sup>, H. Farzadegan<sup>3</sup>, H. E. Volk<sup>1</sup>, M. D. Fallin<sup>4</sup> and C. Ladd-Acosta<sup>1</sup>, (1)Wendy Klag Center for Autism and Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (2)Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (4)Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD**

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## Background:

Prenatal exposure to maternal smoking and drinking are considered harmful to neurodevelopment but associations with autism spectrum disorder (ASD) risk have been conflicting. Potential explanations for reported discrepancies include potential exposure misclassification, unmeasured confounding, and interaction with genetic background.

## Objectives:

Our main goal was to assess whether the effects of prenatal exposure to smoking or drinking on autism risk differ by underlying genetic variation, at individual loci or in aggregate.

## Methods:

The Study to Explore Early Development (SEED) is a multi-site autism case-control study of children aged 3-5 years. Maternal smoking and alcohol use at any point during pregnancy were ascertained using a telephone-assisted interview and genome-wide genotyping data was measured for a subset of SEED mothers and children using Affymetrix and Illumina genome-wide association study (GWAS) arrays. After data cleaning and imputation, our final genotyping analytic sample consisted of 1139 mothers (489 with an ASD case child and 650 controls) and 987 children (409 ASD cases and 578 controls). For each exposure and single-nucleotide polymorphism (SNP) (considering maternal and child genomes separately), logistic regression models were run, including a term for SNP X exposure interaction while accounting for sex, 10 principal components of ancestry, maternal education, family income, maternal age at birth and parity. In addition to single SNP X exposure tests in mothers and children, we also examined child aggregate genetic risk for autism using polygenic risk scores (ASD-PRS) informed by the largest published GWAS for ASD from the Psychiatric Genetics Consortium-iPSYCH collaboration and using discovery-p-value threshold of 0.10.

## Results:

The frequency of prenatal exposure to smoking and alcohol was 9% and 28.3%, respectively. Child ASD-PRS was significantly associated with ASD risk (adjOR=1.50;  $p=1.03*10^{-3}$ ), but did not modify associations for either exposure (p-value for interaction alcohol=0.33, smoking=0.62). However, we did identify a significant interaction between maternal smoking and maternal genotype at 4 SNPs associated with increased child ASD risk (9:138,599,878 in gene *KCNT1* (adjOR =-13764.45, p-val=  $1.37*10^{-9}$ ); 2:220,667,880 in gene *LINC02832* (adjOR =-14295.63, p-val=  $5.51*10^{-9}$ ); 10:7,141,530 in gene *AL392086.3* (adjOR =-2382.30, p-val=  $1.63*10^{-8}$ ); 6:162,602,454 in gene *PRKN* (adjOR =-1811.68, p-val=  $2.23*10^{-8}$ )). We also identified a significant interaction between maternal alcohol use and maternal genotype at 2 SNPs associated with increased child ASD risk (14:106,078,490 in gene *RP11-731F5.1* (adjOR =11.48, p-val=  $2.59*10^{-9}$ ) and 14:106,647,600 in gene *IGHV1-18*(adjOR =19.11, p-val=  $8.69*10^{-9}$ ))

## Conclusions:

We observed an increased risk for ASD among children with prenatal exposure to smoking or alcohol and whose mothers had a specific genotype at 6 loci (4 smoking and 2 alcohol). Additional larger studies are needed to confirm these findings and to identify additional SNPs our moderately sized sample may be underpowered to detect. Gene-environment interactions, such as those we identified, can help identify subgroups of children at increased risk of ASD.

### **310.004** (Oral) Diversity in Gender Identity and Its Link to Neurocognitive Polygenic Propensity Scores in the SPARK Autism Cohort

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**Background:** Previous sociological studies have shown there is an enrichment in gender diversity/dysphoria (Hisle-Gorman, et al., 2019) in autistic samples as compared to the general population. Likewise, individuals who are transgender or non-binary (and do not have an autism diagnosis) are more likely to be autistic and have higher rates of autistic traits (Warrier, et al., 2020). Potential genetic factors that might contribute to this increased prevalence have not yet been explored.

**Objectives:** The objective of this analysis is to identify how common genetic variation underlying neurocognitive traits correlates with gender diversity characteristics in a sample of individuals enriched for autism.

**Methods:** The Gender Development Scale (GDS), a 90-item self-report questionnaire that captures multiple dimensions of gender diversity was administered to 818 participants in the SPARK autism cohort (60% with ASD diagnosis, 78% recorded female at birth). Exploratory factor analysis (EFA) was performed with the GDS itemset, and resulting factors were used as phenotypes to test for associations of polygenic propensity. Polygenic propensity scores, corrected for sex, autism diagnosis, and genetic principal components, were calculated for educational attainment, cognitive performance, neuroticism, autism, ADHD, and other neuropsychiatric conditions for 424 participants (45% with ASD diagnosis, 79% recorded female at birth). Statistical association analyses between the quantitative GDS factors and polygenic scores were performed.

**Results:** EFA of the GDS in this sample established five factors explaining 70.5% of the variance (CFI=.98; RMSEA=.07): binary gender diversity, non-binariness, gender neutral style, both maleness and femaleness, and genital dysphoria. Individuals on the autism spectrum were more likely to identify as a gender different from their sex assigned at birth compared to those without autism (OR=13.20, Z=4.97, p<0.0001). Increased levels of gender diversity, as represented by multiple factors from the GDS, were significantly positively correlated with polygenic propensity for educational attainment and cognitive performance.

**Conclusions:** This is the first study to analyze how common genetic variation in an autism cohort correlates with gender diversity characteristics. Using the GDS, we identified five factors expressing different aspects of gender diversity. Our results suggest that genetic factors associated with increased cognitive ability and educational attainment are associated with greater gender diversity. Furthermore, these findings suggest that the autism community is a rich resource for improving our understanding of the biological factors that influence gender identity.

## ORAL SESSION — EPIGENETICS

### Oral 325 - Beyond the Genes...Protein-Protein Interactions and Complex Epigenetics of Autism

#### 325.001 (Oral) Integrative Genomic and Epigenomic Analysis of Autism Spectrum Disorder

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**Background:** Autism Spectrum Disorder (ASD) is a group of complex neurodevelopmental disorders characterized by a pervasive impairment of social and communication skills along with repetitive and restrictive behaviors. ASD affects 1-1.5% of individuals and its risk is influenced by a combination of genetic ( $h^2$  64-91% and  $h^2_{\text{SNP}} = 0.12$ ) and environmental factors. Both genetic variation and multiple environmental exposures alter the epigenetic landscape. DNA methylation, the most studied and best understood epigenetic modification, plays a pivotal role in neuronal development, proper brain functioning, and thereby mental health.

**Objectives:** Identify DNA methylation signatures of ASD at the time of birth and specifically investigate the impact of common genetic ASD risk variants on the newborn epigenome.

**Methods:** DNA methylation levels were quantified at >850,000 loci in the human genome in 2,065 neonatal dried blood spots from the Danish iPSYCH 2012 cohort with the use of Illumina EPIC methylation array. Genotyping data from Illumina PsychChip was available for 2,022 individuals. Three different statistical methodologies were applied to study the role of DNA methylation in molecular aetiology of ASD: 1) epigenome-wide association study (EWAS) of ASD to identify loci with differential methylation between 843 cases and 688 controls; 2) EWAS of ASD polygenic risk score (PRS) (n = 2,022) to identify methylation differences associated with polygenic burden of the disorder; and 3) methylation quantitative trait loci (mQTL) analysis (n = 2,022) for common variants located within the 5 ASD risk loci (Grove et al., 2019) to determine if and where in the human genome they impact epigenetic regulation.

**Results:** ASD EWAS identified 6 differentially methylated positions at p-value <10e-05, with top finding annotated to a gene mapping *MYTIL*. Additionally, 31 differentially methylated regions, with Šidák-adjusted p-value < 0.05, were associated with ASD, mapping to genes crucial for neuron development, neuron differentiation, and synapse formation. EWAS of ASD PRS replicated previous findings where differential DNA methylation at birth was associated with elevated polygenic burden for the disorder and identified additional differentially methylated regions associated with this trait. Further mQTL analyses of common genetic variants located within the 5 ASD GWAS loci confirmed the ASD risk SNPs to impact DNA methylation levels across the genome. Moreover, employing the mQTL approach allowed for improved mapping of impact of ASD risk SNPs on

epigenomic regulation of the neonatal genome in blood and identified new loci associated with the disorder, not indicated by ASD GWAS itself.

**Conclusions:** We identified differential DNA methylation in blood at the time of birth to be associated with ASD diagnosis. Moreover, by combining epigenomic and genomic data to study the molecular aetiology of ASD, we additionally identified differential DNA methylation at the time of birth to be associated with ASD polygenic burden and provided evidence that common ASD risk variants impact neonatal epigenetic landscape, what could modify risk of this neurodevelopmental disorder.

**325.002** (*Oral*) Protein-Protein Interaction in Autism Spectrum Disorder  
**Z. Z. C. Naing**, *University of California, San Francisco, San Francisco, CA*

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**Background:** Autism spectrum disorder (ASD) is a common neurodevelopmental disorder characterized by impaired social and communication skills along with repetitive behaviors, and restrictive interests. In recent years, advances in whole exome sequencing technologies, as well as improved data analysis approaches have led to a better understanding of the genetic architecture of ASD. It is estimated that 30% of ASD cases can be attributed to *de novo* mutations. Focusing on *de novo* mutations and rare variations in ASD-affected families and case-control populations with matched ancestry, 102 high confidence ASD risk genes have been discovered.

**Objectives:** Despite advances in understanding the genetics behind ASD, the mechanisms by which these genes regulate the neurobiology underlying ASD is poorly understood. Mapping protein interactions networks of proteins encoded by ASD risk genes can facilitate the discovery of molecular pathways and disease mechanisms relevant for ASD and in the future lead to next-generation therapeutics. This is highly relevant as proteins do not act alone to carry out their functions, but dictate a multitude of cellular activities that maintain health or diseases through their interaction with other proteins.

**Methods:** To map the protein-protein interactions of ASD risk genes, we transiently transfected 92 affinity tagged constructs of 102 top ASD risk genes in HEK293T cells and performed affinity purifications of these proteins followed by mass spectrometric analysis (AP-MS). To analyze the MS data, we applied a multi-step bioinformatics pipeline combining the AP-MS scoring algorithms SAINT and CompPASS for identification and quantification of high confidence interacting proteins.

**Results:** This analysis resulted in the identification of 887 unique protein interactors, out of which 26 interactors are shared among these 92 ASD risk genes. We observed many of these protein interactors to be a part of stable protein complexes (such as SIN3-HDAC complexes). Moreover, we also observed enrichment of common Gene Ontology (GO) functional annotations among these interactors such as chromatin modification and nuclear transport.

**Conclusions:**

This strengthens the hypothesis that there might be common pathways leading to the disorder. The interaction map of proteins encoded by ASD risk genes can serve as the first step to deduce molecular pathways and cellular processes that might be dysregulated by ASD variants.

**325.003** (*Oral*) Identification of DNA Methylation Changes in Child Blood Associated with Prenatal Exposure to Infection in the Context of Autism Spectrum Disorder

**E. M. Howerton**<sup>1,2</sup>, **M. Brucato**<sup>1,2</sup>, **Y. Qian**<sup>3</sup>, **J. Daniels**<sup>3</sup>, **A. Y. Song**<sup>3</sup>, **H. Farzadegan**<sup>1</sup>, **K. S. Benke**<sup>2,4</sup>, **H. E. Volk**<sup>2,4</sup>, **L. A. Croen**<sup>1</sup>, **M. D. Fallin**<sup>2,4</sup> and **C. Ladd-Acosta**<sup>1,2</sup>, (1)*Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*, (2)*Wendy Klag Center for Autism and Developmental Disabilities, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*, (3)*Division of Research, Kaiser Permanente, Oakland, CA*, (4)*Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD*

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**Background:** Prenatal exposure to infection is a well-recognized risk factor for autism spectrum disorder (ASD). There is substantial interest in whether DNA methylation, a type of epigenetic mark, is associated with prenatal exposure to infection because it could provide biologic insights into observed associations or serve as an infection biomarker for studies that did not collect that information.

**Objectives:** We conducted an epigenome-wide association study (EWAS) to identify DNA methylation sites in child peripheral blood associated with prenatal exposure to infection. At specific DNA methylation sites related to exposure, we will also examine whether methylation levels vary by ASD status.

**Methods:** We conducted our analysis using data from the Study to Explore Early Development (SEED), a case-control study of ASD in the United States among children born between 2003 – 2006. Participants were aged 2 – 5 years at the time of enrollment, with an average age of 5 years at the time of blood sample collection. Prenatal exposure to infection was reported by the mother during a telephone-assisted interview, including by trimester. DNA methylation measurements in child peripheral blood were obtained from the Illumina 450K array for ASD cases and population controls, with samples randomized across plates and processing date and rigorous quality control measures applied at the sample and marker levels. The final analytic sample included 898 individuals (409 ASD and 489 controls) and 455,664 probes. We used linear regression models to identify differentially methylated loci associated with exposure to infection in each trimester of pregnancy and in the 3 months prior to conception, while adjusting for 11 surrogate variables to correct for measured and unmeasured confounders.

**Results:** The frequency of any infection during pregnancy was 37%, and 9.6% of mothers experienced an infection during the pre-conception window. We identified three statistically significant loci, all of which were hypomethylated when comparing those exposed to infection to unexposed: one locus in an intergenic region on chromosome 5 associated with maternal infection during the pre-conception window (q-value = 0.002), and two loci associated with maternal infection during trimester 3, one on chromosome 19 (*SHANK1*, q-value = 0.010) and one on chromosome 3 (*IQSECI*, q-value = 0.018). The genes associated with infection in trimester 3, *SHANK1* and *IQSECI*, have both been implicated in neurodevelopment, with rare mutations in *SHANK1* previously identified in ASD. We are currently performing secondary analyses to examine whether these methylation changes are also related to ASD case status and plan to report those results as well.

**Conclusions:** Three loci show differential methylation in child blood associated with maternal infection during trimester 3 or the pre-conception period. The changes we identified warrant further investigation to fully evaluate their potential role in autism etiology or their utility as a biomarker of prenatal exposure to infection, which can advance future epidemiologic studies in ASD.

#### **325.004 (Oral) Exploratory Study of Impact of Maternal Medication on Neonatal Epigenomes**

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**Background:** An increasing body of evidence implicates dynamic epigenetic mechanisms to play a crucial role in neuronal development, proper brain functioning, and mediating risk of psychiatric disorders, including autism. Many currently prescribed medications, including anti-psychotic, anti-epileptic and anti-depressant drugs, as well as dietary supplements, like folic acid or vitamin D, have been shown to have lasting effects on the epigenome.

**Objectives:** Since the epigenome is particularly vulnerable to the effect of environmental factors during embryogenesis, when the rate of DNA synthesis is high and the epigenetic marks are being established, we aimed to answer a question if fetal exposure to maternal medication during pregnancy can alter DNA methylation (DNAm) patterns of the child and thereby potentially mediate disease susceptibility after birth.

**Methods:** This study was performed using the MINERVA-iPSYCH case-control sample selected from the Danish iPSYCH 2012 cohort, where neonatal DNAm levels were quantified at >450,000 loci in the human genome by using Illumina's 450K methylation array in 627 autism cases and 633 matched controls. Information on exposure to medication prescribed for 10 common medical conditions during pregnancy: 1) Obesity, metabolic syndrome, hypertension, hyperlipidemia, preeclampsia/eclampsia, 2) Infections, 3) Bacterial infections, 4) Fungal infections, 5) Asthma/chronic obstructive pulmonary disease, 6) Asthma/Premature labor, 7) Allergies, 8) Seizure disorders/epilepsy, 9) Neuropsychiatric disorders, and 10) Autoimmune and inflammatory diseases (excluding diabetes) was obtained for all individuals from the Danish Prescription Registry. In order to identify DNAm changes in newborns exposed *in utero* to different classes of maternal medication we performed 10 epigenome-wide association studies (EWAS), one for each medication class, with DNAm at each tested locus as the outcome variable, exposure to maternal medication as predictive variable, and adjusted the EWAS models for well-established confounders in epigenomic studies (sex, gestational age, blood cell composition, maternal tobacco smoking).

**Results:** Number of individuals exposed to maternal medication varied greatly depending on the medication class tested, with the largest groups of newborns exposed to medication for infections (n = 502), especially bacterial (n = 492), followed by asthma/chronic obstructive pulmonary disease (n = 94) and neuropsychiatric disorders (n = 55). Differential DNAm (p-value <10e-06) was associated with *in utero* exposure to maternal medication during pregnancy in 8 out of 10 performed EWAS analyses. Of specific interest to mental disorders was identification of differential DNAm levels in offspring in the histone deacetylase 4 (*HDAC4*) gene (p-value = 3x10e-07) to be associated with maternal use of neuropsychiatric medication.

**Conclusions:** In this study neonatal differential DNAm in blood was associated with exposure to maternal medication use during pregnancy in a cohort of autism cases and controls for the majority of tested medication classes. We are replicating and will meta-analyze these findings by including methylomic and maternal medication data on additional 2065 newborns (autism/ADHD cases and controls) from the iPSYCH cohort.

## POSTER SESSION — EPIGENETICS

### Poster 420 - Epigenetics Posters

**420.001** (Poster) Alteration in Epigenetic Histone Deacetylase Enzymes in Autism Spectrum Disorder Revealed By In Vivo PET-MRI Neuroimaging

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#### Background:

Prenatal exposure to histone deacetylase (HDAC) inhibitors has led to autism-like behavior in rodent models (Schneider, 2005) and been associated with autism spectrum disorder (ASD) in humans (Christensen, 2013), suggesting that epigenetic HDAC enzymes may play a role in the etiology of ASD. Environmental factors that have been linked to the etiology of ASD (Modabbernia, 2017) also lead to alterations in HDACs (Ferland, 2011; Ramirez, 2008). Postmortem work has shown altered acetylation in ASD-associated genes in children and adults (Sun, 2016), though no study has yet investigated HDAC expression in individuals with ASD *in vivo*.

#### Objectives:

In this pilot study we used positron emission tomography-magnetic resonance imaging (PET-MRI) with [<sup>11</sup>C]Martinostat to determine if HDAC levels are regionally altered in the brain of individuals with ASD. We further investigated whether HDAC expression is associated with behaviors that characterize ASD, including impaired language, social skills and repetitive behaviors.

#### Methods:

Seven participants with ASD (5M/2F, mean age=26.1±6.9years) and seven age- and sex-matched controls (CON) (5M/2F, mean age=26±5.2years) completed a [<sup>11</sup>C]Martinostat PET-MRI scan. Individuals with ASD met diagnosis according to DSM-5 criteria, supported by standard cutoff scores on the Autism Diagnostic Observation Schedule, second edition (ADOS-2) and Autism Diagnostic Interview-Revised (ADI-R), and did not have epilepsy. Controls did not have a first-degree relative with ASD, or a history of a neurological or psychiatric disorder. PET data were collected from 60-90 minutes post-injection of [<sup>11</sup>C]Martinostat. The Aberrant Behavior Checklist (ABC), Social Responsiveness Scale (SRS), and Repetitive Behavior Scale (RBS) were completed by the caretaker and the Peabody Picture Vocabulary Test was administered to the individual with ASD. Whole brain voxelwise analyses were performed using FSL's FEAT (FMRIB software library) with ordinary least squares mixed-effects modeling and age and sex as regressors of non-interest ( $Z > 2.3$ , cluster-corrected  $p = 0.05$ ) to compare [<sup>11</sup>C]Martinostat uptake between the two groups and correlate behavioral scores with [<sup>11</sup>C]Martinostat uptake in ASD.

#### Results:

Higher [<sup>11</sup>C]Martinostat uptake was found in the visual cortex bilaterally in ASD compared to CON. Lower [<sup>11</sup>C]Martinostat uptake was found in the anterior and middle cingulate cortex bilaterally, and right Heschl's gyrus, middle temporal gyrus, globus pallidus, and amygdala in ASD compared to CON. [<sup>11</sup>C]Martinostat uptake correlated positively with the ABC lethargy/social withdrawal subscale in the right orbitofrontal cortex and correlated negatively with the ABC inappropriate speech subscale in the

corticospinal tract and brainstem bilaterally and with the total SRS score in the left frontal white matter in ASD. No other behavioral score correlated with [<sup>11</sup>C]Martinostat uptake in ASD.

Conclusions:

Individuals with ASD showed epigenetic alterations in brain regions associated with socio-cognitive processing and previously implicated in ASD in functional MRI studies (*Patriquin, 2016*). This is the first report of associations between ASD-related behavior and regional HDAC alterations *in vivo*. However, the current sample size is small and [<sup>11</sup>C]Martinostat PET-MRI data from more participants will be needed to determine if HDAC alterations are a common feature in ASD as previously suggested by post mortem work (*Sun, 2016*) and to further understand the association between HDAC levels and ASD-related behavior.

**420.002 (Poster)** Characterization of Screen Exposure in Preschoolers with ASD and Neurotypical Controls and Its Association with Behavioral Problems

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Background: Given the ubiquitous screen use since early stages of development, and their parental use as a tool to regulate child behaviour, it is our interest to know the characteristics of electric device use and compare it with American Academy of Pediatrics recommendations in a specific clinical population of preschoolers with Autism Spectrum disorders (ASD) and a healthy control sample paired by age and gender. An emerging literature states that electronic device exposure as a risk factor for autistic-like symptoms, but evidence is inconclusive yet.

Objectives: The objective of the present study is to describe and compare the characteristics of electronic device use in a population of preschoolers with ASD diagnosis. We also aim at identifying possible associations between excessive screen exposure and behavioral and emotional problems.

Methods: Descriptive transversal study. A convenience sample was used, composed by 27 preschoolers with ASD diagnosis who were referred to the outpatient clinic specialized in ASD at Pereira Rossell Hospital, and 54 typically developing controls matched by age and gender. Controls were either hospitalized because of acute disease or consulted in the ER or at different polyclinics. Time of screen exposure, age at first exposure, adequacy according to AAP recommendations were analyzed as independent variables. Bivariate analysis of the aforementioned variables with syndromes and problems according to CBCL 1 1/2- 5 scales were done.

Results: An extended screen exposure and electronic device use was observed in both studied groups. Less than 10 per cent of the total sample had an adequate time of screen exposure according to AAP guidelines. No statistically significant differences were found in the studied variables between clinical and control group. Association between a longer time of exposure and behavioral and clinical syndromes was found in the non clinical group.

Conclusions: Screen device use is widely extended in the preschool population in general. First exposure occurs at early age. Our study could not demonstrate a greater use of electronic devices in children with ASD. Larger studies are required to deepen knowledge in the field. Advice to parents in well child visits regarding a healthy use of electronic devices is necessary.

**420.003 (Poster)** Poor Sperm DNA Quality and DNA Methylation Alterations: Possible Implications in Offspring Susceptibility for ASD.

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Background:

Extensively documented that Advanced paternal age (APA) causes accumulation of Reactive Oxygen Species (ROS), promoting increased seminal oxidative stress, which induces apoptosis and oxidative damage to sperm DNA in the form of DNA fragmentation. Evidence supports that poor quality sperm DNA and epigenetics, specifically DNA methylation alterations, likely

plays a role. In this study we have explored the impact of DNA damage and DNA methylation alterations in mature human sperm obtained from the fathers of children suffering from ASD and its possible association with Autism.

#### Objectives:

We tested for **a)** ROS and DNA Fragmentation Index (DFI) in semen samples of ASD fathers and healthy controls and **b)** the relationship of paternal sperm DNA methylation, examining a cohort of fathers of ASD children with their children and comparative analysis with healthy controls.

Methods: 8IP Elisa was used to estimate ROS levels and DFI estimation was done by Flow cytometry (SCSA Protocol) in 28 samples each, paternal and control semen. We examined genome-wide DNA methylation (DNAm) in paternal semen samples obtained from fathers of children suffering from ASD (Age > 30 years) along with peripheral blood samples of ASD patients (Age 36 months). A case control model of study was followed where unrelated age and gender matched healthy control semen samples and blood samples were taken and compared with ASD fathers and ASD patients respectively, along with blood samples obtained from the siblings of ASD patients as internal healthy control. We analysed methylation data of 32 samples, including thirteen (13) semen samples [Case (N=06)/Control (N=07)] and nineteen (19) peripheral blood samples [Case (N=06)/Control (N=07)/Siblings (N=06)] using the Infinium HumanMethylation850 (EPIC array) an adapted genotyping microarray that covers over 850,000 CpG methylation sites. Methylation data was investigated in ChAMP (Chip Methylation Analysis Pipeline) Bioconductor package. Differentially methylated sites/regions (DMRs) were calculated using limma package in R.

Results: On the basis of beta value ( $\Delta\beta \geq 0.2$ ) and P value ( $< 0.05$ ), we observed thousands of DMRs. The observed data was mapped against the available ASD data bank (SFARI) and 87.08% ASD genes in SFARI database were covered by identified significant methylated genes (beta value  $\pm 0.2$ ) from this study. Significantly methylated genes were further mapped on the Kyoto Encyclopedia of Genes and Genomes (KEGG) database and observed that genes were dominantly associated with developmental processes, synapse formation, sensory motor conduction, inflammatory pathways, innate immunity and cancer, among paternal sperm samples of ASD fathers and ASD patients as compared to healthy controls. It was observed that DFI% was significantly high (p value:  $< 0.0001$ ) in paternal semen (55.00) as compared to healthy controls (23.79.38) and 8IP levels (ROS) were also significantly high (p value  $< 0.0001$ ) in paternal semen ( $156.47 \pm 36.02$ ) as compared to healthy controls ( $84.41 \pm 8.94$ ).

#### Conclusions:

Poor sperm DNA quality associated with advance age impact sperm epigenome. This study suggest that DNA damage are causal of epigenetic differences in paternal sperm which may contribute to autism risk in offspring and also provides an evidence that consistently directional and potentially related epigenetic mechanisms may be operating in ASD.

## POSTER SESSION — ETHICS

### Poster 421 - Ethics Posters

**421.001** (Poster) Use of a Best Practice Alert (BPA) to Increase Diversity within a US-Based Autism Research Cohort  
**G. Duhon**<sup>1,2</sup>, **A. R. Simon**<sup>3</sup>, **D. L. Limon**<sup>1,4</sup>, **G. Marzano**<sup>2,5</sup> and **R. P. Goin-Kochel**<sup>3</sup>, (1)Texas Children's Hospital, Houston, TX, (2)Baylor College of Medicine, Houston, TX, (3)Trinity University, San Antonio, TX, (4)308 W North Temple, Baylor College of Medicine, Salt Lake City, UT, (5)Psychology, Texas Children's Hospital, Houston, TX

**Background:** Effectively recruiting racially and ethnically diverse samples is key to ensuring representative research data and scientific outcomes with broad application. We recently demonstrated that introducing the SPARK study (Simons Foundation Powering Autism Research) for individuals with autism spectrum disorder (ASD) via a Best Practice Alert (BPA) at the point-of-care in select subspecialty practices reached more racially diverse families compared to other recruitment strategies. It is possible that this strategy could further increase sample representativeness when strategically placed in clinic locations that serve racially/economically underrepresented families.

**Objectives:** To (a) examine rates of interest in the SPARK study between families receiving the BPA in *subspecialty practices* versus *select pediatric primary care practices* that serve racially/economically diverse communities; and (b) examine provider responsiveness to the BPA based on patient race and payor status (a surrogate measure of socioeconomic status).

**Methods:** The SPARK team at Texas Children's Hospital (TCH) worked with EPIC support staff to extend the existing SPARK BPA to five Texas Children's Pediatrics (TCP) locations that were selected based on both (a) number of patients with ASD and (b) prevalence of Black/African American and Asian patients served, as these groups were underrepresented at the TCH SPARK site. The BPA contained study information and fired upon chart opening for patients who met the trigger criteria for eligibility. Once a response was recorded (family was reportedly *Interested*, *Enrolled*, or *Declined*), the study team received notification through EPIC and contacted *Interested* and *Enrolled* families. Providers also had a *Dismiss* option that silenced the BPA until the chart opened again. Demographic characteristics, provider information, and BPA responses were exported from EPIC for TCP BPA's first year (10/2019-10/2020) and included subspecialty BPA responses for comparison.

**Results:** During the surveillance period, the BPA fired for 721 and 2,672 unique patients in the TCP and subspecialty practices, respectively. Within the TCP clinics, 340 (47.2%) responded *Interested*, 162 (22.5%) *Declined*, 13 (1.8%) *Enrolled*, and 206 (28.6%) were *Dismissed*; in the subspecialty practices, 867 (32.5%) responded *Interested*, 531 (19.9%) *Declined*, 40 (1.5%) *Enrolled*, and 1,234 (46.2%) were *Dismissed*. See Table 1 for proportions of *Interested* patients in each group by race. For the TCP group, 137/340 (40.3%) non-White patients and 157/340 (46.2%) White patients were *Interested*, respectively; in the subspecialty group, 224/867 (25.8%) of non-White patients and 485/867 (55.9%) of White patients were *Interested*, respectively. Within the TCP group, 114 (15.8%) Medicaid patients and 209 (29.0%) private-insurance patients were *Interested*, respectively. Within the subspecialty BPA, 389 (14.6%) Medicaid patients and 385 (14.1%) private-insurance patients were *Interested*, respectively.

**Conclusions:** Higher proportions of Black/African American and Asian families receiving the TCP BPA versus the subspecialty BPA were interested in SPARK. This suggests that using a BPA in targeted clinical settings can increase outreach about study opportunities to racially diverse communities. Regarding socioeconomic diversity, TCP providers may have introduced the study differently by payor status, potentially introducing bias in who should receive information about study opportunities. Further investigation is needed to understand these lower rates of *Interested* families in the TCPs.

## Family Issues and Stakeholder Experiences

### PANEL SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES

#### Panel 231 - The Impact of the COVID19 Pandemic on Autism and Other Neurodevelopmental Conditions: Lessons Learned from Studies across the Lifespan

**Panel Chair: Vanessa Bal**, *Graduate School of Applied and Professional Psychology, Rutgers University-New Brunswick, Piscataway, NJ*

**Discussant: Audrey Thurm**, *National Institute of Mental Health, Bethesda, MD*

The COVID-19 pandemic necessitated rapid, dramatic shifts in daily-life across the world. Those with neurodevelopmental conditions (NDC) are assumed to be especially vulnerable to pandemic-related disruptions. Understanding their specific vulnerabilities is critical to effectively respond to immediate and longer-term needs. Accordingly, this panel comprises large-scale studies of the impact of treatment service disruption, and specific adverse effects on a range of behavioral, psychological and/or functional domains in children and adults with ASD and other NDC. Study 1 highlights differences in service loss by age and NDC diagnosis, as well as associations between service loss and increased symptoms and negative parent experiences in individuals with genetic conditions. Study 2 identifies subgroups with differing patterns of risk and resilience among youth with ASD and other NDC from multiple international sites. Study 3 demonstrates an association between employment loss and increases in depressive symptoms in young adults with ASD. Study 4 reports increasing negative impact on services and other domains of daily-life and explores predictors of psychological distress in adults with ASD. These studies provide unique parent and self-reported perspectives that lay critical groundwork to inform service development and supports for individuals with NDC and their families, both now and beyond the pandemic.

**231.001 (Panel)** Impact of COVID-19 Restrictions on Individuals with Intellectual and Developmental Disorders: The Caring through COVID Survey

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Background: COVID-19 restrictions have greatly impacted individuals with neurodevelopmental disorders (NDD) and their caregivers. CARING through COVID was a national survey of individuals with NDD which examined (1) access to tele-education services following early stay-at-home restrictions, (2) increased behavioral symptoms in children (e.g. increased self-injury, sleep disruption, regression), (3) caregiver accounts of positive and negative personal experiences (e.g. depression, family closeness, fear), and (4) helpful resources for families during the COVID-19 mitigation efforts (Jeste et al., 2020).

Objectives: Examine age, region, and NDD diagnosis-based variation in access to services, increased behavioral symptoms in children, and caregiver accounts of their own experiences following COVID-19 restrictions.

Methods: CARING through COVID was an online survey for caregivers of children (ages 0 to >22 years) with NDDs about their experiences during early stay-at-home restrictions. The survey was administered through Qualtrics between April 15 and May 1, 2020. Participation criteria included having a child with a (1) genetic diagnosis and (2) neurodevelopmental or neurological diagnosis (developmental delay (DD), intellectual disability (ID), autism spectrum disorder (ASD), epilepsy). Respondents (n=650) represented 46 states in the US.

Results: Of all therapeutic and educational services reported at the time of the survey, 64% were discontinued, 32% transitioned to tele-education, and 4% remained in-person. Age was significantly associated with the rate of services lost following COVID restrictions, with adults over 22 years losing an average of 81% of their services, compared to children 1-3 years old who lost an average of 53% of their pre-COVID services. Geographic region was not associated with the rate of services lost, but individuals with an autism diagnosis continued in-person services at a higher rate compared to those without ASD or any other diagnosis ( $p < .001$ ).

76% of parents reported increased symptoms in their children following COVID restrictions. Neither age nor geographic region correlated with the number or type of increased symptoms identified. Compared to individuals without ASD, individuals with ASD were perceived by their parents to have increased anxiety ( $p = .044$ ), regression ( $p = .018$ ), aggression ( $p = .003$ ), and restricted/repetitive behaviors ( $p < .001$ ). No differences were seen among any other NDD diagnosis. Age, NDD diagnosis, and geographic region showed no association with the number or type of parent experiences endorsed. Importantly, the rate of

services lost was significantly associated with the number of increased child symptoms ( $p=.032$ ,  $r=.098$ ,  $r^2=.009$ ), as well as the number of negative parent experiences endorsed ( $p=.036$ ,  $r=.089$ ,  $r^2=.007$ ). Parents who rated the tele-education services they received as more helpful also endorsed fewer increased behavioral symptoms in their children ( $p<.001$ ,  $r=-.221$ ,  $r^2=.048$ ) and fewer negative personal experiences for themselves ( $p=.005$ ,  $r=-.161$ ,  $r^2=.051$ ).

Conclusions: To our knowledge, this is the largest survey of parents and caregivers with neurodevelopmental disorders associated with genetic syndromes. COVID-19 restrictions greatly impacted both caregivers and their children, and with stay-at-home restrictions likely to continue, it is critical to recognize that high-quality, accessible tele-education services may directly benefit not only the health of individuals with NDD but also the wellbeing of their caregivers.

**231.002 (Panel) The Crisis-Afar International Network: Preliminary Results on the Impact of the COVID-19 Pandemic in Children with Autism and Related Neurodevelopmental Conditions**

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**Background:**

The social, educational, and economic disruptions brought by the COVID-19 pandemic have impacted all segments of the population. Children, especially those with neurodevelopmental conditions, are among the most vulnerable. In response, to systematically assess the specific impact of COVID-19 on this group, we built on the CoRonavIruS health and Impact Survey (CRISIS) effort developed to assess risk and resilience for short- and long-term impact in the general population. Specifically, we adapted CRISIS for autism and related neurodevelopmental conditions (AFAR) by surveying clinically relevant behaviors and

service access. We then formed an international collaboration of 30 institutions across four continents in eight countries willing to longitudinally collect and share CRISIS-AFAR and accompanying deidentified clinical data in previously characterized individuals with neurodevelopmental conditions.

#### Objectives:

To examine whether homogenous subgroups of individuals could be identified based on their behavior and service changes.

#### Methods:

To date, we analyzed CRISIS-AFAR data from children (N=870) with a prior clinical neurodevelopmental diagnosis recruited across 10 European and North-American institutions (10.3±3.4 years-old, 80% males, 82% autism; 15% Hispanic). At each site, data collection occurred for 7±1 weeks on a time between May and August 2020, varying by institution. Hierarchical clustering examined 14 features measuring changes in behaviors and service access to determine homogenous subgroups. Specifically, the CRISIS-AFAR surveyed caregiver-reported behaviors in the three months prior to COVID-19 (pre-covid19) and the two weeks prior to the survey completion (current). For each child, changes between these time points were computed across several empirically-derived factors assessing daily-living skills, restrictive-repetitive behaviors, other problem behaviors, use of media for social or non-social purposes, sleep patterns, and time spent outdoors. The COVID-19 impact on medical and psychoeducational services was indexed as the proportion of services lost and modified following the pandemic relative to those previously received. Non-parametric tests characterized subgroups (corrected at  $p < 0.004$ ).

#### Results:

The optimal clustering solution revealed three subgroups. One subgroup - the *No-change/some-improvement* (55% of the sample) - largely showed no changes (pre-COVID19 to current) across behaviors, except for slightly increased independence in daily-living skills and decreased rates of insomnia. The second subgroup - *No-change/some-worsening* subgroup (39%) - was characterized by no change in most behaviors except for slightly increased insomnia, disruption in sleep routines, and decreased time outdoors. The third subgroup - *Worsening* (6%) - was characterized by worsening across all domains. Notably, the rates of services lost (versus modified) were similar between the *Worsening* and the *No-change/some-improvement* groups which, in turn, was higher than that of the *No-change/some-worsening* group, except for medical services (Figure 1).

#### Conclusions:

Preliminary analyses revealed a group of children most vulnerable to the adverse impact of the COVID19 pandemic and another, relatively more resilient, albeit in the short-term. Finding that the rates of service loss did not clearly differentiate these two extreme subgroups suggests that additional social and clinical predictors must be examined. By continuing to aggregate CRISIS-AFAR baseline and longitudinal data, as well as previous clinical information, our network will fill this gap.

#### 231.003 (Panel) Job Loss Predicts Worsening Depressive Symptoms for Young Adults with Autism: A COVID-19 Natural Experiment

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**Background:** The COVID-19 pandemic and its associated mitigation strategies have resulted in substantial unemployment and job changes (such as moving to virtual work or reduced hours) among the general population. Rates of change, including job loss, are almost certainly higher for individuals with autism spectrum disorder (ASD), who have greater challenges than adults in the general population obtaining employment and are often the first to lose employment during economic downturns. Though job loss predicts increased risk of depression in the general population, studies have yet to examine this association among individuals with ASD.

**Objectives:** We used a longitudinal design to investigate employment changes for young adults with ASD during the first two months of COVID-19, as well as whether these changes predicted increasing depressive symptoms.

**Methods:** Young adults with ASD were recruited through the Simons Foundation Powering Autism Research for Knowledge (SPARK) research match registry. 315 adults completed an online survey in Mid-March, just days before COVID-19 restrictions

were implemented across the US. Approximately 10 weeks later, 275 of the original sample (87.3% response rate) completed a second online survey. 144 of these adults were employed at Time 1 and were included in the present analyses; they averaged 26.83 years of age (SD = 4.69) with a range of 18 to 35 years. Nearly 50% were male (47.2%, n = 68) and just under 40% (39.6%, n = 57) were living with their parents. Both surveys included measurement of depressive symptoms (Beck Depression Inventory-2). At Time 2, COVID-related employment changes and perceived impact of those changes on well-being were collected. Multiple regression analyses were used to examine associations between employment changes and perceived impact of these changes on Time 2 depressive symptoms, controlling for Time 1 symptoms.

**Results:** Over one-third (37.5%) of young adults who were employed at Time 1 reported employment changes during the first two months of COVID-19. Over 70% of this change was job loss or reductions in hours or pay (“job loss/reduction”); the remaining 30% (n = 16) was comprised of a diverse set of changes including getting a new job, working virtually, changes in duties, increased hours and changes in supports. When controlling for Time 1 depressive symptoms, young adults who experienced job loss/reduction had significantly higher depressive symptoms at Time 2 than those without an employment change,  $B = 3.76$ ,  $SE(B) = 1.82$ ,  $p < .05$ . Amongst those who experienced an employment change, perceived impact of that change also predicted depressive symptoms but in a non-linear fashion. Specifically, those who reported both positive and negative impact of employment changes had increasing depressive symptoms, relative to those who reported no impact of the job change on their well-being,  $B = 2.14$ ,  $SE(B) = 0.85$ ,  $p < .05$  (see Figure 1)

**Conclusions:** COVID-19-related job loss/reduction was common among young adults with ASD and associated with increased depressive symptoms. Mental health interventions or surveillance may need to target all young adults who experience job loss/reduction – not just those who report negative impacts of employment change.

#### **231.004 (Panel) Negative Impact and Predictors of Psychological Distress for Autistic Adults across the Early Weeks of the Pandemic**

*V. H. Bal<sup>1</sup>, E. Wilkinson<sup>1</sup>, C. W. Lehman<sup>2</sup>, J. K. Law<sup>3</sup>, P. Feliciano<sup>4</sup> and W. K. Chung<sup>5</sup>, (1)Graduate School of Applied and Professional Psychology, Rutgers University-New Brunswick, Piscataway, NJ, (2)Simons Foundation, New York, NY, (3)Maryland Center for Developmental Disabilities, Kennedy Krieger Institute, Baltimore, MD, (4)SFARI, Simons Foundation, New York, NY, (5)Department of Pediatrics, Columbia University, New York, NY*

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**Background:** The COVID-19 pandemic has disrupted lives around the world, yielding a global mental health crisis. While parent-report studies indicate that children with ASD are exhibiting more behavioral challenges (e.g., Colizzi et al., 2020; Nonweiler et al., 2020), no studies have yet reported the pandemic experiences of autistic adults. Self-advocates have cautioned that higher rates of co-occurring psychiatric conditions and difficulties adapting to pandemic-related changes may put autistic adults at even greater risk for adverse mental health effects of the pandemic (denHouting, 2020). A better understanding of autistic adults’ pandemic experiences and mental health during this time is needed to inform development of supports.

**Objectives:** To explore the mental health of autistic adults and identify predictors of change in the early months of the pandemic.

**Methods:** In April 2020, 636 independent adults enrolled in SPARK responded to a survey assessing impact of the pandemic and 396 completed a follow-up survey 7.7-9.7 weeks later (80.3% White; 58.8% female; Mean age=37.4, SD=13.4; range=18.5-74.8 years). Participants self-reported level of impact in six areas (Fig.1) on a scale of 1 (not at all) to 4 (severely) and rated four items assessing depression, anxiety, loneliness and hyperarousal in the past week from 1 (rarely or none of the time, less than 1 day) to 4 (most or all of the time, 5-7 days). Items were added to yield a “total impact” and “psychological distress” score, respectively (higher scores reflect more impact/distress).

**Results:** At T1, psychological distress was high, with an average score of 9.3 (SD=3.2); 54.7% endorsed two or more symptoms for at least 3 days in the past week. Being female, younger and having a previous mental health condition was associated with higher levels of overall impact and distress [Table 1]. Impact, but not hope or psychological distress, showed moderate to large increases over time [Table 1]. Moderate to large increases in severity of impact were observed across most areas, with services showing the greatest increase [Fig.1]. Of 267 adults who reported receiving services in January/February 2020, there was a significant increase in those reporting that COVID negatively impacted their services at T2 (88.8%) compared to T1 (50.6%,  $p < .001$ ); 26.6% (n=71) were not receiving online services at T2. Two-thirds of the sample (n=263) reported needing more supports at T2; counseling/therapy (52.1%) and social supports (40.7%) were the most frequently endorsed areas needed.

Linear regression indicated that higher impact, less hope and being older or female were associated with higher concurrent T1 psychological distress ( $p < .005$ ). In the model predicting T2 psychological distress, increases in total impact, decreases in hope and having unmet support needs at T2 were significant predictors of T2 distress ( $p < .005$ ) controlling for T1 distress levels ( $R^2 = 0.53$ ).

**Conclusions:** These findings document concerningly high levels of psychological distress for autistic adults, which remained stable across the early weeks of the pandemic. A decrease in hope predicted T2 psychological distress, highlighting a possible target area for mental health supports. More attention is needed to ensure that adults are receiving necessary services throughout the pandemic.

## ORAL SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES

### Oral 311 - Qualitative Understandings of Autistic Individuals, Their Families and Communities

**311.001** (Oral) Sibling and Service Provider Perspectives on Sibling Involvement in the Lives of Adults on the Autism Spectrum  
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**Background:** Parents often provide support for their adult child on the autism spectrum, but as adults on the autism spectrum age, siblings may become more involved in supporting them. Research about siblings of adults with intellectual disabilities suggests that siblings may take on formal and informal support roles and help plan for the future.<sup>1-5</sup> Yet, limited information is available on siblings' support roles and involvement in the lives of their family member on the autism spectrum specifically. This is important as several characteristics of autism may impact sibling involvement (e.g., ability to express reciprocity, maladaptive behaviors, and the autism-specific adult service systems complexity<sup>6-8</sup>). Further, it is important to consider the perspectives of service providers as they may serve as gatekeepers to inviting and including adult siblings in the care of the adult on the autism spectrum.

**Objectives:** The purposes of this study were to (1) describe perspectives of siblings' involvement in the lives of their family member on the autism spectrum, and (2) explore similarities and differences between siblings' and service providers' perspectives.

**Methods:** Twelve adult siblings and 14 service providers participated in focus groups or interviews in English or Spanish (Table 1). Providers and siblings were asked, "what role do [siblings] play in supporting your client/sibling on the autism spectrum?" Other questions focused on how families determine sibling involvement in future planning. Focus groups and interviews were recorded and transcribed verbatim. Data were systematically coded, stratified by respondent type, and analyzed using applied thematic analysis.<sup>9</sup>

**Results:** Analyses revealed four areas of sibling involvement with their family member on the autism spectrum: (1) encouraging leisure and social activities, (2) promoting independence in self-care, (3) advocacy, and (4) future planning (Table 2). Siblings and service providers had similar perspectives on sibling involvement for the first three themes but reported different views on siblings' level of involvement in future planning. Participants reported that siblings encourage leisure and social activities for their family member on the autism spectrum in community settings (e.g., going to restaurants, movie theaters, and spending time outdoors together). Siblings also encourage independence in self-care activities for their family member more than parents. Finally, siblings act as advocates for their family member by supporting and encouraging the adult on the autism spectrum during medical appointments, individual service plan meetings, and with housing. Providers were less likely, however, to acknowledge siblings' interests and plans for involvement in future planning.

**Conclusions:** Siblings play an important role in supporting their family member on the autism spectrum, and the scope of their support roles often increase over the life course. Yet, our findings suggest a disconnect between siblings' intentions and service providers understanding of the extent to which siblings are positioned to assume support roles for future planning. Service providers tend to underestimate the degree to which siblings intend to be involved in supporting the adult in more formal ways and feel ill-equipped to involve siblings.<sup>10</sup> Service provision for adults on the autism spectrum could be improved with the explicit inclusion of siblings.

**311.002** (Oral) Exploring Leisure Time Use and Impact on Health and Well-Being Among Transition-Age Autistic Youth  
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**Background:** The transition to adulthood has emerged as an important focus for autistic youth, since fewer supports and services exist after they age out of school. Quality of life (QOL) is lower for transition-age autistic youth compared to typically developing counterparts. Leisure-time pursuits have been linked to higher QOL and overall subjective wellbeing, as they provide individuals with opportunities to build relationships, experience positive emotions (e.g., enjoyment, success, affiliation), and acquire new knowledge and skills. Leisure-time activities are also positively associated with health status. Leisure-time has been studied in a limited way in transition-age autistic youth, but prior studies have used parents as respondents.

**Objectives:** The objective of this study was to employ participant-driven photo-elicitation (PDPE) methodology to explore leisure-time use among transition-age autistic youth. We sought to provide insights into supports that can be developed to assist youth in engaging in activities that enhance QOL and promote health.

**Methods:** Youth ages 18-23 years were recruited nationally using purposive sampling through organizations that serve the autistic population and their families as well as universities known to have specific resources for autistic students. Participants took photos of their leisure-time activities over a 7-day period using their own smartphones. They were then interviewed via Zoom using a semi-structured interview guide that was based on the Self-Determination Theory framework and the Iwasaki leisure-time model. Photos were organized and discussed by day. Data were analyzed using directed qualitative content analysis based on the theoretical framework. NVivo (QSR International) was used to assist with coding.

**Results:** Eighteen young autistic adults participated in the study. Playing video games was the most common activity. Other activities were watching television and videos, reading, listening to music, arts (painting, digital art, drawing/sketching/coloring, photography, writing, and needlework), board games, going for walks, and spending time with pets. A major theme was that most youth perceived leisure activities as contributing to their mental health and wellbeing. While most activities were done alone, rather than describing these activities as isolating, youth said they helped with coping with stress. Activities also gave them confidence in overcoming challenges they faced. Most participants mentioned gaining a sense of connection when they were engaged in leisure activities with others who shared common interests. Although many youth participated in some form of physical activity, it was viewed as utilitarian, to promote better health, rather than something that participants enjoyed.

**Conclusions:** Through this research, we gained an understanding of the range of activities that transition-age autistic youth engage in during their leisure time. Overall, this exploratory work suggests that although youth engage in many solitary leisure-time pursuits and spend significant time in front of screens, these activities make positive contributions to their psychological wellbeing. Many youth described purposeful engagement in activities to develop skills, grow emotionally, and manage emotional challenges. These findings suggest that programming in this area might focus less on shifting or expanding upon the types of activities that youth pursue, but instead help ensure that they reap benefits from activities that they already enjoy.

**311.003 (Oral)** Me, My Environment and My Quality of Life: Understanding Autistic Quality of Life Using Photography  
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**Background:**

Measuring the quality of life (QoL) of autistic adults is underpinned by the constructs used to define them. Little research has focussed on how autistic adults construct and define their quality of life (QOL) in their everyday lives. Assessments of QoL employed with autistic adults largely assume that the constructs underpinning QoL are the same for all people. Research employing these measures consistently report that autistic adults experience poorer QoL compared to their non-autistic peers. The neurodiversity movement draws attention to autistic individuals' divergent styles of thinking and strengths, including their exceptional memory and pattern recognition abilities, and high levels of attention to detail. The neurodiversity of autistic individuals and their strengths are largely overlooked in traditional QoL constructs.

**Objectives:**

This research aims understand the autistic community's perspective of QoL, employing a Photovoice methodology, with participants portraying what determines and defines their QoL using photos.

## Methods:

Photovoice is a unique and creative approach to co-producing research, capturing meaning and articulating the needs and perspectives of autistic adults through photos. A steering group of five autistic adults developed and refined the research design, materials and assisted in data interpretation. One autistic co-author is a photographer and co-produced the Photovoice resources, upskilling participants in photography techniques.

15 autistic participants from across Australia took part in the Photovoice study, taking up to 20 photos which captured and reflected their perspectives of their QoL. On completion, two focus groups were held with six participants presenting three photos representing their QOL to identify themes as a group. Each of the 15 participants then took part in an individual interview in which they described and identified themes portrayed within their remaining photos with the researcher. The 289 photos and the focus groups and interviews were analysed thematically, primarily identifying participant's reported themes, capturing participants' collective perceptions of their QOL. Additional themes identified during analysis were included and member checked with each participant.

## Results:

Emerging themes embedded within the photos indicate that QOL is nuanced and multifaceted, with "one photo telling a thousand stories". Themes generated from the photos include What I do, What I need, What makes me who I am, What is around me, and What I experience. The photos reflected ingredients of the themes such as passions, socialisation, relationships, physical and mental health and sensory preferences. Following analysis a Photovoice gallery, including a selection of 47 images was co-produced with autistic participants and researchers. This was launched in November 2020 sharing findings, and participant's perspectives, and can be found here: <https://www.youtube.com/watch?v=8H2Arlbe3B0>

## Conclusions:

Co-producing QoL research is critical in ensuring the construct of autistic QoL truly represents autistic adults' experiences. Understanding QoL from the perspective of autistic adults themselves can underpin a conceptualisation of QoL of relevance to the autistic community, which can ultimately be operationalised into measurement tools capable of providing an accurate and meaningful description of the QoL of autistic adults.

### **311.004** (Oral) A Qualitative Study of Police Confidence in Their Work with Autistic Individuals

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**Background:** Results from several studies reveal that police officers are often unknowledgeable about autism and report concerns about how to appropriately handle situations involving autistic individuals (Crane et al., 2016; Railey et al., 2019). A recent review of autism and the criminal justice system (Railey et al., 2020) identified training about autism as a critical area of need within the criminal justice system, which is consistent with findings from previous reviews (e.g., King & Murphy, 2014). Bandura (1997) stated that individuals must not only possess appropriate knowledge and skills, but they also need belief in their own capabilities to demonstrate these skills. Police officers' efficacy beliefs can affect whether they will change their behavior and whether they will be motivated to persevere in a new situation. This study explored what contributes to an officers' capability beliefs specific to their work and service delivery to autistic individuals.

**Objectives:** The aim of this study was to understand what makes police officers feel more and less confident when working with autistic individuals in the capacity of their job. Research questions supported each interview question regarding officer confidence.

**Methods:** This study employed a qualitative methodology to analyze the feedback from police officers about their confidence in supporting and working with autistic individuals. Data was extracted from a larger study examining police officer knowledge and self-efficacy for working with autistic individuals, which employed an anonymous survey to explore police officers' self-efficacy (Love et al., 2020). Data were analyzed in Nvivo software by two researchers who independently used the constant-comparative method associated with constructivist grounded theory (CGT; Charmaz, 2014). Participants included 317 police officers who were actively serving in the US and who provided anonymous answers to the following questions: (a) "What makes you feel more confident in your capabilities as a police officer to work with someone with autism?" and (b) "What makes you feel less confident in your capabilities as a police officer to work with someone with autism?"

**Results:** Results from the first question resulted in four thematic categories, including (a) knowledge and training, (b) personal experiences, (c) experiences of fellow officers, and (d) personal characteristics. These themes are consistent with Bandura's (1986) four sources of self-efficacy, and the connection between theory and the results will be discussed. An analysis of responses to the second question, which explored factors that contribute to officers feeling less confident, yielded the following four themes: (a) autistic characteristics, (b) diagnosis concerns, (c) effective training and knowledge, and (d) dynamics of emergency situations.

**Conclusions:** There is current international attention on the autism-specific education and training of first responders. While some police departments are responding to state mandates that require autism training, others are proactively choosing to educate and inform their officers to prevent tragic incidents of misunderstanding. This research utilized the voices of police officers to identify areas of need and themes relating to officer confidence. The findings can be used immediately to improve and inform relationships between first responders and the autistic community.

## POSTER SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES

### Poster 422 - Family Issues and Stakeholder Experiences Posters

**422.001** (Poster) "Delivered Right to Your Own Home" Stakeholder Perspectives on an at-Home Autism Likelihood Assessment

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**Background:** Autism Spectrum Disorder (autism) has a complex, multifaceted causal pathway. Even within a single individual, multiple factors impact the likelihood of a diagnosis. Biological and environmental impacts have been implicated within the causal pathway; however, we have limited ability to collect and aggregate data from multiple sources of risk for any individual child. An assessment kit allowing families to collect relevant samples at home could enhance the ability to create personalized risk profiles. Input from the patient population is critical for optimal assessment kit design.

**Objectives:** To inform and optimize the development of a remote kit to assess biological and environmental indicators of an autism diagnosis through qualitative interviews with stakeholders.

**Methods:** Participants were six mothers of children with autism and three mothers of children with neurogenetic disorders (1 Prader Willi Syndrome; 2 Down Syndrome). As part of a larger study, mothers completed a 90-minute in-depth semi-structured phone interview that included a description of the potential aspects of the new kit and questions related to their perspectives of such an assessment. Using a grounded theory approach (Salada, 2016), interview transcripts were coded within Nvivo 12 for three categories related to kit development: willingness, concerns, and supports. Second cycle coding identified sub themes for each category and included axial coding across themes.

**Results:** Three themes were identified: Participation, Research Connection, and Design. Overall, participants were willing to collect most samples. Concerns that may impact participation included collection of invasive items (e.g., blood), activities that may result in child non-compliance (e.g., collecting saliva), and amount of work and skill involved with correct collection of samples (e.g., understanding how to collect dirt/dust). Positive impacts on participation were access to direct supports and involvement of healthcare providers for more invasive samples. In relation to the design of the kit, additional supplies (e.g., ice packs) and small sealed containers were important factors for biosamples (e.g., stool). Participants conveyed the importance of clear instructions in multiple formats, including videos. All mothers endorsed having the kits delivered to their homes. Connections to research was a strong theme across all three coding categories. Study goals impacted willingness to participate in sample collection at all and willingness to complete more invasive or time consuming collections. Ethical issues were also raised regarding data storage and usage. Three participants emphasized the importance of receiving research results, including both the main findings of any study and also personalized reports of their own risk status.

**Conclusions:** Overall, parents were willing to collect a myriad of biological and environmental samples in their homes, particularly if the goals of the research align with their own. Child consent and compliance, collection burden, as well as ethical research practices such as data security and storage were the most salient factors related to whether respondents would engage with a home collection kit. These results support the feasibility of this goal and concurrent importance of communication with patient groups before, during, and after research projects to meet community needs and maximize research impact.

**422.002 (Poster)** A Comparison of Non-Latino White and Culturally and Linguistically Diverse Parents' Perceptions of and Experiences with Autism Identification

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**Background:**

Although autism spectrum disorder (ASD) can be reliably diagnosed by age two, the average age of diagnosis for children in the U.S is still after age four. For children from underserved, culturally and linguistically diverse (CLD) communities, age of identification can be substantially greater. Thus, efforts to improve disparities in identification are warranted and looking to parents' experiences may inform such efforts. The literature suggests that Non-Latino White (NLW) and CLD parents have different beliefs about ASD and different experiences with the identification process that could influence the course of action parents take-- or are able to take-- to obtain an ASD identification.

**Objectives:**

To date, few studies have directly compared NLW and CLD parents' perceptions of and experiences with ASD identification. The purpose of this survey study was to examine whether there are differences between NLW and CLD parents in: (1) perceptions of the causes of ASD, identification, and intervention; (2) barriers and facilitators to receiving an ASD identification; and (3) sources parents turn to for ASD information.

**Methods:**

Eligible participants ( $N = 205$ ) were parents of children with an educational identification and/or clinical diagnosis of ASD and had to be at least 18 years of age and residing in the US at the time of the study. Parents were recruited via ASD-related Facebook groups, email listservs, and community organizations. The link to the Qualtrics® survey was provided in each recruitment method. The CLD group ( $N = 128$ ) consisted of participants who identified as Hispanic/Latino or with a race other than Caucasian. The NLW group ( $N = 77$ ) consisted of participants who identified as Caucasian and non-Hispanic/non-Latino. Chi-square tests were conducted to determine whether there were significant differences in experiences by parent group. The false discovery rate (FDR) approach was used to control for multiple comparisons.

**Results:**

The results suggest that NLW and CLD parents have substantial differences in perceptions of cause, perceptions of identification, parent-reported barriers to identification, and information sources used but were relatively similar in perceptions of intervention and parent-reported facilitators to identification. Notably, CLD parents in comparison to NLW parents: (a) were significantly less likely to endorse genetics as a cause of ASD; (b) reported more barriers to and negative perceptions of identification; and (c) were significantly less likely to turn to healthcare professionals, other parents of children with ASD, and the internet for ASD information.

**Conclusions:**

Our findings suggest that NLW and CLD parents have different perceptions of ASD and experiences with the identification process, culminating in different needs. In many ways, our current systems and practices better support the identification of NLW children, potentially contributing to ongoing disparities in identification. Intentional focus on the needs of CLD communities is important for amending current systems and practices to improve disparities in ASD identification.

**422.003 (Poster)** A Developmental Perspective on Family Accommodation in Autism: Preliminary Findings

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**Background:** Family accommodation refers to ways in which parents modify their behavior to help a child alleviate distress associated with emotional disorders (e.g. Lebowitz, Scharfstein & Jones, 2014). Such accommodation is common among families

of children with OCD and anxiety disorders, where it is associated with increased symptom severity, lower functioning, and poorer treatment outcomes (e.g. Caporino et al., 2011; Lebowitz, Scharfstein & Jones, 2014).

One study to date has examined family accommodation of repetitive and restrictive behaviors and stereotyped interests (RRBs) in autism. Feldman et al. (2019) found such accommodation to be highly prevalent, positively correlating with symptom severity and negatively correlating with adaptive functioning.

**Objectives:** The current study examines short-term trajectories in the context of family accommodation in autism. The main purpose of the study is to extend the results of the original study by examining the relationship between family accommodation and symptomatology 1-2 years after diagnosis. We aim to examine changes in family accommodation 1-2 years after diagnosis and the association between these changes and parallel shifts in RRBs severity.

**Methods:** Participants include 25 parents of children diagnosed with autism spectrum disorder between the ages 4 and 12.10 years (7 females; mean age = 7.11 years, SD = 2.6), who participated in the original study conducted by Feldman et al. (2019). Parents were invited to participate in an abridged reevaluation, including measures of adaptive behavior (Vineland Adaptive Behavior Scales 2; VABS-2; Sparrow, Balla & Cicchetti, 2005), family accommodation (FAS-RRB; Feldman et al, 2019) and RRBs (RBS-R; Bodfish, Symons, & Lewis, 1998). Data was also collected regarding intervention received and other significant developments during the intervening time.

**Results:** Family accommodation 1-2 years after diagnosis remained highly prevalent, with 68% of parents reporting weekly accommodation and 44% reporting daily accommodation. As in the first study, accommodation positively correlated with RRB severity ( $r_s = .768, p < .01$ ). No significant correlation was found between FAS-RRB total score and the VABS 2. However, the family accommodation sub-category '*participation*' (participating in RRB-related actions) negatively correlated with daily living skills ( $r_s = -.534, p < .01$ ) as measured by VABS 2.

Family accommodation at Time1 significantly positively correlated with family accommodation ( $r_s = .427, p < .05$ ) but not with adaptive behavior skills at T2. The family accommodation '*participation*' sub-category at Time1 negatively correlated with daily living skills at Time2 ( $r_s = -.439, p < .05$ ) as measured by VABS 2. RRB severity at T1 significantly positively correlated with RRB severity in T2 ( $r_s = .413, p < .05$ ) and with family accommodation in T2 ( $r_s = .425, p < .05$ ).

**Conclusions:** These preliminary findings indicate that family accommodation of RRBs is present at time of diagnosis and 1-2 years afterward. Such accommodation, both concurrently and longitudinally, appears to associate with elevated symptomatology and reduced daily living skills. These findings are an important step forward in our understanding of family accommodation in a developmental context. The modest and heterogeneous sample are limitations. Ongoing data collection will allow for confirmation and elucidation of these findings.

**422.004 (Poster) A Pathway to Understanding: Autistic People's Use of Internet Memes to Illustrate Autistic Experience**  
**S. E. Woods, Discover Psychology Services, Lacey, WA**

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**Background:** Internet memes are replicating units of cultural information (Dawkins, 1976) shared online. They have the power to unite marginalized people (Shifman, 2014) and shape the mindsets and actions of groups (Knobel & Lankshear, 2007). Internet memes are a powerful communication tool among autistic people that has been largely unexplored. The deficit-focused approach to conceptualizing is deficient. Because of the double empathy problem (Milton, 2012), autistic and nonautistic people may have trouble understanding each other. Participation of autistic people in our understanding of autism is a necessity (e.g., Bottema-Beutel et al., 2020; Gillespie-Lynch et al., 2017). Many autistic people have difficulty discussing their own emotional experiences, especially in medical settings (Poquérousse et al., 2018). Autistic people's visual strengths (e.g., Rutherford et al., 2020; Soulieres et al., 2006) and creative use of the internet to overcome obstacles (Kapp, 2020) make memes important for autistic culture. Exploratory research on autistic internet memes offers insight into autistic identity and culture. It provides opportunities for bridging gaps between professional and autistic communities.

**Objectives:** Exploratory research on autistic internet memes offers insight into autistic identity and culture. It provides opportunities for bridging gaps between professional and autistic communities.

**Methods:** A content analysis of autism-related memes (n = 400) from 4 different Facebook pages by and for autistic people was completed. Data were thematically coded (Braun & Clark, 2006), themes were explored, and clinician implications were identified.

Results: Memes included a broad array of content, including comments on nonautistic discourse about autism, affirmations, positive aspects of autistic identity, struggles related to autism (e.g., social interaction, preference for solitude, sensory differences), and related struggles (e.g., executive functioning difficulties, sleep problems, trauma, anxiety). Several important themes were identified. A prominent message was that autistic struggles arise from *differences between autistic and nonautistic preferences and expectations*, as opposed to resulting from basic deficits in autistic people. These included subtle criticism of nonautistic expectations for social interaction and self-deprecating humor. They often included humor derived from the mismatch in styles. This is consistent with the social model of disability and the neurodiversity paradigm. Humor was used to challenge nonautistic conceptualizations of autism. Another prominent theme was *autistic joy*, often illustrated through examples of pleasure and pride associated with autistic experience (e.g., special interests, sensory experiences, direct communication) and admiration of autism by nonautistic people. *Solidarity* among autistic people as a community and within the disability community was also key. Infographics explaining autistic experience in accessible language and images were discovered (e.g., the tendril theory). As a medium, memes legitimize autistic styles of explanation of autistic experience.

Conclusions: Autistic people acknowledge struggle and joy associated with autism powerfully, conveying a wealth of information through memes. The mismatch between professional and autistic experiences has already been established as a barrier to effective intervention and collaboration. Memes offer solutions. Memes offer evocative and memorable illustrations of the social model of disability. Autistic memes could also be useful in assessment and feedback procedures. Dissemination of research to autistic communities through memes may be effective.

**422.005** (Poster) A Winning Lottery Ticket and a Miracle: Parents of Autistic Adults Describe What It Takes to Get Adequate Services

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Background: The social, psychological, and health outcomes for autistic adults are all unacceptably poor. Rates of independent living, education attainment, employment, work satisfaction, and meaningful relationships are not only lower than average, they are lower than for other disability groups (Levy & Perry, 2011). Despite the increased attention paid to autism by research and clinical communities, these outcomes are not improving.

Objectives: The primary aim of this study was to understand the lived experience of autistic adolescents and adults in the community. Working with various stakeholder groups we sought to identify barriers and facilitators to engagement and participation and examine the service ecosystem from the perspective of autistic youth and their families.

Methods: Data presented here is part of a Narrative Phenomenological examination of community engagement of autistic adolescents and young adults. Autistic individuals, their family members, and clinicians participated in semi-structured narrative interviews and “Collective Narrative” group-based interviews to provide their lived-experience. Data was transcribed verbatim and coded thematically. Interviews provide a means of accessing the post-reflective assessment of a leisure engagement and situating the experience in a broader context of the individual and their social environment. Collective Narrative allows for themes and discoveries to be explored at a community level, for stakeholders to offer their interpretation of events, and to find areas of difference and concurrence in the larger group. At each stage, field notes were kept providing important contextual information and a space for reflexive processes.

Results: Services that meet the needs of autistic adults are few and far between, according to parents. Some families struggle to find services or service providers who meet their needs from the time of diagnosis. The struggle to find adequate services increases as children age with nearly all participants expressing dismay by early adulthood. When asked to envision a program to help their child, parents routinely start their answer with, “If I won the lottery,” or “If God granted me a miracle.” Most often this sentiment has been expressed by mothers in the study, who go on to describe services that don’t exist yet but are not extravagant or unscientific. Mothers present realistic and sensible ideas for programs, but their experience of the system has made it clear that winning the lottery is more likely than getting the services their children need.

Conclusions: Adequate services to meet the needs of autistic adults should not require a statistical anomaly like winning the Powerball or a literal act of God. The research and clinical communities must find ways to work together and in partnership with the autistic community to address these critical shortcomings in service availability.

**422.006** (Poster) Access to Interventions and Services for Families of Young Children with Autism Spectrum Disorder

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Background: Families of children with autism spectrum disorder (ASD) report significant barriers to accessing and engaging in care, including delayed or foregone care, difficulty receiving referrals, care that is not family-centered, and higher rates of unmet service needs relative to other special health populations (Kogan et al., 2008). Prior research examining service utilization in ASD assessed the number or type of services successfully accessed, with the assumption that underutilization reflects problems with access (Krauss et al., 2003). However, few studies have examined the efforts or attempts made to successfully obtain care.

Objectives: This study aims to identify issues of access to care through examining the number and type of services initially sought versus successfully accessed, with the goal of examining the complexity of service seeking and family experience.

Methods: An online survey was distributed via SPARK Research Match to 324 caregivers of a child with ASD between 18 months and 6 years of age ( $M$  age = 4.01). Caregivers reported the number and types of interventions that were sought and successfully accessed from a list of 13 possible interventions/services. Caregivers reported the ASD-related services their child currently receives and any unmet needs in their child's current programming.

Results: Over 97% of caregivers successfully enrolled in services. On average, caregivers sought between 1.29 to 2.6 different programs per intervention/service category, successfully enrolling in 1.11 to 1.75 programs per category. The most frequently attempted and accessed services include speech/language therapy (93.4% attempted, 97.3% success rate), occupational therapy (87.3% attempted, 92.4% success rate) and behavioral therapy/ABA (73.6% attempted, 72.6% success rate). Caregivers made the most attempts at obtaining behavioral/ABA services ( $M = 2.60$ ,  $SD = 1.91$ ), speech/language therapy ( $M = 2.25$ ,  $SD = 1.42$ ), and occupational therapy ( $M = 1.97$ ,  $SD = 1.38$ ). The most difficult services to access included nutritional counseling (41.9% of caregivers who attempted were unsuccessful), mental health counseling (38.9% of caregivers were unsuccessful), and complimentary or alternative medicine (35% of caregivers were unsuccessful). The greatest reported unmet needs were emotional regulation and anxiety; less than a third of participants requiring support in these areas received it (30.8% for emotional regulation, 28.5% for anxiety).

Conclusions: Families of young children with ASD most frequently seek out and successfully initiate services that are considered central to comprehensive early intervention programs for young children (e.g., speech therapy, occupational therapy and behavioral therapy/ABA). Yet, significant unmet needs remain for this population. In particular, these data suggest that underlying mental health challenges such as emotion regulation and anxiety represent an important area of need, and that services addressing these concerns (e.g., mental health counseling) are challenging to access. These data suggest that understanding the nature of difficulties accessing services (e.g., lack of providers trained in mental health counseling for young children with ASD vs. financial or insurance barriers to enrolling in services) is critical for developing innovative strategies to ensure timely and appropriate care for young children with ASD.

**422.007 (Poster)** Affiliate Stigma, Empowerment, and Self-Esteem Among Serbian Parents of Children with Autism Spectrum Disorder

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Background: Concepts of affiliate stigma, empowerment, and self-esteem among parents of children with autism spectrum disorder (ASD) are slowly getting more research attention for the past decade. Yet, these topics remain understudied in Serbia and Southeastern Europe overall. Across different studies, parents of children with ASD have been reporting higher degree of affiliate stigma in comparison to parents of children with other types of disabilities. Findings regarding levels of empowerment and self-esteem among parents of children with ASD and parents of children with different types of disabilities are inconsistent.

Objectives: The aim of the present study is to examine whether parents of children with ASD express greater degree of affiliate stigma and lower levels of empowerment and self-esteem in comparison to the parents of children with physical disabilities (PD). Further, we wanted to explore levels of affiliate stigma, self-esteem, and empowerment among Serbian parents of children with ASD.

Methods: This study is a part of a large project that included a convenience sample of 82 Serbian parents; 40 of children with ASD and 42 of children with PD. The parents were recruited through parental support organizations and public schools from the several cities across the country. We used the Affiliate Stigma Scale (Mak & Cheung, 2008) to measure affiliate stigma (a higher score represents greater stigma level; max = 5), the Family Empowerment Scale (Koren et al., 1992) to examine family empowerment (a higher score represents greater empowerment; max = 5), and the Rosenberg Self-Esteem Scale (Rosenberg, 1965; Rosenberg, 1989) to measure parental self-esteem (a higher score represents greater self-esteem; max = 30).

Results: Results showed that parents of children with ASD ( $M = 1.78$ ,  $SD = 0.508$ ; Min = 14, Max = 30) reported significantly greater degree of affiliate stigma in comparison to parents of children with PD ( $M = 1.46$ ,  $SD = 0.327$ ) ( $t = -3.403$ ,  $df = 66.33$ ,  $p$

= 0.001). No differences between these two groups of parents were found in empowerment and self-esteem. On average, parents of children with ASD reported relatively high level of empowerment (M = 3.98, SD = 0.494), with the highest score on Service System subscale (M = 4.11, SD = 0.452), following by Family subscale (M = 4.06, SD = 0.475), and Community (M = 3.74, SD = 0.761). On average, self-esteem among parents of children with ASD was moderate-to-high (M = 21.28, SD = 4.212; Min = 14, Max = 30).

Conclusions: Based on our results, parents of children with ASD reported a significantly higher level of the affiliate stigma in comparison to parents of children with PD. On average, parents of children with ASD expressed low degree of affiliate stigma, moderate-to-high level of self-esteem, and high level of empowerment. Further research with Serbian parents should include more diverse sample (e.g., parents from rural areas) to examine these constructs, as culture in Serbian smaller cities and rural areas differs from the ones in the larger cities.

**422.008** (Poster) African Americans' Perceptions of Children's Behavior Associated with Autism Spectrum Disorder  
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Background: Racial disparities in prevalence of Autism Spectrum Disorder (ASD) among White and African American children have been documented since the start of surveillance by the Autism and Developmental Disabilities Monitoring (ADDM) network. Parents from different cultural backgrounds have been shown to differentially interpret similar symptom presentations associated with ASD, which depends upon the salience of missing or delayed behavior in their cultural expectations of normative behavior. Before receiving an Autism Spectrum Disorder (ASD) diagnosis, African American parents report fewer ASD-specific concerns compared to White parents. African American children are also less likely to receive an ASD evaluation prior to age 3. While it has been suggested that African Americans' cultural beliefs about delayed or atypical development may contribute to under-identification of ASD among African American children, research that considers the recognition and interpretation of children's developmental problems by African American parents whose children *do not already have* an ASD diagnosis has been mostly lacking.

Objectives: Our study seeks to understand the socio-cultural factors in the African American community that may contribute to under-identification of African American children with ASD. The insights from this study are anticipated to guide interventions to decrease the timing of ASD diagnosis in the African American community.

Methods: Community-Partnered Participatory Research (CPPR) model is based upon the development of trust and shared knowledge among community members, academic researchers, and health care professionals. CPPR was used to conduct focus groups with 30 African American parents of typically developing children at two Black Churches. Participants watched Centers for Disease Control and Prevention's Autism Case Training videos portraying African American children with ASD and discussed their observations. Parents were uninformed of the diagnosis of the children in the videos. Focus groups were audio-recorded, transcribed and thematically coded using NVivo software. Themes were then mapped onto the Social-Ecological Model (SEM) to illustrate the influences of social environments on perceptions of children's behavior, and to help guide interventions for changes in health outcomes

Results: A total of 30 participants who were between 22 and 85 years of age participated in four focus groups. Most parents identified ASD-specific behaviors as delayed or unusual, but only 10% linked these behaviors with ASD. Developmental delays were seen as normal variants of typical development such as being an only child, or a child of a single parent. Behaviors consistent with ASD, especially lack of joint attention and social-emotional reciprocity were viewed as a sign of the child's intraverted personality rather than a deviation from the norm. Mistrust and concerns that physicians' racial bias may lead to suspicion of child abuse was seen as a barrier to discussing developmental concerns. Racial concordance with physicians was perceived as desirable to facilitate discussion of developmental concerns.

Conclusions: Culturally tailored interventions to educate the African American community about ASD should focus on children's joint attention and social-emotional reciprocity, which were most salient to the parents in our study. Insights from this study are useful for training pediatricians to facilitate trust among African American parents.

**422.009** (Poster) Associations Among Autism Symptom Domains and Facets of Parent Strain  
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Background:

Having a child with an Autism Spectrum Disorder (ASD) diagnosis can pose unique challenges for parents. Parents of children with ASD tend to have higher levels of parenting stress compared to parents of typically developing children (Hayes & Watson, 2013). Aspects of ASD symptomatology such as behavior problems, personal care skills, and sensory issues have been linked to higher caregiver strain (Hand et al., 2018; Khanna et al., 2011). However, discrepancies in findings suggest that the associations may not be stable across developmental periods. Moreover, previous research has not addressed the possibility that different symptom domains might affect different aspects of caregiver strain.

#### Objectives:

The aim of the current study is to investigate the associations between autism symptom domains and facets of caregiver strain, as well as the moderating effect of age on these associations.

#### Methods:

Data was obtained from the Autism Treatment Network Registry Call-Back Study. The sample consisted of 483 male (79.7%) and 123 female (20.3%) children with an ASD diagnosis. Participants ranged in age from 2 to 16.8 years ( $M = 6$ ,  $SD = 3.29$ ).

The frequency and impact of ASD symptoms were measured using the five subdomains of the Autism Impact Measure (AIM; Kanne et al., 2014): Repetitive Behaviors, Communication, Atypical Behaviors, Social Reciprocity, and Peer Interaction. Caregiver strain (CGS) was measured using the three subdomains of the Caregiver Strain Questionnaire (Brannan et al., 1997): objective (disruptions in routines and personal life), subjective externalized (feelings directed toward child such as resentment or embarrassment.) and subjective internalized (negative feelings such as sadness or worry) strain. Multiple regressions were conducted for each subdomain of CGS. Predictors included child age, gender, IQ, AIM subdomains, and interactions between age and AIM subdomains. Standardized betas are reported.

#### Results:

No main effects of age, gender, or IQ were found for any subdomains of CGS. Higher Atypical Behaviors predicted higher objective ( $b = .49, p < .001$ ), externalized ( $b = .35, p < .001$ ), internalized ( $b = .36, p < .001$ ) and global ( $b = .49, p < .001$ ) strain. Repetitive Behaviors were associated with lower externalized ( $b = -.25, p = .001$ ) and lower global strain ( $b = -.13, p = .05$ ). In addition, child age moderated the association between Communication and externalized strain ( $b = .15, p = .04$ ). For younger children, as Communication problems increased, externalized strain decreased, whereas for older children, as Communication problems increased, so did externalized strain.

#### Conclusions:

Results suggest that symptom subdomains are differentially related to parent strain. Moreover, the type of strain experienced varies across symptom domains. Atypical Behaviors was strongly related to all types of strain, suggesting that this domain may weigh heavily on parents. Age moderated the association between Communication and externalized strain; parents may have higher expectations for older children's communication skills compared to younger children whose language skills are still developing. More research is needed to clarify the association between Repetitive Behaviors and externalized and global strain.

#### **422.010** (Poster) Associations Among Child Autism Symptoms and IQ with Mindful Parenting and Parent-Child Relationship Quality in Treatment-Seeking Families

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**Background:** Parent-child relationship quality and mindful parenting is associated with positive health outcomes in children with developmental disabilities. In children with autism, mindful parenting and positive parent-child relationship quality have each been associated with lower child externalizing problems (Singh et al., 2006; Smith et al., 2008). Studies have demonstrated associations between child characteristics such as autism symptomatology and the parent-child relationship in this population (Haven et al., 2014). Research is needed to examine other child characteristics (e.g., IQ) and family characteristics (e.g., family stressors) which may relate to positive parent-child relationship quality and mindful parenting. It is particularly important to examine these associations within the context of treatment-seeking families, whose children have mental health needs.

**Objectives:** To examine whether child IQ, autism symptoms, and mental health problems, along with family-level characteristics, are related to parenting in families of autistic children.

Methods: Data were collected from 57 parent-child dyads at baseline prior to being involved in cognitive behavioural therapy for child mental health problems. Parents were 29 to 54 years of age (86% Female;  $M = 44.3$  years,  $SD = 5.4$ ), and children were 8 to 13 years of age (79% Male;  $M = 9.9$  years,  $SD = 1.5$ ). Parent-child relationship quality was assessed using the Positive Affect Index (PAI; Bengtson & Schrader, 1982), which provides a total score and two subscale scores: 1) positive affect towards child and 2) positive affect from child. Higher scores reflect more positive relationship quality. Mindful parenting was measured using the Bangor Mindful Parenting Scale (BMPS; Jones et al., 2014), with higher scores reflecting greater mindful parenting. Autism symptomology was assessed using the Social Responsiveness Scale – Second Edition (SRS-2; Constantino & Gruber, 2012), mental health was assessed using the Clinical Global Impression Scale – Severity (CGI-S; Guy, 1976), and IQ was assessed using the Wechsler Abbreviated Intelligence Scale – Second Edition (WASI-II; Wechsler, 2011). Demographic information (e.g., family income) and the number of family stressors was also assessed.

Results: Correlational analyses revealed that more positive relationship quality was associated with lower autism symptomology ( $r = -.45, p = .001$ ), lower child IQ ( $r = -.32, p = .02$ ), and lower child mental health problems ( $r = -.36, p = .02$ ), while greater mindful parenting was associated with lower autism symptomology ( $r = -.34, p = .01$ ) and lower child IQ ( $r = -.42, p = .002$ ). Neither parenting variable was associated with child gender, age, number of family stressors or family income (all  $p > .05$ ). Results of linear regressions revealed that relationship quality was independently predicted by autism symptomology ( $p = .003$ ) and child IQ ( $p = .01$ ), but not child mental health ( $p = .22$ ). Mindful parenting was independently predicted by autism symptomology ( $p = .002$ ) and child IQ ( $p < .001$ ).

Conclusions: Associations were demonstrated between child characteristics and parent-child relationship quality and mindful parenting in families of autistic children. These protective factors may be addressed in intervention to improve parent-child dynamics, and potentially, child outcomes.

**422.011 (Poster) Autism and the Cultural Imagination: A Critical Analysis of the Cultural Products Sustaining the Use of Behavioral Treatments for Autistics in the United States**

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Background: Our cultural imaginings shape disability discourse and the actions taken for and against Autistic bodies. In the United States, Autistic are often subjected to behavioral treatments (Lovaas, 1987; Wolf, Risley, & Mees, 1963). These treatments are perpetuated and reinforced through the medical model of disability (Glynne-Owen, 2010; Shyman, 2016). Through this medical model lens we create cultural products that serve to reinforce the idea that behavioral treatments are justified, desirable, and necessary. Three examples of such cultural products include the visual representation of autism in the media and our communities, the anti-vaccination movement, and the Autism warrior mother trope.

Objectives: I describe how three cultural products (visual representation, the anti-vaccination movement, and the autism warrior mother trope) serve to perpetuate our cultural imaginings of the necessity of behavioral treatments for Autistic bodies. I analyze these cultural products through a critical disability studies (CDS) and disability studies (DS) framework (Grech, 2015; Linton, 2005; Meekosha & Shuttleworth, 2009; Taylor, 2006). Finally, I discuss some of the ways we can shift our cultural imaginings of Autistic bodies in the United States.

Methods: This is a narrative literature review.

Results: Our prominent thinking about autism has been shaped by the clinical experiments of behavioral scientists (Bettleheim, 1967; Kanner, 1943; Lovaas, 1987) and the continued use of behavioral treatments with Autistics have clear economic implications as a lucrative for-profit enterprise (LaRosa, 2018). Cultural products sustain beliefs in behavioral treatment by driving our imaginings of autism as a problem. Visual metaphors like autism puzzle pieces, popular literature, and empirical research create a visual tapestry that paints autism as mysterious, puzzling, interesting, sometimes terrifying, and mostly undesirable (Autism Speaks, 2017; Deggins, 2017; Google Scholar, 2018; Kovach, 2015). Dr. Andrew Wakefield (1998) wrote a now redacted study that powerfully created a connection between vaccines and autism and cemented a strong and on-going anti-vaccination (anti-vaxxer) movement that continues to grow today (Hayden, 2018; Rozbicki, 2016). Finally, the autism warrior mother trope was born from mothers' long and complicated history with autism (Sousa, 2011) and helps sustain a drive in many mothers to fix their child's autism. From Bettleheim (1967) comparing autism mothers to Nazi camp guards, to blaming refrigerator mothers for causing their child's autism (Douglas, 2013) to Jenny McCarthy's personal memoir on warrior mothers (2008) the vision of mothers as modern warriors fighting against autism will most likely thrive for years to come.

Conclusions: To begin shifting our cultural imaginings of autism, Autistic self-advocates, Autistic researchers, and parent advocates are powerful and necessary voices (Dawson, 2009; Milton, 2014; Perry, 2018). It is also necessary that marginalized Autistic voices such as people of color and transgender autistics are amplified in autism discourse (Brown, Ashkenazy &

Onaiwu, 2017). There are Autistic authors speaking back against behavioral treatments in academic research (Kupferstein, 2018) and in online spaces (Hode, 2012; Mohler, 2018, Kronstein, 2018, Sequenzia, 2015). Critically analyzing the cultural products we consume about autism could begin to shift our cultural imaginings about the desirability of behavioral treatments.

**422.012** (Poster) Autistic People's Experiences of the First UK-Wide Lockdown and Lessons for Conducting Research during and after the COVID-19 Pandemic

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Background: Following a rapid rise in COVID-19 cases, a set of nationwide public health restrictions including limits on social mixing, business closures and guidance to maintain social distance and wear face coverings (hereafter, COVID-19 lockdown) were in force on the UK from March 2020. Anxiety and depression highly co-occur in autism and autistic people are at heightened risk of potential adverse mental health due to the COVID-19 lockdown. Furthermore, the impact of current and future public health measures on autistic people's willingness to take part in autism research remains unknown.

Objectives:

- Understand autistic people's experiences of the COVID-19 lockdown and how it impacted their daily lives.
- Describe how the pandemic may affect future research participation among autistic people.
- Identify adaptations required to research processes to facilitate research participation during and after the pandemic.

Methods: Participants were autistic adults who expressed an interest in participating in a separate study about the autistic people's views about randomised controlled trials following advertising via the UK charity Autistica and social media. Interviews were conducted remotely and were transcribed verbatim. Two authors conducted thematic analysis and met regularly to refine their codes and discuss disagreements. Transcripts were analysed from an inductive perspective where themes were created within a contextualist framework of critical realism.

Results:

The sample included 31 autistic adults (14 males, 15 females, and 2 non-binary people). Most people (77%) had higher education qualifications and half (51%) were employed. We organised findings in four overarching themes: i) positive aspects of lockdown; ii) challenges of lockdown; iii) concerns and hopes about the lifting of restrictions; and iv) views on research engagement and participation. Participants identified positive aspects of lockdown such as enjoying the lack of social pressures and using their well-developed skills for dealing with uncertainty. Autistic people shared challenges of adjusting to lockdown, for example, due to the rapid change in daily routines. While participants were hopeful about the freedom gained from easing restrictions, they were concerned about the inconsistent communication and application of rules during the transition out of lockdown which may serve to exacerbate already rising mental health issues among autistic people. The participants viewed research participation and engagement with increased relevance during the pandemic and welcomed efforts to conduct research using online methods of communication. Although not deterred from participating in-person, they would need more assurance derived from rigorous rationale and stricter safety protocols.

Conclusions: The COVID-19 lockdown had a varied effect in the lives and routines of autistic people evidenced in their mixed experiences that included seeing opportunities and facing challenges. However, healthcare providers and researchers need to be mindful of rising mental health issues during the pandemic, especially for people who were already vulnerable. Apart from the challenges, the findings suggest that the pandemic may have offered opportunities for innovation in research processes (e.g., wider use of remote methods of consent and data collection) enabling more autistic people to engage with research and making studies more inclusive.

**422.013** (Poster) Bedtime Resistance and Parent Stress in Families of Children with Autism

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Background:

Sleep problems are reported in as many as 80% of children with autism spectrum disorders, and occur at significantly higher rates than in typically developing populations. Children's sleep problems also impact the sleep and general wellbeing of family members. This is of particular concern as parents of children with autism already demonstrate higher rates of stress than parents of both typically developing children and children with other developmental disabilities, suggesting that families of children with autism and sleep problems may be at particular risk for psychological distress. It is as yet unknown if parent stress is in part accounted for by child sleep problems, and in particular which domains of sleep problems might uniquely predict this stress. Identifying specific sleep concerns that contribute to parent stress may have implications for developing cost-effective and feasible interventions to improve child sleep, parent stress, and related child and family outcomes.

#### Objectives:

To identify the relationship between subscales on the Child Sleep Habit Questionnaire (CSHQ) and parent stress in families of children with Autism Spectrum Disorders, controlling for child irritability, autism symptom severity, and participation in a comprehensive intervention for toddlers with autism (the Early Start Denver Model) .

#### Methods:

Drawing from a cohort of children with diagnoses of ASD ( $N = 33$ ), initially recruited for a study assessing the effects of an intervention for toddlers with ASD and followed longitudinally through age 6 (Dawson et al., 2010; Estes et al, 2015), we analyzed the relationships between parent stress (Questionnaire on Resources and Stress) and child sleep problems (Child Sleep Habits Questionnaire; 8 subscales, 1 total score), controlling for child's level of autism symptoms (Autism Diagnostic Observation Schedule), child irritability (Aberrant Behavior Checklist-Community), and participation in the Early Start Denver Model (intervention vs control group).

#### Results:

CSHQ subscales Bedtime Resistance (BR) and Sleep Anxiety (SA) were significantly correlated with parent stress. No other CSHQ subscale or total score were significantly correlated. BR and SA were highly intercorrelated. BR was chosen for further analysis; SA yielded similar results. Bedtime resistance was uniquely predictive of parent stress holding ASD symptom severity, and child irritability constant. Participation in the ESDM treatment did not uniquely predict parent stress.

#### Conclusions:

Bedtime resistance uniquely predicted a proportion of parent stress, even when controlling for child irritability and ASD symptom severity in children with ASD. Behavioral interventions to address bedtime resistance may have cumulative positive effects; improving child sleep, reducing parent stress, and improving related challenges for families. Targeted intervention to address bedtime resistance may be a cost-effective, feasible, and acceptable pathway to improve outcomes for children with ASD and their families.

#### **422.015 (Poster) Caregiver Experience with Telebaby: A Telehealth Intervention Designed for Caregivers of Infants with Early Signs of Autism Spectrum Disorder (ASD)**

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**Background:** Service providers face multiple challenges delivering timely and appropriate care to infants exhibiting early signs of autism spectrum disorder (ASD). Barriers such as lack of local service providers with specialized training and lack of access to infants and their caregivers in their natural environments limit the ease and efficiency of treatment provision. The use of telehealth technology to serve families who are concerned about ASD symptoms in their infants is a promising solution (Machalicek et al., 2010; McDuffie et al., 2013; Oakes et al., 2015).

**Objectives:** Characterize caregiver experience with TeleBaby, a telehealth intervention designed for caregivers of infants with early signs of ASD.

**Methods:** Six infants (6-12 months of age) exhibiting early signs of ASD and their primary caregivers participated in this study. Treatment sessions occurred three times per week for one month for a total of 12 sessions. Caregiver coaches introduced three

treatment techniques (Step into the Spotlight, Imitation, Talking to Baby) to the caregiver and allowed for caregiver practice with immediate reflection and planning. One final treatment session was conducted after a 1-month follow-up period. Session attendance was closely tracked and caregivers participated in an exit interview in order to obtain information about caregiver perspective around acceptability of and satisfaction with the TeleBaby intervention. Caregivers had never encountered the interviewer before, and the interviewer was blind to the caregiver's and infant's level of progress throughout the course of the project. The interviewer asked a set of questions in a semi-structured format (initial questions were predetermined but the interviewer asked follow-up questions as needed). Interview questions were concerned with the caregivers' experience in their local service system and the research study. Once interviews were completed they were transcribed by research assistants blind to the purpose of the study and coded for common themes.

**Results:** Session attendance rate was high (96%) with minimal rescheduling throughout the course of treatment. Participating caregivers reported frustration with their local service providers (e.g., practitioners often dismissed caregiver concerns, adopted a "wait and see" approach, lacked capacity or experience to serve infants with high likelihood of developing ASD). All caregivers reported high acceptability and satisfaction regarding the telemedicine-delivered TeleBaby intervention. They reported minimal difficulties managing the technology components required for telemedicine visits and appreciated the liberal rescheduling policy when their infants were having an occasional off day. Caregivers found the TeleBaby intervention techniques easy to implement and particularly enjoyed the live coaching component. Very specific feedback about all aspects of the Telebaby approach will be reported. Overall, all caregivers emphasized that they would not hesitate to participate in the intervention again and would recommend the intervention to others.

**Conclusions:** As more information is becoming available about symptoms of ASD in infants, an increasing number of families are seeking help from practitioners. Telemedicine-delivered intervention approaches such as TeleBaby can give service providers valuable intervention options that allow coaching in the natural environment, reduce the need for clinic and caregiver resources such as clinic space and travel time, and make scheduling/rescheduling fairly easy.

**422.016 (Poster)** Caregiver Perspective on the Psychosocial and Behavioral Impact of COVID-19 on Children with ASD in the United States

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**Background:** Children with ASD are particularly vulnerable to the disruptions caused by the COVID-19 pandemic. With the loss of school and private therapy services, establishing routines and maintaining structure within the home environment has been extremely challenging.

**Objectives:** The aim of this study was to conduct a parent/caregiver survey to assess the psychosocial and behavioral impact of COVID-19 on children with ASD in the United States to understand family support needs.

**Methods:** An anonymous parent/caregiver survey was conducted online between June and August 2020. All demographic and clinical variables were summarized using frequencies and percentages for categorical variables. Logistic regression was conducted to examine the associations of ASD individuals' socio-demographic or clinical characteristics with the parents' ability to manage their child's behaviors following the COVID-19 outbreak.

**Results:** Data from 700 complete survey responses were included representing 555 (79.2%) male and 138 (19.7%) female children. The mean±SEM age of responders' children was 10±4.68 years. There were 534 (76.3%) children with at least 1 sibling. Of these, 96/534 (17.9%) had an ASD diagnosis. The majority of caregivers completing the survey were married/cohabitating, highly educated, and reported an annual household income above \$75,000. ASD comorbid conditions were prevalent (500/700; 71.4%), with anxiety (65%), ADD/ADHD (58.2%), and sensory processing disorder (56.8%) frequently reported. Around 15% of children were non-verbal, while 42% had fluent language.

Behavior problems were present in 573 (81.9%) children before the outbreak of COVID-19. Out of these children, 218/573 (31.1%) were receiving ABA therapy, and 190/573 (27.1%) were receiving pharmacological interventions. There were 98 (14%) parents reporting that they or another family member were concerned for their safety due to their child's behavior, and 24 (3.4%) children were taken to the Emergency Room due to behavioral concerns. Many parents reported difficulties in managing their child's structured on-line school activities (72.4%) and free time (69.7%) during the lockdown. Parents also reported more difficulties in managing their child's behaviors (57.6%), therapies (57.6%), and sleep schedule (47.7%), while challenges in managing meals/dietary needs (27%) and medications (8.6%) were less of a concern. Several factors significantly affected the parents' ability to manage their child's behaviors post COVID, including: level of language ( $p=0.038$ ), difficulty in falling asleep ( $p=0.018$ ), and being under the care of a neuropsychiatrist/psychologist due to behavioral concerns ( $p=0.000$ ; Table 1).

Finally, 480 (68.5%) parents reported that they needed behavioral support for their child, whether center-based (16.4%), home-based (38.4%), or web-based (13.7%) during the lockdown. In preparation for the start of the new school year, 371 (53%) parents were planning to send their child to school for in-person learning, 96 (13.7%) would opt for remote learning, while 125 (17.9%) would opt for a combination of in-person/remote learning.

**Conclusions:** Parents/caregivers reported that the COVID-19 pandemic had a wide-ranging impact on their child/family. Escalating behaviors and changes to structures and routines affected the parents' ability to manage their child's day-to-day activities, and a large proportion of parents felt that behavioral support in or out of the home would have been a helpful intervention.

**422.018 (Poster) Challenging Behavior in ASD and Its Effects on Family**

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**Background:**

Caring for children with Autism Spectrum Disorder (ASD) has the potential to influence the health and well-being of all family members. Conflicting data exists on the psychological and emotional functioning of siblings of children with ASD. Some studies indicate average functioning and advanced psychological well-being (Dempsey, Llorens, Brewton, Mulchandani, & Goin-Kochel, 2012; Macks & Reeve, 2007). On the other hand, a recent meta-analysis of typically developing siblings of individuals with ASD, results from 69 independent samples indicated that ASD-Sibs have significantly more negative outcomes than comparison groups overall. Specific areas of functioning in which ASD-Sibs fared worse include internalizing behavior problems, psychological functioning, beliefs, social functioning, and the sibling relationship functioning (Shivers, Jackson and McGregor, 2019).

**Objectives:**

To assess the relationship between multiple demographic characteristics and the behavioral symptoms of the sibling with ASD and the participant's anxiety symptoms, quality of life, and psychological functioning.

**Methods:**

Research participants included 50 siblings of children diagnosed with ASD. The participants were selected via recruitment flyers. Inclusionary criterion included having a biological sibling with ASD, living with sibling, and between the ages of eight and 18. Exclusionary criteria included the participant experiencing any known developmental disorders. Measures included:

1. Demographic Questionnaire to assess family composition, total income, parent reported stress on a 6 point scale and other relevant variables
2. Child behavior checklist (CBCL, school-age): represents a 112-item questionnaire assessing a child's symptomology, as defined by the DSM-5.
3. Aberrant Behavior Checklist (ABC): represents a 58-item questionnaire assessing problem behaviors of children and adults with ASD and other developmental disabilities
4. KINDL: assesses children and adolescents' perception of their own quality of life.
5. Screen for childhood anxiety related emotional disorders (SCARED): represents a 41-item questionnaire assessing a child's anxiety.

The parents completed the Demographic Questionnaire, the ABC on their child with ASD, and the CBCL on their participating child. The participating child completed the SCARED and KINDL.

**Results:**

Using the Mann-Whitney *U* test for continuous variables and Fisher's exact test for categorical variables, results showed that parent reported stress correlated significantly with higher parent ratings on the ABC measures (Total and sum of each domain: Irritability; lethargy; Stereotype and Hyperactivity) of the sibling with ASD and higher scores of the participant on the CBCL

total T score. Parent stress was higher when the CBCL total T score was higher than the median of 54 as compared to when the CBCL total T score was lower than the median ( $p$ -value=0.014).

#### Conclusions:

While there is much variability observed in sibling literature, the impact of problem behavior in children with ASD can impact family functioning including sibling and parent emotional health. While much attention is focused on the child with ASD and their intervention, the sibling often ignored. This study clearly indicates the need for a family based approach to intervention that takes into account the emotional well-being of the entire family, their access to supports and resources to mitigate the adverse effects of behavior problems in ASD that can take a considerable toll.

**422.019** (Poster) Child Social and Executive Function Problems Relate to Caregiver Sense of Self-Efficacy and Strain in Autism  
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#### Background:

Caregivers of children with Autism Spectrum Disorder (ASD) experience many challenges. ASD has been associated with increased caregiver strain/stress and decreased self-perceived competence in caregiver/parenting abilities (i.e., caregiver self-efficacy). Deficits in both executive and social functioning associated with ASD may affect caregiver stress/strain and caregiver self-efficacy.

#### Objectives:

The present study has the following aims:

- Examine the relationship between caregiver strain and child executive dysfunction and social deficits.
- Examine the relationship between caregiver self-efficacy and child executive dysfunction and social deficits.

#### Methods:

Participants included caregivers (i.e., parents/guardians) of children with ASD ( $N = 32$ ) from a school-based executive function (EF) intervention study. Caregivers' children were primarily male (75%), between the ages of 8 and 12 ( $M = 9.54$ ) with  $FSIQ \geq 70$ , with a research diagnosis of ASD, and teacher-reported flexibility problems in the classroom. Caregivers were majority female (84.4%); caregiver age, race, and ethnicity were not available. Caregiver strain was assessed through the Caregiver Strain Questionnaire-Short Form 7, a 7-item self-report questionnaire assessing child-related caregiver strain through a 6-point Likert scale; higher composite scores indicate greater strain (CSQ-SF7; Brannan, Athay, & de Andrade, 2012), and caregiver self-efficacy was measured through the Family Empowerment Scale, Competence subscale (FES: Koren, DeChillo, & Friesen, 1992; Singh et al., 1995). Child EF was measured by caregiver report on the Behavior Rating Inventory of Executive Function (BRIEF-2; Gioia et al., 2015), which includes three indices: Behavior (BRI), Emotion (ERI), and Cognitive (CRI) Regulation. Finally, social deficits were assessed via the social problems scale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001).

#### Results:

Caregiver strain was moderately correlated with child age ( $r = .377, p = .033$ ) and behavior regulation (BRI) ( $r = .441, p = .012$ ), and highly correlated with emotion regulation (ERI) ( $r = .701, p = .000$ ), and social problems ( $r = .508, p = .003$ ) (Table 1). A simple linear regression performed to predict caregiver strain was significant ( $R^2 = .539, p < .001$ ), and the results indicated that child emotion regulation (ERI) was the lone significant predictor of caregiver strain ( $b = .825, t(32) = 3.473, p < .005$ ). All Variance Inflation Factors (VIF) were below 3.5.

Results indicated that a significant relationship exists between caregiver self-efficacy and child's social problems, ( $r = -.373, p = .042$ ).

#### Conclusions:

Our results indicate that child EF and social deficits are differentially related to caregiver well-being, such that that child emotion regulation problems are strongly related to caregiver strain, and 2) the child social problems are related to caregiver self-efficacy. These findings provide crucial focal points for tailored interventions for caregivers of autistic children. Highly stressed caregivers likely need supports for supporting children's emotional dysregulation, while those with low self-efficacy may need supports to better understand and accept their child's social interaction differences. Future studies should incorporate additional reporters and measures. Overall, better understanding the relationship between caregiver self-efficacy and strain sharpens the lens through which interventionists view and create interventions for those with ASD.

**422.020 (Poster) Comparing Patient Experience with Longitudinal Autism Care Via Virtual and in-Person Visits**

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**Background:**

Individuals with autism spectrum disorder (ASD) experience barriers to specialty medical care for their longitudinal needs. Telemedicine visits can reduce barriers like time off work, travel costs and missed school, yet implementation has been minimal. The COVID-19 pandemic necessitated conversion of traditional in-person autism medical visits to telehealth appointments. Current literature reports experiences from various specialties using telehealth. While telehealth is presumed to remove barriers to care for more remote patients and allow for similar visit experiences this is the first study to examine this in a cohort of patients with autism spectrum disorder receiving longitudinal specialty medical care

**Objectives:**

- Evaluate patient experience of receiving longitudinal autism medical care via virtual visits during the COVID19 pandemic to in-person visits
- Analyze variables impacting satisfaction with virtual visits across study participants
- Assess barriers to in-person visits compared to virtual visits

**Methods:**

Patients seen for longitudinal ASD follow up via telemedicine at a University-based Autism Center during the global pandemic (March 2020-August 2020) who also received in-person longitudinal medical care within the past 24 months were invited to participate in the study. All participants received care from the same physician at both types of visits. Eligible participants received an anonymous, REDCap survey consisting of 25 questions, with a combination of Likert scale questions regarding telehealth perceptions and multiple response questions regarding barriers and benefits. 87 participants were eligible to participate. A nominal incentive was provided for participant's time for survey completion.

**Results:**

Response rate was 44% among eligible participants with descriptive statistical analysis illustrating the average patient age as 12 years old, with a range of 3 years old to 26 years old, respondents had an average continuity of care of 7 years, ranging from 1-15. Respondents reported fast and reliable internet access from their location (79%), easy to understand instructions for the telehealth visit (87%), and no technical difficulties during the appointment (84%). The majority of patients participated in the virtual visits through video conference (89%) via a computer or tablet (81%). Most respondents (89.19%) reported benefits to telehealth, including less disruption in daily schedule, less travel expense and less time away from school. In patients who reported barriers to in-person visits, the most commonly reported barriers to visits were disruption in daily schedule (21.62%) lack of time (18.92%) and other (21.62%). The overall results suggest the two groups (positive vs poor experience) are not distinctly different in the ability to access telehealth, connectivity, internet quality, or perceived barriers to in-person visits. Lastly, the distance traveled to the appointment was associated with certain barriers and benefits among participants of the study.

**Conclusions:**

Longitudinal autism medical care is an essential component of comprehensive care for individuals with autism spectrum disorder. COVID-19 pandemic required abrupt changes to care delivery models to maintain healthcare access for individuals with chronic

conditions like autism. This study highlights the acceptability of virtual visits for patients with ASD to receive longitudinal care and supports the vital role for alternative visit types to continue beyond the COVID19 era.

**422.021 (Poster)** Development of the Self-Assessment of Autistic Traits, a New Self-Report Scale Centered in the Autistic Experience

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**Background:**

Current gold standard tools for identifying and characterizing autism have been critiqued for their lack of specificity and sensitivity, especially in older, higher IQ, and non-male individuals (e.g., Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). Information from autistic people about their inner experience of autism represents an untapped resource for enhancing phenotyping tools.

**Objectives:**

To develop a self-report autism trait questionnaire for adolescents and adults using a Community-Based Participatory Research (CBPR) approach, in which autistic self-advocates lead a team of non-autistic clinicians and researchers (Nicolaidis et al., 2020).

**Methods:**

A team of two autistic co-investigators and eight non-autistic clinical researchers employed a novel measure development procedure designed to center item generation and selection in the personal experience of autistic people. Ground rules were set for team meetings similar to the ASPIRE CBPR process (Nicolaidis, Raymaker et al., 2011, 2019). The autistic co-investigators compiled a list of internet documents written by autistic people that are regarded as seminal in the autistic community for their definitions of the autistic experience. The clinician-researchers extracted themes and descriptors of the autistic experience from the documents which were discussed and translated into 52 items. These items were refined in a two-stage modified Delphi procedure (Waggoner, Carline, & Durning, 2016). The international expert Delphi panel was comprised of 22 autistic adults (ages 25-62 years) that was diverse in terms of ethnicity (n=12 White, n=4 Black, n=4 Asian, n=2 Multiracial, n=1 unreported), gender (n=10 female, n=8 male, n=2 agender, n=2 nonbinary/genderqueer, n=1 exploring, n=1 gender fluid, n=1 "complicated"), and gender diversity status (n=6 self-identified as gender diverse), where participants could endorse more than one classification/identity within each category. The Delphi experts were asked to accept or reject and suggest improvements for each of the 52 descriptors generated by the team. The quantitative data was tabulated and used to prioritize item inclusion, and suggestions for improving items or additional items were addressed with the full research team. This resulted in a comprehensive list of 84 items. In the second step of the Delphi, 19 of the original 22 experts gave feedback on whether or not each of the 84 items was an 'essential' component of the autistic experience. 26 items were eliminated because less than 70% of the Delphi experts deemed them 'essential', resulting in 58 iteratively revised descriptors of autism.

**Results:**

This process resulted in the Self-Assessment of Autistic Traits presented in a format and language that is consistent with common autistic thinking styles, increasing accessibility for respondents. The iterative, team intensive process led to an item pool that addresses aspects of autism that are not captured with current diagnostic or phenotyping tools, such as autistic inertia and changes in abilities outside of early childhood. Many traits that are typically pathologized are presented in a positive manner more in line with how autistic people commonly describe them.

**Conclusions:**

Participatory research techniques with autistic partners leading researchers and clinicians in the development of new assessment tools yields a measure which introduces understudied components of the autistic experience.

**422.022 (Poster)** Engaging Community Stakeholders in Qatar to Develop Support Programs for Young Adults with Autism

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**Background:** Autism services in Qatar are expanding rapidly, but focus primarily on diagnosis and treatment of young children (Alshaban et al., 2017). The shortage of qualified autism providers and minimal opportunities for autistic youth to participate in school, work, and community (Qoronfleh et al., 2019) have led to a growing population of autistic youth transitioning to adulthood, many with co-occurring intellectual disability, who have substantial unmet needs for behavioral support and instruction in critical life skills. There are growing calls for supports for autistic adolescents and young adults. Consideration of local, stakeholder-driven priorities and values is critical to the success of these support programs, particularly given the integral role of families in adult support services (Jeon et al., 2005).

**Objectives:** Identify the priorities for support programming for autistic adolescents and young adults in Qatar, with particular focus on respite care, utilizing family and stakeholder input

**Methods:**

Researchers from Children's National (Washington, DC) collaborated with researchers and community leaders from the Qatar Foundation and World Innovation Summit for Health (Doha, Qatar) to evaluate perspectives regarding adults supports, including respite care, with families of autistic people (n=11) and providers/ community stakeholders (n=20). Participants were recruited via electronic media, flyers, and word-of-mouth, by leveraging existing networks (e.g., schools, clinics, family support groups). Participants responded via brief questionnaires (focusing on respite care) and/or focus groups (covering broader adult support services), conducted separately with providers, in English, and families, in both English and Arabic. Most providers were non-Qatari (90%, n=18) and had advanced degrees (95%, n=19). Most had several years of experience working with individuals with autism (M=15.8, SD=10.28). Relatively few providers specialized in adults (20%, n=4). Most family members were non-Qatari (54.54%, n=6), with children ages 5-31 years (M=16.82, SD=7.21). Families were evenly divided in language preferences between Arabic (n=6) and English (n=5). All family participants were mothers. Qualitative analysis of focus groups was conducted using inductive thematic analysis.

**Results:** The team generated 5 codes encompassing 22 subcodes, then used inductive thematic analysis, which identified four themes: 1) the need for trust and reliability in providers and systems 2) the importance of quality of life 3) the desire for meaningful inclusion of autistic individuals in their communities and 4) challenges navigating services systems. As reflected in the themes, stakeholders emphasized opportunities for autistic adults to develop their skills and make significant community contributions, in addition to valuing respite care. On questionnaires, families endorsed reducing stress (54.55%, n=6), attending to personal business (e.g., work, medical appointments, social activities) (45.56%, n=5), and increasing their ability to care for their child (45.56%, n=5) as motivators for seeking respite. Extensive prior experience in autism was endorsed as critical for trusting respite care providers (72.72%, n=8).

**Conclusions:** Families in Qatar endorsed clear interest in services for young adults with autism, with a focus on opportunities for learning, building purpose, and being actively included in communities. This study highlights the value of including both provider and family expertise in developing new service models.

**422.023 (Poster) Examining Sibling Relationships Among Children on the Autism Spectrum: Clinical Characteristics of Autism and Links with Sibling Status and Rivalry**

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**Background:** Research suggests that having a sibling is a more consistent predictor of well-being in children on the autism spectrum when the quality of the sibling relationship is considered (Walton & Ingersoll, 2015; Tomeny et al., 2017). Little is known, however, about how the varied clinical characteristics of autism spectrum disorder relate to sibling relationship quality. Autism symptoms, behavioural difficulties, and communication ability have been associated with peer and parental relationships,

but investigations of their link with sibling relationship quality, particularly sibling rivalry (i.e., parental differential treatment) and relative status (i.e., sibling leadership and support of one another) are lacking.

**Objectives:** To examine how autism symptoms, behavioural difficulties, and communication ability relate to sibling status and rivalry for children on the autism spectrum. We hypothesized that greater autism symptoms would be associated with lesser status and more rivalry. We expected an interaction between behavioural difficulties and communication ability for rivalry and status, such that rivalry would be higher among children with lesser communication ability and more behavioural difficulties whose multiple challenges may demand more parental attention; we expected relative status would be lower among these children as they may be less dominant over their siblings.

**Methods:** Data from a subsample of children on the autism spectrum ( $n = 92$ ) were drawn from Time 8 of an ongoing longitudinal study, the *Pathways in ASD* study. Assessments of autism symptom symptoms (*Autism Diagnostic Observation Schedule Calibrated Severity Score [ADOS CSS]*; Gotham et al., 2009), behavioural difficulties (*Child Behaviour Checklist Total Problems [CBCL-TP]*; Achenbach and Rescorla, 2001), and communication ability (*Vineland Adaptive Behaviour Scale, 2<sup>nd</sup> Edition Communication Subscale [VABS-II-C]*; Sparrow et al., 2005) were included. To investigate interaction effects, a median split based on the *VABS-II-C* was applied to group the autistic children by communication ability. The parent-reported *Sibling Relationship Questionnaire (SRQ)* measured domains of sibling relationship quality: *Relative Status* and *Rivalry*. Hierarchical multiple regressions, controlling for child assigned sex at birth and birth order, tested hypotheses.

**Results:** Autism symptoms (*ADOS CSS*) were not significantly associated with *SRQ Relative Status* ( $b = 0.08, p = 0.46$ ) or *Rivalry* ( $b = -0.06, p = 0.61$ ). There was a significant interaction between behavioural difficulties (*CBCL-TP*) and communication ability (*VABS-II-C*) for *Rivalry*, but not *Relative Status* (Table 1). Sibling rivalry was more strongly associated with behavioural problems in the group with lower communication ability (Figure 1).

**Conclusions:** Unexpectedly, the predictor variables were unrelated to sibling status, suggesting that these factors may not play a role in this aspect of sibling relationships for children on the autism spectrum. Autism symptoms were not associated with sibling status or rivalry. In line with our hypothesis, however, we found an interplay between children's behaviour and communication abilities, such that behavioural difficulties enhanced rivalry for when those children also had communication difficulties. It may be that siblings compete more with these children for their parents' attention. Overall, our findings underscore the importance of considering the clinical characteristics that may be associated with the sibling relationships of children on the autism spectrum.

**422.025 (Poster)** Experiences of Uruguayan Individuals with ASD and Their Families , during COVID-19 Pandemic. **G. Garrido<sup>1</sup>, M. Montenegro<sup>2</sup>, C. Amigo<sup>3</sup>, C. Nava<sup>4</sup>, N. Barrios<sup>5</sup>, A. Rosoli<sup>6</sup>, S. H. Cukier<sup>7</sup>, R. A. Garcia<sup>8</sup>, C. S. Paula<sup>9</sup>, J. M. Suárez<sup>10</sup>, M. Segura<sup>11</sup>, D. Valdez<sup>12</sup> and A. Rattazzi<sup>1</sup>.** (1)Universidad de la Republica, Montevideo, Uruguay, (2)University of Texas Rio Grande Valley, Edinburg, TX, (3)Clinica de psiquiatria pediátrica Facultad de medicina, UDELAR, Montevideo, Uruguay, (4)Psychological Science, University of Texas Rio Grande Valley, Edinburg, TX, (5)Fleni, Capital Federal, ARGENTINA, (6)Projects, Organización Estados Iberoamericanos, Santo Domingo, Dominican Republic, (7)PANAACEA, Buenos Aires, Argentina, (8)Clinica Las Condes, Santiago, Chile., Santiago, CHILE, (9)Developmental Disorder Program, Universidade Presbiteriana Mackenzie, São Paulo, Brazil, (10)Clínica de psiquiatria pediátrica, Facultad de medicina, Universidad de la Republica, Montevideo, Uruguay, (11)Facultad de medicina, Montevideo, Uruguay, (12)Universidad de Buenos Aires- FLACSO, Buenos Aires, Argentina

**Background:** As the world reels with a worldwide pandemic due to the rapid spread of the virus COVID-19, children with autism spectrum disorder (ASD) experience a plethora of adjustments. The suspension of services and shelter in place has created added issues to an already vulnerable community. National Emergency state was declared by the Uruguayan government on March 13 th, with the consequent shut down of schools and restricted access to health care centers. Confinement was voluntary with a significant adherence of the population. Changes and unknown circumstances can be particularly difficult for children with ASD who benefit from routine and structure. The present study attempted to understand changing patterns for children with ASD and their families, and possible relationships between screen time, behavioral and emotional changes, and treatment changes.

**Objectives:** To explore the new reality of children with ASD in terms of treatment, screen time and behavioral and emotional changes. To explore the relationship between these variables.

**Methods:** A total of 259 caregivers of children and adults with ASD in Uruguay completed an anonymous online survey. The survey was comprehensive and explored sociodemographic information about the individual with ASD, changes experienced during the pandemic including treatment changes, screen time utilization, and behavioral and emotional changes. A descriptive inferential analysis was conducted to understand modifications experienced by individuals with ASD and their families. Chi-

square tests of independence were conducted to understand relationships between treatment changes, screen time, and behavioral and emotional changes. The study has the approval of the research ethics committee.

Results: Response rate was 7,5/100.000 inhabitants. Total sample consisted of caregivers of 215 male children and 44 females. During the pandemic, 23.9% of children found their treatment suspended, while 64.5% received services either by phone or through a videoconference platform. Interestingly, 74.5% saw an increase in screen time. Regarding changes in behaviors and emotions, 44% of children experienced difficulty sleeping, 59.6% experienced difficulty concentrating and paying attention, 53.5% changes in eating (either less or more than before), 63.9% became more irritable, 48.8% increased their wandering, and 47.6% of children experienced mood changes. Chi-square tests of independence were performed to understand relationship between variables and treatment during the pandemic. Significant relationships existed between treatment during the pandemic and eating changes  $\chi^2(5, N = 259) = 11.793, p = .038$ , and mood changes  $\chi^2(5, N = 259) = 12.490, p = .029$ . Screen time utilization was related with: sleep changes  $\chi^2(16, N = 259) = 49.416, p = 0.028$ , difficulty concentrating and paying attention  $\chi^2(16, N = 259) = 46.589, p = 0.000$ , eating changes  $\chi^2(16, N = 259) = 26.906, p = 0.043$ , irritability  $\chi^2(16, N = 259) = 26.884, p = 0.043$ , and behavioral dysfunction  $\chi^2(4, N = 259) = 9.961, p = 0.041$ .

Conclusions: Changes due to life modifications by the pandemic situation had an impact in different areas of autistic individuals. We hypothesize that increased screen time could be moderating the relationship between treatment and behavioral and emotional changes in children during the pandemic.

**422.026 (Poster)** Exploring Psychological Distress and Burden Among Informal Caregivers of Children with Autism Spectrum Disorder in Ghana, West Africa

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Background: Caring for children with autism spectrum disorder (ASD) can be a particularly challenging task for carers and other family members especially in a resource restricted country like Ghana. Globally, there have been reports of increased psychiatric morbidity and burden among caregivers children with ASD. Limited studies in this area have been done in Africa and more specifically Ghana.

Objectives: This study determined the prevalence and predictors of psychiatric morbidity and level of burden among informal caregivers of children with ASD attending the outpatient clinics of selected hospitals in Ghana.

Methods: The study was a cross sectional survey among sixty one informal caregivers of children with DSM-V diagnosis of ASD attending the outpatient clinics of three selected hospitals in Ghana: Komfo Anokye Teaching Hospital Psychiatry clinic, Accra Psychiatric Hospital and Pantang Psychiatric Hospital. The instruments used for data collection were sociodemographic and clinical questionnaire, the 12-Item General Health Questionnaire (GHQ-12) and the Zarit Burden Interview (ZBI). Data was analysed using statistical package for social sciences.

Results: Sixty one (61) caregivers participated in the study. The mean age of children was  $10.64 \pm 5.15$  years, with male predominance (73.8%). The mean age of the informal caregivers was  $43.53 \text{ years} \pm 8.97$ ; mostly female gender (80%). The prevalence of psychiatric morbidity among the caregivers was 45.9% and 36.1% of them had a high level of burden of care. Factors significantly associated with psychiatric morbidity and a high burden were the child's birth order and unemployment status of the caregiver. On multiple linear regression with adjustment for age, predictor of high burden was found to be the employment status of the caregiver (adjusted OR=7.69, 95% CI 1.71-34.68,  $p = 0.008$ ) while predictor of psychiatric morbidity was caring for a child who was either a second or third born as compared to caring for a first born child (unadjusted OR= 4.03, 95% CI 1.28-12.62,  $p = 0.017$ ).

Conclusions: Psychiatric morbidity and burden are highly prevalent among informal caregivers of children with autism in Ghana. There is an urgent need to incorporate mental health screening for caregivers of children with ASD into routine care of their children. The findings are implicated in the inclusion of caregiver outcome in the management of persons with autism in Africa.

**422.027 (Poster)** Families Facing COVID: The Association between Perceived Vulnerability for Contracting COVID-19, and Suspected or Confirmed Cases of COVID-19 and Caregiver Mental Health

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**Background:** Individuals with neurodevelopmental conditions, including autism, are disproportionately impacted by COVID-19. For example, the fatality rate for COVID-19 is significantly higher for people with intellectual and developmental disabilities compared to other individuals, demonstrating the vulnerability in this population (Turk, 2020). Many caregivers of children with autism report high levels of stress and poor quality of life, and unfortunately COVID-19 can exacerbate these negative outcomes. Contributing factors for caregiver distress during COVID-19 may include financial strain, loss of supports/services for their child, and a fear of themselves or their child contracting the disease. It is natural for these caregivers to worry about their child's vulnerability in relation to contracting COVID-19, along with a heightened risk for other physical health issues (Goines, 2010). To date, no study has examined the link between COVID-19 related concerns and caregiver stress in caregivers of autistic children and youth.

**Objectives:** To fill this gap, the present study aimed to 1) describe how families have experienced COVID-19; and 2) determine how perceived vulnerability for contracting COVID-19 is related to caregiver well-being and stress.

**Methods:** 625 caregivers of individuals with autism participated in this large Canadian study, by completing an online questionnaire between June and July 2020. Caregiver stress was measured using the Perceived Stress Scale (PSS), and physical health was assessed through self-reported symptoms and diagnoses, including questions of perceived vulnerability of contracting COVID-19. Correlations examined associations between caregivers perceived stress, and physical health.

**Results:** Caregivers were primarily female (60%) and married or common law (89%). Over half of respondents reported moderate levels of stress (85%), and high anxiety (68%), with a small proportion of caregivers reporting high levels of stress (9%). Just under half of caregivers reported themselves being high risk or vulnerable to contracting COVID-19 and/or developing severe complications, while 41% of caregivers indicated their child was at high risk or vulnerable to contracting COVID-19. Very few (2%) reported having a confirmed case of COVID-19, while slightly higher (6%) reported a suspected but not confirmed case of COVID-19. Of these 51 individuals who had suspected or confirmed case of COVID-19, the majority of symptoms (96%) were reported as mild to moderate, with few reporting severe symptoms (4%). Preliminary results show a significant association between feelings of vulnerability for both the parent ( $p<.001$ ) and child ( $p<.001$ ) and total score of perceived stress scale. However, no association between reporting of a confirmed positive COVID-19 and parental stress, nor between either a confirmed or suspected COVID-19 case in the caregivers extended family or close friend.

**Conclusions:** As expected, caregivers of children with autism are experiencing increased levels of stress during COVID-19. Perceived vulnerability of contracting the virus is related to caregiver stress, but caregiver stress was not related to confirmed cases of COVID-19 in the family. Findings highlight the how the fear of COVID-19 can impact caregiver mental health and quality of life. Future research must focus on supporting caregivers of children with autism, especially as COVID factors may exacerbate stress levels.

**422.028 (Poster) Family Perceptions of Access to Healthcare Services for Autistic Young Adults Who Receive State Developmental Disability Services**

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**Background:**

Preventive health care is vital for autistic young adults (YA) given high prevalence of co-occurring health and psychiatric conditions and early mortality. Approximately 87% of autistic YAs live with family – a higher rate than peers with other disabilities. Adults with developmental disabilities (DD) who live with family are the least likely to receive preventive health care compared adults with DDs in other settings. No published studies have examined the intersectionality between age, race/ethnicity, household income and complexity of health needs in regard to healthcare access for autistic adults.

**Objectives:**

This study examined prevalence and factors of consistent healthcare access among autistic YA (ages 18-25 years) who lived with family and received DD services. We compared autistic YA to autistic adults (26+ years) versus YA and adults with mental, behavioral, and other developmental disabilities (MBDDs).

**Methods:**

We analyzed data from the National Core Indicator's Adult Family Survey of families of state DD service users ages 18 and older who lived with the respondent and received at least one direct service in addition to service coordination. We used bivariate

analyses and multivariable logistic regression to examine family report of whether the individual with a disability was able to always access healthcare when needed and the role of sociodemographic and complex health needs in predicting consistent care.

#### Results:

Approximately 70% of autistic YAs had consistent access to health care when needed, similar to autistic adults but lower rates than those with MBDD. Odds of consistent healthcare access were higher among autistic YA who were Black (OR=3.27,  $p<.001$ ) or who lived in a rural area (OR=1.65,  $p<.05$ ), and lower among those with co-occurring health conditions (OR=.67,  $p<.05$ ) or who needed extensive personal care supports (OR=.66,  $p<.05$ ). Additionally, only 55% of families of autistic YAs felt that the primary care doctor understood needs related to their family member's disability – similar to families of autistic adults – both significantly lower rates than families of MBDD peers.

#### Conclusions:

Nearly one-third of autistic YA who lived with family and receive state DD services had difficulty consistently accessing needed health care, echoing findings of lower rates of preventive care among DD service users who lived with family. Upstream preventive care is critical for addressing high rates of chronic, poorly managed health conditions and increased hospitalizations in adults on the spectrum. Although state DD services are typically funded through Medicaid waivers to reduce unmet health needs, it is unclear how waivers differentially prioritize, require or support medical care unless the individual is enrolled in a managed care program. Additional research is needed to determine whether participation in Medicaid managed care may explain increased access to consistent healthcare among minority YA and other subgroups. Additional innovations in Medicaid waivers could help improve access to care for YA who live with family, including additional supports for families who often must coordinate care despite inadequate preparation for healthcare transition. Other policy recommendations include improved surveillance of healthcare services in this population.

#### **422.029 (Poster) Gender Differences in Perceived Stigma Among Latino Caregivers**

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Background: Current literature has rarely explored the effect of stigma in Latino populations with Autism Spectrum Disorder (ASD), and much of the available research has been conducted in the U.S., hindering generalization to the diverse, global Latino population. Gender is one of the most studied variables in ASD research. Yet, in terms of the role of gender on perceived stigma among diverse populations, no up-to-date research could be identified. Cultural and societal norms shape the different gender roles, and that could extend to the way ASD is experienced among females and their families.

Objectives: The present study explored the relationship between gender and perceived stigma among caregivers of children and adults with ASD in Latin America and provide a cross-cultural account of ASD.

Methods: A total of 2,817 caregivers of children and adults with ASD from six Latin American countries completed an anonymous online survey. Caregivers completed a survey that besides asking sociodemographic and clinical information about the individual with ASD, asked about perceived stigma. Participants answered to four statements targeting stigma which included helplessness, worry, discrimination, and negative impact of ASD. A combined variable of all four statements was created to assess gender differences in terms of agreement to all statements. A descriptive inferential analysis was calculated to understand caregivers' experience with perceived stigma.

Results: For the combined variable "Perceived Stigma," 59.9% of caregivers experienced some form of perceived stigma. Caregivers of female children reported a 7.7% higher agreement to having experienced perceived stigma. In addition, there were statistical differences when considering gender ( $\chi^2=8.203$ ,  $p=0.004$ ) age group ( $\chi^2=7.857$ ,  $p=0.049$ ), and country of residence ( $\chi^2=57.932$ ,  $p=0.000$ ). Caregivers of females (66.3%), pre-school aged children (63.2%), and those from Brazil (67.2%) reported the highest rate of "Perceived stigma"

Conclusions: Caregivers of female children with ASD in Latin America might have a difficult time when attempting to help their children navigate in a society with strong-held pre-determined cultural norms. When observing stigma within a social-cognitive

approach, especially considering Latino/a cultures placed value on societal norms, a distinctive picture emerges. It is possible that Latinos/as importance placed on the roles of *marianismo*, *machismo*, and *familismo* could be influencing stigma. Specially, the role of women in terms of *marianismo*, the idea of females having to endure suffering with dignity and being nurturing and self-sacrificing. This in combination with *machismo*, the notion that males are stronger, and *familismo*, loyalty to family connections, could place females with a mental disorders in a position with a different set of hardships when going against cultural norms. This multi-cultural inclusion allows for a better understanding of the experience among Latino caregivers' concerning perceived ASD stigma, which may ultimately improve access to services and better advocacy programs for Latino individuals and their children with ASD.

**422.030** (Poster) How Do You Talk about Autism?: Label Preferences within the North American Autism Community  
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#### Background:

Understanding the terminology preferences of autism community members is an important step towards avoiding ableist language (Bottema-Beutel et al., 2020). For example, “person-first” language (i.e., “person with autism”) is common in scientific and popular discourse, but many Autistic self-advocates have criticized this in favor of “identity-first” language (i.e., “Autistic person”; Sinclair, 1999).

Given ongoing debates about the use of person-first versus identity-first language in publishing (Vivanti, 2020), documented differences in how these labels are perceived by Autistic and non-Autistic people (Kenny et al., 2015), and the potential that person-first labels may increase the stigma associated with autism (Gernsbacher, 2017), it is important to gain a widespread understanding of the terminology used and preferred by members of the autism community. Surveys of autism terminology preferences have been conducted in the UK (Kenny et al., 2015) and Australia (Bury et al., 2020), but to our knowledge, there have been no large-scale efforts to study this question in North America.

#### Objectives:

We conducted a large survey to investigate autism terminology preferences of people with a connection to autism in North America.

#### Methods:

In consultation with Autistic adults, we developed an online survey asking participants to indicate which terms they use, how likeable and offensive these terms are, and how they would rank them (from the label they like the most to the label they like the least). Free-text boxes allowed participants to explain their preferences.

The survey was distributed through national autism organizations and local chapters across the US and Canada, as well as on social media. 785 North American adults completed the survey (608 self-identified or with an autism diagnosis, 177 with a different connection to autism).

#### Results:

The results demonstrate widely-shared attitudes as well as notable variability. As Figure 1 shows, respondents overwhelmingly preferred using identity-first terms such as “Autistic” and “Autistic person” vs. other terms, including “person with autism.” However, respondents who were not Autistic said that they would use the term “person with autism” more often than Autistic respondents did (34% vs. 17%, respectively).

The rankings in Figure 2 demonstrate a similar pattern. When participants were asked to rank 10 possible labels, the most common top choices were “Autistic” (67%) and “Autistic person” (38%). However, variability in participants’ preferences can be seen as well: For instance, “Person with autism” was the last choice for 26% of Autistic participants and 13% of non-Autistic participants. But it was also the top choice for 3% of Autistic participants and 17% of non-Autistic participants. Analyses of participant liking of terms, perceptions of term offensiveness, and perceptions of term utility are ongoing.

#### Conclusions:

Consistent with previous studies (Bury et al., 2020; Kenny et al., 2016), the terms “Autistic” and “Autistic person” were most preferred by adults in the autism community, although there is considerable diversity of opinion as well. Efforts should be made to defer to Autistic individuals’ preferences, but the patterns described here suggest that identity-first language is preferable for widespread communications among the North American Autistic community.

**422.031 (Poster)** How Does a Participatory Mentorship Program for Autistic University Students Function during a Pandemic? **K. Gillespie-Lynch<sup>1</sup>**, B. Kofner<sup>2</sup>, E. Ilyes<sup>3</sup>, J. Delos Santos<sup>4</sup>, C. Frka<sup>5</sup>, M. Armstrong<sup>6</sup>, E. Yamakado<sup>7</sup>, S. Shevchuk<sup>8</sup>, A. Riccio<sup>9</sup>, S. K. Kapp<sup>10</sup>, J. Herrell<sup>11</sup> and D. DeNigris<sup>12</sup>, (1)Department of Psychology, College of Staten Island; CUNY Graduate Center, Brooklyn, NY, (2)CUNY, NY, NY, (3)Graduate Center; CUNY, Brooklyn, NY, (4)Hunter College, City University of New York, New York, NY, (5)CSI, Staten Island, NY, (6)Washington University of St. Louis, St. Louis, MO, (7)Washington University of St Louis, St. Louis, MO, (8)College of Staten Island, CUNY, Staten Island, NY, (9)Department of Psychology, The Graduate Center, City University of New York (CUNY), New York, NY, (10)Department of Psychology, University of Portsmouth, Portsmouth, United Kingdom, (11)CUNY School of Professional Studies, New York, NY, (12)Psychology & Counseling, Fairleigh Dickinson University, Madison, NJ

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**Background:** As autistic students increasingly enter college, they often exhibit academic strengths (Bakker et al., 2019) yet face social, executive functioning and self-advocacy challenges (Accardo et al., 2019). Supports for autistic students are often neither evidence-based nor informed by their perspectives (Barnhill, 2016). Although promising programs have emerged (Kudder & Accardo, 2018), prior research has *not* provided sufficient opportunities for neurodivergent students to guide program development. Obviously, the transition to online education in response to COVID-19 has been very stressful for many students. However, online education can also provide unique opportunities to work together to develop supports.

**Objectives:** Describe the process through which a *participatory* mentorship program (in which neurodivergent students play leadership roles in developing, delivering, and evaluating programming) transitioned from in-person to online.

**Methods:**

Our no-cost program is designed for autistic students but open to those with other disabilities. Although our goal since program inception was for the program to be participatory, becoming truly participatory took time. Seventeen students/alumni with disabilities (12 autistic) have become mentors thus far.

Students choose to attend an hour per week of one-on-one mentorship, group meetings, or both. Group curriculum is selected/developed based on assessments and group discussions.

In the Spring of 2020, group meetings were led by a doctoral student once a week. In the Fall of 2020, group meetings, offered twice a week, include a Creative Exploration Group where students share and discuss their art (led by a neurodivergent life/executive coach) and a structured Skills Development group (led by two autistic graduate students who guide discussions about autism, executive functioning, social relationships, and media literacy).

Mentees can complete assessments for gift cards, but are under no obligation to provide data. In 2020, we conducted assessments with a smaller set of students than usually participate in assessments (those who were interested in doing assessments completely virtually). In the Spring, 14 students completed pre-tests and 10 completed post-tests. In the Fall, 10 students completed pre-tests.

**Results:** In the Spring of 2020, we observed improvements in self-esteem from the beginning ( $M = 75.9$ ) to the end ( $M = 92.4$ ) of the term ( $p = .04$ ). Although no other changes were statistically significant (likely due to low power), numeric improvements (on the range of 10 points or more on a scale of 100) were observed across a number of domains including self-advocacy, public speaking (the virtual group meetings involved multiple opportunities for students to practice speaking about their interests, hopes, and concerns), planning, communication, self-regulation, and job skills. All students but one reported that they were very satisfied with group meetings. This student was somewhat satisfied, the second highest rating. All students who attended one-on-one mentorship reported that they were very satisfied with mentorship.

**Conclusions:** By collaborating with neurodivergent students, we have developed a program that has proven quite resilient to moving online during the pandemic. Students have gained valuable skills as mentors, researchers, and public speakers. Students have weathered stressful events together and discussed difficult topics, including differences in political opinions, in constructive ways.

**422.032** (Poster) I Can Actually Do It without Any Help or Someone Watching over Me All the Time and Giving Me Constant Instruction..? Autistic Adolescents' Accounts of Using Video Game and Online Networking While Gaming  
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**Background:** Despite evidence suggesting social media and video game play use are popular recreational activities that co-occur during online play time, the interaction between the two and its impact on an individual's well-being, to account for the growing inclusion of social networking within video game design, is virtually unknown for autistic online users who have been presented as unhealthy users.

**Objectives:** The present study aimed to facilitate our understanding of the motivators, functions and the emotions associated with recreational activities that include online gaming and networking while gaming.

**Methods:** A mixed methods design was used to establish the background profile of the autistic teenagers using quantitative data (severity of autism, sensory profile, medical history, loneliness scale and online motivation questionnaire). To achieve a wealthy and comprehensive understanding, one-to-one semi structured interviews were also employed to capture the detailed perspectives of the autistic adolescents.

**Results:** The male teenagers were aged 13–15 years ( $M = 13.75$  years,  $SD = 0.60$ ). Majority of teenagers identified as White (92%), with one identifying as Black. All 12 participants reported moderate to high levels of motivation for online gaming on all factors of motives. The most prevalent among the motives was Recreation ( $M = 4.00$ ,  $SD = 0.67$ ) which included enjoyment and entertainment as reasons for engaging in game play. Escape also featured as a prominent motive ( $M = 3.98$ ,  $SD = 0.57$ ) where being able to forget about daily hassles and real life were scored highly. Social ( $M = 2.54$ ,  $SD = 0.68$ ) and Skill Development ( $M = 2.54$ ,  $SD = 0.49$ ), although still a moderately high motivator, were reported as the least prominent motives by participants. Specifically, gaming for company or to sharpen senses were not seen as important motivators for gaming by participants. Themes analysis revealed the following themes; (i) Perceived benefits of video gaming and networking (sense of agency, cultivating positive emotions, adding a sense of achievement, manageable challenge and self reward to daily life), (ii) Perceived functions of video gaming and networking (escapism from a hostile world, prevention of low mood and anxiety), (iii) Perceived motivations of video game and networking (experience of a different life that is not possible, opportunities to feel connected with others), (iv) Perceived consequences of video gaming and networking (parental conflicts, postponing other self-care activities, neglecting school-related work)

**Conclusions:** The themes highlight that the online gaming experience provides a rich source of satisfaction for autistic teenagers. Video games provide an uncomplicated space to express themselves and a rich source of fulfilment from situations that are often not satisfied in their real world. This study reaffirms the importance of acquiring autistic CYP's unique perspective to fully understand their personal lived experiences and the implications to their well-being. Further research needs to unfold elements which have not been given the necessary attention in existing literature in order to appreciate the autistic teenagers' experience of using video games and online networking while playing games and capture the depth and breadth of what it means to be an autistic young person online.

**422.033** (Poster) Impact of a Sibling Support Group on Relationship Quality and Siblings' Knowledge of Autism Spectrum Disorder (ASD)

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**Background:** Siblings of children with ASD have a unique lived experience. The literature regarding the impact of this experience on their psychological wellbeing has been mixed, with some studies reporting increased adjustment difficulties (Shivers et al., 2018), and others finding that siblings are well-adjusted (Dempsey et al., 2011). Likewise, studies investigating the quality of sibling relationships when one child has ASD have highlighted both positive and negative aspects of the relationship (Kaminsky & Dewey, 2001). Finally, Glasberg (2000) found that siblings acquire delayed knowledge about the nature of autism.

Support groups for siblings of children with disabilities (e.g. Sibshops; Meyer & Vadasy, 1994) have been developed to address these needs. However, research investigating their impact is limited, with studies yielding mixed results with regard to improvements in unaffected siblings' psychological wellbeing (Tudor & Lerner, 2015). There is some evidence that psychoeducational groups improve siblings' knowledge about ASD (Brouzos et al., 2017). Few studies have investigated the impact of sibling support groups on sibling relationship quality.

**Objectives:** To evaluate the effectiveness of a sibling support group in improving the quality of sibling relationships and siblings' knowledge of ASD.

**Methods:** Nine 10-week sibling support groups for unaffected siblings of children with ASD were conducted across two sites (Yale Child Study Center and Virginia Tech Center for Autism Research). Support groups were based on the Sibshop model (Meyer & Vadasy, 1994), with additional activities targeting knowledge of autism and coping with stress. Participants (N=41) ranged in age from 6 to 17 (M=9.86, SD=2.86), although groups were composed of similarly aged children to ensure matched developmental level. The Sibling Relationship Questionnaire (SRQ), Parent- and Self-Report forms (Slomkowski et al., 2001) and the Satisfaction with the Sibling Relationship Questionnaire (SSRQ; McHale & Gamble, 1989) were administered pre- and post-group to assess the quality of the sibling relationship. Participants were also interviewed pre- and post-group with the Concepts of Autism Protocol (CAP; Glasberg, 2000) to assess their knowledge of the nature of ASD and its implications on their siblings' lives. Interviews were coded by raters blind to pre/post timepoint, utilizing the Developmental Conceptions of Autism Category System (Glasberg, 2000).

**Results:** On the SSRQ, siblings self-reported significant improvement in their overall satisfaction in the sibling relationship ( $p=.008$ ). On the SRQ, parents reported a significant reduction in negative behaviors within the sibling relationship, both by the sibling with ASD ( $p=.026$ ) and by the unaffected sibling ( $p=.007$ ), while no changes were found in positive behaviors or in siblings' self-reported ratings. On the CAP, siblings showed significant improvements in their knowledge about ASD ( $p<.001$ ), but no change in their understanding of its implications.

**Conclusions:** The sibling support group was effective in improving participants' overall satisfaction in their relationship with their sibling with ASD, in reducing negative behaviors, and in improving knowledge of autism. It will be important to replicate these findings through a randomly controlled trial with a larger sample size. These findings highlight the value of including sibling support groups within service provision for families affected by ASD.

**422.034 (Poster)** Influence of Parental Experience on ASD Knowledge and Identification: A Mixed Methods Approach  
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**Background:** Knowledge about child development is essential to positive child outcomes and parenting skills and is influenced by many factors, such as number of children raised. Limited research exists regarding the relation between parental experience and autism spectrum disorder (ASD) knowledge or identification.

**Objectives:** The current study examines how parenting experience relates to self-report ASD knowledge and recognition of ASD symptomology.

**Methods:** A total of 211 participants ( $M_{age}=33.08$ ,  $SD=8.74$ ; 89.2%=White; 54.0%=Non-Hispanic; 52.8%=Female) completed an online study. Procedures included a demographics questionnaire, random assignment to a vignette depicting characteristics and symptoms of ASD without mentioning the diagnosis, an attention check, and mixed-method intervention-seeking measures addressing level of concern and action to seek treatment. Qualitative responses were coded as 0 being "No Recognition" and 1 being "ASD recognition" (defined as any ASD terminology). Participants completed the Autism Knowledge Questionnaire (ASK-Q) evaluating ASD knowledge. Parenting experience was defined as the number of children reported in the demographics questionnaire.

**Results:** Correlations and binary logistic regression models examined sex, ASD knowledge, and parenting experience in predicting ASD recognition. 57.1% of the sample were parents (a majority had 1-3 children) and 34% recognized ASD. See Table 1 for bivariate correlations.

Sex, ASD Knowledge, and parenting experience significantly predicted ASD recognition,  $\chi^2(5)=33.88$ ,  $p<.01$ . The model explained 20.0% (Nagelkerke  $R^2$ ) of the variance in ASD recognition and correctly classified 70.0% of cases. ASD knowledge significantly contributed to predicting ASD recognition (Wald( $df=1,211$ )=20.94,  $p<.01$ ).

The second model included the interaction between ASD knowledge and parenting experience and it also significantly predicted ASD recognition,  $\chi^2(5)=34.15$ ,  $p<.01$ . Similar to model 1, 21.0% (Nagelkerke  $R^2$ ) of the variance in ASD recognition is explained and 69.0% cases are correctly classified. ASD knowledge also significantly contributed to predicting ASD recognition (Wald( $df=1,211$ )=9.61,  $p<.01$ ).

Conclusions: Sex was related to ASD recognition and ASD knowledge, potentially due to cultural effects in which women and mothers are the primary caregivers and thus are more experienced with child development. Self-report ASD knowledge was related to ASD recognition, suggesting individuals applied learned ASD knowledge to the vignettes when recognizing concern and determining need for evaluation. Individuals may rely on this knowledge in real-world situations (e.g., observing their own child) to make similar decisions.

The finding that parenting experience did not uniquely predict ASD recognition is concerning because parent knowledge about child development is important in fostering healthy child outcomes. Some participants (both parents and non-parents) confused ASD symptoms for misbehavior and attention-seeking, demonstrating concern about social development/skills, without clear identification of ASD features. Previous research supports a similar lack of ASD knowledge in parents of typically developing children. Together, these findings support a gap in parenting education on ASD. Identifying gaps in parenting knowledge is significant for child outcomes because they may carry implications for future parent interactions with pediatricians, teachers, and other healthcare professionals. These findings support the need for improved parent education on child development patterns and ASD.

**422.035 (Poster)** Investigating Mental Health in Autistic Children and Young People during the COVID-19 Pandemic: Preliminary Findings from the Astar Cohort

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**Background:** The COVID-19 pandemic has had widespread impact on daily life for all and the effects on children and mental health are areas of concern (Holmes et al., 2020). Autistic children may experience the effects of the pandemic differently to the general population. They already have substantially increased rates of mental health disorders (Simonoff et al., 2008) and 10-15% display challenging behaviours that mean they cannot attend mainstream schools and participate in family and community life in the typical ways. While they are a highly vulnerable group, we have limited understanding of how the pandemic is affecting them, who is most severely affected and how best to target limited community-based interventions to those most in need.

**Objectives:** We surveyed the ASTAR cohort to explore the interplay between pre-existing vulnerabilities measured at earlier timepoints and the additional stressors of COVID-19 on autistic children and their families.

**Methods:** The ASTAR cohort ( $N=83$ ) were involved in a pilot evaluation of group-based parenting interventions that aimed to reduce disruptive behaviour and anxiety amongst 4–8 year olds (ISRCTN91411078, as part of the Improving Autism Mental Health project [IAMHealth], [www.iamhealthkcl.net](http://www.iamhealthkcl.net)). Participation criteria were designed to be as inclusive as possible. No exclusion for IQ or levels of disruptive behaviour/anxiety was used to screen into the study. During the COVID-19 pandemic (children aged 6:0–11:10 years), we administered a brief parent-report survey to understand the child's emotional and behavioural experiences. The survey also covers other pandemic-related factors such as infection and self-isolation experiences, and changes in education, family life and parental employment. The survey is being used with another autism cohort (QUEST) and with clinical populations in 8 countries, allowing for comparison across the studies. Semi-structured interviews with 18 purposefully sampled parents of verbal ( $n=9$ ) and minimally verbal ( $n=9$ ) autistic children explored a variety of experiences in detail and factors that promote resilience.

**Results:** Sixty-seven parents (94% mothers) of autistic children (48% verbal, 52% minimally verbal; 84% male) split across mainstream (58%) and specialist education (42%) participated. Non-participating families did not differ from participating families in relation to: child age, verbal ability, gender and education provision, nor parental employment or household income. Figure 1 displays the parent-reported impacts on the child's relationships and education. Most reported a change in education arrangements even though government stipulation was for education to remain in person for children with special educational needs. The impact on relationships varied, with a large proportion of parents reporting parent-child, sibling and friendship relationships had not changed. Table 2 shows initial themes from the qualitative interviews. Both positive and negative impacts were felt across all key domains of child development. Access to appropriate services and supports was a key challenge for families. Further thematic analysis of the interviews, and regression analyses exploring whether pre-existing vulnerabilities measured at earlier timepoints predict COVID-19 outcomes will be completed.

**Conclusions:** The COVID-19 pandemic has had widespread impact on all of society. Understanding the impact on autistic children and who are most severely affected is important for care planning.

**422.036** (Poster) Learning from COVID-19: Barriers and Facilitators to Coping with Routine Disruption in Autistic Children with Complex Support Needs

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**Background:**

The COVID-19 pandemic has created a major, worldwide disruption to people's daily lives. In March 2020, the UK imposed a nationwide lockdown with specific public health guidelines, including restricted freedom of movement, reduced access to non-COVID-related services, and isolation/shielding of 'at risk' groups, including those on the autism spectrum. Autistic people are expected to have experienced disproportionately increased anxiety, distress and other mental health difficulties as a result of changes to their daily routines. In addition to a tendency to engage in insistence on sameness behaviours, autistic individuals are more susceptible to intolerance of uncertainty - a major contributor to heightened anxiety in autism (Wigham et al., 2015). The radical changes to daily routines alongside high levels of uncertainty around COVID-19 are likely to have adversely affected autistic people's well-being and mental health. Amongst the autistic community, children with complex support needs are especially reliant on access to educational, health and social care services and were particularly vulnerable to restricted access to support during lockdown.

**Objectives:**

This study aimed to capture the factors that acted as barriers or facilitators to coping with the first COVID-19 UK lockdown (March 23<sup>rd</sup> to May 10<sup>th</sup> 2020) from the perspective of parents of autistic children with complex support needs.

**Methods:**

Nine parents of autistic children attending Special Education Needs Schools were interviewed about their child's experience of the first month of the UK lockdown. The International Classification of Functioning, Disability and Health (Bölte et al., 2014) was used as a framework to design semi-structured interviews to identify personal and environmental factors that were either helpful or detrimental to adapting to the lockdown. Topics included changes to routine, sleeping and eating patterns, access to resources and support, and child- and parent-led coping strategies and behaviours. A thematic analysis was conducted to identify overarching themes.

**Results:**

Findings indicated that disruption to children's routines often elicited delayed challenging behaviours: children coped well with short-term changes but struggled with long-term disruptions. Verbal ability played an important role in children's ability to cope: more proficient children were able to understand the situation, which led to greater tolerance in the short-term, but increased anxiety and disproportionate preoccupation with COVID-19 in the longer term.

In terms of coping strategies, parents generally chose to limit potential distress and conflict by minimising the demands on the child, and facilitating a child-led daily schedule. From the child's perspective, coping strategies consisted of identifying and staying within a self-defined 'safe space', and substituting former activities (school, friends/relatives, in-person activities) with others (TV, parent, online activities).

Availability of resources, particularly support networks (school and family) and space (opportunities for sensory or physical activity) also positively contributed to the child's (and parent's) ability to cope.

**Conclusions:**

The current study provides valuable insights to support autistic children with complex needs and their families as we continue to experience successive levels of disruption from the COVID-19 pandemic. These insights also provide the foundation to better support autistic people with complex needs through major disruptions in the longer term.

**422.037** (Poster) Learning from the Experts: Evaluating a Participatory Autism and Universal Design Training for University Teaching Staff

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Background: Autistic students in higher education settings often possess academic strengths coupled with difficulties with social interaction, self-advocacy, executive functioning, mental health, and stigma (Accardo et al., 2019; Sturm & Kasari, 2019). This highlights a mismatch between autistic students' needs and traditionally academically-focused higher education accommodations. Limited autism understanding among staff and peers may exacerbate challenges faced by autistic students (Cage & Howes, 2020), but online training can increase autism understanding among peers (Gillespie-Lynch et al., 2015). In this study, autistic and non-autistic scholars developed an online training program for university staff, to improve their understanding and appreciation of autism and Universal Design (UD; teaching strategies designed to be accessible and engaging for diverse learners).

Objectives:

1. To examine hypothesized predictors of reduced autism appreciation and less positive attitudes toward UD at pre-test: male gender, heightened social dominance orientation (SDO), and being in a STEM field.
2. To assess whether online training about autism and effective strategies for engaging diverse students improves staff understanding and appreciation of autism and Universal Design.

Methods: University teaching staff completed the following online: a pre-test survey, two training modules (about autism and UD, respectively), a post-test survey, and a follow-up survey a month after post-test. Ninety participants (mean age = 41.7; 25.7% male, 22.8% STEM disciplines) completed pre-tests and seventy have completed post-tests thus far. Measures included an autism knowledge scale ( $\alpha = .89$ ), an adapted social distance scale, focusing on autism appreciation (e.g. "I would welcome the opportunity to have an autistic colleague";  $\alpha = .90$ ), a measure of positive attitudes toward UD (Lombardi et al., 2015;  $\alpha = .87$ ), confidence in understanding UD, and a SDO measure (Ho et al., 2012).

Results:

In regression analyses, male gender ( $\beta = -.40$ ;  $p < .001$ ), heightened SDO ( $\beta = -.21$ ;  $p = .02$ ), and reduced autism knowledge ( $\beta = .20$ ;  $p = .002$ ), but not being in a STEM field ( $\beta = -.09$ ;  $p = .31$ ), predicted reduced pre-test autism appreciation. Only greater autism knowledge ( $\beta = .28$ ;  $p = .008$ ) was associated with more positive attitudes toward UD. Confidence in one's understanding of UD was lower among faculty in STEM fields ( $\beta = -.28$ ;  $p = .007$ ).

Repeated-measures ANOVAs ( $n = 70$ ) revealed improvements in autism knowledge ( $p < .001$ ,  $\eta^2 = .16$ ), autism appreciation ( $p = .001$ ,  $\eta^2 = .17$ ), attitudes toward UD ( $p = .015$ ,  $\eta^2 = .08$ ), and confidence in UD understanding ( $p < .001$ ,  $\eta^2 = .73$ ) associated with training.

Conclusions: Substantial variation in autism appreciation and attitudes toward UD was apparent among faculty who completed the training. Being male, believing that inequality is just, and lower pre-test autism knowledge predicted less pre-test autism appreciation and more reluctance to use UD to reach diverse students. Being in a STEM field was *not* associated with attitudes but was associated with reduced confidence in one's understanding of UD. Preliminary evidence supports the efficacy of our training in improving knowledge and attitudes. Full results will be presented at the INSAR conference; data completion is due December 2020. Once this study is complete, training materials will be made available open-access.

**422.038 (Poster)** Lived Experiences of Families As Youth with Autism and Mental Health Concerns Transition to Adulthood  
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Background:

In Canada, within a given year 20% of our population will experience a mental illness and this increases to 50% over the lifespan (<https://www.mentalhealthcommission.ca>) with over 70% of adults with mental illness developing symptoms in childhood or

adolescence (Government of Canada, 2006). For youth with autism the figures for mental illness are four or five times higher than youth in the general population (Toskia, Hastings, Emerson, Lancaster & Berridge, 2011). These individuals and their families face challenges accessing appropriate and unified care, often encountering multiple barriers within and between systems of care. As a result, participation in their communities is curtailed limiting their social inclusion.

#### Objectives:

As part of a larger initiative, this study explored the lived experience of families supporting youth with autism (ASD) and mental health (MH) concerns as they transition to adulthood. Social connectedness and awareness of mental health services within their communities and how these aligned with the support needs of the youth were explored.

#### Methods:

A questionnaire and interview based on a semi-structured interview guide were administered. Quantitative and NVivo-based qualitative analyses, respectively, were used. Interview analysis (the focus in this presentation) consisted of 1) line-by-line coding, 2) review of codes for textual linkages both within and across transcripts and 3) examination of the emerging categorization of codes in yielding themes. Interrater review of data by leaders in the ASD and MH field verified themes.

#### Results:

Ten parents of youth with autism and mental health concerns were interviewed. The youths' age ranged from 10-26 years. Comorbid MH concerns included anxiety, depression, emotional dysregulations, Oppositional Defiance Disorder, Obsessive Compulsive Disorder, conduct disorder and psychosis. The majority of parents indicated little support from family/friends/neighbours when they needed it and were overwhelmed. They were concerned about their child's behaviours and the safety of their child, their family and the broader community. Many shared that they were uncomfortable seeking supports for their child or themselves because they don't 'fit' within the system and their community, and that this struggle has been exacerbated as their youth transitions to adulthood.

Parents were more familiar with, and had accessed services from, autism service providers more so than MH services. When supports to address complex behaviours and MH concerns had been found, the most significant barrier to access were youth's unwillingness to engage. In refusing counselling and other related programming, prior negative experiences were commonly cited as a deterrent.

Despite limited services (40% had no or less than an hour of support/week) and limited youth engagement, parents recognized strengths in their youth (i.e., independence, developing interests, success in school/employment) and themselves (i.e., advocacy, developing coping and innovation).

#### Conclusions:

These findings suggest that earlier experiences with services may pave a path, suggesting the need for early engagement and supports that are generative for children and youth. Support to parents in navigating services and strategy development are desired and needed. Clinical and program implications will be offered.

**422.039** (Poster) Marital Status of Parents Raising Individuals with Autism Spectrum Disorder (ASD) from Age 2 to 25  
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Background: Previous estimates of divorce in families raising a child with ASD have hovered around from 25% (Hartley et al., 2010; Baeza-Velasco et al., 2013) with an 80% figure that was much cited, but never supported (Freedman et al., 2012). Consensus suggests the risk of divorce in parents of children with ASD remains high into their child's early adulthood (Hartley et al., 2010). In addition, there is limited information about the factors that contribute to divorces in families of autistic individuals at different points of development.

Objectives: In this study, we describe changes in marital status and predictors, both child and family factors, of divorce over a 20-year period among parents of a longitudinal sample of 247 individuals with ASD (n = 192) and other developmental disabilities (n = 55).

Methods: Participants included parents of 247 individuals, in a longitudinal study, initially referred for ASD and other developmental delays. Kaplan-Meier survival curves were fit to determine the risk of divorce over time in the sample as a whole. Cox proportional-hazards models were then fit separately for both child (Gender, Birth Order, ADOS CSS Social Affect and RRB scores, ASD Diagnosis, Highest Verbal IQ and Vineland Daily Living Scores) and family factors (Mother's Age, Level of Education, Race and total number of children) to determine which factors affected the risk of divorce in the sample. Variables with statistically significant regression coefficients were combined into a final model.

Results: Approximately 36% of individuals with ASD experienced a parental divorce at some point in their life in our sample by age 25. Two peaks emerged for more frequent divorces: when children were under age 5 and between ages 10 and 15 (see Figure 1). Higher daily living skills in the children reduced the risk for divorce ( $b=-.025$ ,  $se=.012$ ,  $p=.04$ ); while families where the oldest sibling had autism were at higher risk for experiencing a divorce than only children ( $b=.81$ ,  $se=.36$ ,  $p=.02$ ), with other birth orders in between. Risk of divorce was significantly higher for parents with a high school education or less ( $b=0.83$ ,  $se=.29$ ,  $p=.004$ ). An increase in mother's age at child's birth reduced the risk for divorce ( $b=.06$ ,  $se=.02$ ,  $p=.009$ ). The overall rate of individuals experiencing a divorce is about 22% for those without an ASD diagnosis and 35% for those with an ASD diagnosis.

Conclusions: The results suggest that divorce in families of children with ASD remains high through early childhood into early adulthood as suggested earlier (Hartley et al., 2010). Understanding the factors that contribute to these changes in marital status may help us better support families across time.

#### **422.040 (Poster)** Moving from Participants to Engaged Collaborators: Designing and Piloting a Stakeholder Developed Research Consultation Model

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Background: Approaching stakeholders as engaged collaborators in the research process represents a significant, yet necessary shift in the field in order to better align early intervention research with the values, goals and needs of the stakeholder community. Although there are existing models for stakeholder engagement in research activities, none had been developed specifically by members of the autism stakeholder community.

Objectives: Given the unique needs and perspectives of the ASD community, the goal of this work was to collaboratively develop and pilot a model for stakeholder engagement across different stages of early intervention for ASD-related research.

Methods: Project STEER (Stakeholders Engaged in Early Intervention Research) represents an effort to develop a sustainable model that puts stakeholders at the center of autism spectrum disorder (ASD) early intervention research and is driven by 10 adults with ASD, 10 parents of children with ASD, and 10 community-based clinicians/policy makers in Columbus, Ohio and Chicago, Illinois. Project STEER has used a Participatory Action Research approach, focused on collaborative reflection and systematic data collection, to create and pilot strategies for stakeholder engagement across different stages of the research process. We began with a series of discussion and engagement activities to identify when and in what way stakeholders could collaborate in the research process. Project STEER members provided feedback on a draft stakeholder consultation model. The first half of the consultation model was then piloted with a sub-group of STEER stakeholders. Acceptability and feasibility data were collected after each opportunity for stakeholder engagement across the early stages of research.

Results: Project STEER members identified specific times within the research process that would be particularly critical for stakeholder engagement including: active involvement in the development of project aims, recruitment materials, data collection and interpretation, and dissemination strategies. It was emphasized that opportunities for flexible participation and a range of communication strategies (e.g., taking a survey vs. attending a meeting) were necessary to ensure engagement from the broad and representative stakeholder community. The draft consultation model included stakeholder engagement in (1) creating research questions and study aims, (2) study population and demographics, and (3) recruitment and participant materials including informed consent. Identified engagement activities included group Zoom calls, online surveys, and interactive activities (e.g., creating a social media post for study recruitment). Stakeholders rated the Zoom calls, online surveys and interactive activities as acceptable and feasible.

Conclusions: This work offers a first step in identifying creative strategies for stakeholders to be considered as partners, rather than simply participants, in the early intervention research process. Importantly, additional efforts are planned to pilot the second half of the stakeholder consultation model, including (4) data analysis/interpretation and (5) dissemination strategies (planned for

Winter 2021). As stakeholders have led the development of this model, we expect that the final result will be a more acceptable, engaging and sustainable model for stakeholders to serve as active collaborators in research.

**422.041 (Poster) Parent Perspectives on Use of Cannabis in Children with Autism Spectrum Disorder**

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**Background:** As the prevalence of autism spectrum disorder (ASD) continues to rise, so has interest in the identification of effective treatments. While there are some evidence-based pharmacologic treatments for ASD, many parents turn to alternative therapies with anecdotal support and popularity through social media. Children with ASD are reported to receive complementary and alternative medicine interventions at rates much higher than the general population. There has been an increasing interest in the use of cannabis as more states are passing legislature to approve use both recreationally and in certain health conditions such as ASD. Parents are often reluctant to talk about these alternative treatment options with their child's medical providers, leading to decreased opportunities for parents and providers to engage in shared decision making.

**Objectives:** The primary objective of this study is to determine the different reasons parents have for considering cannabis treatment for their child with ASD and what additional personal beliefs and outside information helped inform those decisions. A secondary objective is to determine parental knowledge of cannabis risks and benefits and the relationship between that knowledge and other factors reported to influence decisions about cannabis use in a child with ASD.

**Methods:** We completed semi-structured interviews with 21 parents of children with ASD. We asked open-ended questions about perspectives regarding cannabis use for youth with ASD as well as potential symptom targets. Parents were also asked where they would look for more information regarding cannabis use in ASD as well as comfort with speaking with their child's medical provider. All interviews were audio-recorded and professionally transcribed. Transcriptions were coded using a systematic approach to generate codes and identify themes. Prior to the interview, each participant completed a survey collecting demographic information, rating of child's level of impairment, as well as current and past medication history. This information will be used to look for any associations with identified themes.

**Results:** All respondents were biological parents, age 27-52 years, with 33% having a graduate/professional degree. Most children were male (N=18), age 18 months-10 years, and 38% were rated by parents as requiring substantial support related to symptoms of ASD. Based on preliminary findings, participants reported limited prior knowledge of cannabis use in children with ASD and cited the internet and social media groups as sources of information to further their knowledge. Many parents remarked that cannabis was appealing as a treatment option because they felt it was a more "natural" option compared to conventional medications and less likely to lead to dependence or negative long-term consequences. Many participants felt comfortable asking their child's doctors about cannabis.

**Conclusions:** While many studies have previously looked at parental attitudes toward complementary and alternative treatments for children with ASD, this is one of the first to ask explicitly about cannabis use. As medical and recreational use of cannabis gains legalization, more parents may be interested in it as a treatment option. The results of this project will help clinicians better understand the factors driving parental decision-making in using cannabis for children with ASD.

**422.042 (Poster) Parent Stress Affects Their Responses to Children's Negative Emotions in ASD Families**

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**Background:** Researchers have found that child ASD symptoms can place a substantial strain on the family system. These parents and caregivers present significantly higher stress levels and lower wellbeing than those of parents of children with other disorders or whom are typically developing. Research has demonstrated the deleterious impact of parent stress on child behaviors and outcomes. However, more research is needed to understand the mechanisms of this impact. One likely mechanism is the way parents respond to their child's expression of negative emotions. Literature in this area distinguishes between supportive (i.e., emotion-focused, problem-focused, and expressive encouragement), unsupportive (i.e., distressed and punitive), and distressed parenting responses styles. This study is one the first to examine the relationship between parents' stress level and their style of responding to negative emotions by children with ASD.

**Objectives:** The present study aims to understand the influence of parent stress on their responses to negative emotions and behaviors in children with ASD. We hypothesize that greater parent stress levels will be associated with more unsupportive and distressed responses, and fewer supportive responses.

**Methods:** Participants are 28 primary caregivers of children with ASD who were recruited for a larger study on family patterns in ASD. The Parenting Stress Scale is an 18-item measure that indicates stress related to parenting. The Coping with Children's Negative Emotions Scale consists of 12 scenarios in which youth may experience negative emotion. Parents identify how they would respond to each scenario using six responses which they are to rate on a 7-point Likert-scale regarding their likelihood of responding that way. We ran descriptive statistics on each parenting response style, and we conducted linear regression models to better understand relations between parent stress and responses to negative child emotion.

**Results:** Parents reported higher rates of supportive response styles, including emotion-focused ( $M = 5.75, SD = .69$ ), problem-focused ( $M = 5.67, SD = .69$ ) and expressive encouragement ( $M = 5.23, SD = .98$ ), compared to unsupportive or distressed styles. Heightened parent stress levels were associated with increased frequency of distressed responses to child emotion ( $B = .04, p < .01$ ). However, the relationships between stress level and the use of supportive or unsupportive responses were not statistically insignificant ( $p > .05$ ).

**Conclusions:** Our findings indicated that while parents reported using more supportive response styles, higher parent stress levels predicted a more distressed pattern of responding to negative child emotions. It is likely that increased parent stress impacts their choice of parenting behavior during their child's heightened emotional moments. The effect may be more pronounced in distressed parenting responses, over supportive and unsupportive parenting responses. These findings suggest that future studies should aim to support parents of children with ASD and provide them with tools of stress management in order to improve their parenting as well as to improve the parent-child relationship.

**422.043 (Poster)** Parent-Child Integrated Music Program Supports Parent Well-Being in Families of Young Children with and without ASD

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**Background:** There is increasing recognition of the need to consider parent and family well-being when evaluating programs for young children with ASD, including consideration of how to support family involvement in community activities. Community music activities may provide an ecologically valid setting to support both children with ASD and their parents. Social musical experiences play an important role in parent-child interactions and early childhood peer interactions. Musical experiences promote prosocial behavior, emotional well-being, and social connection in children and adults. A limited but emerging body of research also shows support for the use of musical activities and music therapy to promote children with ASD's social communication skills. However, little research has examined the impact of music programs on parents of children with ASD.

**Objectives:** To examine changes in parents' affect and sense of connection to others during their participation in an integrated parent-child weekly music class program.

**Methods:** Thirty-three children with ASD (27 male,  $M=43.8$  months) and thirty TD children (17 male,  $M=37.0$  months) and their parents participated in an integrated twelve-week music program that embedded parent training and peer interaction in shared musical activities. At the start and end of their first, middle, and last session, parents completed the Positive and Negative Affect Schedule (PANAS) to measure their affect in the moment and the Inclusion of Other in the Self (IOS) scale to measure their connection to their child and to other class members. Children's engagement states were coded from videos of each child's first and last sessions. Mixed-models were used to examine changes in parent affect, connectedness to others, and children's engagement throughout the program.

**Results:** Parents' PANAS positive affect scores significantly increased and PANAS negative affect scores significantly decreased within sessions (i.e., from start to end of a given class),  $p's < 0.01$ . Parents' IOS connection scores to other class members significantly increased within sessions,  $p < 0.001$ , and parents reported greater connectedness to other class members at the middle and last session versus the first session,  $p < 0.001$ . Parents' sense of connectedness to their own child did not change, likely due to high baseline ratings of connectedness. Parent ratings did not differ by diagnostic group for any measure. While children's active engagement during classes increased over the sessions,  $p < 0.001$ , it was not associated with parent affect or connectedness ratings.

**Conclusions:** Participating in an integrated parent-child music class was associated with increased positive and decreased negative affect for parents of children with and without ASD, as well as an increased sense of connection to other class members. These findings are consistent with studies of musical experiences in other populations (e.g., parents of infants). The positive impact of program participation for parents, which was not related to children's class engagement, may reflect parents' direct participation in social musical activities, as well as broader involvement in shared parenting experiences. By creating positive emotional experiences and increasing connections to others, community or therapeutic music programs may be a viable context for supporting family well-being in families of children with and without ASD.

**422.044 (Poster)** Parent-Reported Behavioral Changes during the COVID-19 Pandemic in Children with Autism Versus Other Conditions

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**Background:**

Following the declaration of the COVID-19 pandemic in March 2020, numerous countries imposed intensive measures to manage the outbreak, namely social distancing and confinement. There is evidence of negative impact of these measures on children, including increased anxiety and depression (Xie et al. 2020) and behaviour difficulties (Orgilés et al. 2020). Paradoxically, positive impacts following a previous outbreak have been documented, e.g. increased family and social support and more attention to self-care activities, all of which negatively correlate with post-traumatic stress (Lau et al. 2006). These findings suggest a pattern of resilience in response to stressful events. Currently, little is known about the impact of the COVID-19 pandemic on the functioning of children with autism.

**Objectives:**

We examined parent-reported behavioural changes during the COVID-19 pandemic and assessed whether the changes differed in children with autism versus other conditions.

**Methods:**

In close collaboration with stakeholders following a Participatory Action Research approach, we integrated COVID-19 guidance recommendations for persons with disabilities from WHO and UNICEF into an online survey, which was originally developed as part of the *UNICEF-WHO Global Report on Developmental Delays, Disorders, and Disabilities* to describe current practices and resources available to these populations. The online survey was available from June 11 - July 21, 2020, resulting in a convenience sample of caregivers across provinces and territories in Canada. This study focused on parent-reported changes on 12 domains of functioning (Table 1). Each domain was rated as either 'worsening', 'no change', or 'improving.' We conducted multinomial regressions to assess the extent to which condition (autism versus other conditions) predicted parent-reported behavioural changes on each domain.

**Results:**

Out of n=883, 35% of respondents identified as caregivers of a child with autism. Improvement in at least one domain of functioning was reported by 65.8% of parents. No change in functioning was the most frequently endorsed response averaged across all domains (50%), followed by worsening (31%). The domain most frequently endorsed as improved was daily living skills (25%), followed by health problems (20%), and diet/eating difficulties (19%). We found that individuals are more likely to report worsening than improvement on the following domains if they are caregivers of children with autism rather than caregivers of children with other conditions (Table 1): mental health, diet/eating, social interaction, repetitive behaviours, safety concerns, sensory issues, and education compared to caregivers of children with other conditions. There were no significant differences in likelihood to report worsening compared to improvement on other domains between caregivers of children with autism and those of children with other conditions.

**Conclusions:**

Some parents reported improvement in some functioning suggesting evidence of resilience from the COVID-19 pandemic among children with autism and other conditions. However, evidence of worsening of functioning was also concerning, with parents of children with autism being more likely to rate their children as showing worsening of functioning compared to parents of children with other conditions. Future studies examining predictors of resilience are needed to tailor support for all families with a child with autism and other conditions.

**422.045 (Poster)** Parental Distress and Parenting Quality in Families of Children with ASD: Evidence for Potential Compartmentalization

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**Background:** Parents of children with autism spectrum disorder (ASD) report increased levels of stress and mental health challenges (Hayes & Watson, 2013). Parent well-being is generally considered a key contributor to parenting behavior (Belsky, 1984); however, parents of children with ASD often appear to provide similar quality parenting despite higher personal distress (e.g., Baker et al., 2010). This apparent contradiction may be explained by an increased ability of parents of children with ASD to compartmentalize their parenting, buffering spillover from their own emotional state.

**Objectives:** The current study examined the compartmentalization hypothesis by testing whether associations between parental distress and positive parenting were lower and/or less consistent for families of children with ASD as compared to those of children with neurotypical development (TD).

**Methods:** The sample consisted of 73 preschool children with ASD and 55 children with TD (age 2-5 years) and their primary caregivers (12% fathers). The groups with ASD/TD differed on child gender (78%/46% male), caregiver race/ethnicity (32%/56% Caucasian, non-Hispanic), and caregiver education (TD higher), so each of these were controlled in regressions. Parents completed measures relating to their stress (PSI-PD), depression (CES-D), and emotion dysregulation (DERS). Parents also reported on their positive parenting (APQ), and warmth was coded from the Five-Minute-Speech-Sample interview (FMSS).

**Results:** Status groups differed on every parenting and distress variable of interest, with TD families exhibiting healthier levels on all factors with the exception of caregiver depression, for which the group with ASD reported significantly lower levels,  $t = 3.94, p < .001$ . Families of children with TD demonstrated significant associations between parent distress and parenting for five of six correlations tested. In contrast, none of the correlations were significant for families of children with ASD, with many close to zero or in the opposite direction (Table 1). Hierarchical regressions controlling for potential confounds and main effects revealed a significant interaction between status group and a parent distress composite in the prediction of reported positive parenting,  $\beta = .36, t = 2.29, p = .024$ , such that parent distress only predicted lower positive parenting in families of children with TD,  $t = -2.08, p = .040$  (slope for ASD:  $t = 1.04, p = .30$ ; Figure 1). The interaction in a binary logistic regression predicting parental warmth did not reach significance ( $p = .10$ ). Given significant associations between group status and several demographic variables, the latter were substituted for group status as moderators and none were significant.

**Conclusions:** Data provide evidence for compartmentalization in that associations between parent distress and positive parenting were consistently lower and non-significant for families of children with ASD as compared to the TD group. These findings suggest that parents of children with ASD may be more able to buffer potential spillover from their own distress to their positive parenting. Additional resilience may be suggested by lower depression scores among the caregivers of the preschoolers with ASD. Further investigation into potential contributors to the lower positive parenting scores for families of children with ASD is required, including consideration of child characteristics.

#### 422.046 (Poster) Parental Quality of Life and Child's Community Participation in Young Children with Autism Spectrum Disorder in Singapore

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**Background:** Parents of children with autism spectrum disorder (ASD) tend to experience greater parenting stress and psychological ill-effects than parents of typically developing children. Quality of Life (QoL) of parents is increasingly recognized as a critical outcome measure in the management of children with ASD. Identifying specific child factors, which can impact parental QoL, can facilitate targeted intervention strategies

**Objectives:**

The primary aim of this study was to describe the QoL of parents of young children with ASD in Singapore and their child's community participation. The secondary aim was to identify associations, if any, between the child's community participation, severity of ASD symptoms and parental QoL.

**Methods:**

This was a cross-sectional study conducted at a tertiary developmental pediatric centre in Singapore from September to December 2019. Inclusion criteria was 1. Parent with a child with ASD aged between 5 and 8 years, and 2. Child diagnosis of ASD following clinical evaluation by a developmental pediatrician or formal psychological evaluation with the Autism Diagnostic Observation Schedule. Parents completed the Quality of Life in Autism Questionnaire (QoLA), parent version. The QoLA contains 2 subscales: part A measures parental self-rated QoL (score range 28-140, higher scores denote greater perceived QoL); part B measures perceived problems due to child's ASD-related behaviors (score range 20-100, higher scores denote fewer perceived problems due to behavior). Parents also answered questions on the frequency of their child's community participation. Descriptive statistics and T- tests were used to analyze data.

#### Results:

Parents of 48 children (72.9% males) with ASD completed the study; the mean age of children was 74.8 months (SD 23.9). The majority (67%) of children attended less than 1 social event per month and more than half (55%) attended less than 1 community event per month. The mean QoLA part A score in the cohort was 100.3 (SD 16.1); this was significantly higher for our cohort compared to other international cohorts of children with ASD (Table 1). The mean QoLA part B score was 39.6 (SD 16.4); this was significantly lower for our cohort compared to international cohorts and denotes higher perceived problems with the child's ASD-related behaviors. (Table 1) There was no significant association between parent-reported QoLA part A, QoLA part B and community participation scores.

#### Conclusions:

Self-reported QoL of parents with children with ASD in our cohort appears to be high despite children having greater problematic behaviors. Although community participation of children was sub-optimal, this was not associated with poorer parental QoL. Other child and parental factors that may contribute to QoL such as parental resilience and mental health should be explored in further research.

#### **422.047 (Poster) Predictors of Parent Activation in Caregivers of Children with ASD Using PAM-DD**

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Background: Patient activation (PA) refers to one's beliefs, knowledge, ability, and persistence to manage one's care (Hibbard et al., 2004). Importantly, PA has been shown to be related to medical and behavioral health outcomes (Hibbard & Greene, 2013). The concept has been extended to activation in parents of children with chronic health and mental conditions, including neurodevelopmental disabilities. For example, a study using a Parent Activation Measure for Developmental Disability (PAM-DD), indicated positive associations between parent activation and service satisfaction and youth outcomes, and lower caregiver stress (Crossman et al., 2020). However, there is limited research on activation in parents of children with autism spectrum disorder (ASD).

Objectives: To fill the gap, we examined child and family characteristics related to parent activation using the PAM-DD.

Methods: This study utilizes secondary data analysis of the Registry Call Back Assessment (RCBA) study, which was a longitudinal substudy of the Autism Treatment Network (ATN) Registry study (Murray et al., 2016). Participants completed a series of measures at RCBA visit 1 and visit 2, including Vineland-II, Child Behavior Checklist, Aberrant Behavior Checklist, Pediatric Quality of Life Inventory, Children's Sleep Habits Questionnaire, Caregiver Strain Questionnaire, PAM-DD, parent and child characteristics.

#### Results:

A total of 658 families completed the measures at first visit, and 407 families completed a second visit. Child participants' average age at study enrollment was 72 months (SD = 39.40). Most child participants were male (80%), White (77%), non-Hispanic (86%), and used public insurance (63%). About half of caregiver participants had college or greater education (49%), and annual incomes of \$50,000 or more (48%). Cross-sectionally, at time 1, greater parent activation was related to lower levels of child sleep issues ( $r = -.11$ ), irritability ( $r = -.12$ ), lethargy ( $r = -.08$ ), internalizing ( $r = -.16$ ) and externalizing behaviors in child participants ( $r = -.21$ ), parental concerns ( $r = -.12$ ), and caregiver strain ( $r = -.19$ ) and higher levels of peds quality of life ( $r = .15$ ) and child adaptive behaviors ( $r = .10$ ),  $p < .05$ .

Longitudinally, greater parent activation at time 2 was related to several time 1 measures: older child age at registry ( $r = .11$ ), lower levels of child sleep problems ( $r = -.14$ ), hyperactivity ( $r = -.13$ ), internalizing ( $r = -.23$ ) and externalizing behaviors ( $r = -.21$ ) in child participants, and caregiver strain ( $r = -.22$ ), and higher levels of child quality of life at time 1 ( $r = .13$ ),  $p < .05$ . In a multivariable model, older child age at initial registry ( $\beta = .12$ ) and lower levels of caregiver strain at Visit 1 ( $\beta = -.15$ ),  $p < .05$ , were related to higher levels of parent activation level at Visit 2,  $R^2 = .097$ ,  $F(7, 319) = 4.88$ ,  $p < .001$ .

Conclusions: Overall, both child and caregiver characteristics were related to parent activation. Child symptom severity and problem behaviors (e.g., externalizing behaviors) and sleep issues and caregiver strain negatively impacted caregivers' activation level. On the other hand, higher levels of adaptive behaviors and quality of life may help increase activation in parents of children with ASD.

**422.048 (Poster)** Predictors of Resilience in Parents of Children with Autism Spectrum Disorder (ASD)

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Background: Parents of children with Autism Spectrum Disorder (ASD) experience elevated stress. Research indicates an inverse relationship between stress and resilience such that higher resilience is associated with lower perceived stress, suggesting that resilience could be a promising treatment target. Preliminary efficacy data from autism-adapted resilience intervention are also promising. However, identifying predictors of resilience among parents of children with ASD requires continued investigation.

Objectives: The primary objective of this study is to examine the amount of variance in resilience scores explained by four blocks of variables (e.g., parent variables, child/parenting variables, social supports, and mental health practices) that may be related to resilience. A secondary aim was to examine the strength of individual variables within blocks in predicting resilience.

Methods: Fifty parents (15 males, 35 females, mean age = 40.5 years) of children with ASD (4:0-10:11 years) rated resilience on the Connor-Davidson Resilience Scale (CD-RISC). At the same timepoint, parents completed additional questionnaires, which were categorized into four blocks of predictors: (a) parent variables (e.g., internalizing symptoms, broad autism phenotype traits), (b) child/parenting variables (e.g., parenting stress, child problem behaviors, child social impairment), (c) social supports (e.g., degree of engagement in religion, number of close relationships), and (d) positive mental health practices (e.g., acceptance, mindfulness, optimism, self-compassion). All variables were continuous, apart from religious practice which was ordinal (0 = no religious practice, 1 = a little, 2 = some, 3 = regular practice). The regression model included the four blocks of predictors to identify the amount of variance in CD-RISC scores explained by each block. Additionally, the adjusted beta values for all predictors within each block were examined to identify significant predictors of CD-RISC scores.

Results: Regression analyses demonstrated that three of the four blocks – parent variables, social support, and mental health practices – accounted for 76% of the total variance in CD-RISC scores ( $R^2 = 0.76$ ,  $p < 0.01$ ; see Table 1). Specifically, the block of parent variables accounted for 46% of the variance ( $R^2 = 0.46$ ,  $p < 0.05$ ), social support accounted for an additional 7% of the variance ( $\Delta R^2 = 0.07$ ,  $p < 0.05$ ), and mental health practices accounted for another 22% ( $\Delta R^2 = 0.22$ ,  $p < 0.05$ ). The contribution of child/parenting variables was not significant ( $\Delta R^2 = 0.01$ ,  $p > 0.10$ ). Within the four blocks, four individual variables were significant predictors of CD-RISC scores: anxiety ( $\beta = -0.49$ ,  $p < 0.01$ ), engagement in religious practice ( $\beta = 0.38$ ,  $p < 0.05$ ), optimism ( $\beta = 0.34$ ,  $p < 0.05$ ), and self-compassion ( $\beta = 0.45$ ,  $p < 0.01$ ). In essence, higher parent resilience in this sample was associated with greater engagement in religious practices, higher optimism and self-compassion, and lower anxiety.

Conclusions: Findings indicate that certain factors – anxiety, religious practices, optimism, and self-compassion – may be particularly important in understanding resilience among parents of children with ASD. This may suggest potential treatment targets for resilience interventions. Continued investigations with larger samples and among parents of older children are needed to expand the present findings.

**422.049 (Poster)** Provider Perspectives on Usual Care and Ndbi Models within an Early Intervention System

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Background: Naturalistic, Developmental, and Behavioral Interventions (NDBIs) are evidence-based interventions for young children with ASD. There has been growing interest in translating NDBIs into the Early Intervention (EI) system to better serve young children with ASD in addition to those who have an increased chance of having ASD. In order to do so, it is also important to understand the intervention practices that young children with ASD and social communication delays already receive within

this system. To date, research has yet to examine the existing use of both manualized NDBI programs and broader NDBI strategies by EI providers. This is a gap that limits our understanding of “usual care” for children being served within the EI system and the more naturalistic capacity for the EI system to serve these children.

**Objectives:** The goals of the current study were to understand provider perspectives on how young children with ASD or social communication delays are currently served within the EI system, and how best to translate NDBI programs and strategies within this system. Specifically, this study examined: 1) provider-reported use of both manualized NDBI programs and broader NDBI strategies; 2) factors that impact the use of NDBI programs and strategies within the EI system; and 3) methods to increase the delivery of NDBI programs and strategies within this system of care.

**Methods:** Eighty-eight EI providers participated in this study. Providers were recruited if they were currently serving a child under 36-months who either had a medical diagnosis of ASD or whom they suspected had an increased likelihood of having ASD. All providers completed a measure of NDBI program and strategy use (Frost et al., 2020). Thirty-three providers also participated in a supplemental focus group. Focus groups were semi-structured and included EI providers within the same county. An iterative approach grounded in content analysis was used to analyze qualitative data.

**Results:** Providers reported relatively high competence in supporting young children with social communication delays but greater variability in the ways in which they deliver this support. Although a handful of EI providers had received training in a manualized NDBI program, the vast majority of providers described using broader NDBI strategies that were not encompassed by a manualized framework. Importantly, even providers trained in manualized NDBI programs underscored feeling the need to adapt these models by blending the terminology and strategies from different programs, and by following the caregivers’ lead in the types of strategies taught. Participating EI providers almost unanimously described that their training in NDBI programs and/or strategies was impacted by system-level factors, such as their county’s service delivery model.

**Conclusions:** This study provides insight into usual care for young children with an increased chance of having ASD who are served within the EI system. Overall, it provides important information about the inherent strengths and limitations of EI providers and systems, and foundational next steps to support the translation of early interventions that are both evidence-based and appropriately flexible to meet the needs of the EI system.

#### **422.050 (Poster) Psychological Impact of COVID-19 Pandemic in Italian Families of Children with Neurodevelopmental Disorder**

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**Background:** The restrictive measures imposed to control the COVID-19 pandemic have produced drastic changes in families' lifestyle and habits. Research on the psychological impact of the COVID-19 pandemic highlighted negative effects on the general population and, particularly, on parents (Wang et al., 2020; Zhang et al., 2020). Changes in daily routines and sudden decrease of support from educational and therapeutic environments may have strongly impacted children with NDD and their families (Nonweiler, et. al.2020). However, little empirical evidence exists about this issue.

**Objectives:** In this study, we investigated parental and child adjustment in Italian families of children with NDD and typical developing (TD) children during lockdown.

**Methods:** A total of 164 parents participated to an anonymous online survey, 82 parents of children with neurodevelopmental disabilities (NDD) and 82 parents of typically developing children (TD), matched for: parental gender, child gender, family SES, living area at the time of survey completion, child age. In the NDD group, 59% of children (N=49) had a diagnosis of Autism Spectrum Disorder and 41% of other neurodevelopmental disorders (N =33). The survey included questions about sociodemographic information, ad-hoc questions about family’s organisation in relation to COVID-19 outbreak, parental stress (10 items from the Parental Stress Scale - PSS, Berry and Jones, 1995), coparenting (brief form of the Coparenting Relationship Scale - CRS, Feinberg et al., 2012) and child externalising behaviour (*hyperactivity/inattention* and *conduct problems* scales from the Strengths and Difficulties Questionnaire - SDQ Goodman et al., 2001). For PSS, CRS, and SDQ participants were asked to respond to each item twice: firstly, with reference to the lockdown period (“Now”); secondly, with reference to the month just before the lockdown’s beginning (“Before”).

**Results:** In both groups, we found increased parental stress ( $F(1,162)=15.03, p<0.001, \eta^2=.085$ ) and child externalising behaviour ( $F(1,162)=23.59, p<0.001, \eta^2=.127$ ) during the lockdown compared to before. Moreover, child externalising behaviour were higher in children with NDD compared to children with TD, both during and before the lockdown ( $F(1,162)=10.53, p= 0.001, \eta^2=.061$ ). In the NDD group the increase of child externalising behaviour was predicted by the decrease in provided therapy. No significant changes between pre and during lockdown were found in coparenting, in either

groups. However, the quality of coparenting acted as moderator between the time spent with the child and level of parental stress during the lockdown, differently in the two groups (*NDD*: significant when coparenting was low:  $\beta = 2.86$ ,  $p = .016$ ; *TD*: significant when coparenting was high:  $\beta = 2.41$ ,  $p = .027$ ).

Conclusions: Our results pointed out the role of good coparenting relationship for limiting parental stress during pandemic home confinement, and highlighted the importance to ensure continuity in therapies for children with NDD (e.g. telehealth) during home confinement and to provide psychological support for parents.

**422.051 (Poster)** Resiliency Intervention for Siblings of Children with ASD

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Background:

Neurotypical siblings (NT sibs) of individuals with autism spectrum disorder (ASD) are at elevated risk for stress, emotional, and adjustment problems. Resiliency is the ability to cope and adapt when faced with stressful events, Thus, interventions to enhance resiliency might be particularly beneficial to NT sibs.

Objectives:

We conducted a randomized waitlist-controlled pilot trial to examine the feasibility, acceptability, and preliminary efficacy of an adapted virtual mind-body resiliency group intervention for NT sibs of individuals with ASD.

Methods:

We modified an existing resiliency intervention (the Stress Management and Resiliency Training-Relaxation Response Resiliency Program [SMART-3RP]) by incorporating results from formative qualitative research with NT sibs and parents of individuals with autism and feedback from youth advisors. From May to July 2020, we randomly assigned teens (aged 14-17) to immediate intervention vs. waitlist control. The intervention included 8 group sessions delivered by a study clinician via a video conferencing platform. We measured feasibility based on enrollment and group attendance rates; acceptability was based on post treatment survey responses. We explored group differences in pre-post changes in 1) stress coping (Measure of Current Status-A) and 2) resiliency (Current Experiences Scale) using independent samples t-tests and effect size calculations.

Results:

We enrolled 40/52 (77%) eligible teens and randomly assigned them to the intervention (n=20) and control (n=20) conditions. 18/20 (90%) of intervention participants attended at least 7 of the 8 sessions. Among 19/20 (95%) of intervention participants who completed the post treatment survey, 79% reported practicing relaxation response exercises at least “a few times a week,” and 77% found the program sessions to be at least “somewhat helpful.” Post-treatment, the intervention group showed greater improvements than the control group in stress coping ( $d=0.60$ ) and resiliency ( $d=0.24$ ).

Conclusions:

Findings from our wait-list controlled pilot trial showed promising feasibility, acceptability, and preliminary efficacy of the modified SMART-3RP program, delivered virtually for NT sibs of individuals with ASD. Small to medium effect sizes for improvements in stress coping and resilience support further testing the modified SMART-3RP for teen siblings in a larger efficacy trial.

**422.052 (Poster)** Rethinking Stakeholder Roles in ASC Early Interventions: The Development of a Stakeholder Driven Early Intervention Research Agenda

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**Background:** Multiple types of early interventions (EI) are available for children with autism spectrum conditions (ASC); yet, data about how to select, prioritize, and individualize different intervention approaches for a particular child is absent. Further, there is a clear mismatch between the range of outcomes studied in research, and the outcomes/values described by stakeholders like adults with ASC, caregivers and clinicians. This may reflect the fact that stakeholders have rarely been engaged in discussions about which outcomes and measurement approaches should be used in EI research.

**Objectives:** A goal of this project, referred to as Project STEER (Stakeholders Engaged in Early Intervention Research), is to develop a stakeholder-driven research agenda. It is expected that this agenda will help ensure better alignment between research questions that are of value to the community and those that are studied by researchers.

**Methods:** Project STEER has used a Participatory Action Research approach to develop a research agenda that reflects strategies, measurement, and outcomes relevant to ASC EI stakeholder goals and priorities. Our participatory action approach uses collaborative reflection and systematic data collection to mobilize specific actions (Baum, MacDougall, & Smith, 2006); this approach has been particularly well-suited for the current project aims given that a lack of collaboration, focus and clearly defined next steps have hampered prior attempts to create a meaningful research agenda in this area. Project STEER stakeholders include 10 adults with ASC, 10 parents of children with ASC, and 10 community-based clinicians/policy makers in Columbus, Ohio and Chicago, Illinois. Project STEER has successfully engaged these stakeholders in facilitated group meetings to collectively define problems with current approaches to identifying and measuring EI outcomes and jointly identify recommendations that put stakeholder-driven perspectives at the center of the EI research agenda.

**Results:** Project STEER has developed 3 core components of a stakeholder research agenda: Guiding Principles, Research Priorities, and Systems Implications. The Guiding Principles emphasize critical perspectives such as a need to include autistic voices in research and to ensure accessibility of research findings to the stakeholder community. Stakeholder generated Research Priorities focus on developing and testing strategies for better family support, more coordinated and cohesive service delivery systems, understanding quality of life for the child and family, and intervention approaches and treatment targets that account for the heterogeneity of ASC. Finally, Systems Implications highlight the need for continued efforts at the policy and systems levels to ensure that findings in research have direct and lasting impacts on children with ASD and their families.

**Conclusions:** Project STEER represents a critical step forward in realigning the research questions and approaches considered and used by researchers with the goals and priorities of stakeholders. The first phase of the project has allowed for identification of topics that stakeholders believe should be at the center of scientific endeavors. Now we are validating this research agenda using an online survey to engage a broader range of stakeholders across the country. The finalized Project STEER agenda will be disseminated broadly across lay, scientific and policy-focused outlets.

**422.053 (Poster) Self-Determination As Perceived By Autistic Adolescents and Their Parents: A Mixed-Methods Approach**  
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**Background:** Adolescence is a critical period of transition for autistic youth. Mandated school supports end after graduation, and teens are increasingly required to self-advocate. Self-determination (SD) skills (e.g., problem-solving, goal setting, self-advocacy) are linked to positive adult outcomes including friendships, living independently, and employment opportunities. SD has been under-explored in autistic youth with average or above intellectual abilities, including how parents and teens perceive teens' SD abilities, opportunities to practice SD, and focus of goals.

**Objectives:**

- To quantitatively examine the differences between parent and autistic youth self-report of SD skills and opportunities to practice SD.
- To describe the types of goals teens choose to work towards and compare youth and parent perspectives on current goals and progress attaining them using qualitative data.

**Methods:** Participants were 42 dyads consisting of diploma-track autistic high school students and their parents. Students were 14-20 years old (M=16.3, SD=1.3) with FSIQ $\geq$ 80 (M=104.5, SD=15.4), who met DSM-5 criteria for ASD supported by the SCQ and/or ADOS-2. Teens and their parents completed the American Institutes for Research Self-Determination Scale (AIR-SDS). The AIR-SDS measures overall SD skills (e.g., I/My child set their own goals to satisfy wants or needs) and opportunities to practice SD at home and at school. Bivariate correlations and Paired-samples t-tests examined the relationship between parent- and self-report of SD skills and practice opportunities. The AIR-SDS also asks respondents to report on current goals (e.g., Give

an example of a goal you/your child is working on now). These open-ended responses were coded by two raters (inter-rater reliability=86%, with a 3<sup>rd</sup> coder resolving discrepancies) using a priori categories (see Figure 1). The next phase of analysis involves a thematic analysis of the open-ended responses to better understand the differences between parent and self-report of goals.

**Results:** Correlations found no significant associations between parent and self-report of SD skills or opportunities to practice SD at home or school ( $p=.804-.924$ ). T-tests highlighted that both respondents reported similar opportunities to practice SD at home ( $p=.393$ ), though teens rated their SD skills higher than parents ( $t=6.28, p<.01$ ) and perceived fewer opportunities to practice skills at school ( $t=-2.70, p<.01$ ). The majority of respondents (42%) in both groups identified that teens were working on academic goals related to high school work or graduation. However, the next largest category was daily living skills for parents and leisure for youth. When further investigating this relationship, we found that only 28% of parent-teen dyad's goals matched. Preliminary themes from the open-ended responses highlight important ways that autistic adolescents and their parents differ in establishing and evaluating goals.

**Conclusions:** Results indicate differences in how teens and parents perceive youth SD skills and opportunities to practice SD. Although parents and youth both prioritized academic related goals, the lack of cohesion between the content of these goals emphasizes the discrepancy between parent and self-report of SD. Therefore, youth may face difficulties in getting support at home for goals that parents are unaware of. Collaboration between parents and their children could help to improve outcomes during this transition period.

#### 422.054 (Poster) Stress and Resilient Coping in Caregivers of Autistic People during the COVID-19 Pandemic

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**Background:** A large number of caregivers of autistic people experience mental health problems, including stress and anxiety, while at the same time can cope effectively and make positive gains. Mental health difficulties in caregivers of autistic people likely reflect a combination of factors, including situational stressors, child and family characteristics, and adaptive coping. The impact of various disruptions due to COVID-19 has the potential to present considerable additional challenges over and above those typically experienced by caregivers of autistic people, and may lead to health and safety-related concerns (i.e., fear of infection), disruptions to work and/or income, lack of access to services and supports, adoption of multiple roles (e.g., caregiver and educator), and social isolation. The purpose of this study was to better understand the impact of child and family factors and COVID-19-related disruptions and difficulties on caregiver mental health (i.e., perceived stress), as well as the role of resilient coping in this association.

**Objectives:** The objectives of the present study were: (1) To characterize caregiver stress during COVID-19, (2) To identify contributing factors of caregiver stress, and (3) To model the relation between contributing factors (i.e., demographic factors and difficulties and disruptions associated with COVID-19), resilient coping, and caregiver stress. To carry out the objectives of the study we tested three hypotheses: (1) Caregivers of autistic children would report high levels of perceived stress, (2) Caregiver stress would be significantly associated with demographic variables (e.g., number of children with autism in the home, age of the child, autism severity, etc.) and difficulties and disruptions associated with COVID-19, and (3) Caregiver resilient coping would contribute a statistically significant amount of variance in caregiver perceived stress after accounting for demographic variables and difficulties and disruptions associated with COVID-19.

**Methods:** 620 caregivers of autistic individuals participated in this Canadian study. Caregivers completed an online questionnaire between June and July 2020 that included demographic information, disruptions and difficulties due to COVID-19, perceived stress, and resilient coping.

**Results:** Majority of caregivers (98%) reported experiencing some degree of disruption and difficulty as a result of COVID-19, with more than half of respondents reporting moderate levels of stress (85%). Caregiver stress was significantly associated with a number of demographic factors, as well as difficulties and disruptions as a result of COVID-19. As predicted, caregiver resilient coping contributed a statistically significant amount of variance in caregiver perceived stress after accounting for demographic variables and difficulties and disruptions associated with COVID-19. However, a large proportion of variance remains unaccounted for in this model and future research is necessary.

**Conclusions:** As expected, caregivers of autistic individuals continue to experience elevated levels of stress and anxiety during COVID-19. The tendency to cope with stress in an adaptive manner represents one of the many important factors to consider in

supporting these families. Future research is needed to better understand mental health in caregivers and families of autistic people as a result of the COVID-19 pandemic.

**422.055** (Poster) Stress, Coping, and Quality of Life in Parental Caregivers of Individuals with Autism Spectrum Disorder  
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**Background:** Parental caregivers of children with Autism Spectrum Disorder (ASD) are exposed to stressors associated with the daily care of raising a child with a developmental disability, which may negatively impact parental quality of life (QOL).

**Objectives:** The specific aim of this study was to examine the relationships between demographic factors, stress, and coping among parental caregivers of children with ASD to determine whether predictors of QOL exist.

**Methods:** This study was descriptive, and an electronic survey was distributed to Florida parents of children, age 3-21 years old, diagnosed with ASD. The survey measured parent-reported demographic factors, severity of the diagnosis of ASD in the child, parental stress, coping, and QOL. Data were analyzed using multiple regression.

**Results:** Study findings suggest that, in parental caregivers of children with ASD in Florida (N = 152) daily stressors, coping self-efficacy, and household income were predictors for physical QOL; daily stressors and coping self-efficacy were predictors of psychological QOL, and coping-self efficacy, household income, and severity of the diagnosis of the child were predictors for environmental QOL.

**Conclusions:** Coping self-efficacy and improved income can positively improve QOL, while severity of the diagnosis of ASD and daily stressors can negatively impact QOL. Clinically, nurses with a better understanding of the parental stress and coping in parents of children with ASD can better recommend tailored resources to improve QOL. Policies to support financial help for families may also improve QOL. Future research should focus on interventions to improve coping-self efficacy.

**422.057** (Poster) The ASD Parent Perspective: Examining Parent Gender As a Moderator in the Relationship between Child Behavior Problems, ASD Symptom Severity, and Parent Stress.  
*C. Noble and T. Du Rocher Schudlich, Psychology, Western Washington University, Bellingham, WA*

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**Background:**

Parents of children with autism spectrum disorder (ASD) experience a great amount of stress. Over 90% of children with ASD are diagnosed with a co-morbid disorder such as anxiety or conduct problems. Evidence indicates that parent stress is associated with ASD severity and behavior problems. However, there are gaps in the literature examining these associations in fathers and whether these associations differ across mothers and fathers.

**Objectives:**

The current study addressed the gaps and inconsistencies in the literature by examining whether ASD symptom severity and associated behavior problems predicted parent stress, as well as by assessing whether parent gender moderates the relationships between child behavior problems, ASD symptom severity, and parent stress. It was hypothesized that child behavior problems would significantly predict increased stress levels for mothers, whereas ASD symptom severity would significantly predict increased stress for fathers.

**Methods:**

We recruited 244 parents of children ages 3-5 diagnosed with ASD within the last 8-12 months via Facebook and flyers emailed to Autism clinics throughout the United States with a link to Qualtrics. Parents completed the Child Behavior Checklist (1.5-5yrs) to assess their child's behavior problems as well as the Gilliam Autism Rating Scale (3rd edition) to assess their child's ASD severity. Parents also completed the Parenting Stress Index-Short Form (4th Edition) to assess their stress levels.

**Results:**

Hierarchical regressions examined ASD symptom severity and the child's behavior problems as predictors of parent stress. Multiple linear regressions examined whether associations between child behavior problems, ASD symptom severity and parent

stress varied as a function of parent gender (see Table 1). We followed up significant interactions with simple slopes analyses. Behavior problems (CBCL total) significantly predicted parent stress; however, there was not a statistically significant difference in this relationship between mothers and fathers. Additionally, ASD symptom severity was significantly associated with parent stress and parent gender also moderated the association between symptom severity and parent stress. ASD symptom severity was significantly associated with greater stress for both fathers,  $t(1,236) = 4.968, p < .001$ , and for mothers,  $t(1,236) = 2.203, p = .029$ . However, simple slope analyses indicated a greater magnitude of this association for fathers (see Figure 1).

#### Conclusions:

Consistent with previous studies, both ASD symptom severity and behavior problems were significantly associated with parent stress. Additionally, there was a greater association between ASD symptom severity and parent stress for fathers compared to mothers, which is inconsistent with previous literature and with our hypotheses. The fathering vulnerability hypothesis describes fathers as more susceptible to stress within the home because fathers often rely on the mother to help define their role in the family, so stressful situations that impact both parents would provide a greater risk to the father's stress. Previous studies reported that mothers are typically the primary caregiver and thus more often exposed to their child's behaviors. However, in our study most fathers identified as the primary caregiver (92.7%). In combination with the fathering vulnerability hypothesis, this could possibly explain this unique finding. Clinical implications will be discussed.

**422.058 (Poster)** The Development of an Autistic-Led Research Agenda for Autistic Women and Girls in Australia  
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**Background:** Autism has historically been understood as a male disorder. However, recent evidence suggests that autistic women are being missed or misdiagnosed (Rutherford et al., 2016). Autistic girls and women experience unique challenges, including specific physical health issues (Mademtzi et al., 2018). Autistic girls and women also report 'masking' or 'camouflaging' their autistic traits in order to fit in (Lai et al., 2017). This effort has a significant impact on their wellbeing, and has been associated with an increase in mental health problems and suicide (Cassidy et al., 2018). The majority of autism research has been conducted with males. In addition, the research agenda has predominantly been set by researchers rather than the autistic community. Participatory research practices allow for effective translation of research outcomes, and ensure that research is relevant and beneficial for the community it aims to help (Long et al., 2017). While there have been increases in participatory research in autism, there has been no research that specifically focuses on developing a research agenda with the community of autistic women and girls. This is important given their unique needs and risk factors.

**Objectives:** This project aimed to utilise participatory research practices to develop an autistic-led research agenda for autistic girls and women in Australia.

**Methods:** An advisory group of autistic women from a range of backgrounds was recruited to develop and drive the project. Qualitative interviews were conducted with autistic girls (aged 7 and above) and autistic women (aged 18 and above). Participants included cis, trans, non-binary and gender diverse individuals who had a formal diagnosis of autism, or self-identified as autistic. All participants were interviewed by an autistic woman, and were asked questions about their needs and support systems, their strengths, as well as what research for autistic women and girls should focus on.

**Results:** The qualitative interviews were analysed using thematic analysis to identify the main themes or areas that are important for autistic women and girls. These themes were then used to develop an autistic-led research agenda for autistic girls and women.

**Conclusions:** This is the first project that outlines the development of an autistic-led research agenda for autistic girls and women in Australia. The research priorities identified will result in outcomes that are directly relevant for the autistic community. This will significantly improve our understanding of the specific needs and challenges identified by autistic girls and women themselves. In turn, this will allow for the provision of appropriate supports and services to better support autistic women and girls.

**422.059 (Poster)** The Developmental Process of Parent Advocacy for Black Families of Children on the Autism Spectrum: Semi-Structured Interviews of Black Autism Parents Serving As Peer Coaches.  
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**Abstract:** In this exploratory study, the qualitative method of Portraiture (Lawrence-Lightfoot & Davis, 1997) is used to recognize the characteristics associated with parent advocacy in Black mothers of children on the autism spectrum across three states: California, Pennsylvania, and New York. This study used liberating methodologies to co-construct portrait narratives of six mothers to illustrate the resources they used to navigate service-delivery systems (e.g., early intervention, special education) after their child's diagnosis and discuss how those resources contributed to their advocacy skills. The preliminary results of this study found: (1) Black mothers discuss using internal resources (i.e., non-dominant cultural capital) to navigate service-delivery systems after their child's diagnosis (Yosso, 2005). (2) Black mothers describe disseminating advocacy strategies to parents they coach.

**Background:** Black children are diagnosed with ASD 1.6-5 years posterior to White children (Mandell et al., 2009), and are also three times more likely misdiagnosed (Mandell et al., 2007). Even when controlling for socioeconomic status and education, families of Black autistic children are less knowledgeable about evidence-based autism intervention services and advocacy (Longtin & Principe, 2016). Despite these obstacles, there are Black mothers that advocate for diagnosis and intervention for their own and other children in their communities.

**Objectives:** This study aims to demonstrate the use of qualitative, liberating methodologies to illustrate the resources Black mothers of children on the autism spectrum used to navigate service-delivery systems after their child's diagnosis and discuss how those resources contributed to their advocacy skills (Lawrence-Lightfoot & Davis, 1997; Watson, 2019).

**Methods:** We used the methods of a qualitative phenomenological framework, Portraiture, to analyze the interviews (Lawrence-Lightfoot & Davis, 1997; Lawrence-Lightfoot 2005). Portraiture methods are like ethnography, but distinct in the approach and level of engagement that the portraitist takes part in data collection. During the analysis of the data, the lead author who is also a Black mother of a child on the autism spectrum engaged with the peer coach mothers in the process of co-construction of a portrait of "successful advocacy". During each interview, field notes of key ideas and non-verbal communication were taken to use during analysis; we used open-coding techniques (Glaser & Strauss, 1967; Tavory & Timmermans, 2009) and analytic memoing. Narratives for each mother were written based on their collective and object-interviews, open coding, analysis of memoing and journal writing.

**Results:** A common theme of the powerful roles that the maternal grandmothers played in providing emotional support and advocacy modeling was salient. These mothers never felt alone because they had both their families and key community partners (e.g., doctors, interventionist, teachers), who served as cultural brokers and built the trust to help when they needed it most. The preliminary analysis has implications on approaches that schools can use to create culturally sensitive interactions with Black families of children with ASD.

**Conclusions:** This work attempts to expand the knowledge of ASD families with intersectional identities (race, gender) by focusing on their assets, rather than deficits, creating a portrait of advocacy and resilience for us to learn from.

**422.060 (Poster)** The Experiences of Affiliate Stigma, Social Support, and Stress Among Mothers of Children on the Autism Spectrum

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**Background:**

Autism Spectrum Disorder (ASD) is a pervasive neurodevelopmental disorder, characterized by deficits in social interactions, communication, and restricted and repetitive behaviors (APA, 2013). Parents of children with ASD often experience affiliate stigma as a result of the parent and the child being the target of negative judgments and comments from, friends, family, and the general public. Sleep duration and relationship status of the parents have been shown to lead to increased stress and internalization of affiliate stigma (Lovell & Wetherell, 2018). Parent-directed stigma, child-directed stigma and related stress are associated with adverse outcomes in the parents of children with ASD, such as increased negative interactions with family members, depressive symptoms, decreased psychological wellbeing, feelings of isolation, and decreased employment (Mak & Kwok 2010; Mickelson, 2001, Kinnear et al, 2016).

**Objectives:**

Our study investigated whether

- an increase in both mother-directed and child-directed affiliate stigma would result in an increase in maternal stress.
- a mother's level of social support would be negatively related to feelings of maternal stress.
- social support would mediate the relationship between both child-directed stigma and mother-directed stigma and maternal stress.

Methods:

#### Participants

62 mothers of a child/adolescent (ages 4-20) with a diagnosis of: ASD, PDD-NOS, or Asperger's syndrome.

93.5% were biological mothers

Average age: 44 years-old (SD: 7.1)

Race: 88.7% Caucasian

#### Measures

Demographics Questionnaire

Child's Autism related behaviors

The Child-Directed Stigma Scale

Perceived Stigma Scale

Multidimensional Scale of Perceived Social Support

Questionnaire on Resources and Stress

#### Procedure

Participants were recruited through clinics, schools, and social service agencies serving individuals with ASD. Participants completed measures online using Qualtrics. A hierarchical multiple regression analysis was performed to understand the unique contribution of all significant variables on maternal stress. To test for the role of social support as a mediator, we performed a simple mediation analysis with percentile bootstrap confidence intervals.

Results:

Results of a hierarchical multiple regression analysis revealed

- That social support has a strong negative relationship with maternal stress ( $\beta = -.457, p < .001$ )
- That even after controlling for child's autism-related behaviors, both mother-directed stigma and child-directed stigma are positively related to maternal stress ( $R^2 = .54$ ).
- Percentile bootstrap confidence intervals based on 5,000 samples separately assessed the indirect effects of stigma directed at mothers and on child on maternal stress through social support and did not contain zero (.0418 to .6613) and (.0060 to .5487) respectively.

Conclusions:

We found that mothers who perceived stigma directed at themselves or their child with ASD reported increased stress levels and that this relationship was significant even after accounting for other sources of maternal stress, such as, autism-related behavior and social support.

We also found a negative relationship between social support and maternal stress, even after controlling for autism-related behaviors and both types of stigma. Mothers who experienced lower levels of social support reported increased stress and this accounted for 20% of the variance in maternal stress. These findings highlight the importance of ensuring that mothers have adequate social support as well as helping them cope with the deleterious effects of stigma.

**422.061 (Poster)** The Factors Predicting Poor Mental and Physical Health in Parents of Children with Autism Spectrum Disorder (ASD): Data from 2016 -2018 National Survey of Children's Health (NSCH)

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**Background:** Growing evidence suggests that parents of children with autism spectrum disorder (ASD) are at risk for poor mental and physical health. While child behavior problems and parenting stress have been identified as significant factors associated with poor mental health in parents of children with ASD, the relative contributions of other child and parent characteristics remain unclear. In addition, the majority of published studies exclude fathers, use small clinical samples, and focus solely on mental health.

**Objectives:** The purpose of this study was to determine the factors predicting poor mental and physical health in parents of children with ASD using a nationally representative large sample.

**Methods:** Using population-based cross-sectional survey data from the 2016 - 2018 National Survey of Children's Health (NSCH), this secondary data analysis examined selected child (sleep problems [ $\leq 8$  hours], behavior problems, and autism severity) and parental (caregiving stress, coping, emotional support, amount of time providing care, amount of time coordinating care, and out of pocket cost for healthcare) characteristics as predictors of mental and physical health in 2,270 parents (mothers = 1,594, fathers =676) of children (4 to 17 years) with ASD. Multivariate logistic regression was used to determine predictors of poor mental and physical health in mothers and fathers of children with ASD while controlling for sociodemographic covariates.

**Results:** The mean age of mothers, fathers, and children with ASD were 42.43 7.94 years, 46.15 8.29 years, and 11.25 years respectively. For *mothers* of children with ASD, reporting moderate to severe child behavior problems (OR = 4.60, 95% CI [1.36-15.53]) and spending 1-4 hours per week coordinating care had significantly poorer mental health compared to those mothers spending no time coordinating care (OR = 4.90, 95% CI [1.11-21.58]). For mothers physical health, those reporting moderate to severe child behavior problems (OR = 4.94, 95% CI [1.26-19.40]) and spending 1-4 hours per week coordinating care had significantly poorer physical health compared to those reporting no time spent coordinating care (OR = 3.99, 95% CI [1.07-14.91]). For *fathers* of children with ASD, greater perceived caregiving stress (OR = 3.00, 95% CI [1.37-6.58]) and spending 5+ hours per week providing care compared to no time spent providing care (OR = 12.68, 95% CI [1.42->100.0]) were significantly associated with poorer mental health; only greater perceived caregiving stress (OR = 2.96, 95% CI [1.48-5.92]) was associated with fathers' poorer physical health.

**Conclusions:** For parents of children with ASD, child behavior problems were significant predictors of poor mental and physical health for mothers while perceived caregiving stress was associated with of father's poor mental and physical health. To address both parent's needs, targeted interventions focused on addressing child behavior problems and reducing caregiving stress may result in improved mental and physical health of both parents of children with ASD.

**422.062 (Poster)** The Impact of Uncertainty on the Everyday Lives of Autistic Children and Their Families

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**Background:**

Anxiety is common in autistic children and approximately 50% of autistic children experience high anxiety. One key mechanism underlying anxiety is intolerance of uncertainty, which is a tendency to react negatively on an emotional, cognitive, and behavioural level to uncertain situations. Understanding the types of uncertain situations that cause difficulties for autistic children, their responses to those situations, and how intolerance of uncertainty impacts on family life is critical to the development of appropriate anxiety interventions.

## Objectives:

The study aimed to provide a descriptive, thematic analysis of the impact of uncertainty on the daily lives of autistic children and their families.

## Methods:

Fifty families were recruited to the study through clinical services in the North East of England. The children were aged 6 – 16 years, had a diagnosis of autism, and were experiencing anxiety related to uncertainty. Data were collected as part of a randomised pilot trial of a parent group-based intervention aimed at increasing tolerance to uncertainty in autistic young people: Coping with Uncertainty in Everyday Situation (CUES©). Parents completed a semi-structured interview during which they a) identified two everyday uncertain situations that were challenging for their autistic child, b) described their child's reactions to these situations, and c) described the impact on the child and the wider family. The data from the semi-structured interviews were then analysed thematically.

## Results:

Across the 100 uncertain situations from 50 parents, the most commonly identified were school-related situations: uncertainties included changes in routine, different teachers, getting answers wrong, getting in trouble, what to do at break time, and tests. Thematic analysis revealed five main themes that described how anxiety related to uncertainty increased restricted and repetitive behaviours such as physical mannerisms, inflexibility, and repetitive questions. Parents also reported that children often missed out on opportunities for enjoyment, friendship, education and had low self-image and low mood. Difficulties with uncertainty affected family life, with parents accommodating their child's anxieties around uncertainty through reassurance, changes to routines and avoidance of specific people, places, or activities.

## Conclusions:

This is the first study that has explored the types of uncertain situations that cause difficulties for autistic children and how these difficulties impacted on the daily lives of them and their families. It provides insight into a wide range of everyday uncertain situations that can be challenging. These are situations that occur in typical daily life and cause increased distress, worry, frustration and anger, lowered mood and self-image. Uncertainty may lead to missed opportunities for learning and fun, whilst also impacting on parental energy and wellbeing. Interventions to increase autistic children's ability to cope with everyday uncertain situations could improve quality of life for autistic children and their families.

**422.063** (Poster) The Mental Health of Young People with ASD during the COVID-19 Pandemic: Data from the QUEST Cohort  
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Background: Understanding the impact of the COVID-19 pandemic on the mental health of children and young people has been identified as a key priority for mental health science (Holmes et al., 2020). Autistic young people (YP) present a particularly vulnerable group as we know they already have substantially increased rates of mental health disorders, compared to the general population (Simonoff, et al., 2008). Further, they may experience the effects of the pandemic differently to the general population; and some autistic young people may be more severely impacted than others. Understanding how the pandemic affects young people with autism will enable professionals to target limited community-based interventions to those most in need.

Objectives: Using a longitudinal sample with three previous timepoints, this study aims to identify which young people with autism and their families are most adversely affected by the pandemic, and in what ways.

Methods: Participants were part of the QUEST cohort, a community-based sample of young people diagnosed with autism in early childhood. At time 1 (age 4-9 years, n=277) data was collected on ASD severity, other emotional and behavioural problems, IQ, and psychiatric diagnoses. At time 2 (age 11-15 years, n=211) data was collected on adaptive functioning, mental health and behavioural problems, parenting style and family functioning. At time 3 (age 13-17 years, n=214) data was collected on psychiatric diagnoses, health economics and service use. During the COVID-19 pandemic (time 4, age 16-20 years), we administered a brief parent-report survey to explore changes in emotional and behavioural experiences during the pandemic. A parallel self-report version was also included for those YP judged by parents as being able to complete it. The parent-report survey is also being used with another ASD cohort (ASTAR), and with clinical populations in 8 countries, allowing for cross-study comparisons.

Results: Sample characteristics are provided in Table 1. At the time of writing, the COVID-19 survey was completed by 108 families (51% of eligible sample). Non-participating families did not differ from participating families in terms of the YP's ASD severity, IQ or ethnicity (all  $p > .2$ ). The majority of participating families (73%) reported a change in their child's education arrangements since the start of the pandemic, with almost half (45%) currently only attending school/college remotely; despite government stipulation that face-to-face education should be made available to students with special educational needs. Figure 1 summarizes parents' reports of YP mental health during the pandemic. Responses were varied, but almost half (49%) reported that their YP was sad/depressed/unhappy; a similar proportion (50%) reported that their YP was moderately/very worried. Regression analyses will examine how this data relates to behavioural and mental health data collected at earlier timepoints; and whether any individual, family or wider background factors are associated with the level of impact experienced by families during the pandemic.

Conclusions: This study reports on the mental health of a well-characterised cohort of autistic YP during the COVID-19 pandemic. Understanding how earlier vulnerabilities relate to current mental health and other outcomes will have important implications for service planning.

**422.064 (Poster)** The Relation of ASD Symptom Severity to Parental Expressed Emotion, Affiliate Stigma, and Typically-Developing Sibling Internalizing Behavior

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Background: Caregivers of children with ASD experience greater stress, psychopathology, and social isolation than caregivers of typically-developing (TD) children or those with other disorders. They also may be more likely to experience expressed emotion (EE), which is characterized by criticism/hostility and emotional overinvolvement toward their child, as well as affiliate stigma (e.g., marginalization, devaluation, discrimination), as a result of having a child with ASD (Romero-Gonzales et al., 2018). TD siblings of children with ASD often experience more negative functioning than siblings of individuals without a developmental disorder (Shivers et al., 2019).

Objectives: The current study examined the relation between ASD symptom severity, parental EE (criticism and emotional overinvolvement), parental affiliate stigma (affective, behavioral, and cognitive), and TD sibling internalizing behaviors using correlational and hierarchical regression analyses. It was hypothesized that ASD symptom severity in the child with ASD would be significantly related to all parental and TD sibling variables; that affiliate stigma would be significantly related to EE and TD sibling internalizing behaviors; and that EE would be significantly related to TD internalizing behaviors.

Methods: Data from a larger completed study was used that included 120 caregivers of a child with ASD, with 55 of the caregivers also having at least one TD child. Caregivers completed a demographic questionnaire and measures assessing their own affiliate stigma and EE as well as ASD symptom severity of their child with ASD and behavior of their TD child. Demographic variables were correlated with criterion variables to determine covariates. Caregiver sex was included as a covariate in subsequent analyses examining emotional overinvolvement and TD sibling internalizing behaviors. Hierarchical regressions were also used to understand the unique contribution of affiliate stigma in predicting parent and sibling criterion variables.

Results: Table 1 shows intercorrelations (zero-order or partial, if accounting for caregiver sex) among all variables of interest. ASD symptom severity was significantly positively correlated with all components of parental affiliate stigma, parental criticism, emotional overinvolvement, and TD sibling internalizing behaviors (Table 1). All components of parental affiliate stigma were significantly positively correlated with criticism, emotional overinvolvement, and TD sibling internalizing behaviors. Hierarchical regressions indicated affiliate stigma predicted criticism and emotional overinvolvement above and beyond ASD symptom severity and caregiver sex (Table 2). Criticism and emotional overinvolvement did not predict unique variance in TD sibling internalizing behavior beyond ASD symptom severity and caregiver sex ( $\Delta R^2 = .001, p = .79$ ).

Conclusions: Findings suggest that families with children with more severe symptoms of ASD may experience greater levels of affiliate stigma and EE and that these two constructs are predictors of different areas of family functioning. As such, these may be vital areas of intervention when working in a clinical setting. Limitations of the current study included self-report data, limited diversity in the sample, use of cross-sectional data, and reduced sample size for TD siblings, which may have reduced power to detect unique variance in predicting internalizing behaviors. Future research will help further understand how affiliate stigma and expressed emotion affect families of children with ASD.

**422.065 (Poster)** Trends in U.S. Autism Research Funding: Interagency Autism Coordinating Committee Autism Research Portfolio Analysis Report

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**Background:** The Office of Autism Research Coordination (OARC) of the U.S. National Institutes of Health (NIH) will present findings from the upcoming *2017-2018 Interagency Autism Coordinating Committee (IACC) Autism Research Portfolio Analysis Report* that describes autism research investments made by both government and private funders.

OARC/NIH coordinates and manages the IACC, a federal advisory committee composed of federal officials and public stakeholders. The Committee was established by Congress to coordinate federal agency activities and to provide advice to the Secretary of Health and Human Services related to autism spectrum disorder (ASD). The IACC's *Strategic Plan* provides a framework to guide the efforts of U.S. federal agencies and partner organizations. OARC conducts an annual portfolio analysis of U.S. research projects to help guide the IACC's strategic planning efforts and inform the IACC of progress toward implementation of the *Strategic Plan*. The *Portfolio Analysis* is also used by agencies and organizations to better understand trends in ASD research funding.

**Objectives:** OARC will present findings from its *2017-2018 IACC ASD Research Portfolio Analysis Report*, which provides information on autism research investments made by U.S. federal and private funders of ASD research. This report will be the first to assess the composition of research projects that are investigating racial and ethnic disparities in ASD as well as a comprehensive analysis of the cross-cutting objective on the topic of ASD in females.

**Methods:** Data including project description, institution, and funding amount were collected from U.S. government and non-government funders of autism research. All projects included in the *Portfolio Analysis* were coded according to the seven research questions and 23 objectives outlined in the *2016-2017 IACC Strategic Plan*. Each of the questions in the *Strategic Plan* address general topic areas that are represented as community-focused questions (e.g., How can I recognize the signs of ASD, and why is early detection so important?). Each question includes three to four objectives; there is also one cross-cutting objective that focuses on ASD in females. The data were analyzed in several ways to provide information on the types of research being funded and the research topic areas supported by each funder.

**Results:** OARC collected U.S. ASD research project data for 2017 and 2018 and aligned research projects with the 23 objectives in the *Strategic Plan*. The analysis provides an overview of the distribution of research projects and funding across the seven *Strategic Plan* Question areas, analysis of projects across multiple scientific subcategories, a breakdown of federal and non-federal funders' contributions to ASD research investments, geographical distribution of research projects, and trends in research funding over time. The data provide information on the degree to which the objectives and budget recommendations described in the *IACC Strategic Plan* are being met. These data will be made available to the public through the Autism Research Database on the IACC website: <https://iacc.hhs.gov/funding/data/>.

**Conclusions:** These analyses of ASD research funding provide a broad overview of the autism research landscape in the U.S. and the roles of government and non-government funders in supporting ASD research.

**422.066 (Poster)** Understanding Existing Involvement with Community-Based ASD Care Systems for Children from Linguistically Diverse Families within a Family Navigation Model

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**Background:** Children and families from diverse ethnic and linguistic backgrounds face numerous barriers to receiving assessment for autism spectrum disorder (ASD) and subsequent access to services. Our team is engaged in ongoing work to develop a statewide Family Navigation Network that partners with community providers to assess families' connections to community resources and build competence to access supports. As part of this ongoing work, we have focused on expanding diverse language resources and engaging in targeted community conversations to understand barriers to navigating care systems. To better understand the existing state of service connection and utilization amongst families referred for Family Navigation by providers, the present study examined baseline service utilization at time of Navigation referral across racial, ethnic, and linguistic groups.

**Objectives:** To identify existing disparities and improve care coordination, this study examined differences in baseline engagement with community systems of care across racial, ethnic, and linguistic groups for children under age five who come from medically underserved populations and who have or are at risk for ASD.

**Methods:** Families were referred for Navigation by a community primary care provider or early interventionist. For each family, the navigator asked about family knowledge of or engagement with 6 core service categories identified by the study team as best practice for young children at developmental risk (See Table 1). Navigators logged this information into a REDCap database to communicate back to the referring care team. Out of 626 participating families, 583 selected English as their primary language; 30 selected Spanish; 8 selected Arabic; and 5 selected Other.

**Results:** Services of interest were early intervention, speech therapy, and occupational therapy. Mean age at point of referral was 33.1 months for English-speaking (ES) children and 39.6 months for non-English speaking (NES) children. When looking at children  $\leq 35$  months and  $\geq 36$  months who were already involved in state Part C and school services respectively at first point of contact, 66.3% of ES children were enrolled in Part C services compared to 52.6% of NES children; 10% of ES children were receiving school system services versus 16.7% of NES children. Only 26.2% of ES families were not currently enrolled in services compared to 46.5% of NES families. When asked about speech therapy, 28.6% of ES families indicated current involvement compared to 18.6% of NES families. When asked about occupational therapy, 19.9% of ES families indicated current involvement compared to 9.3% of NES families.

**Conclusions:** Conversations with families revealed differences in utilization of services between ES and NES families. NES families were overall less likely to be involved with services than ES families, although they were slightly more likely to be involved in school services. This identifies a target for provider education and pre-referral navigation, since a formal psychological evaluation is often not necessary for children to receive Part C services. Future research will continue to expand family navigation services to further broaden equal access to and enrollment in services for children with or at risk for ASD.

**422.067 (Poster)** Use of Stakeholder Focus Groups to Develop Content and Structure of a New Measure of Social Communication for Young Children with Autism Spectrum Disorder

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**Background:** Children with autism spectrum disorder (ASD) show pervasive, often severe deficits in social communication that are a major target of early intervention programs. Sensitive and efficiently tracking both long- and short-term change in early social communication skills is essential in both research and community settings. However, current measures of social communication in ASD suffer from limited sensitivity to change, incomplete content coverage, and high burden of administration (Anagnostou et al., 2015).

**Objectives:** As part of a larger effort to develop a new parent- and teacher-report measure of social communication in young children with ASD, this study aimed to identify key social communication domains, skills, and behaviors considered most important to parents, teachers, and experts.

**Methods:** Twenty-one parents, nine teachers, and fourteen expert clinicians participated in a total of seven focus groups regarding their perceptions of social communication challenges and needs in young children (ages 2-6) with ASD. Thematic analysis was used to analyze focus group transcripts and extract themes and subthemes from the groups.

**Results:** Participants identified challenges with expressive language, receptive language, and social skills. In addition, they noted important differences in social behaviors across contexts and partners, and described ways in which communication challenges and emotion regulation problems compounded and interacted with one another. Respondents also identified strategies for supporting and building social communication skills. Sub-themes included content regarding differences in interactions with adults vs. peers, key deficits in use of expressive communication in flexible and functional ways, and difficulties with understanding and responding to others' emotions.

**Conclusions:** Parents, teachers, and experts identified a number of key concerns with social communication in young children with ASD. Some identified areas of concern (e.g., interaction between communication and emotion regulation deficits; differences in communication capacities and strategies across settings) are not well represented on existing measures of social communication intended for use in this population. As development and validation of this new measure of social communication continues, focus group content will be integrated during the item development process, including addition of items in areas tapping key areas of divergence between focus group themes and current measure content. This strategy is consistent with best practices in development of patient-reported outcome measures (Food and Drug Administration, 2009) and will likely result in a

measure with increased relevance and sensitivity to changes in key areas of social communication related concerns for parents and teachers.

**422.068 (Poster)** Use of Technology in Autistic Children and Adolescents during COVID-19 Lockdown

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**Background:** Due to COVID-19, Quebec temporary closed school activities (March 16 to August 28) and social services (March 16 to May 6). Autistic children were left facing many challenges, such as coping on their own with pandemic-related stress. The literature suggests that autistic children and adolescents have a great interest in technological tools, such as televisions, computers, smartphones, electronic tablets, and video games (Morrison et al., 2018). That said, there is an interest in knowing whether this population uses technological tools as a coping method in the context of the COVID-19 lockdown.

**Objectives:** To explore the impact of technological tools use on families with autistic children or teenagers (hereinafter “children”) during the lockdown in Quebec due to COVID-19.

**Methods:** One hundred and nine parents of autistic children (2.5–18 years old) completed the French-language version of the *Questionnaire on the Needs of Children and Adolescents with Autism and their Families during the COVID-19 Pandemic*, an anonymous online survey. Fifty-six autistic children (5.75–18 years old) completed a sub-section of the survey, which was intended for them. The survey included multiple-choice and open-ended questions. For both sections (parents and children), descriptive analyses and independent *t*-tests were carried out using SPSS software, and thematic analyses were conducted for the open-ended questions.

**Results:** When autistic children were asked what contributed to their well-being during the lockdown period, the most common answer was electronic devices. Indeed, almost the entire sample (94.6%;  $n = 52$ ) reported that the use of electronics gave them a sense of well-being. Two thirds of the parents (67%;  $n = 73$ ) had implemented larger access to technologies to accommodate their children. Access to electronics was also the third item out of 15 identified by the parents as helping their children to cope. Along with *establishing a routine* (67%) and *reducing school responsibilities* (46.6%), 41.3% ( $n = 45$ ) of the parents indicated that *access to electronics* made their child's adjustment easier. There was a significant difference between older children's parents ( $M = 11.42$  years old,  $SD = 3.83$ ) and younger children's parents ( $M = 9.82$  years old,  $SD = 4.16$ ; *t*-test:  $t(107) = 2.00$ ,  $p = .049$ ) regarding free access to technologies. Parents of older children ( $M = 11.76$  years old,  $SD = 3.40$ ) were significantly more likely than parents of younger children ( $M = 10.28$  years old,  $SD = 4.28$ , *t*-test:  $t(107) = 2.00$ ,  $p = .048$ ) to consider that access to technology facilitated their child's adaptation.

**Conclusions:** This study shows that technological tools have played an important role for autistic children during the COVID-19 lockdown. For some of parents, technologies helped their child to cope with the lockdown. The positive integration of technologies in daily lives of autistic children should be better understood.

**422.069 (Poster)** Vaccine Hesitancy and Beliefs about Causes of Children's Developmental Disorders Among Parents of Children Awaiting Developmental/Behavioral Evaluation

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**Background:** Although recent data show that children with autism spectrum disorder (ASD) are well vaccinated for childhood vaccines recommended during the first two years of life, parents of children with ASD are among those most at risk for becoming vaccine hesitant (i.e., having concerns about vaccines that may lead to delay/refusal of one or more vaccines) compared to other parent groups, including parents of children with non-ASD developmental delays. However, little is known about the onset/timing of their vaccine concerns and the potential influence of the ASD diagnosis, itself.

**Objectives:** To characterize vaccine hesitancy, parents' beliefs about causes of children's developmental disorders, and factors associated with vaccine hesitancy among parents of children currently on a clinic waitlist for developmental/behavioral evaluation.

**Methods:** Data were collected from 138 caregivers (91.4% female) whose children were awaiting behavioral/developmental evaluation. Participants completed a questionnaire about information/services families seek while they await diagnostic evaluation, the *Parent Attitudes About Childhood Vaccines* questionnaire (PACV; measure of vaccine hesitancy), the *Revised*

*Illness Perception Questionnaire* (IPQ-R; measure of attributions about children's diagnoses and etiological beliefs), and provided demographic information.

**Results:** Overall, 48/118 parents (40.7%) were vaccine hesitant (PACV score  $\geq 50$ ) and 17/83 (20.5%) agreed with vaccines as a cause for their child's developmental difficulties; 66/136 (48.5%) children had received a prior ASD diagnosis and 59/136 (43.4%) had not. Vaccine hesitancy did not differ between parents of children +/- a prior ASD diagnosis. However, those reporting a prior ASD diagnosis were significantly more likely to be seeking information about ASD compared to those without a prior ASD diagnosis ( $p < .01$ ); a similar trend was observed for vaccine-hesitant parents (VHPs) compared to non-hesitant parents ( $p < .06$ ). Proportions of parents endorsing various causes did not differ between those with children +/- a prior ASD diagnosis. Yet, VHPs were significantly less likely to endorse genetics as a cause ( $p < .02$ ) and more likely to endorse diet/eating habits ( $p < .001$ ), environmental pollution ( $p < .04$ ), and vaccines ( $p < .02$ ) as causes. Characterizing participants by both *hesitancy status* and *beliefs about vaccines as a cause for developmental difficulties*, 35/83 (42.2%) were not hesitant and disagreed with vaccines as a cause, 15/83 (18.1%) were not hesitant but agreed with/were unsure about vaccines as a cause, 21/83 (25.3%) were hesitant and agreed with/were unsure about vaccines as a cause, and 12/83 (14.5%) were vaccine hesitant but disagreed with vaccines as a cause.

**Conclusions:** The prevalence of vaccine hesitancy in this sample was high, suggesting that concerns about vaccines may develop prior to a formal diagnosis. That the prevalence of vaccine hesitancy and proportions of parents endorsing various causes did not differ between groups +/- a prior ASD diagnosis could indicate that the question of autism is not resolved for the former. This may explain their continued pursuit of diagnostic services and suggest that information seeking largely follows receipt/acceptance of a diagnosis, which may subsequently influence beliefs about causes of ASD/developmental delays. This information could inform the design and timing of preemptive, tailored educational strategies around both vaccines and causes of children's developmental disabilities.

**422.070 (Poster) Websites: Supports for Autistics and Their Families during the COVID-19 Pandemic**

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Background:

The COVID-19 pandemic has had a worldwide impact. In Canada, findings from a recent Canadian Mental Health Association survey demonstrate increased mental health concerns, such as feeling anxious and worried, having trouble coping and having suicidal thoughts, since the start of the outbreak. These struggles are likely amplified for vulnerable groups like persons with autism given the disruption to routines, elimination or reduction in services, and uncertainty regarding future supports and services. In this public-health crisis, web-based support offering information and resources specific to autism during the pandemic may help families manage the various strains associated with the pandemic by offering ways to navigate and cope.

Objectives:

- To determine what information/resources were accessed by autistics and their families during the first 6 months of the pandemic and the perceived impact of that information/resources on autistics and their families.
- To conduct an environmental scan and review that identifies what organizations have developed information/ resource websites addressing the needs of autistics during COVID-19.

Methods:

For the first objective 19 parents and/self-advocates engaged in focus groups. The evaluation was based on interpretive description to understand what was needed and deemed important in terms of support/resources for autistics and their families during the pandemic. For the second objective a scoping review was conducted using Google Advanced Search. Thirty websites met inclusion criteria and were evaluated according to content, topics, features, searchability and general impressions.

Results:

Learnings from focus groups indicated that parents have sought information on how to 'educate' their children when schools and community venues are closed, how to manage stress – their child's and their own, and how to access funds to support their child during the pandemic. Website features that were notably important included the availability of government funding and information related to current needs like how to encourage your child to wear a mask in public. Website searchability and accessibility features were of importance to self-advocates and parents. A review of websites focused on COVID-19 and autism

revealed that sites included a combination of unique content and links (ranging from 1 – 200) to other websites. Websites tended to address multiple topics (health and well-being, government programs/supports, education, mental health), and a number of the websites included social media links to help people connect with one another. Gaps noted: (i) websites were focused primarily on children and adults, but not adolescent/young adults, (ii) websites predominantly offered information in a textual format and did not include accessibility features, (iii) websites searchability functions were often limited, and (vi) the majority of websites failed to include dates, making it challenging for users to determine the currency, relevance and accuracy of information.

#### Conclusions:

Findings invite considerations for how websites can provide information and resources to families; namely, whether information offered can be comprehensive and inclusive to all autistics and their families. Findings will inform the breadth of information needs and effective methods for sharing information.

#### **422.071 (Poster) What Happens after the Coach Leaves? Examining the Changes in Parenting Stress in Caregivers of Toddlers with ASD before and after the Withdrawal of Clinical Support**

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#### Background:

Parenting stress negatively impacts both parental and child outcomes (Neece et al., 2010) and potentially counteracts the effectiveness of early interventions (Osborne et al., 2008). It is imperative to employ interventions that target both child and parent outcomes to yield holistic and sustainable treatment effects for children with ASD and their families. As raising children with ASD comes with unique challenges, parenting stress needs to be teased out into subdomains of sources of stress and further examined at the subdomain level since there are stressors from all aspects of the caregivers' environment that could contribute to the overall experienced stress.

#### Objectives:

To extend previous work by Kasari et al. (2015) and to investigate how different aspects of parent-related stress changed over the active treatment course and after the clinical support had been withdrawn, between the two treatment groups that received either a short-term, caregiver-mediated intervention (i.e., JASPER; Kasari et al., 2015) or a parent education intervention (PEI; Brereton & Tonge, 2005).

#### Methods:

This study includes 86 toddlers with ASD and their primary caregivers ( $M_{\text{age}} = 31.5$  months), randomized to receive either one of two types of intervention as part of an RCT trial (Kasari et al., 2015). The Parenting Stress Index (PSI; Loyd & Abidin, 1985) was administered at entry, exit, 3-month and 6-month follow-ups. Linear mixed-effect models were utilized to examine which of the seven parent-related subdomains changed over time by treatment group, specifically before and after the clinical support was withdrawn. Chronological age, Mullen Scale of Early Learning (MSEL; Mullen, 1995) score, and Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999) score were accounted for in the statistical models.

#### Results:

Significant time effect was found on the Competence score for both treatment groups [ $F(1,73)=9.75, p=.003$ ] from entry to exit, indicating improvement, though no significant difference in treatment effect was found between the groups over time [ $F(1,73)=1.74, p=.19$ ]. Four subdomains reflected significantly worsened stress, from exit to 3-month and 6-month follow-ups: Isolation [ $F(2,137)=2.77, p=.03$ ]; Role Restriction [ $F(2,136)=5.41, p=.006$ ]; Depression [ $F(2, 134)= 2.35, p=.02$ ]; Spouse Relationship [ $F(2,137)=4.24, p=.02$ ]. Overall, no significant group-by-time interactions were observed— both groups experienced similar levels of deteriorated psychological well-being after the clinical attention was withdrawn.

#### Conclusions:

Though no overall reduction of stress in the parent domain over time was found in the original study (Kasari et al., 2015), our analysis indicates changes do manifest at the level of subdomains, under the parent domain of PSI, especially after the clinical support ended. Both treatment formats afforded the participants an increased sense of competence at exit, but both groups

reported continually worsening stress related to isolation, depression, role restriction, and spousal relationship, through six months after the clinical attention had ceased. Providing booster sessions as follow-ups after parents exit the study may aid such transitional period, and delivering the sessions in telehealth format could conserve clinical resources (Shire et al., 2015). Lastly, one should look beyond the immediate post-treatment effect to evaluate whether an intervention yields sustainable benefits for both parents and their children with ASD.

**422.072 (Poster) When Should You Tell Your Child They Are Autistic? Insights from a Participatory Study with Autistic University Students**

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**Background:** Prior literature has explored parental experiences with their child's autism diagnosis (Crane et al., 2019). However, very little is known about how the process of learning one is autistic impacts development. Learning about one's autism through open dialogue with parents may have positive impacts on self-perception and autism understanding (Riccio et al., 2020). Previous research has identified benefits of early disclosure for other conditions (Goodwin et al., 2015) and anecdotal evidence suggests similar benefits for autistic people (Jones, 2001), but no prior studies have evaluated if earlier discovery that one is autistic is associated with better adult outcomes.

**Objectives:**

To examine how the timing of learning one is autistic influences adult well-being, Quality of Life (QoL), and perceptions of autism.

**Hypothesis a:** Autistic adults who learned about their autism earlier in life will have higher well-being and QoL than those who learned later.

**Hypothesis b:** Learning one is autistic earlier will be associated with more positive perspectives on autism.

**Methods:** Autistic university students ( $N=84$ ,  $M(\text{age})=23.93$ , 50.0% male, 63.3% White, 78.3% undergraduates) participated in an online survey developed by a team of autistic and non-autistic scholars. They answered questions like: "How old were you when you first learned you were autistic?", "How did you feel when you learned you were autistic?", "How do you feel about autism now?" Responses were coded to establish reliability and summarize patterns.

**Results:**

Separate regressions predicting QoL and well-being from the age of participants' discovery of their autism diagnosis, gender, current age, academic level, and self-reported autistic traits revealed that learning one is autistic earlier in life ( $p < .001$ ), lower traits ( $p < .001$ ), being older ( $p = .02$ ) and being a graduate student ( $p = .04$ ) were associated with heightened QoL. Learning one is autistic earlier in life, being older, and lower traits were also associated with heightened well-being ( $ps \leq .001$ ).

Participants learned they were autistic in varied ways: 46.8% from clinicians, 38.3% from parents, and 18.1% found out on their own. Learning from clinicians was associated with heightened camouflaging in adulthood.

Most participants described experiencing positive feelings when they first learned they were autistic (Table 1) and about their autism now. Contrary to hypotheses, people who learned they were autistic *later* in life described *more* positive emotions, such as relief, than those who learned earlier ( $p < .001$ ). Although numerically more participants described autism positively concurrently (63.5%) than when they learned they were autistic (54.1%), this was not significant ( $p = .32$ ). Positive current feelings about autism were associated with less camouflaging and more connection to an autism community ( $ps < .003$ ).

**Conclusions:** These findings suggest that learning about one's autism diagnosis early in development lays a foundation for thriving in adulthood. However, learning one is autistic later in development was associated with more positive viewpoints about autism itself. These findings echo participants' recommendations highlighting the importance of considering not only age but

also developmental factors when deciding when to tell someone about their autism diagnosis.

**422.073** (Poster) Who Knows You Best: Adult Self-Report Vs. Sibling Report Vs. Parent Report

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Background: The practice of relying solely on parent report in Autism Spectrum Disorder (ASD) is being re-examined (Bishop & Seltzer, 2012; Mazefsky et al., 2011; Ozsivadjian et al., 2014). Though parents are able to provide insight into the lives of their child, parent report has limitations. Autistic self-report and sibling report provide alternatives to parent report. Through exploring self-report and sibling report, researchers would help amplify autistic voices and provide alternatives when parent report is inaccessible. In this pilot study, we explore how different perspectives impact reporting on special domains in ASD.

Objectives: Illustrate how adult self-report and sibling report compare to parent-report measures for autism specific domains.

Methods: Nine family triads consisting of an autistic adult, a sibling, and a parent participated. Participants completed questionnaires relating to special domains of ASD. Internalizing symptoms domain included Beck's Anxiety Inventory (BAI; Beck & Steer, 1993) and Beck's Depression Inventory (BDI; Beck, Steer, & Brown, 1996). Restricted and repetitive behaviors (RRBs) domain contained Social Responsiveness Scale (SRS-2-SR; Constantino, 2012) subdomain SRS-RRB and Family Accommodation Scale for Restricted and Repetitive Behaviors (FAS-RRB; Feldman et al., 2019). Social skills domain contained SRS-2-SR subdomains communication, awareness, and motivation as well as Theory of Mind Inventory (ToMI; Hutchins, Prelock, & Bonazinga, 2012). Adaptive functioning domain included SRS-Cognition (SRS-2-SR, Constantino, 2012). Pearson correlational coefficients were conducted between family member dyads.

Results: For internalizing symptoms, the BDI self-report was significantly correlated with sibling report  $r(9) = -.79, p < .05$ . For RRBs, SRS-RRB sibling report was significantly correlated with parent report  $r(9) = .94, p < .01$ . Within the social skills domain, SRS-Communication  $r(9) = 1.00, p < .01$  and SRS-Motivation  $r(9) = .90, p < .01$  parent report was significantly correlated with sibling report. SRS-Awareness  $r(9) = -.86, p < .01$  self-report was significantly negatively correlated with sibling report. Across early  $r(9) = .67, p < .05$ , basic  $r(9) = .70, p < .05$ , and advanced  $r(9) = .70, p < .05$  TOMI self-report was significantly correlated with parent report. Basic  $r(9) = .73, p < .05$  and advanced  $r(9) = .75, p < .05$  TOMI self-report was significantly correlated with sibling report, while the advanced  $r(9) = .67, p < .05$  TOMI sibling report was only significantly correlated with parent report. For adaptive functioning, SRS-Cognition  $r(9) = .90, p < .01$  parent report was significantly correlated with sibling report.

Conclusions: There is much to be learned from examining a variety of perspectives in reporting measures for ASD. Exploring self-report measures allows researchers and clinicians to focus on the needs and desires of autistic adults. Sibling reports provide valuable, varied insight into the autistic adult while growing our understanding and utilization of sibling's perspectives for when parent report is not available. Based on this pilot study, sibling report of internalizing symptoms appears more consistent with self-report compared to parents. However, for RRBs, parent report correlated with self-report more often, indicating that parents may be more consistent reporters. Future exploration into online socialization of autistic adults is imperative to help researchers understand why parents and siblings were not correlated with self-report in social domains. The goal of this study was not to establish who is "most accurate," but to explore ways for researchers and clinicians to make mindful decisions about where and how information is collected.

**422.074** (Poster) Young Adult and Caregiver Perspectives on Emerging Adulthood in Autism Spectrum Disorder

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Background: As increasing numbers of individuals with ASD enter adulthood or receive diagnoses in adulthood, it has become increasingly important for autism researchers to seek direct input from individuals on the spectrum and their families. Arnett (2000) outlined a theoretical framework for emerging adulthood that could have important implications for understanding adult outcomes in autism spectrum disorder (ASD). Some individuals with autism will experience the fluidity in identity and autonomy described by the Arnett's framework, but may be less likely to experience normative adult outcomes such as marriage, steady employment, and parenthood than their typical peers. In contrast, many individuals with ASD will need extensive support throughout their lives, but the societal expectations associated with emerging adulthood still influence the experiences of high-need adults with ASD and their families. An in-depth investigation of the ways in which the experiences of young adults with ASD are different from and similar to Arnett's descriptions of emerging adulthood could be significant to both our understanding of adulthood in ASD and of emerging adulthood as a unique developmental stage.

**Objectives:** To understand how individuals with ASD and their caregivers conceptualize the developmental transition to emerging adulthood, and to identify ways in which this mirrors and contrasts with the transition to emerging adulthood in typical development.

**Methods:** Fifteen semi-structured interviews were completed with participants from a well-characterized longitudinal study of autism. Five interviews were conducted with adults with ASD, five interviews with parents of adults with ASD without intellectual disability, and five interviews with parents of adults with ASD with intellectual disability. In addition to the qualitative data collected for this study, data on participants' IQ, autism severity, and adaptive behavior in adulthood have also been collected (Table 1). Trained coders analyzed interviews using the constant comparative method to examine commonalities and discrepancies between interviews and inductively identify themes.

**Results:** Initial coding identified several emergent themes that parallel normative emerging adulthood, including the desire for meaningful daily activities and social and romantic relationships. However, the majority of the identified themes appear to diverge from normative emerging adulthood. Many of the participants with autism noted that the transition to adulthood forced them to reexamine the personal significance of their autistic identities. Both adults and parents identified access to services such as Social Security and vocational rehabilitation as a significant concern in emerging adulthood. Additionally, parents noted that emerging adulthood was accompanied by a new caregiving challenge of continuing to provide support for their child with ASD whilst simultaneously finding ways to foster increased independence. Additional coding will continue to identify similarities and contrasts between Arnett's theory of emerging adulthood and participants' interview responses.

**Conclusions:** Emerging adulthood is a key period that has been well-characterized in typical development. By qualitatively examining the experiences of adults with ASD and their families during this developmental period, this study enriches our understanding of 1) how Arnett's theory of emerging adulthood relates to nonnormative development and 2) the significance of the transition to adulthood for individuals on the spectrum.

**422.075 (Poster)** "Increasing Awareness of Regional Center Services for Autism Spectrum Disorders in the African American Community: A Faith-Based, Community-Partnered Participatory Research (CPPR) Approach"

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**Background:** California Department of Developmental Services (DDS) administers the Lanterman Services Act and the Early Intervention Services Act for individuals with developmental disabilities, independent of socio-economic status or other characteristics. Significant racial and ethnic disparities, however, exist in expenditures for services across most Regional Centers (RC). African American/Black (AA/B) individuals comprise 8.9% (28,371) of the DDS-served population. South Central Los Angeles Regional Center (SCLARC) serves the largest percentage of AA/Bs with developmental disabilities among all RCs. For 2018/19, SCLARC reported per-capita Purchase of Services (PoS) expenditures were \$27,997 for AA/Bs and \$60,487 for Whites. Within the AA/B community, faith centers have provided education and promoted influential health initiatives, including for Autism Spectrum Disorder (ASD), independent of individuals' religious beliefs.

**Objectives:** Decrease PoS disparities in the AA/B community by raising awareness of ASD and underutilization of services. Engage faith centers to support AA/B families in accessing information about RC services and developing skills for self-advocacy.

**Methods:** The Community-Partnered Participatory Research (CPPR) model guided the partnership among Healthy African American Families II (HAAF), the University Center for Excellence in Developmental Disabilities (UCEDD) and three African American faith centers. Four Community Health Advisors (CHA) received four 3-hour trainings on ASD and RC services. Forty-nine AA/B parents/caregivers with a family member with ASD receiving RC services participated in twelve focus group/instructional sessions to determine perceived barriers to services. Participants received information about RC services and their rights to appeal, and set goals for services to acquire from the RC. CHAs followed up monthly with participants by phone for three months to help families achieve their goals. Focus group transcripts were thematically analyzed using NVivo software. Pre- and post-surveys with CHAs and participants were also analyzed.

**Results:** Pre-focus group, 44.8% of the participants indicated level 5 or less awareness of RC services (1=unaware, 10=perfectly aware). Post-focus group, 87.8% of participants indicated level 6 or greater. On a similar scale of self-efficacy, pre-focus group,

50% indicated a confidence level of 5 or less. Post-focus group, 71% indicated level 6 or greater. Upon study completion, 80% of participants met their goals for RC services. Both the CHAs and the parents/caregivers reported high levels of satisfaction with the program. Based on the thematic analysis of focus group transcripts, the main barriers to equitable access to RC services are: (1) inequity in access to information about services, and (2) parents' perceptions of RC personnel as disrespectful and judgmental, especially when there is disagreement. We developed a manual for training CHAs to use culturally and linguistically appropriate strategies to support AA/B families in advocating for RC services.

Conclusions: Partnering with faith centers is an effective approach to raising awareness about ASD, navigating and accessing RC services, advocacy strategies, and resources in the AA/B community. The CHAs provided a safe environment for families to share challenges, hear how others dealt with similar issues, and receive mutual support. Culturally tailored training for RC personnel is essential to close the disparity in PoS.

## Gastrointestinal (GI)

### POSTER SESSION — GASTROINTESTINAL (GI)

#### Poster 423 - Gastrointestinal (GI) Posters

**423.001** (Poster) Altered Gut Microbiota in Youth with Autism Spectrum Disorder Associated with the Severity of Social Deficits and Executive Dysfunctions.

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**Background:** Autism spectrum disorder (ASD) is a common neurodevelopmental disorder in Taiwan and worldwide (prevalence rate, ASD, 1%), presenting clinically and genetically heterogeneous disorder with early onset at childhood lasting to adulthood without biological treatment. Moreover, the role of the microbiome in neuropsychiatric disorders has been highlighted to modulate the behavioral impairments.<sup>1-4</sup> However, the discrepancies between studies might bias via differences in sample number, methodology, and variability include differences in unknown environmental factors, such as diet. Though evidence suggested decreasing gut microbiota dysbiosis also decreased core symptoms. Their underlying pathogenesis remains unclear.<sup>5-8</sup>

**Objectives:** Hence, we aim to identify the direct associations between the gut microbiome and behavioral impairments are needed in ASD, discovering the underlying mechanism of how gut microbiota dysbiosis modulated the clinical symptoms.

**Methods:** The sample consisted of 114 youths from age 6 to 25 years old, including 82 males with a clinical diagnosis of ASD (age= 16.16 ) according to the DSM-5 criteria from National Taiwan University Hospital, Taiwan, and 31 typically developing control males (TDC) (age=13.19 5.29), without other neuropsychiatric disorders. The ASD diagnosis was confirmed by ADI-R and ADOS. All stool samples were analyzed by 16s metagenome sequencing. The clinical and executive functions were measured by the social responsiveness scale (SRS) and behavior rating inventory of executive function (BRIEF) simultaneously. In the statistical analysis via QIIME2 and R, the significance level is the FDR-corrected q value <0.05.

**Results:** There were no differences between alpha diversity of species richness estimates (Chao1 and ACE and diversity indices (Shannon and Simpson). The significant group differences in weighted- Unifrac beta diversity which ASD youth had higher variability of microbial communities than TDC. Three microbiotas, parabacteroides sp Marseille P3236, Campylobacter jejuni, and Streptococcus paprauberis, were significantly higher in TDC than ASD. The top 2 distinct microbial community components have explained the 67.4% social impairments and 52.3% executive dysfunctions.

#### **Conclusions:**

These findings support a connection between metabolism, social impairments and executive dysfunction and may advance the discovery and development of molecular biomarkers for ASD.

**423.003** (Poster) Comparative Analysis of Gut Microbiota between Children with Autism Spectrum Disorder and Typically Developing Children: A PCR and Metagenomic Approach

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**Background:** Autism spectrum disorders (ASD) is an umbrella term that incorporates a set of neurodevelopmental disorders previously referred to as autistic disorder, Asperger's syndrome, pervasive developmental disorder not otherwise specified, and childhood disintegrative disorders. Several emerging studies have identified an imbalanced composition of the intestinal microbiota in ASD individuals, often reported under the controversial term "dysbiosis." However, the characterization of a distinctive ASD microbial pattern is still unclear.

**Objectives:** This study analyzed the comparative abundance of major gut microflora between children with ASD and typically developing (TD) children.

**Methods:** All children between 3 to 15 years with ASD presenting to a tertiary care center in India were eligible for the study. The control population included the TD siblings of ASD patients. Fecal specimens were collected in the homes of the participants by their parents. Fecal specimens were shipped to the laboratory on the same day, where each specimen was frozen at  $-80^{\circ}\text{C}$  until DNA extraction. Relative and Absolute qPCR, as well as 16S rRNA diversity using High throughput Sequencing (HTS) of metagenomic DNA analysis, was carried out for studying the comparative abundance of the targeted microbiota.

**Results:** Twenty-four children were enrolled in the study; six were excluded due to inadequacy of stool sample, and eighteen children (all boys, median age=7.5 years) were included for final analysis. These included 12 children with ASD and six TD siblings of ASD patients. The DNA concentration from fecal samples of TD children was in the range of 157.19 and 187.54ng/ $\mu\text{l}$ , and the corresponding figures in related ASD children were 226.49 and 205.54 ng/ $\mu\text{l}$ , respectively. From the Quantitative Insights Into Microbial Ecology analysis, out of 178154 and 195285 processed reads from TD siblings and related ASD children, 168851 and 186985 sequence reads were identified as 16S rRNA sequences in TD siblings and related ASD children, respectively. In the metagenomic analysis, comparative analyses of gut microbial composition at the phylum level revealed the predominance of Firmicutes (60.83 %), followed by Actinobacteria (18.39%), Proteobacteria (12.28%), and Bacteroidetes (8.47%) in ASD children. In contrast, the composition of Firmicutes, Actinobacteria, Proteobacteria, Bacteroidetes in TD siblings were 77.71%, 13.84%, 1.08%, and 7.05%, respectively.

**Conclusions:** There was decreased gut bacterial diversity in the gut microflora of children with ASD. The phylum *Firmicutes* was significantly less, and the phylum *Bacteroidetes* was significantly more in children with ASD as compared to TD siblings. Also, *Clostridium perfringens* was significantly higher in the gut microbiota of children with ASD. These results suggest that gut-microbiota-based disease analysis can predict the novel connection between gut microbes and ASD and may play a role in revealing the pathogenesis of ASD.

#### **423.004 (Poster) Genetic Liability to Autism and Inflammatory Bowel Disease: Is There Evidence for a Shared Genetic Aetiology?**

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**Background:** Observational studies suggest that people with autism are at increased risk of gastrointestinal conditions, while a family history of gastrointestinal conditions seems to be associated with increased risk of autism in offspring. The reasons underlying these associations are currently unknown.

**Objectives:** We evaluated whether there is evidence for a shared genetic aetiology between autism and inflammatory bowel disease (IBD) or the major IBD subtypes: Crohn's disease and ulcerative colitis.

**Methods:** Publicly available summary statistics from the largest genome-wide association study (GWAS) were identified for autism (Grove et al., 2019, N=46,350), IBD (de Lange et al., 2017, N=59,957), Crohn's disease (de Lange et al., N=40,266) and ulcerative colitis (de Lange et al., N=45,975). Three different analyses were carried out. Firstly, linkage disequilibrium (LD)-score regression was used to estimate genetic correlations between autism and each gastrointestinal condition. Secondly, two-sample Mendelian randomisation (MR) was used to estimate causal effects of genetic liability to autism on risk of each gastrointestinal condition, and vice versa. Finally, in order to further interrogate findings, polygenic risk scores (PRSs) were generated using individual-level data from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort (available N=7,505). These were regressed on a composite measure of autistic traits in ALSPAC, an autism mean factor score previously described by Steer et al., 2010

**Results:** There was limited evidence to suggest a genetic correlation between autism and IBD ( $r_g = -0.07$ ; 95%CI: -0.15 to 0.02,  $p = 0.158$ ), as well as limited evidence for an effect of genetic liability to ASD on risk of IBD (ORMR= 0.91; 95%CI: 0.76 to 1.1,  $p = 0.323$ ). However, there was evidence indicating that genetic liability to ulcerative colitis was causally linked to increased risk of autism (ORMR= 1.03; 95%CI: 1.01 to 1.06,  $p = 0.017$ ). PRS analyses in ALSPAC suggested that higher maternal polygenic risk for ulcerative colitis and Crohn's disease was associated with a higher autism factor mean score in the offspring (ulcerative colitis:  $\beta_{PRS} = 0.02$ ; 95%CI: 0.00 to 0.05,  $p = 0.025$ ; Crohn's disease:  $\beta_{PRS} = 0.03$ ; 95%CI: 0.01 to 0.05,  $p = 0.004$ ). In contrast, there was limited evidence to suggest an association between offspring polygenic risk for each gastrointestinal condition and autism factor mean score.

Conclusions: Our findings suggest that genetic liability to ulcerative colitis increases the risk of autism. In our ALSPAC analyses, maternal PRSs, but not offspring PRSs, for both Crohn's disease and ulcerative colitis were associated with autism traits in offspring. Our findings suggest a causal link and a polygenic association between genetic liability to IBD subtypes and risk of ASD. These may be of maternal origin. Further work is needed to investigate the potential mechanisms, such as intra-uterine effects and inflammatory pathways, that may underly the associations.

**423.005** (Poster) Haploinsufficiency of CHD8 Leads to Distinctive Gastrointestinal Deficits and Gut-Brain Axis Abnormalities  
*I. Chaterjee, D. Getselter and E. Elliott, Medicine, Bar Ilan University, Safed, Israel*

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**Background:** Many individuals diagnosed with autism spectrum disorders report gastrointestinal abnormalities, that may range from constipation to gut reflux. Treatment of these abnormalities are proposed as an important step in improving quality of life. It is not clear what are the role of these gastrointestinal symptoms in the presentation of the core behavioral phenotypes of autism. Mutations in CHD8 is one of the leading genetic factors in the etiology of autism, and individuals with mutations in CHD8 report gastrointestinal difficulties. This suggests that the genetic etiology of autism may be directly related to gut function and the gut-brain axis.

**Objectives:** We aimed to characterize how CHD8 haploinsufficiency affects gut function, including gut permeability, proper gut development, and microbiome regulation. Further, we aim to understand if CHD8 abnormalities in the gut may play a role in the behavioral symptomology of autism.

**Methods:** First, we performed characterization of the gut epithelial function (gut permeability analysis), gut morphology, and gene expression (RNA-seq) in the CHD8 haploinsufficient mouse model. This was followed by whole-throughput analysis of the microbiome (16S sequencing). Furthermore, in a separate model, we induced haploinsufficiency of CHD8 specifically in gut epithelial cells (using villin-cre/floxed CHD8 system) and have characterized the behavioral phenotype in these mice.

**Results:** CHD8 haploinsufficient mice display an increase in gut permeability. In parallel, these mice display a decrease in mucus layer width and goblet cells (mucus producing cells) in the small intestine. Gene expression analysis revealed that 900 genes are differentially expressed specifically in gut epithelial cells of these mice (in comparison to only 10 that are differentially expressed in neurons). Downregulated genes are enriched for genes involved in tuft cell function (important for gut permeability) and upregulated genes are involved in inflammatory response and anti-microbial response. Microbiome analysis revealed an increase in overall microbiome load (increase in total amounts of bacteria), and an increase in alpha diversity of microbiome in CHD8 haploinsufficient mice. Knockout of CHD8 specifically in gut epithelial cells induced some behavioral changes that are similar to those seen in a full body CHD8 haploinsufficiency.

**Conclusions:** Our data suggests that autism-associated gene CHD8 has an important role in regulating gut function through several mechanisms, including proper development of gut cells and regulation of microbiome. Furthermore, the gut-specific CHD8 knockout model gives preliminary evidence that gut phenotypes play a direct role in behavioral changes seen in autism. These findings are a significant step forward in understanding the interplay between genetic etiology, autistic behavior, and the gut-brain axis.

**423.007** (Poster) Mapping the Mucosal Microbiome in Gastrointestinal Biopsy Specimens from Children with ASD: A Pilot Study  
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**Background:** Microbial dysbiosis is a common finding in children with autism spectrum disorder (ASD), particularly in children with chronic gastrointestinal (GI) symptoms. There is evidence to suggest that the fecal microbiome may not accurately reflect the mucosal microbiome and that these differences may have important consequences when trying to understand the impact of dysbiosis on the host's physiology. Moreover, it is known that the gut luminal microbiome composition varies with anatomic location, suggesting that dysbiosis may sometimes be localized to a specific region of the lower GI tract rather than being pan-colonic.

**Objectives:** The objective of this pilot study was to use unbiased methods to map the mucosal microbiome, in multiple sites within the lower GI tract, from children with ASD and chronic GI symptoms. To our knowledge, this is the first study in GI-symptomatic children with ASD to specifically evaluate the microbiome in multiple locations throughout the lower GI tract

**Methods:** The study samples were comprised of three individual mucosal biopsy specimens (from: (1) terminal ileum, (2) transverse colon, and (3) rectum) taken from five GI-symptomatic children (ages 6 years – 9 years) with ASD who were undergoing clinically-indicated ileocolonoscopy. Shotgun metagenomic sequencing was performed to identify and quantify microorganisms in each biopsy specimen, and results from the taxonomic profiling were subsequently merged to estimate similarities and differences among the samples.

**Results:** Microbial diversity differed between the three different regions of the lower GI tract of five children with ASD and chronic GI symptoms. **Figure 1** highlights the microbial diversity identified within the three different GI regions from the five individuals (top: bar graphs) and the variability of microbial composition between each sample (bottom: principal component analysis (PCA) plot). In comparison to the transverse colon and rectum, the microbial composition within the terminal ileum was less diverse and displayed a higher level of similarity across the five individuals.

**Conclusions:** Results from this pilot study demonstrate feasibility of our proposed approach - we acquired robust sequence data from biopsies that were previously collected and stored in RNAlater. In addition, even with this small sample size, we were able to identify species-specific differences within and across the samples collected from three different regions of the GI tract of five children with ASD and chronic GI symptoms.

**423.008 (Poster)** Molecular Co-Expression Analysis Identifies Dysregulated Ion Transport As a Potential Mechanism for Right-Sided Colonic Hypomotility in Children with Autism

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**Background:** Gastrointestinal (GI) symptoms are more common in children with autism spectrum disorder (ASD) compared to typically developing (TD) children. Of the GI symptoms most commonly observed in children with ASD, chronic constipation is reported by parents to be especially problematic. In children with ASD who have sought medical assistance for chronic constipation on a background of colonic inflammation, two clinical trends (phenotypes) were observed based on the children's response to anti-inflammatory therapy: (1) patients who experience remission from constipation while undergoing anti-inflammatory therapy (*fast responders*), and (2) patients who experience recurrent right-side fecal loading while undergoing anti-inflammatory therapy (*slow responders*). In an earlier study we showed that total gene expression derived from right colon biopsies of 35 patients (15 *fast responders*, 20 *slow responders*), distinguished the fast responders from slow responders.

**Objectives:** The objective of this study is to further characterize the two ASD subgroups through microRNA (miRNA) and total gene (mRNA) co-expression analysis to identify potential molecular regulators of the atypical constipation phenotype.

**Methods:** In the original pilot study, hierarchical clustering of the right colon gene expression profiles from 35 patients resulted in two distinct clusters; the separation was based largely on clinical phenotype (*fast* vs *slow* responder; **Figure 1** – left panel). In this follow-up study, miRNA expression profiles were assessed for 12 of the 35 original right colon biopsies (6 *fast responders*, 6 *slow responders*) and analyzed together with mRNA profiles. Total RNA was quantified using NanoDrop and miRNA expression was assessed based on ~800 known miRNAs using NanoString nCounter SPRINT protocol. Differential expression of miRNA in fast vs. slow responders was determined using nSolver software and miRNA-mRNA co-expression was evaluated using Ingenuity Pathway Analysis (IPA).

**Results:** We identified 12 differentially expressed miRNAs ( $p=0.05$ ; **Figure 1** - right panel) and ~1500 differentially expressed transcripts (DETs) ( $p=0.01$ ) between slow vs fast responders. The mRNA comparison revealed decreases in expression of genes involved in Ca<sup>2+</sup> and Na<sup>+</sup> transport, smooth muscle cell generation, and smooth muscle contraction in patients exhibiting the slow responder phenotype. The co-expression analysis revealed a downregulation of gene(s) involved in inositol phosphate metabolism (e.g. CDC25A) and a concomitant increase in miR-125b-5p, which is known to impact CDC25A expression, in the slow responder group. Furthermore, a decrease in miRNA let-7a-5p, which has also been experimentally observed to target genes involved in inositol phosphate metabolism (e.g. CDC25A, CDIPT), was associated with a concomitant decrease of both CDC25A and CDIPT.

**Conclusions:**

A central finding of the miRNA-mRNA co-expression analysis was a downregulation of transcripts coding for ion channels and transport in the smooth muscle in slow responders compared to fast responders. Since smooth muscle contractility in the GI tract is integral to colonic motility, this observed decrease in factors necessary for smooth muscle cell contractility suggests a potential mechanism for the persistent hypomotility, even following treatment for gastrointestinal inflammation, observed in slow responders.

**423.009 (Poster)** Prevalence of Gastrointestinal Symptoms Among Individuals with ASD, with and without Co-Occurring Intellectual Disability

**C. B. Hologue**<sup>1,2,3</sup>, **P. Danika**<sup>1,4</sup>, **R. Reetzke**<sup>1,4</sup>, **J. S. Hong**<sup>1,4</sup>, **L. Kalb**<sup>1,2,3</sup> and **R. Landa**<sup>1,4</sup>, (1)Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD, (2)Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, (3)Department of Neuropsychology, Kennedy Krieger Institute, Baltimore, MD, (4)Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD

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**Background:**

While gastrointestinal (GI) symptoms are known to be highly prevalent among children with autism spectrum disorder (ASD), prior research has not assessed whether co-occurring intellectual disability (ID) influences the parental reporting of these symptoms.

**Objectives:**

To examine differences in the parental certainty and odds of reporting GI signs and symptoms among children with ASD with and without ID.

**Methods:**

Participants were 209 children and adolescents with a clinical diagnosis of ASD (6-18 years, mean =10.7, SD=3.5), assessed at an urban, outpatient ASD specialty clinic. Diagnosis of ASD and ID were determined by a licensed physician or psychologist based on the DSM-IV-TR or -5. At diagnostic intake, parents were asked to endorse whether, in the past 3 months, their child had experienced or displayed a range of signs or symptoms related to GI problems on custom medical form. Response options were yes, no, or unsure. First, we assessed whether having ASD with ID (relative to ASD without ID) was associated with parental certainty regarding the presence or absence of GI signs or symptoms (i.e., responses of yes and no were considered 'certain' and responses of unsure were considered 'uncertain'). Next, multivariate logistic regression models assessed the association between ID and each GI sign or symptom while adjusting for child sex, age, race, and parental education. Each model excluded children whose parents were uncertain regarding presence or absence of that particular GI symptom or sign. Given the relatively small sample of children with ASD with ID, p-values < 0.10 were considered statistically significant.

**Results:**

161 (77%) did not have ID, whereas 48 (23%) had ID. Parents of children with ASD and ID reported higher levels of uncertainty regarding the presence or absence of GI signs and symptoms; significant differences were observed for abdominal pain, nausea, bloating, and other GI symptoms (p<0.10, Table 1). Among children whose parents were certain about the presence or absence of symptoms, having co-occurring ID was associated with significantly higher odds of bloating and other GI symptoms (p<0.10, Table 2), after adjusting for potential demographic confounders. Other symptoms were not statistically different between the groups, though the group with ID reported greater abdominal pain, constipation, diarrhea, spitting up, and regurgitating food, whereas the group without ID tended to have more of nausea, tilting head to side and arching back, and refusal of foods (Table 2).

**Conclusions:**

Parents of children with ASD and ID reported more uncertainty regarding the presence or absence of GI signs and symptoms, relative to parents of children with ASD only. GI symptoms may be elevated among children with ASD and ID, though this relatively small sample size and the challenges of ascertaining these symptoms in children hinders this inference. Further research is needed to improve the accurate identification of GI symptoms among children with co-occurring ID.

**423.011 (Poster)** Study of the Gut Microbiome Profile in Children with Autism Spectrum Disorder and Their Unaffected Siblings.

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**Background:** Autism spectrum disorder (ASD) is a highly clinically and genetically heterogeneous neurodevelopmental disorder with characteristic behavioral manifestations including impaired social communication and restricted, repetitive behavior. Up to now, there has been no FDA approved drugs for its core behavioral symptoms. The youth with ASD often display gastrointestinal

(GI) dysfunction and altered gut microbiome compositions compared with their healthy biological unaffected siblings in the same family, who shared similar environmental conditions.<sup>1</sup> The metabolome directly or indirectly is affected through chemical transformation by the trillions of gut microbes, the microbiome, which has been proposed to modulate complex behaviors; such proposed environmental endophenotype of ASD may integrate with genetic risks to impact behavioral endpoints through the actions of small molecules produced in tissues outside the brain.<sup>2,3</sup>

**Objectives:** We aim to present a comprehensive comparison of extensively identified metabolism mechanisms in human feces from cohorts of matched ASD, unaffected siblings, and typically developing control youths.

**Methods:** A total of 190 samples were assessed, including 103 ASD youth (M:F=99:4, age= 17.32±4.52), 43 unaffected siblings (M:F=23:16, age= 14.51±6.21) and 32 healthy controls (all males, age= 15.67±3.21). All the samples were analyzed with 16S metagenome sequencing, and along with the social responsiveness scale (SRS) score and school function via Social Adjustment Inventory for Children and Adolescents simultaneously. The statistical analysis was done via QIIME2 and R, with the significance level being the FDR-corrected q value <0.05.

**Results:** The gut microbiome of unaffected siblings contained a higher relative abundance of Streptococcaceae as well as Aerococcaceae (family level) than the ASD and control groups. The ratios of Prevotella/Bacteroides (P/B) and Firmicutes/Bacteroidetes (F/B) were significantly lower in both youths with ASD and their unaffected siblings. Further, through the linear discriminant analysis effect size method, we have identified the three-group difference of microbial community, which were majorly in class level of C. bacilli, such as planococcaceae, lactobacillales, and bacillaceae. There were significant correlations between the altered gut microbiome, the severity of social deficits, and impaired school functions in youths with ASD and their siblings.

**Conclusions:** We identified many differential levels of microbiotas among the ASD, unaffected siblings, and control groups. These microbiotas correlate with clinical behavioral and functional scores. These findings support the emerging concept of healthy distal gut microflora in the development of neural systems. Moreover, our findings provide the insights that altered microbiome, as one of the possible etiologies of ASD, may be identified via the comparison between ASD probands and their healthy, unaffected siblings, who might be at risk of ASD.

**423.012 (Poster)** The Directional Relationship between Internalizing Symptoms and Gastrointestinal Problems in Autism Spectrum Disorder

**K. Gynegrowski, Marist, Poughkeepsie, NY**

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**Background:** Autism Spectrum Disorder (ASD) is characterized by impairments in social communication and restricted or repetitive behaviors and interests. Individuals with ASD experience co-occurring gastrointestinal (GI) problems and internalizing symptoms such as anxiety and depression. For example, children with greater constipation and abdominal pain display greater symptom severity on measures of irritability, anxiety, stereotypy, and social withdrawal when compared to children with no GI symptoms. However, there is minimal research on the directional relationship of these conditions.

**Objectives:** This study aimed to analyze the direction of the relationship between GI problems and internalizing symptoms in individuals with ASD.

**Methods:** The sample for this study included 2,444 individuals with ASD who had been seen at the Thompson Center for Autism and Neurodevelopmental Disorders, part of a multi-site system of autism centers specializing in ASD diagnosis and treatment. Participants ranged greatly in age from 1 to 54 years old (M = 7.33, SD = 5.71). Caregivers answered four dichotomous questions on whether their child had any past or present GI problems: constipation, diarrhea, nausea or vomiting, or stomachaches, stomach pain, or reflux. Caregivers reported on specific dietary traits (e.g., picky eating, milk aversion), and the sum of dietary problems served as a covariate in subsequent analyses. Caregivers also reported the use of any medications, and a dichotomous variable was created where 0 = no GI medications, and 1 = at least one GI medication. Three specific internalizing symptoms, withdrawn/depressed, somatic complaints, and anxious/depressed, were measured by The Child Behavior Checklist (CBCL). The CBCL is a psychometrically sound parent-report measure assessing internalizing and externalizing symptoms, with items rated on a 3-point scale. To test the relationship among GI problems and internalizing symptoms, we ran a structural equation modeling analysis to compare fit statistics across four models: unrelated, with GI problems and internalizing symptoms as independent variables; unidirectional, with GI problems predicting internalizing symptoms; unidirectional, with internalizing symptoms predicting GI problems; and bidirectional, with GI problems and internalizing symptoms correlated. Internalizing symptoms were always represented as a latent, unobserved construct with the three observed CBCL variables, and GI problems were represented as a dichotomous dummy-coded variable. Each model included GI medications, the total number of medications, age, gender, verbal IQ, nonverbal IQ, full scale IQ, total dietary issues, household income, and the number of dependents in the household as exogenous, correlated, covariates. The models were evaluated for relative and absolute model fit

using a chi-square ( $\chi^2$ ) goodness of fit statistic, a Comparative Fit Index (CFI), and a Root Mean Square Error of Approximation (RMSEA).

Results: The best-fitting model was unidirectional, wherein internalizing symptoms led to GI problems.

Conclusions: Results suggest that individuals with ASD who struggle to express internal emotions may show GI symptoms in response. Better knowledge about the relationship and progression of these co-occurring conditions would be useful in developing treatment plans. Research might identify subgroups of individuals with ASD at risk for anxiety-triggered GI issues that could benefit from very different interventions, aside from GI medications.

## PANEL DISCUSSION — IMMUNOLOGY

### Panel 212 - Microbiota and Immune Signaling in Neurodevelopmental Disorders

**Panel Chair: Jane A. Foster**, *Department of Psychiatry & Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada*

**Discussant: Tamar Gur**, *Ohio State University, Columbus, OH*

Trillions of microbes cover the surfaces of our bodies and inhabit our gastrointestinal tract. In the past decade, research efforts examining the role of the microbiome in mental health have moved to the forefront of neuroscience and psychiatry. Our increasing knowledge on pathways and involved mediators along the gut-brain axis has revolutionized our understanding of brain-body interaction. Intestinal bacteria act along the gut-brain axis in part by modifying the immune response. On the other side, bacteria produce neuroactive mediators and can modulate neuronal function, plasticity and behavior. Understanding the influence of microbiota-brain axis on brain function and behaviour is at the forefront of neuroscience research and microbiota-brain is essential to normal and healthy brain development. This session will highlight recent work in animal models examining the importance the brain's innate immune cell in neurodevelopmental disorders and will explore recent work examining the potential of microbiota-targeted therapies in autism.

**212.001 (Panel Discussion)** The Role of Bidirectional Communication between Gut Bacteria and T Cells in Neurodevelopment  
*J. A. Foster, Department of Psychiatry & Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada*

#### Background

Researchers in psychiatry and neuroscience are increasingly recognizing the importance of gut-brain communication in mental health. Based on a foundation of animal studies demonstrating the vital role for microbiota-brain communication in brain development, behavior, and brain function over the life span, clinical studies have started to consider the microbiome in psychiatric disorders. Work to date by our group and others suggest that microbiota-immune-brain signaling is an important pathway that influences brain structure, gene expression of stress-related and plasticity-related genes, stress-reactivity, and behaviour.

#### Objectives

In mice, this study examined the importance of peripheral T cells in the maturation of the microbiome and neurodevelopment.

#### Methods

T cell receptor deficient mice ( $TCR\beta^{-/-}\delta^{-/-}$ ) and C57BL/6 mice were bred in house. Mice were exposed to immune challenge with lipopolysaccharide (LPS) at postnatal day (P) 3 and maternal separation at P9 (16 h overnight). Behavioural assessment of growth and development as well as behaviour (righting reflex, ultrasonic vocalizations in response to brief maternal separation, open field, sociability and grooming).

At P24, fecal samples were collected. Microbiota composition was determined by amplifying the 16S rRNA gene variable 3 (v3) region and then sequenced using the Illumina MiSeq platform data analyzed using DADA2, a Bioconductor pipeline. Alpha and Beta diversity analyses were conducted using the phyloseq package in the R software.

#### Results

Loss of T cells resulted in a delay in the development of the right reflex, increase vocalizations at P7, increase activity and exploratory behaviour at P17, and increased self-grooming. Genotype differences were evident in microbiota composition between  $TCR\beta^{-/-}\delta^{-/-}$  and C57BL/6 mice.  $TCR\beta^{-/-}\delta^{-/-}$  mice were found to have significantly lower alpha diversity than C57BL/6 mice (Shannon:  $p < 0.05$ ). Samples were found to cluster by mouse strain in PCoA plot with bray-curtis (PERMANOVA:  $p < 0.001$ ). Relative abundance at both the phylum and genus level of taxa revealed significant differences between strains. Ongoing analyses examines the relationship between specific immune related taxa and behaviour.

## Conclusions

These findings show the important relationship between the immune system and gut microbiota. By understanding the relationship and influence between the immune system and gut microbiota, we can further begin to understand microbiome-immune-brain signaling pathways and its relation to behavior in early development.

**212.002** (*Panel Discussion*) Microglial P2Y<sub>12</sub>R in Sex-Biased ASD-like Behavioral Phenotypes  
*U. Eyo, Neuroscience, University of Virginia, Charlottesville, VA*

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**Background:** Autism spectrum disorder (ASD) refers to a group of heterogeneous neurodevelopmental disorders with hallmarks of aberrant social, communication and repetitive behaviors. ASD occurs in 1 in 59 children and is diagnosed more frequently in boys over girls. However, boys and girls present with different behaviors when diagnosed. Of interest, there is mounting evidence for the hypothesis of a dysregulated immune system in ASD. Moreover, pre-clinical models of ASD, often focus on male phenotypes and ignore female phenotypes despite a growing incidence of ASD diagnosis in girls. This raises the need for the development of adequate pre-clinical mouse models that better recapitulate sex-biased behaviors in ASD. Microglia represent the primary brain-resident immune cell and orchestrate brain wiring. Microglial phenotypes have been repeatedly reported to be altered in ASD and specifically manipulating microglia is sufficient to generate ASD-like phenotypes in mice. Moreover, a growing body of literature indicates sex differences in microglia raising possibilities for microglial dysfunction as a factor in regulating sex differences in neurodevelopmental disorders such as ASD. Among microglial genes, the *p2ry12* gene which encodes the P2RY<sub>12</sub> purinergic receptors has emerged as a signature gene for microglial identity.

**Objectives:** The objectives of this project are three-fold. First, we sought to test the possibility of developing a pre-clinical mouse model that adequately re-capitulates sex different behaviors of human ASD in mice. Second, we sought to do this specifically targeting microglia with the hypothesis that microglial dysfunction could elicit sex-biased ASD-like behaviors in mice. Finally, having developed such a model we will attempt to determine the underlying circuits that are dysregulated in this model.

**Methods:** To test the possibility that microglial dysfunction could elicit ASD-like behaviors in mice, we studied mice lacking P2RY<sub>12</sub>. We hypothesized that lacking the functions of a notable microglial homeostatic gene would perturb microglial function and facilitate the development of sex-biased ASD-like phenotypes. We therefore performed various ASD-relevant behavioral tests in wildtype and P2RY<sub>12</sub><sup>-/-</sup> mice of both sexes. We also undertook some cFos immunohistochemistry to assess neuronal activity in relevant brain regions.

**Results:** Our findings indicate sex-biased ASD-like phenotypes in P2RY<sub>12</sub><sup>-/-</sup> male and female mice that mirror behaviors in human boys and girls with ASD. Moreover, we are beginning to observe different neuronal activity patterns between wildtype and mutant mice and are exploring these differences.

**Conclusions:** We are developing a pre-clinical mouse model that can mimic the human condition of ASD-like behaviors in a sex-biased manner by mutating a signature microglial gene. We are attempting to validate this model with other behaviors and determine the underlying circuit and neurobiological mechanisms that precipitate these ASD-like sex differences that we hope can be used to further understand the human condition.

**212.003** (*Panel Discussion*) Gut-Derived Metabolites in Autism Spectrum Disorder and Mouse Models of Behavior  
*S. K. Mazmanian, Division of Biology & Biological Engineering, California Institute of Technology, Pasadena, CA*

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## Background

The gut microbiome has been associated with effects on the brain, such as modifying risk-taking behaviors and hyperactivity, impacting learning and memory, modulating expression of neurotransmitters, and affecting brain myelination patterns in mice. Recent studies have reported that the gut microbiome, and certain microbial metabolites, are altered in individuals with autism spectrum disorder (ASD).

## Objectives

We sought to translate into humans our preclinical findings that specific gut microbial molecules are dysregulated in mouse models of neurodevelopment, research that is supported by several clinical studies identifying metabolic imbalances in feces and circulation of individuals with ASD. The objective of this study was to take the first steps in testing whether targeting the gut microbiome is a safe and effective option to modulate complex behaviors in humans.

## Methods

We previously reported that the microbial metabolite 4-ethylphenyl sulfate (4EPS) was elevated in a mouse model of neurodevelopment and in a large cohort of ASD individuals. In new unpublished work, engineered bacteria that selectively produce 4EPS in the gut of mice led to changes in brain activity, functional and structural connectivity in brain regions linked to emotional behavior, as well as gene expression signatures of altered oligodendrocyte function. Indeed, production of 4EPS by the microbiome is associated with increased proportions of immature oligodendrocytes in mice and, accordingly, decreased myelination of neuronal axons in the brain. Furthermore, mice exposed to 4EPS display anxiety-like behaviors, reduced social activity and decreased vocalization. These findings reveal that 4EPS can impact the function of oligodendrocytes in the brain and modulate complex behaviors in mice, and suggest that microbial metabolites may be associated with neurodevelopmental disorders in humans.

ASD is defined by core symptomatic behaviors involving delayed or reduced social communication and repetition of familiar traits. Additional features of ASD may include social anxiety, irritability/aggression, altered sensory integration, and GI symptoms. A pilot human study was designed to explore if AB-2004, an oral gut-restricted sequestrant reduces systemic levels of specific bacterial metabolites that are elevated in ASD. Primary endpoints are safety and tolerability. Additionally, metabolites were measured in the blood and urine of study participants, behavioral assessment tools implemented at baseline and end of treatment, as GI symptoms evaluated.

## Results

In an open-label Phase 1b/2a clinical trial with 26 adolescent ASD participants, we confirm safety and tolerability of AB-2004, with little to no adverse events reported. Using metabolomic analysis, we validate reduction of key gut-derived metabolites in urine and blood after 8 weeks of treatment. Importantly, drug therapy was associated with improvements in multiple behavioral domains, most significantly in anxiety and irritability, as measured by the aberrant behavioral checklist and other assessment instruments. GI symptoms were reduced based on standardized functional assessment tools. Preliminary fMRI data suggest that oral AB-2004 affects connectivity between specific brain regions implicated in autism.

## Conclusions

These early findings require replication in larger placebo-controlled trials to test the hypothesis that targeting the gut microbiome may represent a new approach to addressing the core and non-core symptoms of ASD.

**212.004** (*Panel Discussion*) Microbiota Transfer Therapy for Autism: Microbiome and Metabolites Changes  
**R. Krajmalnik-Brown** and **J. Adams**, Arizona State University, Tempe, AZ

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**Background:** Recent studies in human cohorts and mouse models have shown a link between gut microbiota and autism.

**Objectives:** To investigate the link between gut microbiota and autism by modifying the gut microbiota through a Microbiota Transfer Therapy

**Methods:** An open-label phase 1 study with a follow-up at 2 years post-treatment was conducted. The treatment involved 2 weeks of oral vancomycin, a bowel cleanse, and 7-8 weeks of microbiota transplant. Fecal microbiota was profiled before, after treatment and at follow up by 16S rRNA gene amplicon sequencing, and metabolites were assessed in blood and fecal samples.

**Results:** Gastro-intestinal symptoms and behavior improved significantly, and most improvements remained two years after treatment. The microbiota and metabolites changed with treatment. Beneficial gut microbial changes were sustained 2 years after treatment. We identified important metabolic changes also.

**Conclusions:** MTT is a promising therapy for treating GI disorders for autism. Using a multi-omic approach we are looking at microbes, pathways, genes, and metabolites, which likely lead to the trial's success and can lead to biomarkers or targets for treatment.

**212.005** (*Panel Discussion*) Microbiota Transfer Therapy for Autism: GI and ASD Outcomes  
**J. Adams** and **R. Krajmalnik-Brown**, Arizona State University, Tempe, AZ

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Background: Gastrointestinal problems including chronic constipation, diarrhea, and/or abdominal pain are common in children and adults with ASD, and are resistant to standard treatments.

Objectives: Investigate a novel method of treatment, Microbiota Transfer Therapy

Methods: An open-label phase 1 study with a follow-up at 2 years post-treatment was conducted. The treatment involved 2 weeks of oral vancomycin, a bowel cleanse, and 7-8 weeks of microbiota transplant.

Results: At the end of treatment there was an 80% reduction in GI symptoms, and a 23% reduction in autism symptoms. At a 2 year follow-up, most of the GI improvements remained (59% reduction compared to baseline), and there was a 47% reduction in ASD symptoms. Five factors in the early medical history of the children with ASD were different compared to controls, and likely contributed to the GI symptoms.

Conclusions: MTT is a promising therapy for treating GI disorders for autism, and randomized double-blind placebo-controlled studies are warranted to further investigate this treatment.

## POSTER SESSION — IMMUNOLOGY

### Poster 424 - Immunology Posters

**424.001** (Poster) Inflammatory Pathways to Autism: Exploring Causality within a Two-Sample Mendelian Randomization Framework

*C. Dardani<sup>1</sup>, J. Robinson<sup>2</sup>, A. Sadik<sup>3</sup>, P. Pagoni<sup>4</sup>, J. Zheng<sup>5</sup>, E. Stergiakouli<sup>6</sup>, R. Gardner<sup>7</sup>, J. Grove<sup>8</sup>, T. iPSYCH ASD Working Group<sup>9</sup>, G. Davey Smith<sup>1</sup>, S. Sullivan<sup>1</sup>, B. Leppert<sup>1</sup>, H. J. Jones<sup>1</sup>, S. Zammit<sup>6</sup>, G. M. Khandaker<sup>6</sup> and D. Rai<sup>1</sup>, (1)Population Health Sciences, Bristol Medical School, Centre for Academic Mental Health, Bristol, United Kingdom, (2)MRC Integrative Epidemiology Unit, Bristol Medical School, University of Bristol, Bristol, United Kingdom, (3)Avon and Wiltshire Mental Health Partnership NHS Trust, Bath, United Kingdom, (4)Karolinska Institutet, Stockholm, Sweden, (5)Aarhus University, Aarhus, Denmark, (6)Denmark, (7)Population Health Sciences, Bristol Medical School, MRC Integrative Epidemiology Unit, Bristol, United Kingdom, (8)Division of Psychological Medicine and Clinical Neurosciences, Cardiff University, Cardiff, United Kingdom, (9)University of Cambridge, Cambridge, United Kingdom*

Background: Inflammation and immune system activation have been proposed to have a key role in autism aetiopathogenesis. There is increasing observational evidence suggesting atypical levels of circulating cytokines in blood plasma and serum of autistic children, as well as associations with core autism-related behaviours. However, inferring a causal role of circulating cytokines in autism has been limited, as the majority of evidence so far has been based on studies with small and selected samples.

Objectives: In 18,381 autism cases and 27,969 controls from the Psychiatric Genetics Consortium and the iPSYCH, we tested the hypothesis that two-major categories of cytokines, implicated in birth complications and secreted by T-helper cells (Th1 and Th2), could be causally linked to autism risk.

Methods: Based on the cytokine categories of interest, we focused on interferon-gamma (IFN-g) as the main Th1 cytokine, and interleukins 4, 5, 10 and 13 (IL4, IL5, IL10, IL13) as the main Th2. We additionally tested macrophage secreted cytokines (tumour necrosis factor alpha; TNF-a, IL1, IL6). We used Mendelian randomization (MR), an approach that utilizes common genetic variants as proxies for risk factors and allows the estimation of their causal effects on outcomes of interest. Within this framework, we selected genetic variants associated with cytokine levels from available genome-wide association studies (Sun et al., 2018, N= 3,301; Ahola-Oli et al., 2017, N= 7,681; Sliz et al., 2019; N= 8,280) and extracted effect sizes and standard errors from the latest available autism GWAS (Grove et al, 2019, N= 46,350) to generate causal effect estimates. In order to further interrogate our findings, we selected brain tissue expression quantitative trait loci (eQTLs) from the largest brain tissue eQTL meta-analysis to date (Qi et al., 2018, N= 1,194) and examined whether changes in gene expression levels of the inflammatory markers of interest might affect autism risk. Finally, analyses were repeated using a subsample of the autism GWAS excluding all intellectual disabilities cases.

Results: We found evidence consistent with a causal effect of genetically predicted levels of IFN-gR (OR= 1.15; 95%CI: 1.03, 1.29), IL-4R (OR= 0.81; 95%CI: 0.66, 0.98; p= 0.03), IL-10 (OR= 0.8; 95%CI: 0.65, 0.98; p= 0.03), IL-13 (OR= 0.8; 95%CI: 0.65, 0.98; p= 0.03) and IL-13R (OR= 1.16; 95%CI: 1.01, 1.33; p= 0.03) on risk of autism. Brain eQTL MR analyses suggested that increased expression of IFN-gR gene in brain tissue was linked to autism risk (OR= 1.15; 95%CI: 1.03, 1.27; p=0.009).

Findings were consistent after repeating our analyses using the autism GWAS subsample excluding intellectual disability cases. There was limited evidence to suggest a causal effect of genetically proxied macrophages secreted cytokines on autism risk.

Conclusions: Present findings are consistent with a potentially causal role of Th1 and Th2 family of cytokines on risk of autism, especially IFN- $\gamma$ , IL4R, IL10, IL13. This information may advance the biological processes underlying the origins of autism and further research focusing on these pathways is warranted.

**424.002** (Poster) Prevalence of Celiac Disease in a Large Cohort of Italian Children with Autism Spectrum Disorders  
**M. Prosperi<sup>1,2</sup>, E. Brunori<sup>1</sup>, A. Cosenza<sup>1</sup>, R. Tancredi<sup>2</sup>, F. Muratori<sup>1,2</sup> and S. Calderoni<sup>1,2</sup>**, (1)IRCCS Fondazione Stella Maris, Calambrone (Pisa), Italy, (2)Department of Clinical and Experimental Medicine, University of Pisa, Pisa, Italy, (3)IRCCS Stella Maris Foundation, Pisa, Italy

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Background: Recent studies suggest that a sort of immune system dysregulation might be present in Autism Spectrum Disorder (ASD), supporting the proposal that the immunity system may be involved in various ways in ASD. Some studies have found an association between celiac disease (CD) and ASD, while others hypothesized a random link. To date, studies assessing the prevalence of CD in subjects with ASD provide controversial results.

Objectives: This investigation aims to evaluate the prevalence of celiac disease (CD) in a large sample of school-aged children with Autism Spectrum Disorder (ASD), as well as to characterize their clinical profile.

Methods: Medical records of 405 children with ASD aged 5-11 years (mean age: 86 months; SD: 22 months) referred to a tertiary care university hospital were reviewed: among them, 362 had carried out a serological screening for CD.

Results: Nine patients with positive CD serology were identified, eight of which satisfied the criteria for CD diagnosis. The estimated CD prevalence in ASD children was 2.18% (95% CI, 0.8-3.7), which was not statistically different from that of an Italian population -matched for age range- considered as a control group (1.58%;  $p=0.36$ ). Three out of the eight ASD patients with CD did not have any symptoms suggestive of CD.

Conclusions: Our findings did not show a higher prevalence of CD in ASD subjects than in the control pediatric population but could suggest the utility of routine CD screening, given the frequent atypical clinical presentation in this population.

**424.003** (Poster) Serological Test for Maternal Autoantibody Related Autism  
**A. Ramirez-Celis<sup>1</sup>, M. Becker<sup>2</sup>, M. Nuño<sup>1</sup>, J. Schauer<sup>3</sup>, N. Aghaepour<sup>2</sup> and J. Van de Water<sup>3</sup>**, (1)UC Davis, Davis, CA, (2)Stanford University, Stanford, CA, (3)MIND Institute, University of California, Davis, Davis, CA

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Background: Autism spectrum disorder (ASD) is a behavioral disorder that is estimated to affect 1 in 59 children in the USA, and the incidence seems to be on the rise, making it a public health concern. However, biomarkers that accurately predict ASD risk remain unavailable. We previously reported a sub-type of ASD known as maternal autoantibody related autism (MAR-ASD), which is driven by maternal autoantibodies reactive to proteins present in the developing brain. We then identified eight proteins that are the target of the ASD-specific maternal autoantibodies as CRMP1, CRMP2, GDA, NSE, LDHA, LDHB, STIP1, and YBOX.

Objectives: This project aimed to create and validate a robust serological assay to determine ASD-specific maternal autoantibody patterns against the eight previously identified proteins, and to determine the relationship of these reactivity patterns with an ASD diagnosis in the offspring, using machine learning (ML) subgroup discovery techniques.

Methods: This retrospective-case-control-study used plasma samples obtained from mothers whose children were enrolled in the CHARGE (Childhood Autism Risks from Genetics and Environment) study. This project included a total of 780 maternal samples: 450 from mothers of children diagnosed with ASD and 342 control mothers of neurotypically developing children (TD). The participants provided written consent and fulfilled the recruitment and eligibility criteria. Autoantibody reactivity of maternal plasma samples against protein antigens was determined by Enzyme-Linked Immunosorbent Assay (ELISA) using commercially available proteins. To detect high-precision ASD indicator patterns, we used subgroup analysis and exceptional model mining ML methods. In addition, we used the least absolute shrinkage and selection operator (LASSO) ordinal logistic regression model to determine important autoantibody-antigen combinations that describe the ADOS severity score.

Results: We found maternal autoantibody reactivity to single antigens was not correlated with ASD diagnosis since we observed reactivity to at least one antigen in both groups (ASD=134, 65% and TD= 96 57%;  $p= 0.1108$ ). However, we identified several specific patterns of reactivity composed of 2 or more antigens that were present only on the ASD group. The most abundant ASD-specific patterns were CRMP1 + GDA (ASD= 19, TD= 0, OR 31.04,  $p<0.0001$ ), CRMP1 + CRMP2 (ASD= 16, TD= 0, OR 26.08,  $p= 0.0005$ ), NSE + STIP1 (ASD= 14, TD= 0, OR 22.82,  $p= 0.0001$ ) and CRMP2 + STIP1 (ASD= 9, TD= 0, OR 14.78,  $p= 0.0064$ ). We also found that autoantibody reactivity to CRMP1 increases the odds by 2.3 times of presenting with a higher ADOS severity score (OR 2.3; 95% CI: 1.358- 3.987,  $p= 0.0021$ ).

Conclusions: This is the first report that identifies, with 100% accuracy, patterns of maternal autoantibody reactivity associated with a subtype of autism known as MAR-ASD, which accounts for up to 18% of total ASD cases in our current study. This ELISA is a novel serological test that, after substantial clinical validation, has potential for use as a risk assessment test for women at high risk of having a child with autism. Additionally, this work provides support for a better understanding regarding the etiology of this subtype of autism.

## International and Cross-Cultural Perspectives

### PANEL SESSION — INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES

#### Panel 225 - Cultural Perspectives on Families' Experience of Autism and Autism Services

**Panel Chair:** *Adrienne Perry, Psychology, York University, Toronto, ON, Canada*

**Discussant:** *Joachim Nyoni, Education, Lusaka, Zambia*

Although there is a considerable body of research on families of children with autism, it is based primarily (though not exclusively) on middle-class, white, American or European samples and has tended to focus on negative aspects (such as parenting stress) and service system inadequacies. Although more recent research includes examination of positive aspects as well as challenges families face, the perspectives of families from other countries and of immigrant families are conspicuously absent. This set of studies focuses on the experience of families of children with autism who are either living in other countries (Zambia and Taiwan) or who are immigrants to Canada (one study of a heterogeneous group of immigrants, the other of South Asians specifically). Using quantitative and/or qualitative methods, we explore the perspectives of parents from other countries and cultures, including their understanding of the diagnosis, their experience of stress and coping, positive and negative family impacts, how culture influences these experiences, and their perspectives on autism supports and services. The results have important implications for future research and clinical practice with diverse families. We hope this panel will also challenge some assumptions, change some attitudes towards families from different backgrounds, and promote greater diversity awareness generally.

**225.001 (Panel)** Exploring Diagnosis and Treatment from the Perspective of Zambian Mothers

**B. Zapparoli<sup>1</sup>** and **A. Perry<sup>2</sup>**, *(1)Clinical Neuropsychology, Boston Children's Hospital, Boston, MA, (2)Psychology, York University, Toronto, ON, Canada*

**Background:** Parents of children with autism and developmental disabilities (DD) in low-income countries such as Zambia are underrepresented in research despite the impact that having a child with autism/DD can have on a family. Women and girls overwhelmingly shoulder the responsibility for family caregiving and experience greater stress, reduced opportunity for employment, and often end up caring for others even in their own advanced age (Mckenzie et al., 2013). Research suggests that Zambian parents experience unique frustrations that are likely to increase their stress, including increased rates of poverty, marital strain, social stigma, and a need for more institutional-level supports and services (Chiluba & Moyo, 2017; Nyoni & Serpell, 2012; Mung'omba, 2008; Trani & Loeb, 2012).

**Objectives:** This project is part of a larger mixed-methods study examining factors contributing to parenting stress in Zambian parents of children with autism/DD. This presentation will focus on the experiences of Zambian parents with regards to obtaining a diagnosis, understanding their child's condition, and obtaining services for their child.

**Methods:** Interviews were conducted with 15 Zambian mothers using a semi-structured interview guide. A focus group was then conducted with 10 caregivers, who were invited to share their opinions about the results of the earlier quantitative survey and interview-based study and to expand or provide context to enrich our interpretation of the findings. The interviews and focus group discussion were audio recorded and then transcribed verbatim. An inductive approach was used to analyze the data.

**Results:** Parents reported varied experiences of the diagnostic process. Notably, a number of parents did not know their child's diagnosis or did not understand what the diagnostic label meant. Misunderstandings about the etiology of DD in the broader community reportedly contributed to increased social stigma and marital strain. For example, some mothers reported being blamed for their child's disability and felt that this contributed to infidelity or abandonment by their spouses. Lack of access to information about their children's conditions, and lack of access to services and interventions were frequently described as sources of stress. Financial difficulties played a role in limiting parents' access to services and interventions; however, services were limited even for parents who had the means to afford them. Interventions and support for children with DD were mainly obtained through non-governmental organizations (NGOs), hospitals, and schools. Parents often complained about the quality of services received through public hospitals and mainstream schools, while private hospitals and schools for children with special needs/special education teachers were often praised.

**Conclusions:** The results highlight challenges and provide direction for improvements. At a broader systemic level, the results indicate that increasing knowledge and training about autism and DD amongst healthcare providers and teachers would improve the supports available to Zambian mothers. Additionally, removing barriers to accessing healthcare and special education

services is necessary. Increasing knowledge and sensitivity about DD in Zambian society at large is also essential to improving the experiences of Zambian children and their families.

**225.002 (Panel) Exploring Knowledge, Attitudes, and Practices of Autism Treatment in Taiwan**

**H. S. Ho<sup>1</sup>, A. Perry<sup>2</sup> and H. T. Wang<sup>3</sup>, (1)York University, Markham, ON, Canada, (2)Psychology, York University, Toronto, ON, Canada, (3)National Taiwan Normal University, Taipei, Taiwan**

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**Background:** Although numerous autism interventions exist, only a small subset is considered to be evidence-based such as interventions based on applied behavior analysis (ABA). However, parents often choose non-evidence-based approaches for a variety of reasons. Research suggests that treatment selection is based on a variety of child, parent, and intervention factors, although most of this research has been conducted in Western countries. Cultural factors influence every aspect of parents' experience of the autism diagnosis, such as the perceived seriousness of the disorder and the types of treatment or intervention services selected. Little is known about the perspectives of parents of children with autism from other countries, such as Taiwan.

**Objectives:** This present exploratory study focused on examining the knowledge and attitudes of parents in Taiwan, identifying the types of evidence-based and non-evidence-based treatments they were currently using or had previously used for their children with autism, and examining predictors of ABA-based intervention specifically.

**Methods:** Using a mixed methods sequential explanatory design, this project was conducted in two phases, with a quantitative survey followed by qualitative interviews (Creswell et al., 2003; Ivankova et al., 2006). In phase 1, a survey was used to examine the knowledge of and attitudes towards autism and ABA-based services, as well as to explore the service utilization patterns of a sample of 147 parents of children with autism in Taiwan. Children were aged 8 on average and had been diagnosed by psychiatrists and were screened using the SCQ for the study. In phase 2, semi-structured interviews were conducted with key informants to clarify and elaborate on the quantitative results obtained in phase 1.

**Results:** 76% of the parents had high scores on the autism knowledge scale. Parents in this sample were generally positive about their child's future (86%). In terms of autism treatments, the most frequent treatments used were: occupational therapy (80%), speech therapy (67%), and physiotherapy (52%), which were publically funded. Factors parents considered when selecting interventions included: distance (83%), cost (69%), and recommendations from medical professionals (69%) and school/other professionals (56%). Very few parents (8%) reported currently using ABA-based intervention and an additional 20% had previously used it. Binomial logistic regression was used to examine the relative strength of predictors of ABA-based service use (currently or previously). Knowledge of ABA was significantly related to the selection of ABA-based services ( $p = .002$ ), controlling for other parent characteristics (e.g., education) and child characteristics (e.g., severity),  $X^2(7) = 15.284, p < 0.001$ . In phase 2 of the study, specific factors contributing to this ABA knowledge gap were identified at the parent level, at the intervention level, and at the systems level.

**Conclusions:** Although parents in this sample had a good understanding of autism and a positive outlook regarding the diagnosis, the use of ABA-based intervention was low and various barriers in the selection of autism treatments were identified. The findings underscore the importance of providing timely knowledge about evidence-based interventions so that parents can make informed decisions.

**225.003 (Panel) Experience of Canadian Immigrant Families of Children with Autism**

**T. Kuan<sup>1</sup>, O. Weiss<sup>2</sup> and A. Perry<sup>3</sup>, (1)York University, Toronto, ON, Canada, (2)Children & Youth Division, Surrey Place, Toronto, ON, Canada, (3)Psychology, York University, Toronto, ON, Canada**

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**Background:** Parents of children with autism spectrum disorder (ASD) experience major impacts on the family but much of the literature focuses on the negative impact. The Perry Model of Stress (Perry, 2004) provides a different approach to conceptualizing the experiences of parents, positing that stressors (child characteristics and other life stressors), resources (individual and family system resources) and supports (informal social support and formal supports and services) must be considered in understanding both negative and positive family impacts of having a child with ASD. Clinical wisdom suggests that negative impacts may be particularly felt by immigrant families. However, there is a lack of literature exploring the impact of having a child with ASD in immigrant populations.

**Objectives:** This exploratory study aims to investigate whether there are differences in how Canadian-born versus immigrant parents are negatively and positively impacted by having a child with ASD and how potential differences in the stressors, resources and supports relate to immigration status.

**Methods:** This study is a secondary analysis of survey data collected from parents of children with ASD ( $n = 163$ ) receiving services at a public agency located in Toronto, Canada (a very ethnically diverse city) for another study unrelated to immigration status. Constructs included in the survey included positive and negative impact (Trute & Hiebert-Murphy, 2002) as well as various resources and supports in the Perry (2004) model. In this community sample, 70 parents (43%) were immigrants to Canada from 37 different countries with a majority from East Asia, Eastern Europe and South Asia. They ranged in age from 24 to 61, 85% were 2-parent families and there was a wide range of SES. Children (80% male) ranged in age from 3 to 18 ( $M = 9.17$ ;  $SD = 3.62$ ) and all had a diagnosis of ASD from community professionals.

**Results:** Independent samples  $t$ -tests were conducted to compare groups and showed no differences between immigrants and Canadian-born parents for either positive or negative impacts on the family ( $t(158) = 1.41, p = .161$ ;  $t(158) = -1.28, p = .202$ ). Scores for the resources and supports were generally similar in the two groups and the only significant differences indicated more optimal scores in the immigrant sample, contrary to expectation. Specifically, immigrant parents had higher positive coping ( $t(158) = 2.43, p = .016, d = .39$ ), higher satisfaction with formal services ( $t(158) = 2.24, p = .026, d = .36$ ) and higher social support satisfaction ( $t(158) = 2.85, p = .005, d = .45$ ), in spite of the fact that their children had lower adaptive skills ( $t(158) = -2.86, p = .006, d = .46$ ).

**Conclusions:** These findings indicate that there is more similarity than difference between these two samples and that immigrant families do not necessarily report more adverse impacts. Further analyses using hierarchical linear regression are underway (and will be reported at INSAR) to explore whether these differences predict positive and negative impacts differentially in Canadian-born and immigrant parents.

**225.004 (Panel) Experiences of South Asian Immigrant and Canadian-Born Mothers**

N. Luthra<sup>1</sup> and A. Perry<sup>2</sup>, (1)McMaster Children's Hospital, Hamilton, ON, Canada, (2)Psychology, York University, Toronto, ON, Canada

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**Background:** The Perry (2004) model of stress suggests that mothers experience both negative and positive impacts of raising a child with a Developmental Disability (DD) such as Autism Spectrum Disorder (ASD) as they deal with stressors with the help of personal and family resources as well as social supports and services (Hastings & Taunt, 2002; Luthra, Perry & Minnes, 2014). However, these variables can vary across cultures due to differences in culturally acceptable developmental timetable, conceptualization of disability, its causes, treatments, and implications for the family (Harry, 2002; Welterlin & LaRue, 2007). Immigrant mothers' conceptualization may differ based on their culture and may alter as they acculturate to a more western understanding of disability (Daley, 2004; Mandell & Novak, 2005). There is some research in Canada about immigrant mothers' experience with services and barriers they encounter on their journey (Khanlou & Haque, 2013), however there is a scarcity of literature specifically examining positive impact in South Asian immigrant mothers of children with autism/DD (Gabel, 2004; Ravindran & Myers, 2013).

**Objectives:** This study used the Perry (2004) model of stress to explore these main questions:

1) Is there a significant difference between the two groups on positive and/or negative impact? 2) Are there differences in any of the *stressor* (child's age, adaptive skills, maladaptive behaviors, financial burden and other life stressors), *personal* (self-efficacy, mental health, coping) and *family* resources (family hardiness, marital satisfaction), formal and informal sources of *support* variables? 3) Are there different predictors of positive impact in the two groups?

**Methods:** A correlational embedded mixed method design (Creswell et al., 2003) was used. Quantitative questionnaire data completed by 56 Canadian and 51 South Asian immigrant mothers of children with a DD served as the primary data and qualitative themes from semi-structured interviews with a sub-sample of mothers from both groups as secondary data. South Asian immigrant mothers were from India, Pakistan, Bangladesh, Sri Lanka, and Afghanistan, spoke 11 languages besides English, and had been in Canada for average 13.5 years. About 75-80% children in both groups were male and over 80% had ASD (by parent report).

**Results:** Interestingly, the South Asian group reported significantly higher positive impact ( $t = -2.43, p = .017, d = .48$ ) relative to Canadian-born mothers. They also reported higher positive coping ( $t = -3.97, p < .001, d = .78$ ) and greater helpfulness of social supports ( $t = -2.80, p = .006, d = .54$ ), but also higher negative coping ( $t = -2.30, p = .023, d = .46$ ) and greater mental health issues ( $t = 2.71, p = .008, d = .53$ ). Their children were reported to have significantly lower adaptive skills ( $t = 3.73, p < .001, d = .72$ ). Predictors of positive impact for Canadian-born mothers were child's age, positive coping and family hardiness and for South Asian mothers were mother's mental health and positive coping.

**Conclusions:** There was considerable similarity between Canadian-born and South Asian immigrant mothers, but some key differences. It is important for service providers to be cognizant of these differences, and provide culturally sensitive services to immigrant mothers. Clinical implications will be discussed in detail in the presentation, along with supportive qualitative themes.

## ORAL SESSION — INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES

### Oral 326 - Impacts on Families and Individuals

**326.001** (Oral) An Intersectional Analysis of the Experiences of Parents Raising Children with Autism and Other Developmental Disorders in Ethiopia

**B. T. Tekola<sup>1</sup>**, **M. Kinfe<sup>2</sup>**, **F. Girma<sup>2</sup>**, **C. Hanlon<sup>3</sup>** and **R. A. Hoekstra<sup>1</sup>**, (1)Department of Psychology, King's College London, London, United Kingdom, (2)Department of Psychiatry, School of Medicine, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia, (3)Addis Ababa University and King's College London, Addis Ababa, Ethiopia

**Background:** The experiences of parents raising children with autism and other developmental disorders (DD) have been widely researched, though most of this research comes from Western, high-income countries. In comparison, little is known about the lived experience of parents of children with DD in low-and middle-income countries (LMIC) in general, and in Africa in particular.

**Objectives:** We aimed to explore the experiences of parents raising a child with DD in urban and rural Ethiopia. Specifically, we explored how stigma interacted with poverty, single parenthood and DD in shaping the experiences of the parents in our study, using intersectionality.

**Methods:** Participants comprised nine parents of a child with DD in Addis Ababa and nine parents from the rural town of Butajira (4 fathers; 14 mothers). Their children with DD (6 primary autism diagnosis; 12 intellectual disability) were aged 4-9 years. All participants completed an in-depth semi-structured interview. Data were analysed using thematic analysis.

**Results:** Four themes were developed: “recognising and responding to delays or differences in the child’s development”, “negotiating the social world”, “experiencing multiple and intersecting struggles”, and “remaining positive and hopeful”. Stigma pervaded all themes. Culture shaped the types of delays or differences in their child’s development that parents noticed early and the kinds of support they sought. Despite stigma and lack of understanding from others, not all parents were withdrawn from family relationships and social life completely and permanently. Most parents were facing multiple struggles such as lack of appropriate services for their child with DD and financial difficulties, but often their experiences varied based on, among other things, where they lived (urban or rural) and their socio-economic status. For single mothers, the challenges that come with raising a child with DD were experienced on top of the acute financial difficulties they were facing. Most of the time they worried about how to survive: how to feed their family, fulfil basic needs and pay house rent. The intersection of single parenthood, poverty, stigma and DD also left single mothers and their children in our study without a means of livelihood. Parents, especially mothers who were primarily responsible for the daily care of their child with DD, prioritized the needs of their child with DD by foregoing family relationships, social life, their work and their religion. Spiritual beliefs, the many sacrifices that they made and their commitments to care for their child enhanced and maintained parents’ hope and meaning of life.

**Conclusions:** This study highlights the varied experiences of parents raising a child with DD in Ethiopia. Our findings suggest that poverty, single parenthood, stigma and DD interacted with one another to shape the experiences of some parents raising a child with DD in urban and rural Ethiopia. Despite diversity, parents raising a child with DD in urban and rural Ethiopia also shared experiences in terms of ongoing struggle, sacrifice and hope. Interventions aiming to support families with children with DD in low-resource settings like Ethiopia should include a focus on stigma, single parenthood and poverty reduction.

**326.002** (Oral) Depression Among Latinx Mothers of Children with ASD: Did a Culturally Tailored Parent Psychoeducation Intervention Show Positive Effects on Maternal Depressive Symptoms?

**W. Zeng<sup>1</sup>**, **S. Magaña<sup>1</sup>**, **K. Lopez<sup>2</sup>** and **W. A. Machalicek<sup>3</sup>**, (1)Steve Hicks School of Social Work, University of Texas at Austin, Austin, TX, (2)Arizona State University, Phoenix, AZ, (3)University of Oregon, Springfield, OR

**Background:**

Mothers of children with ASD have higher rates of negative mental health outcomes including depression (Vasilopoulou & Nisbet, 2016). There are very few empirical studies on the emotional experiences of Latinx parents of children with ASD and how intervention can improve issues with their mental health. Parents Taking Action (PTA) is a culturally tailored parent

education intervention that was developed to address service disparities faced by Latinx families of children with ASD. Parents received 14-session home-based education program from peer-leaders who were trained on the content and intervention protocol. A two-site (Illinois and California) randomized waitlist-control trial was conducted and data were collected at three time-points: baseline (T1), four-month (T2), and eight-month post baseline (T3).

**Objectives:** The purpose of this study is to assess the intervention's longer-term effects on Latina mothers' depressive symptoms across the three time-points.

**Methods:**

The participants were 91 (intervention n=39, control n=52) Latinx mothers of children with ASD aged 8 years or younger, who completed all three assessments using the Center for Epidemiologic Studies Depression Scale (CES-D). Total CES-D scores were calculated for all participants. We assess the intervention effects across time-points by conducting repeated measures analysis of covariance (ANCOVA) models for total CES-D scores from T1 to T3. Maternal education was controlled for as it was the only significant between-group demographic variable. We also analyzed differences in intervention effects by site by running OLS regression models at eight months.

**Results:**

Overall, the mothers were 37 years old and were primarily foreign born (90%). The differences in baseline CES-D scores between the intervention and control groups were not significant ( $t=1.19$ ,  $p=.24$ ). The intervention group mothers' average total CES-D scores decreased by 5.3 points (T1=17.6, T2=13.1, T3=12.3) while the control group mothers remained essentially unchanged (T1=14.9, T2=14.9, T3=14.2) across the three time-points. Our ANCOVA models also showed that there were significant intervention effects ( $F_{[1, 88]}=4.38$ ,  $p=.04$ ) even after maternal education was accounted for. There were no significant treatment differences across the two study sites.

**Conclusions:**

The intervention group mothers at both sites reported significantly lower depressive symptoms scores eight-months post baseline compared to the control. The findings of this RCT study suggest that the content, structure, and delivery mode of PTA contributed to the decrease in depressive symptoms from baseline to eight-month post baseline. The findings also indicate that the culturally tailored parent education program could be employed to improve mental health outcomes of Latinx parents of children with ASD.

**Reference:**

Vasilopoulou, E., & Nisbet, J. (2016). The quality of life of parents of children with autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, 23, 36–49.

**326.003 (Oral)** Impact of Covid-19 on the Experiences of Parents and Family Carers of Autistic Children and Young People in the UK

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**Background:** The outbreak of Covid-19 has triggered profound changes to the life of family carers of autistic children and young people (CYP), including a switch to online teaching, restricted access to services and family support due to social distancing measures and changes to home routines.

**Objectives:** This study examined how the coronavirus pandemic, the Coronavirus Act (2020) and the lockdown impacted on families of autistic CYP in the UK, particularly in relation to their caregiving experiences and wellbeing.

**Methods:** Ethical approval was provided to run an anonymous qualitative survey between 1st and 30th April 2020. The survey was co-produced with three parents of autistic children, one of whom is autistic. 449 participants completed the survey: 401 mothers, 35 fathers and 13 carers (including siblings). All lived in the UK and cared for at least one autistic CYP. 41% of the autistic CYP were diagnosed with co-

occurring conditions such as a learning disability, anxiety, ADHD and dyspraxia. 82% of the participants were identified as white, 18% of the participants identified with an ethnic minority background including Arab, Persian, Black, Asian, or mixed.

Results: Thematic Analysis was used to analyse survey data. Five key themes were identified within the dataset: (i) A sense of familiarity, (ii) New struggles (iii) New opportunities and unexpected freedoms, (iv) Personal accounts on mental health and (v) Re-imagining the future, returning to pre-covid normal is not enough. According to our findings 86% of family carers think that the needs of autistic people and their families have not been adequately addressed during Covid-19, 46% of family carers stated that they consider their autistic children or themselves to be at higher risk for Covid-19 than the general population. 70% of family carers report that their daily routines have changed. Importantly, many participants did not want to return to the pre-Covid world. 58% of family carers still had access to at least one type of specialist support. However, this was not always timely nor sufficient.

Conclusions: This is the first study to examine the experiences, perspectives and needs of parents raising an autistic during a world pandemic. Importantly, this study also established priorities for future research and analysed caregiver's 'wish list' for future service and support provision. This knowledge, produced by parent's first-hand accounts, may help researchers gain a better understanding on the potential stressors and/or facilitator factors experienced during this challenging period. A particularly big impact of Covid-19 has been the removal of respite and the lack of a support scheme specific to the needs of working family carers. Our data show that services can still adapt and support families, so planning and consideration into service delivery methods that can remotely support disabled people and their families need further planning. Enforced changes to daily routines have often been stressful for autistic CYP and their families, particularly if they have not received support. Moving forward, transitions and changes (which will continue to occur) need to be as clearly communicated in advance as possible so planning can more effectively take place.

**326.004** *(Oral)* Understanding Barriers to Good Mental Health for Autistic People during the COVID-19 Pandemic  
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Background:

Autistic people are more likely to experience mental health problems (Lai et al, 2019). Autistic people consistently report mental health as a key life challenge and a priority for research (Roche et al, 2020). The COVID-19 pandemic has led to drastic changes of circumstances and routines for many autistic people, with potentially serious consequences for their mental health and wellbeing. The pandemic has also compromised support services for many autistic people.

Objectives:

The aim of the research was to inform a mental health programme being developed by a national autism charity in partnership with a national mental health charity. Firstly to identify information and support needs which could be addressed during the pandemic. Secondly to identify issues on which to base a campaign for more and better autism specific mental health support. Thirdly to identify sub-groups of the autism community affected disproportionately by the pandemic.

Methods:

A national, open access, online survey was conducted in two waves. The survey was co-designed with autistic people and publicised via social media, email and the website of the charity. The first fieldwork wave in June and July 2020 focused on the impact of the pandemic. The second wave in the autumn focused on anxiety and depression and the therapies respondents had accessed. 579 autistic people and 514 family members completed both waves. A further 2,466 autistic people and 2,538 families completed one wave only, resulting in an overall achieved sample of 6,097.

Results:

Among autistic people, the most frequently reported worries were their mental health, what will happen after lockdown, and their friends or family contracting COVID-19. The most commonly report difficulties caused by the pandemic were in buying food and necessities, anxiety becoming harder to manage, and getting less mental health support. Autistic respondents identifying as female or non-binary were more likely to report worries. People with high support needs, and their families, more frequently reported negative impacts. Spending time outside, using video calls or the phone to talk to friends and family, and doing exercise were most likely to be reported as helpful in coping. Counselling, Cognitive Behavioural Therapy (CBT) and mindfulness were the therapies respondents were most likely to say had made helped with anxiety or depression, though a minority of respondents

reported that CBT had made things worse. Among respondents completing both waves, negative impacts were reported less often in the second survey, possibly reflecting an easing of lockdown restrictions.

#### Conclusions:

This was the largest such survey within its national setting. Consistent with anecdotal reports, a minority of respondents reported mood, anxiety levels or behaviour were improved during the lockdown, due to fewer work, education or social pressures. However, overall, autistic people's mental health and wellbeing, already less satisfactory than that of the rest of the population, has deteriorated further as a result of the pandemic. Furthermore their ability to access support has been compromised. However this can be at least partially remedied by the provision of online information, adoption of coping strategies, and access to talking therapies.

## POSTER SESSION — INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES

### Poster 425 - International and Cross-Cultural Perspectives Posters

**425.001** (Poster) "I Was Confused... and Still Am" Barriers Impacting the Help-Seeking Pathway for an Autism Diagnosis in Urban North India - a Mixed Methods Study

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**Background:** The importance of timely recognition of autism in young children and referral to effective interventions is widely recognised. In most countries, especially low and middle-income countries (LAMIC) such as India, there is a long delay between when parents recognise developmental or behavioural concerns in their child and obtain an autism diagnosis. There is thus a need to build on the evidence base of the contextual barriers that prolong the help-seeking pathway followed by families of children with autism in India in order to identify opportunities that can facilitate the provision of an autism diagnosis and access to available interventions at a younger age.

**Objectives:** The objective of this study was to explore 1) the extent to which the nature of parental concerns and prior knowledge of developmental disorders impact the time between symptom recognition and autism diagnosis, and 2) the contextual family, societal and health-system related factors that impede the autism help-seeking pathway.

**Methods:** A mixed methods study design was employed. Case-registers of 84 participants were accessed and data was extracted on the sex of the child and types of presenting concerns. The impact of these on the age of the child at initial parental concern and diagnosis and time taken for diagnosis was quantitatively explored. Semi-structured in-depth interviews were conducted with parents or primary caregivers of 20 children with autism. The interviews explored the nature of initial parental concerns and parents' experience of obtaining an autism diagnosis for their child, including who they consulted, the advice they received and the action they took along each step of the help-seeking pathway

**Results:** Children were approximately 2.5 years old when parents recognised developmental or behavioural concerns, and 4 years old when they were diagnosed with autism. Social communication difficulties and lack of language were the most common presenting concerns by parents, being recognised more often in girls than boys. Comorbidities such as seizures or physical health conditions were prioritised over autism-related concerns such that these children obtained a diagnosis later than those who did not have comorbidities. A lack of awareness of age-appropriate attainment of child developmental milestones, and neurodevelopmental disorders like autism, was apparent in the community as well as health professionals. Parents who sought advice from family members and general physicians would often be advised to 'wait and watch' their child, as they would 'catch-up' in their development. The disempowerment of mothers in taking decisions for their child's health, and often a lack of any social support, also contributed to delayed diagnoses.

**Conclusions:** The pathway to an autism diagnosis was found to be a complex and arduous one. We triangulate our quantitative and qualitative findings to make recommendations of potential actions that can be taken at various stages within the help-seeking pathway to minimize its length. These include increasing awareness of age-appropriate milestones amongst the community and health professionals and harnessing the potential of existing cadres of non-specialist health workers by equipping them with scalable tools for developmental monitoring of young children.

**425.002** (Poster) A Comparison of Parenting Stress and Resilience in Parents of Children with Autism between India and the UK: A Qualitative Analysis  
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**Background:** Raising a child with Autism Spectrum Disorder (ASD) involves unique and specific cultural challenges that are often not considered in research (Spong, 2019). To effectively address the psychological needs of parents of children with ASD, as part of any intervention program, it is necessary to identify and understand the socio-cultural factors that contribute to parenting stress and resilience. While questionnaires may identify similar levels of stress in different populations, the causes of stress may be significantly different and go unacknowledged. Cultural differences mean families define stress differently, need different resources and build resilience in different ways. Our study reports qualitative data from Indian and UK parents based on the Double ABCX framework of McCubbin and Patterson (1983). The analysed transcripts help to illustrate some unique cultural elements that contribute to stress and resilience.

**Objectives:** To compare the experiences of stress and resilience in parents of children with ASD in India and the UK. To improve understanding of how cultural factors may lead to improved methods for culturally adapted interventions.

**Methods:** Semi-structured telephonic interviews were conducted with 30 parents who have a child diagnosed with ASD (15 from India, 15 from the UK) and were transcribed verbatim. Transcripts were analysed using thematic analysis.

**Results:** Several themes emerged from the analysis. Both Indian and UK parents explained that their stressors ranged from child-related factors (severity of autism symptoms) to financial and family level challenges. Indian parents utilised a combination of cultural and religious-based explanation (for example, attributing their child disability to 'Karma') to make sense of their child's autism diagnosis. The role of religion and superstition was unique to the Indian context. A lack of general awareness of disability issues in Indian culture also served to place pressure on parents. Parenting stress was more prominent among Indian parents in our research. Indian parents reported difficulty in accessing appropriate resources, and they referenced a general lack of formal and informal support networks related to autism. As a resource for coping with stress, Indian parents reported using a blend of technology (internet), traditional forms of medicine (Ayurveda) and spiritual support (seeking help from spiritual healers). Additionally, one clear difference between parents in both countries was that the Indian parents, especially mothers, faced blame for giving birth to a disabled child and the quality of parenting was also linked to their child's autism.

**Conclusions:** Severity of autism, financial and family pressures were common factors to both parental groups. However, there were substantial differences in the nature and the experience of stress. Our research suggests that using traditional questionnaires may not uncover the culturally specific nature and diversify of stress and resilience experienced by parents with autistic children. The findings allow us to fill out the lived experiences behind the framework. Our findings give a clear indication of why Indian parents may be reluctant to seek help for their children or even seek a diagnosis. We hope our findings will help practitioners to understand the unique needs of parents from diverse cultures and provide appropriate culturally sensitive support.

**425.003** (Poster) A Lost Year? Art, Creativity and Strengths in Autism during covid19 Lockdown.

*C. D'Agostino<sup>1</sup>, L. Echenique<sup>2</sup>, N. Galetta<sup>3</sup>, N. Santamaria<sup>4</sup>, V. De Chiara<sup>5</sup> and A. Larroulet<sup>6</sup>, (1)Universidad Caece, Mujeres TEA, Yoenfoco, Buenos Aires, Argentina, (2)Grupo Cidep, Mujeres TEA, Buenos Aires, Argentina, (3)Private practice, Buenos Aires, Argentina, (4)Motivatea, Buenos Aires, Argentina, (5)CTA, Buenos Aires, Argentina, (6)Socializarte, Buenos Aires, Argentina*

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**Background:**

Art, creativity, special abilities and strengths in ASD are rarely addressed in research and practice. During Covid-19 our country was in lockdown for 8 months with only online resources. We organized a social media online contest and exhibition for individuals with ASD to promote art and creativity. 138 participants from 15 provinces sent 6000 pictures during 5 months that were exhibited online. 100 ASD organizations from the country donated and sent a small price to participants to their homes so every participant had a reward.

**Objectives:**

**Objectives:** The aim of the study was to explore the time and motivation of individuals with ASD to create and show art and creativity during lock down with and online survey, the profile of strengths and special abilities and to explore the importance and role of them during pandemic and normal times.

## Methods:

An online survey based on the state of the art of strengths and creativity in ASD was administered after 8 months lockdown project. The survey had quantitative variables, multiple choice and likert scales. Preliminary statistic data was processed in this pilot exploratory descriptive study with SPSS. The sample were 100 parents (N 100), 92% mothers, reporting on 100 of participants with ASD from ranging from 4 to 34 years of whom 64 were male and 36 were female, and less than half of the sample also presented intellectual disability (39%).

## Results:

Reported favorite art activity for was painting (70%) drawing (53%) collage (34%) photography (27%), music (23%) and sculpture (23%). Reported strengths were excellent memory (69%), detail focus (50%) creativity (45%) Hiper-focus or flow (46%) Visual processing (34%) perfect pitch in music (33%) systematization (27%) and synesthesia (7%).

Almost all families reported having more quality time with their son/daughters (89%). The ASD individuals also had more time for art and creativity activities (90%) with high motivation for creating (73%) and for showing their work online (73%). More than half of the sample discovered new interest and skills (57%).

Measuring how challenging lockdown was in a likert scale (1 very difficult/ 5 easier than regular life) families reported that as parents was difficult but they got used to it (2, 41%) and, 16% reported that was easier than normal life (5). For their son/daughter results were similar (49%)- 2- difficult but they got used to it-, and for some- 5- easier than normal life (20%).

When asked about the importance of art, creativity and special interests during pandemic times (1- indispensable, 5 not important) families reported they were indispensable 40% and very important 49%, 11% important, and in normal times 31% reported indispensable, and 63% very important, 6% important. All the sample reported that they needed more spaces and opportunities to develop their skills in their communities.

## Conclusions:

Results suggests that strengths, art and creativity played an important role for individuals with ASD and their families during lockdown, and future efforts might be needed to shed light in the unique role of them in challenging and not challenging times.

**425.004 (Poster)** A Mixed-Method Evaluation of Feasibility, Acceptability and Initial Efficacy of the Who- Caregivers Skills Training (CST) Pilot in India.

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Background: There exists a significant gap in the availability and access to early intervention in ASD across low and middle-income countries(LMICs). Training non-professionals to facilitate evidence-based parent-mediated interventions that are culturally acceptable, accessible and diagnosis-agnostic to circumvent challenges in early detection and affiliate stigma, can bridge the service gap. The World Health Organization-Caregivers Skills Training program(WHO-CST), which meets these criteria, is undergoing various field-testing stages in over 35 countries.

Objectives: To report on the acceptability, feasibility and initial efficacy of the WHO-CST pilot program delivered by non-specialist facilitators in Mumbai, India.

Methods: The WHO-CST program was translated into Hindi and adapted to the local context, based on feedback from various stakeholder groups. Master-Trainers trained in the intervention, in turn, trained non-specialist facilitators to deliver CST at two sites in Mumbai. 22 primary caregivers (parents) of children with communication delays (ASD=20 and non-ASD=2) volunteered to participate in a quasi-experimental pre-post study. The intervention consisted of nine center-based group-sessions and three individualized home-visits per family. The content based on naturalistic-developmental-behavioral and positive behavior support principles included sessions on building engagement, communication, daily living activities, addressing challenging behaviors, and enhancing parental well-being.

A mixed-methods explanatory design was used to evaluate program acceptability, feasibility and efficacy. Quantitative metrics of feasibility included caregiver attendance, fidelity, and adherence to CST strategies. Metrics of efficacy included measures of parental stress, self-efficacy and child outcomes in social-communication skills, collected at baseline and completion of intervention. Pre-post change was assessed using Wilcoxon signed-rank test. Program acceptability, feasibility and effectiveness were also assessed using focus groups with caregivers. Data from the qualitative data were transcribed and analyzed by two independent coders using principles of inductive thematic analysis.

Results: The program was found to be feasible. All caregivers who enrolled completed the program. Caregiver fidelity scores increased from baseline (Md= 0.57) to end of intervention (Md= 2.58),  $z = -3.05$ ,  $p < 0.01$ ,  $r = 0.65$ . Parents engaged with their children for an average of 4.29 times a week during the program, the average duration of engagement per session being 10-15 minutes. On metrics of efficacy, parent showed significant improvement in levels of self-reported distress on the PSI-SF ( $z = -2.42$ ,  $p < 0.05$ ,  $r = 0.51$ ). Child social-communication outcomes as measured on the Social-Communication Checklist also showed significant improvement ( $z = 3.66$ ,  $p < 0.001$ ,  $r = 0.78$ ).

The findings from the quantitative data were supported by data from qualitative interviews. Parents found multiple aspects of the program helpful and feasible, including didactics, demonstrations, peer-discussions, and home-visits. Parents reported *new learnings* from participating in the program, such as understanding child's level of functioning, setting appropriate goals, and learning new strategies that led to *changes in parenting style* (more child-led, focus on play routines and ADLs), improvement in *self-efficacy*, and *changes in children's developmental skills* (language, engagement, behaviors, independence). Further, parents perceived an overall *positive impact* (stress reduction and well-being).

Conclusions: The WHO-CST intervention was found acceptable and feasible, with both content and process considered relevant and effective by caregivers who participated in the pilot in India. Further studies are warranted to evaluate impact at scale

**425.005 (Poster)** Adaptation of a Parent Mediated Communication Intervention for Autism for Virtual Delivery in Response to the Pandemic Lockdown, in New Delhi, India

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Background: The unexpected outbreak of COVID-19 pandemic led to the complete restriction on movement as the response by the government of India. As a result, the home based delivery of a social-communication parent mediated intervention for children with autism, PASS Plus, delivered through non-specialist counsellors, being delivered in the Communication-centered Parent mediated intervention for Autism Spectrum Disorders in South Asia (COMPASS) trial was also suspended. For providing continued intervention services to the families, PASS Plus was adapted for remote delivery through virtual sessions on practice cases with a view to re-establishing delivery in the trial.

Objectives: In the present study we describe the adaptation of PASS Plus for virtual delivery and the barriers and facilitators impacting its acceptability and feasibility.

Methods: The experiences of virtual delivery across 50 cases are described. Two thirds of the parent-child dyads (n=34) were already engaged through home based, face-to-face delivery while others were recruited after establishment of movement restrictions (n=16); these latter families received complete virtual delivery. Verbal consent was requested for virtual delivery from all 50 cases. The steps of adaptation included i) introduction of additional modules to support digital literacy for families and counsellors ii) development of virtual supervision methodologies iii) documentation of barriers and facilitators in intervention delivery by counsellors v) establishing mitigating strategies to overcome barriers .

Results: Of the total participants(n=34) receiving intervention before suspension of face to face delivery due to the COVID-19 pandemic, half of them (n=17) agreed to virtual delivery. The barriers to virtual delivery for families included i) personal reasons: for example a preference for face to face sessions (n=4), concern over misuse of video shared digitally for intervention delivery (n=1), lack of space at home (n=1) and lack of time for sessions(n=2) ii) technology related reasons: for example poor internet connectivity (n=1), absence of a smartphone (n=2) or low digital literacy for using smartphone(n=1) iii) participants not contactable (n=3) iv) Financial concern primarily of a lack of money for data services (n=2). These factors were considered when adapting the intervention for virtual delivery and approaching the new participants(n=16) for complete virtual delivery. Preparatory sessions were introduced to support building digital skills of families around the use of smartphones. The barriers faced by counsellors were mostly around technical skills(use of smartphone and apps) that were supported via enhanced training.

Conclusions: Our experience suggests that virtual delivery of a home delivery based, communication-centered and parent-mediated intervention for children with autism can be successfully achieved through adaptation considering the service provider and user barriers. Training and support for building digital skills of the non-specialist counsellors can also add to effectiveness of the virtual intervention delivery. We have observed that not being able to reach out to families with restricted digital access is a major drawback of virtual sessions, which extends the digital divide for already vulnerable families.

**425.006 (Poster)** Assessing Autism Knowledge and Stigma across the Global Landscape Using the ASK-Q  
*A. J. Harrison<sup>1</sup>, A. de Bildt<sup>2</sup>, L. Yu<sup>3</sup>, N. Naqvi<sup>4</sup>, A. K. Smir<sup>5</sup>, H. Low<sup>6</sup>, C. Yang<sup>7</sup> and S. Saade<sup>8</sup>, (1)Educational Psychology, University of Georgia, Athens, GA, (2)Department of Child and Adolescent Psychiatry, University Medical Center Groningen, University of Groningen, Groningen, Netherlands, (3)School of Psychology, South China Normal University, Guangzhou, China, (4)Iona College, New Rochelle, NY, (5)Accare Child and Adolescent Psychiatry or University of Groningen, Groningen, Netherlands, (6)Universiti Sains Malaysia, Penang, Malaysia, (7)East China Normal University, Shanghai, China, (8)Psychology, Université du Québec à Montréal, Montreal, QC, Canada*

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### **Background:**

Substantial variability exists with regard to ASD service provision around the world. Providing more equitable care for all individuals with ASD is an important emerging public health concern. Service disparities observed in many low- and middle-income countries may be driven, in part, by limited knowledge of ASD; however, measurement limitations have made it difficult to quantify autism knowledge across countries. As a result, the autism stigma and knowledge questionnaire (ASK-Q) was developed as a cross-culturally sensitive, comprehensive assessment tool to measure the nature and extent of ASD knowledge. This instrument has been requested for use in 26 countries, but limited information exists about measure performance across regions and patterns of knowledge variability across countries and demographic groups.

**Objectives:** The current study aims to first examine whether the autism stigma and knowledge questionnaire (ASK-Q), is suitable for use across the global contexts by examining the basic psychometric properties of the instruments in a large, trans-continental sample. The secondary aim of this study is to use one common measure (ASK-Q) to quantify different patterns of autism knowledge and stigma across different countries and demographics.

**Methods:** The current study compiled data from 4207 participants collected using adapted versions of the ASK-Q administered in seven different countries (China, Canada, Tanzania, France, the United Kingdom, the Netherlands, and Romania), representing four different continents. The ASK-Q is a 49-item questionnaire, with dichotomous (agree/disagree) response options. The measure is comprised of 3 knowledge subdomains (Etiology, Diagnosis, Treatment) and a stigma subscale that contains items also loading onto one of the knowledge domains. Participating research sites also included some demographic data about participants including gender, role in participating in study, occupation, age, and education level.

### **Results:**

In spite of the measure being administered in five different languages, the ASK-Q demonstrated strong overall internal reliability ( $\alpha = .91$ ). The measure subscales had more variability in terms of internal consistency: Etiology subscale  $\alpha = .79$ , Treatment subscale  $\alpha = .64$ , Diagnosis subscale  $\alpha = .79$ , and Stigma subscale  $\alpha = .60$ ). The examination of cross-country differences in autism knowledge revealed a significant difference in total knowledge scores,  $F(4052) = 325.90, p < .0001$ . Post hoc results revealed that significantly higher knowledge levels in French Canada compared to most of the other examined countries (UK, France, China, the Netherlands). Conversely, participants in China demonstrated significantly less overall knowledge compared to all other countries assessed.

### **Conclusions:**

Results reveal that the total ASK-Q score demonstrates strong internal consistency across countries and identifies meaningful differences in knowledge across countries. Although, ASK-Q subscales followed similar cross-country trends to the overall score and will be examined in more detail in the conference proceeding, scale subdomains do not perform reliably across cultural contexts. This indicates the need for an item level analysis of the measure and perhaps minor revision to ensure psychometric strength across countries. Follow up analyses will also include data from Laos and Lithuania and will control for occupation and other sociodemographic variables to better understand patterns of autism knowledge.

**425.007 (Poster)** Autistic Identity and the Experience of Disability: Related Concepts with Various Meanings  
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Background: Identity refers to the way an individual sees themselves and is perceived by others with regard to their characteristics (personal identity) and those they share with the groups to which they belong (social identity). The Neurodiversity and Disability rights movements can offer conceptual tools to represent oneself, advocate for more social justice and create a sense of belonging in these communities. However, not all autistic people identify with them.

Objectives: Analyze the use and the meanings related to autistic and disability identities according to autistic individuals.

Methods: 460 adults (18-74 years old,  $\mu=35.5$  SD=11.6) from France, Belgium, Switzerland, Senegal and Quebec (Canada) were joined *via* an online questionnaire. A majority had received a diagnosis of autism (69%) and 31% were self-diagnosed. Gender identity: female (58%), male (22%), other identities (e.g. autigender, genderqueer, neurogender, trans, xenogender) (22%).

They were asked: “*Is autism an aspect of your identity?*” and “*Do you consider yourself disabled or having disabilities?*”. Respondents had to choose among multiple answers and specify in their own words. A qualitative content analysis was performed to identify emerging categories and compare the coders’ interpretations. We had parity between autistic and non-autistic coders.

Results: Autism is a part of identity for the majority, with importance ranging from “a lot” (43%) to “extremely” (32%). Considering autism as part of one’s identity (in varying degrees) did not differ significantly by country, age, gender or (self-)diagnosis. Ten categories about autism were identified: “an integral part of who I am”, “only part of my identity among others”, “a neurological functioning”, “explains my ways of acting or behaving”, “a strength”, “associated to difficulties in my life”, “I use camouflage to hide my true self”, “diagnosis makes sense of my impression of alienation in the social world”, “the prism through which I experience the world”, “associated to a community”.

Regarding disability, 27% consider themselves disabled and one in five did “not know”. Men (44%), participants from Quebec (52%) and those for whom autism is not part of their identity or to a lesser extent (60%) are more likely to not consider themselves disabled compared to others ( $p < .001$ ). Twelve ideas about the experience of disability were identified: “it’s invisible”, “depends on the person’s autonomy”, “I have also a health problem or a chronic disease”, “my hypersensitivities are a disability”, “I had difficulties in relationships or social situations”, “sometimes I feel disabled, sometimes not”, “a social disadvantage in terms of employment and economic security”, “society and environment are not adapted to me”, “I experience discrimination”, “I deviate from normalcy in my ways of being, behaving or moving”, “I adapt, pretend, have strategies”, “an administrative category”.

Conclusions: Identity is a complex and multifaceted process. This study shows that autistic identity and experience of disability are mobilized to varying degrees and with various meanings at the intersection with other affiliations such as gender. Clinicians and stakeholders must be sensitive to the diversity of identities and their cultural meanings within the autistic community and not consider autism as a monolithic identifier.

**425.008** (Poster) Behavioral Treatment and Response Intervention Received By Children with Autism in Ethiopia  
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Background: Although autism spectrum disorders (ASDs) are a global occurrence, information on provision of services, and effectiveness of treatments in Ethiopia is scant. It is well-documented in the literature that early identification coupled with access to mental health, behavioral, and educational intervention services for children with ASDs are crucial to promoting child development and quality of life. As in most developing countries, educational materials regarding the type of intervention required for children with autism in Ethiopia are still underdeveloped. Specifically, there is no documentation regarding the use of standardized diagnostic instruments, how autism interventions are selected and implemented, or whether well-researched evidence-based educational curriculum and behavioral protocols designed for children with autism are used. Given the few studies directly or relatedly documenting autism intervention and its effectiveness in Ethiopia, the results from this study can help to establish a culturally-competent response to intervention procedure manual for assessing treatment outcomes and promotion of evidence-based practices in Ethiopia.

Objectives: This study aimed to examine the effectiveness of behavioral treatment and outcome response to intervention received by children with autism in Ethiopia.

**Methods:** This mixed method study used both qualitative and quantitative approach to collect data. Data were collected from the two primary organizations that provide services to children with autism (n=120) in the capital city, addressing the following questions: (a) What behavioral treatments are used? (b) Under what conditions are they effective? (c) What intervention responses/outcomes are considered most effective in the Ethiopian context?

**Results:** Even though most children enrolled in these centers don't have a formal diagnosis, 90.01% of them had SCQ scores above the clinical cutoff, which is the score recommended for distinguishing pervasive developmental disorder from other psychiatric disorders in children. No significant difference found in the "autism- positive" response rate between male and female students. The qualitative analysis result shows that participant centers have an existing practice of assessment to effective intervention, which starts from the process of intervention selection and development. Interventions are designed to influence symptoms, in this case, communication, social, emotional, and behavioral symptoms experienced by children with ASDs. The identification and utilization of interventions are informed by existing research and literature but are shaped more by the cultural context and by intuitive approaches to providing services for children with ASDs. Neither center is following a specific intervention response manual, and that there is no written guideline or manual related to assessing the outcomes of intervention. There is clearly a need for such guidelines, particularly written in the local languages. However, the interview and FGD results show that they already have a process and procedure that seems easily fit to the response to intervention framework (RTI).

**Conclusions:** Teacher-training colleges and institutions of higher education in the developing world should be supported in their efforts to provide sufficient training for individuals entering these fields, so that children with ASDs and other special needs can be served in humane and adequate ways that foster their optimal development.

**425.010 (Poster)** Characterizing the Diagnosis and Service Odyssey in Texas: Results from a Needs Assessment Survey  
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**Background:** Understanding the experience of ASD across diverse families is essential as it helps shape the advancement of education and health care systems and policies. However, research suggests that the experience of ASD can be highly dependent on the context and environment in which the child and family reside (Fountain et al., 2011). Texas is a diverse state, comprised of over 50% of racial/ethnic minorities. Yet, little is known about the journey individuals with ASD and their families undergo to access diagnostic assessments, services, and supports in Texas. A needs assessment survey was conducted in Texas to capture and understand the experience of ASD in Texas.

**Objectives:** The current study's objectives were to investigate the status of ASD diagnostic and treatment services and supports in Texas to identify critical areas for community engagement, research focus, and service development.

**Methods:** A survey was created and disseminated across Texas, United States, to understand the barriers, challenges, and experiences of diverse families of children with ASD. The survey included closed- and open-ended questions directed to parents or primary caregivers of children and youth with ASD (Age 0 to 22 years). The survey was available online (Qualtrics) and available in paper format with postage-paid envelopes for return to the researchers. The surveys were available in English and Spanish. The survey was distributed across community events, parent support groups, clinical service providers, and online research directories. In this study, we present data for completed surveys ( $n = 144$ ).

**Results:** The sample reflects the experience of primarily White (40.3%) and Latino (40.3%) families. On average, families reported 2.43 years between parents' first concern to the age when their child received an ASD diagnosis. A linear regression analysis was conducted to identify significant factors in a child's first ASD diagnosis. Factors included in the model were the child's race/ethnicity, ASD severity, age of first concern, age when reporting concerns, the number of professionals visited prior to a diagnosis, parent nativity, parent education, and household income. The linear regression model was significant,  $R^2 = 0.50$ ,  $F(8, 119) = 14.85$ ,  $p < .001$ . Further inspection identified ASD severity ( $p = .035$ ) and the age when reporting concerns ( $p < .001$ ) as significant predictors in the model. These results suggest that children with greater support needs and earlier engagement with a health professional about developmental concerns have a younger age of ASD diagnosis. Additional analyses will examine child, family, and community-level demographic characteristics on the professional responses with an ASD diagnosis, community views of ASD, and ASD treatments and services.

**Conclusions:** The needs assessment survey results highlight the importance of parents and primary caregivers in sharing their concerns with health care professionals. Additional analyses will identify other key areas to target in developing research and service projects to alleviate disparities in access to diagnosis, treatments, and support for all Texas families. This model can be adapted for other communities to ensure that researchers and providers are responsive to the community.

**425.011 (Poster)** Comparison of Familial and General Public' Autism Knowledge and Stigma: Building Family Foundation for Autism Advocacy in China

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**Background:** Service provision for autistic individuals in China has been historically underdeveloped, despite the overall economic and societal growth of this country. One of the barriers to diagnosis, intervention and education opportunities that has been identified is the widespread misconceptions and high stigma about autism in the general public assessed by the ASK-Q (Yu et al., 2020). This finding highlighted the need for not only policy-level measures but also community-level experts and advocates for disseminating autism science and eliminating stigma.

**Objectives:** The current study utilized the standardized ASK-Q instrument to compare autism knowledge and stigma between family members living with autism and non-family members in the public in China. The aim was to investigate whether family members have greater scientific understanding of autism relative to the general public, a pattern seen with parents of children with other neurodevelopmental disorders (e.g., ADHD; West et al., 2005). The results were expected to recognize family members as candidates to effectively penetrate the public in raising awareness and advocacy.

**Methods:** A nation-wide survey was conducted online with 1,251 participants in China (mean age = 32 years, range = 18 ~ 88 years) including 200 family members of autistic individuals and 1051 non-family members. Cutoff scores for knowledge adequacy and stigma rejection (>13 for diagnosis/symptoms, >10 for etiology, >10 for treatment, and >4 for not endorsing stigma) were used to obtain the numbers of individuals with higher and lower knowledge in each category within each group. Chi-squared tests were performed to evaluate the degree of knowledge gap between- and within-group.

**Results:** The participants who responded as having familial relations with autistic people included first-degree (parents, sibling) and second-degree (cousins, uncles) relatives. The family members as a group demonstrated significantly higher autism knowledge than the general public in all categories (disagnosis,  $\chi^2=38.275, p<0.001$ ; etiology,  $\chi^2=61.517, p<0.001$ ; treatment,  $\chi^2=47.558, p<0.001$ ) and lower stigma (stigma,  $\chi^2=69.449, p<0.001$ ). The percentages of adequate knowledge were 85.5%, 93.5%, and 84.5% in the family group, and 37.1%, 65.84%, and 58.8% in the non-family public. Only 11% of family members indicated autism stigma endorsement whereas 42.1% of nonfamily did so. Nonfamily females had significantly higher knowledge and lower stigma than nonfamily males ( $p<0.001$ ), while there was no gender disparity within family members.

**Conclusions:** The current study directly compared family members living with autism against the general public and provided new information for the construct and demographics of the societal misconceptions and stigma beliefs about autism in China. The results indicated drastic disparities between the two groups that family members of autistic individuals have unequivocal knowledge advantages over the lay community. The pattern suggested considerable improvement in autism awareness among families, whereas the extremely low knowledge in the lay community remain profound barriers to service scale expansion and quality improvement. We emphasize that families living with autism should take advantage of their roles as both community participants and knowledge experts to actively facilitate autism science flow to the lay community and advocate for systematic changes of autism service and integration in China.

**425.012 (Poster)** Cross-Cultural Adaptation and Psychometric Properties of Participatory Autism Stigma and Knowledge Scales for Use in Brazil

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**Background:** In Brazil, people with Autism Spectrum Disorder (ASD) have some laws that promote their inclusion in basic and superior education (Lei nº 12.764/2012; Lei nº 9.394/1996; Lei nº 13.146/ 2015). Due to these laws, ASD is the third most common disability among students enrolled in primary schools and the fourth most common among students in college in Brazil (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira [INEP], 2019). The country frames inclusion as one way all students can experience basic rights of education without discrimination. But, neurotypical people sometimes do not understand some behaviors associated with autism and can demonstrate stigma toward people with ASD. Some studies show that when knowledge about ASD increases, the level of stigma decreases (Allport, 1954; Foster & Hill, 2018). In Brazil, we do not have any available instrument to evaluate stigma about autism, and instruments measuring knowledge are scarce (Nunes, Souza, & Giunco, 2009; Penido et al. 2016), and do not include autistic people in their development.

**Objectives:** The aim of this research was to cross-culturally adapt and to investigate the psychometric properties of a Participatory Autism Knowledge Scale and a Participatory Stigma Scale, both developed in collaboration with autistic students and scholars.

**Methods:** The adaptation of both scales followed recommendations in the literature (Borsa, Damásio, & Bandeira), following six steps: 1) translation and cross-cultural adaptation; 2) synthesis of versions; 3) evaluation by judges in Brazil (one with expertise in psychometrics, 1 autistic person, and 13 university students); 4) back-translation; 5) feedback from one of the original authors of the scales and 6) pilot-study (9 university students). Several items were modified during the scales' adaptation process, which became known as Escala de Atitudes em Relação à Pessoa com Autismo (EARPA) e Escala de Conhecimento para uso no Autismo (ECAT). This psychometric study was performed after the adaptation process and had 532 Brazilian participants. They were mostly college students (81.4%,  $n=433$ ) and females (74.6%,  $n=397$ ).

**Results:** Results show that EARPA is a unidimensional instrument while ECAT has a multidimensional structure. Moreover, preliminary results indicate that the stigma scale has very satisfactory fit indexes ( $\chi^2 = 1873.75$ ,  $df = 36$ ;  $p < 0.001$ ; RMSEA = 0.078; CFI = 0.968; TLI = 0.957) and that the items presented adequate factorial loadings. The factor's composite reliability, as well as the McDonald's Omega, were also adequate, indicating the instrument's accuracy. For ECAT, fit indexes were also satisfactory for a four-dimension structure ( $\chi^2 = 577.06$ ;  $df = 249$ ;  $p = 0.000$ ; RMSEA = 0.051; CFI = 0.966; TLI = 0.952), with almost all items having satisfactory factorial loadings with the dimensions. The factor's composite reliability was satisfactory ( $> 0.70$ ) for three of the dimensions.

**Conclusions:** The inclusion of several steps in the cross-cultural adaptation process accumulates evidence of content validity and internal consistency for both scales in the Brazilian context. The instruments show suitability to Brazilian samples and could be used in the future for evaluating and improving stigma and knowledge in different cultural contexts.

**425.013 (Poster)** Cross-Cultural Adaptation of Routine Autism and Developmental Scoring Measures: A Feasibility Study from a South-African Cohort

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**Background:** Research into specific biomarkers for autism spectrum disorders (ASD) in Africa is limited. The Biomarkers of Neurodevelopmental Outcome (BONO) study aims to validate early 'risk' or 'stratification' markers for ASD that are currently identified in Western European cohorts. However many assessment measures have not been validated in low- and middle-income countries. We plan to follow up 4500 school-aged children from two lower socioeconomic residential areas in Cape Town, South Africa, whose mothers were enrolled antenatally in the Safe Passage Study. Participants will undergo broad (screening) and deep phenotyping to detect autism symptoms, cognitive development, and emotional and behavioural difficulties. We report the results of the feasibility study that was implemented to allow for careful consideration of cultural and socioeconomic diversity when selecting measures, so as to prevent bias.

**Objectives:** The aims of the feasibility study were to ascertain comprehensibility, suitability and cultural appropriateness of assessment measures.

**Methods:** One hundred children aged 4-12 years were recruited from March to October 2019. Measures included the Social Communication Questionnaire (SCQ), Childhood Autism Rating Scales (CARS), Strengths and Difficulties Questionnaire (SDQ), and selected subscales of the Mullen Scales of Early Learning (MSEL) and Wechsler Abbreviated Scales of Intelligence-3rd edition (WASI). Questionnaires were translated into Afrikaans, and we applied recommended cut-off scores. We ascertained comprehensibility, suitability and cultural appropriateness of all measures and tested symptom frequency in the cohort.

**Results:**

The SCQ and CARS results showed a similar distribution. The frequency of children who scored around cut-off was comparable with Western studies. The same two children performed above cut-off on both measures. Both questionnaires were well understood although some caregivers over-reported on specific items.

The SDQ was well received although the frequency of emotional, social, conduct and hyperkinetic symptoms was elevated with 19.6% of children having an SDQ total score classified as "abnormal", 18.4% "borderline" with 62% in the "normal" range.

The MSEL results were skewed towards low performance. The majority of children performed below age expectations, with approximately a third having severe difficulties. For the receptive language subscale, only 9% scored within the average range, 46.3% were below average, and 34.1% scored very low. In contrast to the MSEL, the WASI verbal (VIQ) and performance

subscales, including full-scale (IQ) estimates, were normally distributed. However, VIQ and full-scale IQ scores were shifted approximately 25 points and 17 points respectively below Western IQ distributions.

**Conclusions:** The findings of the feasibility study justified some practical adjustment to the protocol. We adjusted for over-reporting on the SCQ and CARS by reassuring caregivers that we expected a negative response for most questions. We hypothesised that lack of learning opportunities, cultural and psychosocial factors may have affected performance on MSEL and WASI assessments. We therefore added the Vinelands Adaptive Behaviour Scales-3 to provide more relevant information on the child's everyday functioning and social interaction. Minor changes included word substitutions with colloquial versions, but no further adaptations were made. In conclusion, a feasibility study is vital to inform research design when using standardized Western instruments in a different sociocultural context.

**425.014 (Poster)** Determining Future Directions for Parent Education & Training Programmes in Autism Spectrum Disorder  
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**Background:**

The World Health Organization has recognised Autism Spectrum Disorder (ASD) as a public health concern and have recommended access to appropriate assessment and interventions. Psychoeducation and parent support soon after diagnosis are considered global best practice. Parent Education & Training (PET) programmes provide education, skills and support to parents. Despite the high need for PET there has been limited research in this field and few programmes are available, particularly in low- and middle-income countries (LMIC).

**Objectives:**

To determine future directions for Parent Education & Training programmes in low-resource environments by 1) evaluating the broader evidence-base of PET; 2) conducting a comparative feasibility study of two PET programme in South Africa.

**Methods:**

A scoping review of all peer-reviewed publications outside the USA was conducted. Two reviewers independently searched seven key databases for titles and abstracts. Four reviewers extracted data with a focus on descriptive characteristics of PET programmes, research methodologies and implementation factors. A mixed-methods quality appraisal of publications was performed. A comparative feasibility study of two PET programmes in a low resource setting was also conducted. EarlyBird/EarlyBird Plus (EB/EBP), a UK developed 12-week programme was compared to Autism Cares (AC), a locally developed 5-day programme. A mixed method, quasi-experimental design was used to collect pre, post, and 3-month follow-up data. Measures included standardised and custom-designed quantitative outcome measures and qualitative semi-structured interview data. A multi-stakeholder group used an ASD PET evaluation framework to compare the programmes.

**Results:**

A total of 37 publications were found in the scoping review. These described a highly diverse range of PET programmes across 20 countries. Programmes varied significantly in their goals, modalities and length. A broad range of outcomes measures were used. Quality appraisal rated only 27% of studies to have met all the methodological quality criteria. Factors relevant to implementation such as manualisation, fidelity and cost were commented on infrequently.

In the comparative feasibility study eighteen parents participated in the EB/EBP programmes and eleven in Autism Cares. Strong parental acceptability for both programmes was found along with the need for some adaptations to the local context. Limited efficacy testing showed positive changes for parental stress, knowledge of ASD and changes in child, more so for EB/EBP. The multi-stakeholder group judged EB/EBP as most suitable for next-step research citing factors relating to implementation including scalability and sustainability.

**Conclusions:**

Our findings contributed to the limited evidence-base for ASD PET in low-resource environments and highlighted the need for global collaboration in this area. We propose the following five recommendations for future directions of PET programmes: 1)

expansion of local PET research in different settings; 2) creation of standardised outcomes for PET through involvement of global stakeholders; 3) dissemination of PET findings and lobbying of potential funders; 4) setting up of a global PET network; 5) caution around implementation of PET programme without a robust evidence-base that includes intervention outcomes as well as implementation outcome data.

**425.015** (Poster) Developing a Cost of Illness Inventory Questionnaire for Children with Autism in India

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**Background:**

The economic burden of autism is likely to be substantial; with costs attributed to healthcare, education, productivity losses, informal care and respite care, as well as others. In India, approximately, 2 million children aged 2-9 years have autism. Despite this, there is currently limited evidence on the cost of illness in India. Given the economic costs of autism determined in high income contexts, there is a need to understand these costs to inform the identification of effective and cost-effective interventions. The Communication-centred Parent-mediated treatment for Autism Spectrum disorder in South Asia (COMPASS) project is conducting a randomized controlled trial, to evaluate the effectiveness and cost-effectiveness of a parent-mediated intervention for autism in New Delhi, India [ISRCTN ID: 21454676].

**Objectives:**

This research aimed to produce a comprehensive cost of illness inventory (COII) suitable for children with autism in South Asia (India).

**Methods:**

A structured and iterative design process was followed including literature reviews, interviews with caregivers, pilot testing and translation. The first stage of development included in-depth caregiver interviews (n=15), literature reviews and a desk review of existing tools from other settings. This allowed the first draft version of the COII to be developed. Across the development of the COII thirty-two families were involved in the design and piloting of the tool; the majority (88%) of these families had a child with autism. Prior to pilot testing the COII was forward translated (from English to Hindi) and back translated. Each stage of the process of development of the COMPASS COII resulted in the further refinement of the tool.

**Results:**

COII development took place from November 2018 to October 2019. Pretesting was conducted with four families, and the first draft developing from this process was administered to six families. Iterative modifications resulted in a second draft, which was tested on twelve families and finalised. The final COII is hosted by REDCap Cloud and is a bilingual instrument (Hindi and English). Domains covered in the COII include education, childcare, relocation, healthcare contacts (outpatient, inpatient, medical emergencies, investigations and medication), religious retreats and rituals, specialist equipment's, workshops and training, special diet, support and care, certification, occupational adjustments and government rebates/schemes. Contextual complementary health approaches are also captured. Though it is very comprehensive, administration and completion of the COII was determined to be feasible, with it taking around 35 minutes to complete by trained researchers.

**Conclusions:**

The COMPASS COII was developed using experiences gathered from an iterative process in a metropolitan area within the context of one low- and middle-income country setting, India. Compared to COII tools used for children with autism in high-income country settings, additional domains were required, such as complimentary medication (homeopathy) and the need to record out-of-pocket expenses in a system with a virtual absence of health insurance coverage. The COII will allow future research to define the cost of illness of autism in India and will support relevant economic evaluations. Understanding the process of developing the questionnaire will help researchers working in LMICs.

**425.016** (Poster) Development of Attention Control in Autism: Results from a Community-Based Project in Delhi, India

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#### Background:

The ability to inhibit and flexibly shift visual attention develops across early childhood. Alterations in its development have been implicated in Autism Spectrum Disorder (ASD); reduced inhibitory control has been found in autistic compared to neurotypical groups. The antisaccade task has been used to measure attention control, and to assess a child's ability to learn to inhibit and anticipate saccades related to visual cues, both within and between blocks of trials.

However, the majority of our knowledge of attention control results from samples in high-income countries (HICs). We need to expand our research to investigate abilities in children beyond these limited settings, and specifically in low and middle income countries (LMICs). This is particularly important because socioeconomic factors are associated with the development of children's executive functioning.

To make such research accessible to different populations, we need to conduct this work within the community, close to people's home or to their health facility. Eye-tracking technology offers an advantage over other methods, due to its availability of relatively low-cost and portable devices, as well providing objective markers.

#### Objectives:

We aimed to assess attention control and learning using eye-tracking in children aged 3-5 years with and without ASD in a community LMIC setting, specifically New Delhi, India.

#### Methods:

Three groups of children were assessed within community or healthcare facility settings in the Delhi/NCR region, India: children meeting their developmental milestones (NT), children with a diagnosis of Autism Spectrum Disorder (ASD), and children with a diagnosis of Intellectual Disability (ID). Data was analysed from 104 participants (n=32 NT group; n=46 ASD group; n=26 ID group). There were no differences in age at assessment between groups (mean age:  $4.42 \pm 1.17$  years). The number and latency of prosaccades (looks towards a peripheral distractor stimulus appearing on the screen) and antisaccades (an anticipatory look in the direction of the target stimulus appearing on the opposite side of the screen) were calculated offline. Generalized Estimating Equation (GEE) was utilised to analyse data.

#### Results:

Preliminary results demonstrate that the number of prosaccades decreased and antisaccades increased within and across blocks, which was indicative of children learning to inhibit saccades towards the distractor, and to anticipate looking towards the target stimulus. The clinical groups (ASD, ID) demonstrated reduced learning compared to the NT group within blocks. However, across the four blocks of trials, the ASD and ID group continued to learn at an increased rate than that of the NT group. No differences were found between the ASD and ID groups.

#### Conclusions:

These results suggest that the clinical groups may have a reduced rate of learning in the shorter term, but the learning process continues for a longer time than the NT group, although does not reach NT levels over the course of the trial. However, this task did not discriminate between the two clinical groups (ASD, ID). This study investigated attention control in pre-school children in a community LMIC setting, showing its feasibility and the need for additional research in this population.

**425.017 (Poster)** Diagnostic Process and Barriers Among Asian American Parents of Children with Autism and Other Developmental Disabilities

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**Background:** Early diagnosis and intervention are beneficial not only for children with autism and other developmental disabilities (DDs), but also for caregivers' well-being (Giarelli & Fisher, 2016). However, multiple studies highlight racial and ethnic disparities in DD health care and service use, including in diagnosis and early intervention (Dababnah et al., 2018; Magaña et al., 2016). Yet, while the literature focused on historically underserved communities is growing, there is little known about Asian children with DDs and their families about diagnosis.

**Objectives:** This study aims to describe how Asian American (AA) parents of children with DDs navigate services to obtain a diagnosis for their children.

**Methods:** We developed a survey that includes items about diagnostic processes and barriers. The survey was professionally translated into four languages: Korean, Japanese, Mandarin, and Vietnamese. Participants were eligible to complete the survey if they 1) lived in Maryland; 2) identified as Asian or AA; 3) and were a parent or other primary caregiver of a child 18 years or younger with autism or another DD. Between October 2019-July 2020, 73 AA parents completed the survey online and in-person. About half of the parents who participated were Chinese; the remaining participants were Korean, Indian, Japanese, Vietnamese, Filipino, or Bangladeshi. Their children had autism (58%), Attention Deficit Hyperactivity Disorder, a developmental delay, an intellectual disability, Down syndrome, or Cerebral Palsy. We used descriptive statistics to summarize our findings.

**Results:** Nearly three-fourths of the parents reported having concerns about their children's development pre-diagnosis and discussing their concerns with a healthcare professional. Respondents had early concerns (average of 28 months). In response to parents' concerns, some professionals conducted a developmental screener (32%), but notable percentages of participants reported the professional responded by telling the parent it was too early to identify developmental concerns (29%), the child's developmental was typical (17%), or the child would "grow out of it" (14%). There is an average 12-month gap between noticing developmental delays and getting a diagnosis for their child. Parents encountered many barriers to obtaining a diagnosis for their child, including trouble understanding how the healthcare system worked (62%) and stigma related to disabilities (19%). 36% of the respondents said that language interpreters were unavailable when needed and 41% reported interpreters did not help them to understand what the professionals were saying. 72% also said the diagnostic process caused family stress.

**Conclusions:** To our knowledge, this was the first study to understand diagnosis process and barriers of AA parents raising children with autism and other DDs. The majority of parents reported they trusted their providers' advice, yet experienced delays in obtaining a timely developmental evaluation. Thus, providers should listen to parents' concerns and act quickly to refer children for evaluations. In particular, providers should be aware that cultural and language barriers might make it more difficult for providers to recognize developmental delays or understand parents' concerns; or for parents to navigate the healthcare system, coordinate care, or overcome disability-related stigma.

**425.018 (Poster)** Does the Desire to Dominate People and Nature Contribute to Cross-Cultural Variations in Autism Stigma? **K. Gillespie-Lynch<sup>1</sup>, B. Bockstal Fieulaine<sup>2</sup>, S. Saade<sup>3</sup>, E. Cappe<sup>4</sup>, N. Daou<sup>5</sup>, B. Kofner<sup>6</sup>, R. Obeid<sup>7</sup>, G. Y. H. Lam<sup>8</sup> and J. MacCormack<sup>9</sup>**, (1)Department of Psychology, College of Staten Island; CUNY Graduate Center, Brooklyn, NY, (2)Département de Psychologie, Université Reims Champagne Ardenne, Reims, France, (3)Psychology, Université du Québec à Montréal, Montreal, QC, Canada, (4)Université de Paris, Boulogne-Billancourt, France, (5)McNeese State University, Lake Charles, LA, (6)CUNY, NY, NY, (7)Department of Psychological Sciences, Case Western Reserve University, New York, NY, (8)Department of Educational and Psychological Studies, University of South Florida, Tampa, FL, (9)University of Lethbridge, Lethbridge, AB, Canada

**Background:** Stigma reduces the well-being of autistic people (Robertson, 2010). Given that stigma arises when an individual "falls short" of culturally-defined norms (Goffman, 1963), it is not surprising that autism stigma varies across cultures (Obeid et al., 2015). Heightened acceptance of inequality and racism are associated with autism stigma (Gillespie-Lynch et al., 2019; Obeid et al., 2020). Stigma may reflect a general desire to dominate; autism stigma (lacking appreciation for neurodiversity) may be intertwined with seeking to dominate nature (lacking appreciation for biodiversity). Indeed, the term neurodiversity was inspired by the desire to expand biodiversity to include neurological diversity (Singer 2017).

**Objectives:** To identify factors that contribute to autism stigma in three multicultural countries: the US, with high levels of autism resources but access inequalities (apparent across countries), Lebanon, with very limited resources, and France, where questionable autism interventions, such as psychoanalysis or "packing" are more common. We hypothesized that stigma would be higher in Lebanon and France than the US. We expected heightened social dominance orientation (SDO) and reduced biodiversity appreciation to predict stigma.

**Methods:** Undergraduates from the Parisian region ( $n = 85$ ), Beirut ( $n = 156$ ), Midwest ( $n = 201$ ), South ( $n = 404$ ), and Northeast US ( $n = 555$ ) participated in an online survey that assessed: demographics, stigma (social distance;  $\alpha$  France = .86;  $\alpha$  Lebanon =

.84;  $\alpha$  US = .89), autism knowledge ( $\alpha$  France = .70;  $\alpha$  Lebanon = .75;  $\alpha$  US = .86), biodiversity appreciation, SDO, Culture Value Orientation, and social desirability bias.

#### Results:

Although autism knowledge measures often exhibit sub-par internal consistency, the participatory autism knowledge scale exhibited satisfactory internal consistency across countries. Unexpectedly, autism knowledge was highest in France, followed by the US, and Lebanon ( $ps < .001$ ). Biodiversity appreciation was lowest and SDO highest among students in the US, followed by Lebanon, and France ( $ps < .005$ ).

French students were less likely to attribute autism to heredity or preternatural causes and more likely to index environmental causes than participants in the US and Lebanon ( $ps < .001$ ).

A regression revealed that being French ( $B = .16$ ) or from Lebanon ( $B = .07$ ), being male ( $B = .08$ ), heightened SDO ( $B = .14$ ), and vertical individualism ( $B = .12$ ), and reduced horizontal collectivism ( $B = -.14$ ) and biodiversity appreciation ( $B = -.08$ ) were associated with heightened autism stigma ( $ps < .007$ ). Heightened autism knowledge ( $B = -.26$ ), more pleasant past experiences with autism ( $B = -.15$ ), having worked with autistic people ( $B = -.06$ ), and more social desirability bias ( $B = -.06$ ) were associated with reduced stigma ( $ps < .02$ ).

Conclusions: These findings suggest that autism stigma and disrespect of biodiversity arise from a broader belief that those who are in power (e.g., “neurotypical humans” when compared to “neurodivergent” humans or humans in general when compared to other animals) deserve their privileges. By recognizing common causes shared by different social justice movements, we can work together to ameliorate stigma and combat environmental degradation by teaching the value of interdependence and respect for diverse ways of being.

#### **425.019** (Poster) Effects of Internet-Based Online Modules on Behavioral Principles for Parents of Children with ASD

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#### Background:

Many children with autism and other developmental disabilities have deficits or delays in social-emotional or communication skills, which might lead to challenging behaviors as communicative attempts (Dunlap & Fox, 2011). It is also reported to have a significant impact on others who experience the child’s challenging behaviors daily, such as parents. Parents of children who exhibit challenging behaviors report that these behaviors have negative effects on family’s stress, social isolation, and well-being (Meadan et al., 2010). Therefore, parents’ roles become very significant in a child's development especially when a child has a disability and exhibits challenging behaviors (Lopez-Liria et al., 2020). However, when parents are uncertain of what a correct response is to a child’s challenging behaviors, it can significantly increase their stress (Bearss et al., 2018) and could result in parent-child interactions that are coercive in nature (McIntyre, 2013). Parents who live in areas with severe service disparity, such as South Korea, report heightened financial hardships of paying for services such as applied behavior analysis (ABA) due to the limited number of professionals available.

#### Objectives:

In order to mitigate service disparity in Korea, we developed and evaluated the effectiveness of the Challenging Behavior Online Modules (CBOM) with parents of children with ASD/DD who exhibit challenging behaviors in Korea on increasing their knowledge in behavioral principle, positive parenting practice, and decrease in parental stress. We also collected qualitative social validity data to examine feasibility and acceptability.

#### Methods:

In this randomized controlled trial, a total of 88 participants in intervention and waitlist control groups completed the study. More than half of the participants reported having children with ASD (54.5%,  $n = 48$ ). CBOM is consisted of six online video modules that are approximately 11 minutes long. Participants in the intervention group were given access to the modules for three weeks. Dependent variables include researcher-developed Parent Knowledge Assessment (PKA), Parenting Young Children (PARYC; McEachern et al., 2012), and Korean-Parenting Stress Index (K-PSI-4-SF; Chung et al., 2019). We conducted repeated-measures ANOVA analyses, treating time and treatment conditions as fixed factors. If the interaction effect was significant, Tukey’s test for post hoc analysis was performed to further investigate the mean differences.

## Results:

Significant interaction effects of Group  $\times$  Time were found across all measures, with no preexisting differences between the two groups at pretest, which indicate that the changes are likely due to treatment alone. Large effect sizes (2.29 and .75) were found for PKA and PARYC, respectively, and relatively small (.32) effect size was found for K-PSI-4-SF. Social validity data also supplement the quantitative findings. Parents spoke highly of the acceptability, satisfaction, and effectiveness of the modules, and shared that such modules would be very helpful to parents in Korea where ABA service disparity is pronounced.

## Conclusions:

While the CBOM was found to be effective in promoting positive changes in Korean parents, future study should examine how to better tailor the CBOM and to develop more online resources to meet the individual needs of diverse parents.

### **425.020** (Poster) Evaluation of the Program Parents Taking Action for Parents of Pre/Adolescents with Autism Spectrum Disorder in Colombia

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**Background:** The prevalence of Autism Spectrum Disorder (ASD) has been increasing in the last decades around the world. In Colombia, there is not a clear statistic about the prevalence of ASD, but it is estimated that 16% of the population under 15 years old has some type of developmental disability. In addition, disability in Colombia is still considered a taboo and it has a strong stigma that prevents people with disabilities from fully participating in the community. Unfortunately, the lack of research and information about supports for families of children/pre/adolescents with ASD limits the understanding of how ASD is approached and what services and supports are available for this population. This project includes a curriculum for Colombian parents of pre/adolescents with ASD which includes topics of puberty, sexuality, and adolescence development

**Objectives:** This research project evaluates the effectiveness of the program Parents Taking Action (PTA) in Bogota, Colombia. This program aims to increase parent empowerment, at the family level, by increasing aspects such as self-efficacy, knowledge, goal attainment, and use of new strategies/skills.

**Methods:** this study used a quasi-experimental pretest-posttest design with multiple replications and follow-up. This research design included two intervention groups and one control group. In addition, the program included 4 weekly sessions; each session was three hours long and included the topics of the curriculum, active learning activities and discussions. The program includes 9 modules, and it is designed to provide parents with a space to practice strategies, learn from others and set goals.

**Results:** the PTA program was offered to 38 Colombian parents of pre/adolescents with ASD between the ages of 10-17 in the city of Bogota. This study showed that there were significant gains in the pre-post analysis in all three groups for levels of empowerment, knowledge, self-efficacy, and use of strategies. Also, the difference between intervention groups and the control group was significant in all dimensions (knowledge  $p < 0.000$ ; use of strategies  $p < 0.001$ ; empowerment  $p < 0.005$ ; and self-efficacy  $p < 0.000$ ).

**Conclusions:** the results of this study show that the program Parents Taking Action is effective in terms of increasing knowledge, use of strategies, self-efficacy, and empowerment in relation to the topics related to puberty, adolescence and sexuality for parents of pre/adolescents with ASD. Also, the findings also indicated that parents are not only acquiring knowledge, but they are also applying the knowledge and strategies with their children. This is also significant as their empowerment and self-efficacy increased after receiving the program. The program had a high impact in the Colombian participants as the information is scarce and parents do not have resources to be informed about the complicated developmental stage of pre/adolescence. Finally, the program is an effective tool for community organizations and health providers to provide extra support to these families during their youth's stage of puberty and pre/adolescence.

### **425.021** (Poster) Examining Beliefs about the Causes of Autism in Kenya: What Have People Been Told and What Do They Personally Believe?

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Background: Although autism affects people at similar rates globally, reliable information about autism and evidence-based supports are far from equally distributed (Hahler & Elsabbagh, 2015). Autism resources remain particularly scarce in Kenya (Riccio, 2011). In one of the only prior studies about autism in Kenya, parents and educators reported experiencing stigma and pronounced challenges accessing care (Gona et al., 2015). They expressed misconceptions about autism, including that it is caused by witchcraft. Although an important first step, Gona's research did not distinguish between what participants personally believed and what they had been told by others.

Objectives:

To examine if people in Kenya describe the etiology of autism similarly or differently from what they have been told by community members.

To determine if misconceptions about autism were more common among parents or educators.

Methods: In collaboration with the Kenya Autism Alliance and autistic university students, we adapted a training which had been associated with improved knowledge and/or stigma among college students and educators internationally. We delivered two half-day long trainings in Nairobi and Mombasa. Ninety-eight people attended the training, 74 (34% parents, 37% educators) provided complete data. We adapted two knowledge measures to address strengths as well as challenges and align with the cultural context. We measured stigma with a social distance scale. Nine open-ended questions assessed access to care, personal, and community conceptions of autism. Answers to two questions, "What have you been told causes autism by others?" and "Please share what you yourself think causes autism?", were coded after independent coders obtained reliability.

Results:

When asked what they had been told causes autism by others, participants most commonly had heard that autism is attributable to biomedical causes (40.7%; e.g., genetics), followed by issues with parents (35.8%; e.g., what the mother consumed during pregnancy), environmental toxins (28.4%; e.g., vaccines), and preternatural forces (27.2%; e.g., witchcraft; Table 1).

When asked what they themselves believe causes autism, participants overwhelmingly indicated biomedical causes (78.1%), followed by toxins (43.9%) and issues with parents (40.2%; Table 2). They almost never personally endorsed preternatural causes (2.5%).

Chi square tests revealed that participants were more likely than their community members to attribute autism to biomedical causes and less likely to endorse preternatural causes ( $p < .001$ ). However, they did not differ from community members in attributing autism to parents or vaccines ( $p > .60$ ).

Parents (26%) were more likely to attribute autism to vaccines than teachers (4%;  $p = .04$ ). Teachers (33%) were more likely to attribute autism to parents than parents (4%;  $p = .02$ ).

Conclusions: Participants in Kenya received a mix of accurate information and misinformation about autism from community members. They successfully rejected some misconceptions (e.g., preternatural causes) while accepting others (e.g., that autism is caused by vaccines). To better understand perspectives on autism in different cultures, it is important to distinguish between what people have been told by community members and what they themselves believe.

**425.022** (Poster) Experiences, Opportunities and Challenges of Autistic Students in Higher Education in Singapore: A Qualitative Analysis

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Background:

Autistic people are entering higher education (HE) in increasing numbers. Research on understanding their experiences and support needs has only emerged in the last few years and was predominantly conducted in Western countries, with only two exceptions to date (one study each from Japan and Israel). Supporting autistic people in education is a top research priority for autistic people, but autism research in Singapore and in most Asian countries has largely focused on early, primary or secondary school education, rather than higher education. To the best of our knowledge, the present study is the first in Singapore and the

third outside of Western countries to explore the experiences, perspectives, opportunities, challenges, and needs of autistic HE students.

#### Objectives:

The present study adopted a qualitative and exploratory approach, aiming to understand the experiences, opportunities and challenges faced by autistic HE students in Singapore's local polytechnics and universities. The present study also sought to find out the availability and efficacy of supports available to autistic students from transition into HE to transition out of HE and into employment. These findings could contribute to improving and strengthening relevant supports to better enable autistic students to fulfil their potential in HE.

#### Methods:

20 autistic students (aged 21-29; 15 males) and 22 non-autistic students (aged 20-30; 8 males) who either supported or worked with autistic peers during classes or assignments provided anonymous responses to online open-ended survey questions which were transcribed and thematically coded.

#### Results:

Figure 1 summarizes the themes that emerged. Similar to students in other countries, our surveyed autistic HE students had unique, diverse experiences that ranged from highly enjoyable to highly challenging—some excelled academically, while some faced difficulties; some made friends while others struggled to form connections. Autistic students indicated that having a comprehensive transition plan generally made entering HE easier, and that receiving support from others was usually beneficial. Non-autistic students, however, either felt ill equipped to understand, engage with, or support autistic peers or were unwilling to due to negative perceptions of autistic people. Two findings, namely that autistic students in Singapore did not spontaneously refer to mental health difficulties, and that non-autistic students often engaged in “othering” their autistic peers, may pertain more specifically to the educational and sociocultural context of Singapore. Both autistic and non-autistic students noted the presence of deep-rooted stigma about neurodevelopmental/mental health conditions in their country's HE settings —this could deter disclosure, in turn hindering autistic students from receiving reasonable accommodations.

#### Conclusions:

More flexible, individualised supports need to be developed and existing supports refined, in tandem with improving non-autistic peers' knowledge of and attitudes towards autistic people. Future research directions include expanding the literature base in Asian countries by obtaining perspectives from other stakeholders (especially faculty and families) and examining factors that predict successful and positive HE experiences. Lastly, inclusivity cannot be limited to the HE context, and changes need to be made on a societal level to address underlying stigma (e.g. in primary and secondary school, in the workforce).

**425.023 (Poster)** Exploring the Use of the ASK-Q As a Baseline and Outcome Measure in Face to Face and Virtual (mobile phone) Autism Knowledge Trainings in Tanzania

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**Background:** ASD is prevalent globally, but there is variability in the awareness of ASD depending on the country. In Tanzania, educators and clinicians report reduced awareness of ASD in the community and few training opportunities and resources. A U.S based non-profit has provided free trainings on ASD to teachers and clinicians in Tanzania using in-person and virtual formats. Both have their advantages. In-person trainings can be tailored specifically to a particular audience and provides opportunity for discourse and networking. Virtual trainings can reach a larger audience and raise awareness throughout the country.

**Objectives:** Analysis of the Autism Stigma Knowledge Questionnaire (ASK-Q) as a baseline and outcome measure of autism knowledge to assess effectiveness of in-person and virtual autism knowledge trainings among Tanzanian educators.

**Methods:** The studies used a pre-post methodology with the ASK-Q. Content was identical across in-person and virtual trainings and incorporated different topic areas including, etiology, assessment and communication. Information was presented in English and Swahili. The in-person training was delivered in July 2018 in Mwanza, Tanzania and lasted three days. Of the 39 recruited participants, 34 (17 males and 17 females;  $M_{age} = 40.29$ ,  $SD_{age} = 8.50$ ) successfully completed the study. The virtual trainings were launched in July 2018 and July 2019, were available for free for six months after the start date, and were accessible to participants on any mobile device (phone or tablet) with internet access. Sample sizes were 84 (52 females and 29 males,

majority age (39.3%) over 39 years) and 179 (74 females, 104 males, majority age (27%) between 20-24 years) for the 2018 and 2019 virtual trainings respectively. Both trainings included end-of-module quizzes. The 2019 training modified the ASK-Q post-test administration by embedding all post-test questions into the end-of-module quizzes.

**Results:** Pre-post-test comparison for the in-person training was significant,  $t(34) = 5.12, p < .001$ . (pretest mean = 36.09 (SD= 3.80; posttest mean = 39.63 SD= 2.52). Cronbach alpha (.460) for the measure at pre-test was lower than expected, most likely due to the small (n=34) sample size. Cronbach alpha on the ASK-Q was higher for the 2019 virtual training (.657) compared to 2018 (.542). Pre-post comparisons were not significant for either virtual training (2018 pretest mean=35.92, SD=3.56; post-test mean 36.14, SD=4.57; 2019 pretest mean=38.90, SD=5.01, post-test mean=38.27, SD=5.11). Participant completion for in-person training was 87%, completion rate for the 2018 and 2019 virtual trainings was 41% and 39 % respectively. Results from the end of module quizzes for the virtual trainings ranged from 73-96% for both years.

**Conclusions:** Positive outcomes using a pre-post-test methodology did not translate to the virtual format, despite the improved reliability of the ASK-Q in the virtual trainings. Reasons could be the high participant baseline scores in the virtual trainings and significantly lower completion rates for these trainings. Considerations need to be given to the viability of a pre-post-test methodology in the virtual space, particularly when participants access content via their mobile devices. Future applications of these virtual trainings should consider alternative methods to capture participant learning.

**425.024 (Poster)** From Engagement to Competency: Making Disability Naïve Frontline Health Workers Competent to Deliver an Evidence Based Autism Intervention in New Delhi, India

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**Background:** The Communication-centred Parent-mediated treatment for Autism Spectrum Disorder in South Asia (COMPASS) program is an ongoing randomized control trial being conducted in India. It is evaluating the effectiveness and cost-effectiveness of delivering an evidence-based intervention PASS Plus (Parent-mediated treatment for Autism Spectrum Disorder in South Asia Plus), an adaptation and expansion of the Preschool Autism Communication Therapy (PACT), to families of children with autism. The estimated prevalence of children with autism in India, aged 2 to 9 years, is over five million and the paucity of specialist care makes access to interventions difficult for most families. To address this issue, COMPASS is using the task-sharing approach by training non-specialists to deliver the intervention to families in their homes using video feedback. These non-specialists work within a supportive supervision framework in the project. COMPASS is engaging and training health system workers called the Accredited Social Health Activists (ASHAs). ASHAs are embedded within the Ministry of Health and Family Welfare, and each is linked to a Public Urban Health Centre (PUHC) under the Delhi State Health Mission. The primary role of ASHAs is to mobilize their communities to avail services related to maternal and child health care

**Objectives:** To describe the processes and experiences of an autism intervention delivery project and its interaction with the health system in a state of India, as a model to inform the future scalability of early interventions for neurodevelopmental disorders through the process of task-sharing.

**Methods:** The present study describes the process followed to support autism naïve non-specialists to become competent at delivering a complex autism intervention. It included the following steps i) engagement, ii) recruitment, iii) training iv) internship and v) competency evaluation. The engagement process introduced the ASHAs to the organisation, autism and the COMPASS program, and their potential roles within it. The recruitment process comprised telephonic screening followed by in-person interviews to gauge capabilities of ASHAs specific to project requirements. The shortlisted ASHAs received a 7-day classroom training followed by an internship period with practice cases. Finally, competency assessments, comprising a test of knowledge and skills through role-plays, was administered.

**Results:** The COMPASS team approached 23 PUHCs across seven districts of Delhi and met with 408 ASHAs across 24 engagement meetings. On follow-up calls, 188 ASHAs reconfirmed their willingness to join the program. Telephonic screening was conducted with 127 ASHAs and 72 ASHAs were selected for in-person interviews, 45 ASHAs attended. 33 ASHAs were shortlisted for training, 24 ASHAs commenced training and 18 ASHAs completed the 7-days training. 15 ASHAs entered the internship and 8 ASHAs achieved competency in intervention delivery

**Conclusions:** There was a significant attrition along the pathway to having a competent non-specialist frontline worker deliver a complex autism intervention. These reasons included low digital literacy, a lack of family support and a requirement for improved remuneration. The lessons learnt from this process can inform health systems on possibility of developing a cadre of

disability specific health workers who can deliver evidence-based interventions for neurodevelopmental disorders under supervision.

**425.026** (Poster) Impact of COVID-19 and Lockdown on People with ASD and Their Families in Latin America  
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#### Background:

There is a worldwide emergency because of the COVID-19 outbreak. Challenges related to quarantine and lockdown are an added burden to those already experienced by families with a member on the spectrum living in low and middle-income countries. Approximately 6 million individuals with autism live in Latin America. These countries share cultural heritage with Europe mixed with cultures of native aboriginal communities of America or Africa. Health disparities are present for the poorest and most vulnerable populations (women, children, and aboriginals). As a new risk factor, the COVID-19 affects the already scarce services for individuals on the spectrum, telehealth adaptations, family dynamics, and up to an unknown degree, the outcomes of individuals with ASD.

#### Objectives:

Describe the impact of the COVID-19 lockdown on people with ASD and their families in Latin America in relation to any changes in feeding and sleep habits, anxiety and behavior. Analyze the impact of the pandemic on the services, taking into account the different types of treatment and schooling, their possible discontinuity, the telehealth intervention and its scope and limitations.

#### Methods:

1826 families from Argentina, Brazil, Chile, Mexico, Peru, the Dominican Republic, Uruguay, and Venezuela participated in this multicentric study. Caregivers completed an online survey designed by Red Espectro Autista Latinoamérica (REAL). Questions inquired about changes in education, services and support, behaviors, outings, adaptations for educational and health services before and during the pandemic.

#### Results:

Right before the lockdown, 26.9% of the participants were receiving speech therapy, 19.6% medication, 19.5% occupational therapy, 17.6% school support, and 15.5% behavioral therapy. Overall, 30% of the treatments were suspended either due to centers closure or by health providers' decisions. 40% of the families have received services through telehealth. Participants reported sleep disturbances (40.8%), eating problems (45.4%), irritability (64.8%), "aggressive" behaviors (hitting, pinching, biting and shoving) (35.5%), wandering (46.6%), anxiety (59.1%) mood disturbances (46%) and setbacks (60%). The majority of participants reported an increase in screen use outside of educational use (80%) and behavioral improvement when they were allowed to go out of the house (50%). Most families (75%) shifted to remote learning.

#### Conclusions:

Sleep problems increase at the same level as attention problems, hyperactivity, dysfunctional behaviors and irritability/aggressiveness. Anxiety increased markedly. Parents mention a task overload due to telehealth interventions and the lack of experience of professionals with technology. Caregivers identified some advantages for remote services, such as lower stress level by not traveling and avoiding the demands of social interaction outside the household. Many families say they have been able to learn more about their children's treatment goals and strategies. This should help us to rethink the relationships between families and professionals and include families in therapeutic proposals. Socioeconomic inequalities and the technological gap are evident. The current global crisis should serve as an opportunity to promote changes in the health and education systems, providing sufficient support with a more ecological, inclusive and autism-friendly perspective.

**425.027 (Poster)** Impact of COVID-19 on Children with Autism and Parents: A Preliminary Investigation into a School Sample in Mainland China

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**Background:** Earlier in 2020 China instituted a nationwide lockdown after the outbreak of a novel coronavirus (COVID-19). The isolation has not only disrupted people's routine life but also afflicted mental distress on individuals under quarantine. Children with autism and their families are among the most vulnerable populations that experience COVID-19-related challenges.

**Objectives:** To understand the impact of COVID-19 on children with autism and parents to inform our teaching and parent support post-COVID-19 to better meet the needs of the students and families.

**Methods:** A survey was developed with input from parents and non-autism researchers. The survey assesses the impact of COVID-19 on children with autism and their parents with respect to parents' implementation of home-based interventions. The survey, published on the survey platform [www.wjx.cn](http://www.wjx.cn), was distributed to online parent groups. Respondents were asked to consent before answering the survey. IRB was waived because the survey did not collect identifiable information and the collected information was analyzed as secondary data. Fifty-six parents participated and 54 responses were valid. Descriptive statistics (Table 1) and qualitative analysis (Table 2) were used to analyze the results.

**Results:** Parent-reported impacts of COVID-19 on children with autism included discontinuation of schooling, limited (social) opportunities, less generalization of learned skills to non-home contexts, and skill regression. Parents reported intensified behavioral issues in children, including mood swings, self-stimulation, and less compliance with the home-based intervention plan. These behavioral irregularities resulted in parent caregiving difficulties. Although 36 parents reported implementing home-based intervention and adapting its content, schedule, and intensity, only four parents preferred this configuration. Reasons for parents' preferences for school-based intervention (Table 2) aligned with their reported challenges moving to home-based interventions.

Thirty-one parents reported receiving support from professionals, peer parents, community resources, or family members. For others, the biggest challenges were social isolation and a lack of means to provide home-based intervention. Parents expressed needs for (1) professional support for intervention strategies, remote consultation, and home visit services; (2) child care for respite and within-family division of labor in caring for the child; (3) financial support for childcare; (4) information about autism; and (5) emotional support for combatting loneliness, opportunities to share feelings, and peer support.

Twenty-two parents expressed interest in how parents from other countries implemented intervention and accessed supports for parent mental well-being during the pandemic. These parents expressed resilience in their beliefs in (1) patience and quality time with the child; (2) reasonable expectations; (3) self-discipline and endurance; and (4) coordination of childcare responsibilities among family members.

**Conclusions:** The impact of COVID-19 on both children with autism and parents was evident from this sample of parents. Parents reported lockdown-related challenges for children and themselves related to gaps in family support opportunities. Implications for schools are the need for parent supports to empower them for a larger role in supporting child learning during the pandemic.

**425.028 (Poster)** Impact of Lockdown Due to COVID-19 on People with ASD and Their Families in Argentina.

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Background:

Argentina is among the countries most affected by COVID-19, with 2,737 infected for every 100,000 inhabitants. For children, adolescents and adults with ASD and their families, facing a situation of confinement is challenging. In order to understand the

challenges they face, it is crucial to understand their socio-economic and cultural context. Argentina shares cultural heritage with Europe mixed with cultures of native aboriginal communities of America. 40.9% of the population is in poverty. Inequity in health systems is common for the poorest and most vulnerable populations (women, children, aborigines). Research and health provision is significantly under-resourced.

#### Objectives:

Describe the impact of the COVID-19 lockdown on people with ASD in Argentina in relation to any changes in feeding and sleep habits, anxiety and behavior. Analyze the impact of the pandemic on the services, taking into account the different types of treatment and schooling, their possible discontinuity, the telematic intervention and its scope and limitations.

#### Methods:

834 participants (81% caregivers, 16% therapists, 3% people with ASD) from Argentina participated in this study through an online survey designed by Red Espectro Autista Latinoamérica (REAL). The survey enquired about 8 aspects, as follows: Place of residence, Pre and post-pandemic schooling, Situation at home, Treatments and supports at the time of the start of the pandemic, Behavioral changes from home isolation, Leaving the home, Treatments and Supports during the pandemic, Main concerns during quarantine.

#### Results:

When the pandemic started, 56% of people with ASD received speech therapy, 19% medication, 41% occupational therapy, 35% school support, and 65% behavioral therapy. 24% of the treatments are completely suspended due to the closure of centers (30%) or by a health provider (27%). 43% of the families have received counseling through video calls and 18% only by telephone. When faced with the need for help, 59% call to therapists. Sleep problems (46%), eating problems (40%), irritability (63%), aggressiveness (35%), dysfunctional behaviors (52%), wandering (47%), anxiety (63%) and setbacks (65%) are reported. 56% have difficulties understanding why they cannot leave their home. Behaviors improve in 44% of people when outings began. For most families (80%), schooling was done remotely during the pandemic. 78% of people with ASD increased the use of screens outside of educational use.

#### Conclusions:

It seems that for individuals on the spectrum, staying at home and the changes in services delivery (from face to face to remote) impacted behaviors. The most-reported difficulties were irritability and anxiety, although sleep and eating problems were also present in a significant proportion of the sample. The technology gap and lack of internet penetrance in the country might have contributed to the disruption of services and support for families during the home for shelter period. An abrupt and drastic change as the one provoked by health measures during COVID-19 will disrupt individuals' routines and activities, which in individuals with autism would be a source of anxiety and disturbance.

#### **425.029** (Poster) Impact of Lockdown Due to COVID-19 on People with ASD and Their Families in Peru.

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#### Background:

Peru is among the countries most affected by COVID-19, with 2,860 infected for every 100,000 inhabitants. For children, adolescents and adults with ASD and their families, facing this situation of confinement is very difficult. To understand the challenges of families of people with ASD, it is crucial to understand their socio-economic and cultural context. Peru has 30% of the population of African American aboriginal origin. One in every 4 children is in poverty. Inequity in health systems is common for the poorest and most vulnerable populations (women, children, and aborigines). There is not enough research and health professionals available in the area of autism.

#### Objectives:

Describe the impact of the confinement due to COVID-19 the pandemic in people with ASD in Peru in relation to food, sleep, anxiety and behavior. Analyze the impact of the pandemic on services, taking into account the different types of treatment and schooling, its possible discontinuity, telematic intervention, its scope and limitations.

#### Methods:

In this exploratory study, 110 people - including therapists, families and people with ASD - from Peru participated through an online survey designed by Red Espectro Autista Latinoamérica. The survey enquired about 8 aspects, as follows: Place of residence, Pre and post-pandemic schooling, Situation at home, Treatments and supports at the time of the start of the pandemic, Behavioral changes from home isolation, Leaving the home, Treatments and Supports during the pandemic, Main concerns during quarantine.

#### Results:

When the pandemic started, 46% of the people with ASD received speech therapy, 6% medication, 16% occupational therapy, 21% school support, 23% behavioral therapy. 30% of the treatments are totally suspended due to the closure of centers (27%) or by health provider (12%). 32% of the families have received advice through video calls and 16% only by telephone. 17% of the families took care of the therapies. Faced with the need for help, 72% turn to therapists. Sleep problems (36%), eating problems (26%), attention (55%), irritability (55%), aggressiveness (26%), ambulation (35%), anxiety (40%) and setbacks (56%) are reported. Behaviors improve in 36% of people when outings began. For most families (73%), schooling was done remotely during the pandemic. 87% of people with ASD increased the use of screens outside of educational use.

#### Conclusions:

The increase in irritability, attention problems and anxiety levels are high in this situation. Most families have requested remote help from therapists. Parents mention the overload of tasks due to tele-treatment at home during confinement and the lack of experience of professionals with technology. Socioeconomic inequalities and the technological gap are evident. The advantages are lower stress level by not traveling and avoiding the demands of social interaction. Many families say that they have been able to learn more about their children's treatment. This should promote the inclusion of families in therapeutic proposals. The current global crisis should serve as an opportunity to make changes in the health and education systems, providing support to families and people with ASD with a more ecological, inclusive and autism-friendly perspective.

#### **425.030** (Poster) Impact of the COVID-19 Lockdown in Malaysia: An Examination of the Psychological Wellbeing of Parent-Child Dyads and Child Behaviour in Families with and without Children on the Autism Spectrum

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#### Background:

Responding to the COVID-19 pandemic, the Malaysian government implemented rapidly changing, multi-stage nationwide lockdowns since March 2020 with ambiguous protocols that provided little recognition or support for families of children on the autism spectrum. Of concern, home confinements, school closures, and related uncertainties may negatively impact families of children on the autism spectrum disproportionately, piled on top of existing stressors resulting from the poor infrastructure to support these families in Malaysia (a culturally-diverse, developing South-East Asian country).

#### Objectives:

The current exploratory research is part of a broader mixed-methods, longitudinal project examining the impact of the COVID-19 pandemic on families. The current quantitative research aimed to (a) examine parent-reported changes in behaviour and psychological distress of children formally diagnosed with an autism spectrum condition (ASC) pre-lockdown and mid-lockdown in Malaysia, compared to a control group of typically developing (TD) peers and (b) examine the changes in psychological distress and wellbeing of parents pre-lockdown and mid-lockdown between ASC and TD groups.

#### Methods:

The children's ages ranged between 5 to 17 years. The sample included 72 ASC parent-child dyads ( $M_{childage}=109.05$  months,  $SD_{childage}=35.58$  months; 75% boys;  $T$ -scores  $\geq 60$  on the Social Responsiveness Scale-2 [SRS-2];  $M_{parentage}=38.3$  years,  $SD_{parentage}=5.62$  years) and 62 aged-match TD parent-child dyads ( $M_{childage}=104.68$  months,  $SD_{childage}=33.78$  months, 58.1% boys;  $T$ -scores  $< 60$  on the SRS-2;  $M_{parentage}=37.8$  years,  $SD_{parentage}=5.93$  years). The primary caregiver completed an online survey including the following: demographic and diagnostic information; SRS-2; Conners' Parent Rating Scales-3 (CPRS-3; *Inattention, Hyperactivity/Impulsivity, Global Index, Anxiety, and Depression subscales*); Perceived Stress Scale-Child (PSSC); Perceived Stress Scale-Adult (PSSA); DASS-21 *Depression and Anxiety* subscales; and Scale of Positive and Negative Experience (SPANE) based on their experience pre-lockdown and mid-lockdown (March 18th to June 9th) in Malaysia.

#### Results:

There were no significant gender differences (boys/girls) in all the child scales. The 2 (diagnosis [ASC, TD])  $\times$  2 (lockdown [pre-lockdown, mid-lockdown]) mixed-model ANOVAs revealed main effects of lockdown on **child's behaviour** [CPRS-3 *Inattention* ( $F(1,130)=12.41, p<.001, \eta_p^2=.09$ ); CPRS-3 *Hyperactivity/Impulsivity* ( $F(1,130)=7.14, p<.001, \eta_p^2=.05$ ); CPRS-3 *Global Index* ( $F(1,131)=14.80, p<.001, \eta_p^2=.10$ )], **child's psychological distress** [CPRS-3 *Anxiety* ( $F(1,132)=16.46, p<.001, \eta_p^2=.11$ ); CPRS *Depression* ( $F(1,131)=6.97, p<.01, \eta_p^2=.05$ ); PSSC ( $F(1,130)=10.02, p<.001, \eta_p^2=.07$ )] as well as **parent's psychological distress** [PSSA ( $F(1,129)=6.81, p<.001, \eta_p^2=.05$ ); DASS-21:*Depression* ( $F(1,129)=8.18, p<.001, \eta_p^2=.06$ ); DASS-21:*Anxiety* ( $F(1,129)=7.82, p<.001, \eta_p^2=.06$ )], and **parent's wellbeing** [SPANE ( $F(1,130)=12.33, p<.001, \eta_p^2=.09$ )]. There was a main effect of diagnosis in all child and parent variables; however, there was no significant interaction effect between diagnosis and lockdown (see Table 1). Among the ASC group, no significant pre-lockdown and mid-lockdown changes were found in SRS-2 total or five subscales scores ( $t$ -tests;  $ps>.05$ ).

#### Conclusions:

The results provide preliminary evidence indicating negative effects of the Malaysian lockdown on both children on the autism spectrum and TD children, as well as their parents. Parents of both groups reported more behavioural concerns and higher psychological distress among their children, as well as higher personal psychological distress and poorer wellbeing mid-lockdown. These quantitative results will be triangulated with the qualitative interview data to provide a holistic understanding of the impact of the pandemic, informing translational policy and practice recommendations.

#### 425.031 (Poster) Inland Southern California: A Service Desert for Individuals with Autism Spectrum Disorder (ASD) and Their Families: Descriptive Analyses of Unmet Service Needs

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**Background:** Children with autism spectrum disorder (ASD) need specialized services to support their academic, behavioral, and social wellbeing. Early intervention, reliant upon early diagnosis, promotes positive outcomes. However, large regions exist in which families face substantial barriers to timely assessment and intervention services, leading to geographical pockets of underserved families. One such area is the Inland Empire (IE) region of Southern California, where services are sparse and many families fall into at-risk groups for later age of diagnosis (e.g., Hispanic or Latinx). This study aims to examine the assessment and service needs of families with children with ASD in order to identify areas for improvement and inform future development of services in the IE region.

**Objectives:** 1) What are the assessment and evaluation needs of children with ASD and their families in the IE? 2) What are the intervention and healthcare needs of children with ASD and their families in the IE?

**Methods:** An online survey was developed and distributed to parents ( $n = 55$ ) of children with ASD, medical practitioners ( $n = 15$ ), and service providers ( $n = 20$ ) in the IE region ( $N = 90$ ). Parents were asked open- and close-ended questions about the diagnosis process, accessing services, perceptions of service needs, and satisfaction with different aspects of the service delivery system. Practitioners and service providers were asked open- and close-ended questions about their comfort providing services to individuals with ASD, training in ASD, and perceptions of service needs. Likert scale survey items were analyzed using descriptive statistics, and open-ended responses were coded qualitatively using a conventional content analysis approach to assess the specific needs of families of children with ASD in the IE region.

**Results:** Only 12% ( $n = 11$ ) of the total participants agreed that the intervention needs of individuals with ASD are currently being met. For parents, only 24% ( $n = 13$ ) agreed that the assessment needs of individuals with ASD are currently being met. Many parents reported a long latency between diagnosis and treatment (e.g., 36% indicated six months or more;  $n = 12$ ). Additionally, the vast majority of parents (78%;  $n = 43$ ) reported that they wished their child was receiving additional services.

Qualitative analyses of open-ended responses provided insight from parents, medical practitioners, and service providers regarding how to improve the service delivery system for children with ASD in the IE (e.g., increased coordination of care, timely access to evaluations, individualized services; see Tables 1 and 2).

**Conclusions:** Results captured the need for increased services in the IE region, as reported by parents, medical practitioners, and service providers. Parents indicated the need for increased access to comprehensive assessment and effective interventions for their children with ASD. These results, in particular the themes that emerged from qualitative analyses, may inform service providers, medical professionals, and policymakers in the IE as to how to improve the service delivery system (e.g., increase both quantity and quality of services, providing ASD-specific training to providers), in hopes of better supporting individuals with ASD and their families.

#### **425.032 (Poster) Knowledge of Evidence-Based Practices in Chinese Parents of Individuals with ASD**

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#### **Background:**

Parent knowledge and involvement are strong predictors for positive intervention outcomes. For parent-professional partnerships to be successful in planning and using interventions for children with autism spectrum disorder (ASD), parents must have knowledge to advocate for valid and effective interventions. Although researchers have investigated other stake holders' knowledge of evidence-based practices (EBPs) such as special education teachers and clinicians, there is very little research on parents' knowledge and perception of the importance of EBPs for their children with ASD. Moreover, there is even less research on how EBPs have been translated or disseminated in international communities not within the English-speaking, Western population.

In order to provide appropriate support for parents of children with ASD in all communities, we need more information on the current knowledge of EBPs and identify possible barriers that may affect parental involvement.

#### **Objectives:**

This study aims to identify some Chinese parents' knowledge of EBPs for individuals with ASD; factors influencing their agreement with an intervention proposed by a clinician/teacher; and external sources, if any, they use to inform their decision about treatment options for their child with ASD.

#### **Methods:**

We distributed an internet survey to a convenience sample of Chinese parents of children with ASD in the Guangdong province. The survey results were aggregated for descriptive statistics.

#### **Results:**

Preliminary results from 87 Chinese parents with children with ASD showed that 58.6% of the participants had no knowledge of what EBPs were and an additional 29.7% of the participants had heard of EBPs but not sure what they were. Familiarity with each EBP collected from the 2020 NCAEP report (Steinbrenner et al., 2020) ranged from 44% (Sensory Integration) to 14.3% (Time Delay) and usage of each EBP ranged from 45.3% (Music-Mediated) to 11.9% (Time Delay). When asked if they suggest or ask about an intervention to their primary service provider, 67.9% said "no" because they did not have knowledge (50.88%), were afraid of making an error (31.58%), or did not want to jeopardize the relationship (17.54%). We also asked types of service received, history of parent training, qualitative information on external sources (e.g., internet sources), and how parents assessed trustworthiness of a source, among others. Results from more participants and other questions will be available. Demographics of preliminary participants are available in the supplemental image.

#### **Conclusions:**

Although all participants expressed the desire to learn more about ASD and interventions, parents chose external sources rather than their primary service providers to gain information on interventions. Given that participants who answer survey questions

voluntarily are more likely to be active about their child's education compared to the general population, these results amplify the need for service and education providers to increase parent involvement and training. In addition, we must facilitate dissemination of research into communities that do not use English as a primary language. Languages and cultures differ but it is universal that effective collaborative efforts between parents and service providers can promote positive developmental outcomes for individuals with ASD.

**425.033 (Poster) Learning from Autistic People How to Assess and Reduce Autism Stigma**

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Background: Autistic university students often experience academic strengths coupled with social difficulties (Sturm & Kasari, 2019), including stigma. Online trainings have been used to improve autism stigma internationally (Obeid et al., 2015). However, prior research has not included autistic students in the process of developing trainings to improve understanding. In this study, autistic university students played a leading role in developing and evaluating a participatory autism training.

**Objectives:**

- 1) Determine if a participatory autism training (developed in collaboration with autistic university students) is more effective than a non-participatory training.
- 2) Evaluate if social distance scales inadvertently contribute to stigma.

**Methods:**

Four autistic university students helped adapt an autism training by making concepts/assessments more accessible/engaging and by adding videos highlighting their perspectives. A non-participatory training was developed by non-autistic educators. After pilot assessments, we matched the trainings in length and interactivity, pre-registered this research, and conducted an initial evaluation in NYC. The initial evaluation revealed improvements in explicit and implicit stigma associated with both trainings. Students described the IAT as tedious, so we removed it prior to the current multi-site evaluation wherein university students from NYC ( $n = 614$ ), Cleveland ( $n = 203$ ), and Beirut ( $n = 250$ ) completed a pre-test, were randomized to one of the trainings, and completed a post-test. Assessments included a participatory autism knowledge scale ( $\alpha = .84$ ), social distance scale ( $\alpha = .88$ ), and a scale assessing attitudes toward inclusion ( $\alpha = .67$ ).

Due to concerns raised by an autistic self-advocate on Twitter that social distance scales may “other” autistic people, we conducted a follow-up study. Sixty students were randomly assigned to either a social distance scale or an autism appreciation-focused scale (e.g., “I would welcome the opportunity to have an autistic boss”) followed by semantic differentials assessing perceived similarity of autistic people to oneself and others, an IAT, the participatory training, and post-test.

**Results:**

Three mixed models with country and training type as between-subjects factors, social desirability as a covariate, autism knowledge, stigma, and attitudes toward inclusion as outcomes revealed improvements with training in knowledge, stigma, and attitudes toward inclusion ( $ps < .001$ ). Interactions between improvements and training type ( $ps < .001$ ) and country ( $ps < .001$ ) were observed in all models. Follow-up analyses revealed greater improvements following the participatory than non-participatory training and for students in Lebanon relative to the US. Social desirability bias influenced, but did not account for, improvements in stigma and attitudes toward inclusion.

In the follow-up study, perceived similarity of autistic people to oneself and others was numerically *higher* following the social distance than the acceptance-oriented scale. Improvements following the participatory training were again observed.

Conclusions: This research provides empirical support for the oft cited, but rarely tested, benefits of involving autistic people in research about autism. Not only was the participatory training more effective than the non-participatory training, the participatory

knowledge measure exhibited better internal consistency than most measures developed without autistic input. Findings also suggest that assessing social distance does not contribute to the “othering” of autistic people.

**425.034** (Poster) Mealtime Behaviors and Parents Strategies in Children with Autism Spectrum Disorders  
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Background:

An estimate of 2 million individuals in India have Autism Spectrum Disorder (ASD; Krishnamurthy, 2008), and approximately 50%-90% exhibit feeding difficulties (Kodak & Piazza, 2008). Feeding difficulties in children results in slower weight gain (Siddiqi et al., 2019), inadequate nutrition intake (Attlee et al., 2015), sleep disturbances (Prosperi et al., 2017), and increases problem behaviors (Johnson et al., 2014). Feeding behaviors vary across culture, specifically, feeding behaviors in India differ from Western cultures, yet, literature on feeding difficulties in ASD from Indian context remains limited (Padmanabhan & Shroff, 2020). For increasing knowledge on feeding difficulties and concurrent parent strategies used for overcoming feeding difficulties, the current study surveyed parents of children with ASD in South India.

Objectives:

To differentiate feeding difficulties, mealtime disruptive behaviors, and parent strategies between children with ASD with and without feeding difficulties.

Methods:

Primary caretakers of children with ASD, between the age of 2 and 10 years, without other neurodevelopmental disabilities or other developmental delays participated in the survey (N = 70). Participants responded to 39 questions divided into 2 subcategories, demographic information and feeding behaviors. Using parent ratings of their child's feeding difficulties, the survey responses were divided into children with feeding difficulties (n = 42) and those without. Feeding difficulties, mealtime disruptive behavior and parent strategies were compared between the two groups using chi-square test and Kruskal Wallis H test.

Results:

All children had delayed communication abilities and attended speech and language therapy but did not receive feeding interventions. Parents of 42 children (60%) reported normal feeding behaviors and 28 shared their child had feeding difficulties (40%). The number of feeding difficulties between the two groups did not significantly differ. However, the two groups significantly differed on the number of strategies used by the parents, ( $\chi^2(1, N = 70) = 7.457, p = .006$ ). Chi-square test revealed the two groups significantly differed on the use of “distractions during mealtimes”,  $X^2(1, N = 70) = 5.59, p = .016$ , “Allowing child to sip fluids between feeds”,  $X^2(1, N = 70) = 5.105, p = .024$ , “feeding child only when they request”,  $X^2(1, N = 70) = 8.491, p = .006$ . The groups also significantly differed on the total number of mealtime disruptive behaviors, ( $\chi^2(1, N = 70) = 11.396, p = .001$ ). Chi-square test revealed the two groups significantly differed on “spitting food”,  $X^2(1, N = 70) = 9.076, p = .003$ , “crying and screaming”,  $X^2(1, N = 70) = 3.673, p = .050$ , “holding food in the mouth for an extended period”,  $X^2(1, N = 70) = 10.048, p = .002$ .

Conclusions:

The two groups differed on mealtime behaviors but exhibited similar feeding difficulties. Children with feeding difficulties exhibited more mealtime disruptive behaviors than the other. Parent of children with feeding difficulties used more strategies than other group. Mealtime disruptive behavior might concern parents more than feeding difficulties in their children. Future research should focus on parent concerns and feeding-based interventions access barriers.

**425.035** (Poster) Mental Health and Social Support of Caregivers of Children and Adolescents with ASD and Other Developmental Disorders during COVID-19 Pandemic  
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Background:

Previous findings have demonstrated that parents of children with autism spectrum disorder (ASD) and other developmental disorders such as attention-deficit/hyperactivity disorder (ADHD), language delay, intelligent disability, etc., experience higher levels of parenting stress, anxiety and depression that are associated with negative outcomes for families.

Objectives:

The present study aims to investigate the caregivers' mental health and the mediating role of social support in the relationship between symptoms severity and parenting stress during COVID-19.

Methods:

During 20 March to 8 April, 1932 caregivers of children and adolescents with ASD and other developmental disorders from 31 provincial-level administrative units in China were enrolled to fill in a sociodemographic questionnaire, Depression, Anxiety and Stress Scale (DASS21, Lovibond & Lovibond, 1995) and Social Support Rating Scale (SSRS, Xiao, 1993). 70.91% of their children were diagnosed with ASD, 13.25% ADHD, 36.80% language delay, 35.27% had intelligent disabilities and 6.99% other developmental disorders. The disability severity symptoms and behavioral problems of their children were also collected.

Results:

The results showed that 46.01% of the caregivers had depression, 44.67% had anxiety and 44.62% had stress during COVID-19 pandemic. Fathers were found to get more subjective support than mothers ( $P < 0.05$ ). Caregivers who had the highest educational attainment had the most social support ( $P = 0.01$ ). People who had the more household income had the significantly lower level of depression and anxiety ( $P < 0.05$ ). Their employment status during COVID-19 was found significantly related with their depression, anxiety, stress and social support ( $P < 0.05$ ).

Conclusions:

The findings showed that quite a lot of caregivers experienced mental health problems during COVID-19 and it also illustrated the need to promote their engagement in functional social support and the application of behavioral strategies with their children to help them to reduce the impact of stress, anxiety and depression affected by the COVID-19.

**425.036** (*Poster*) Parental Perceptions of Children's Autistic Traits in British and Minority Egyptian/Sudanese Communities in the UK

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Background: Most autism research is conducted in White participants in high-income Western countries. A few studies have reported that culture influences autism detection and interpretation of symptoms, but these have mainly been conducted in families of children with autism. However, views held in families who have no previous experience of raising a child with autism are important to understand the potential reasons why autism symptoms may not be recognised in the community.

Objectives: This study explored how UK-based Egyptian/Sudanese and British parents of typically developing children perceive atypical development relevant to autism and autistic traits, with the aim to uncover potential differences between the two cultural groups and factors that could affect reporting of autistic-like behaviours.

Methods: Participants were 19 mothers self-identifying as British and 19 mothers and 1 father self-identifying as Egyptian/Sudanese. Participants covered all age ranges from 18-29 to 70-74, but the majority were aged 30-49. Their children's ages varied from infancy to adulthood. We collected qualitative data through focus group discussions (FGDs) and individual cognitive interviews (CIs), to achieve methodological triangulation. We conducted 3 FGDs for each cultural group, 12 CIs in the British group and 8 CIs in the Egyptian/Sudanese group. FGDs explored autism symptoms and atypical child development. CIs focused on 10 items describing a variety of autistic traits, drawn from a widely used screening tool, the *Autism-spectrum Quotient: Children's version* (AQ-Child). Data from the two communities were analysed collectively using template analyses; subsequently, comparisons were made between the British and the Egyptian/Sudanese groups within themes.

Results: Three overarching themes were developed (template available in the Figure): 1) Value judgements of traits and behaviours, whereby participants' perspectives on children's development seemed influenced by their considerations on whether behaviours relevant to autism were desirable and important for development, or inappropriate; 2) Considerations of differences

between children, including comparisons with peers or siblings, discussions of age and developmental milestones and comments on personality traits; 3) Problematic interpretations of the wording of autistic traits descriptions in the AQ-Child, including difficulties in understanding some items, and ambiguity of wording. Cross-cultural comparisons suggested subtle differences between British and Egyptian/Sudanese parents' interpretations and value judgements of traits relevant to autism. British participants referred to age expectations and comparisons with other children more often than the Egyptian/Sudanese group, suggesting that there may be cultural differences in parents' thought process when evaluating children's development. However, overall within-group variability appeared larger than cross-cultural differences. In particular, when discussing desirability of traits, British participants suggested that older and working-class parents may have tighter boundaries than younger and middle-class families in what they consider appropriate behaviour for children.

Conclusions: Cultural differences and within-community factors, such as socioeconomic status and age, may influence the way in which parents of typically developing children perceive and report on children's development relevant to autism. Our findings can inform the adaptation and implementation of screening and diagnostic tools in multi-cultural settings, to promote better recognition of autism symptoms in diverse communities, where autism tends to be underdiagnosed.

**425.037 (Poster)** Parental Perspectives on the Impact of COVID-19 on Their Young Children with Autism Spectrum Disorder and Themselves - a Preliminary Study from India

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Background:

COVID -19 has impacted individuals in ways like never before. It's impact on families of children with Autism Spectrum Disorder (ASD) and the children themselves, has resulted in a sense of anxiety and panic among parents/caregivers. Many countries, including India, have gone through an extended period of lockdown which has shifted lifestyle significantly, causing disruptions especially for children with ASD, for whom routines play an important role. Parents of these children have taken over the roles of teachers and therapists in addition to their usual roles of parenting, employment and managing homes creating significant influences on the nature of their interactions. In addition, developmental and educational services that children with ASD receive have now moved to a predominantly virtual mode.

Objectives:

This study aimed to understand the impact of COVID-19 on young children with ASD and their parents during the lockdown, from a region near the Himalayan foothills, India

Methods:

A total of 10 families of children with ASD attending an intervention center participated in two semi-structured focus group discussions (FGD) (n=5/group). This was conducted with the parents via Zoom, in order to explore the study objective in open dialogue (~2hours/FGD). The study was led by two investigators using a set of predetermined probes. Audio recordings were transcribed by hand and coded to extract significant themes. All 10 children attended the same intervention center in-person before the pandemic that included physio (PT), occupational, speech-language (SLT) and behaviour therapy, and moved to virtual mode during the pandemic.

Results:

Mean (SD) age of children whose parents contributed to the study was 62.7 (10.53) months; range: 48-84mo. The FGD consisted predominantly of mothers (90%). All families belonged to lower-middle SES. Other socio-demographic variables across the 2 FGDs were similar (e.g. education, religion etc.). All families spoke Hindi. Pre-COVID children spent ~ 3hours, 5days per week at the intervention center. However, during the lockdown, there was a significant drop in time spent (virtual) with staff of the intervention center - children attended ~ 1 hour per day for 5 days a week. A total of 10 themes emerged from the FGD: these included positive, negative and mixed experiences. Positive themes included improved (a)communication skills and, (b)play routines attributed to increased time spent with the child(ren). Negative themes included (a)enhanced parental stress, (b)change in child's behaviour e.g. increased aggression attributed to being home-bound, altered routines and lack of in-person intervention/presence of limited virtual intervention sessions, (c)increase in restrictive repetitive behaviours and, (d)worsening of academic skills. Families provided mixed responses in areas of (a)social- emotional abilities, (b)attention and (c)compliance to virtual therapy (PT, SLT)/classroom activities during COVID-19.

## Conclusions:

Given that virtual mode of learning may stay on, parents will continue to be mediators between therapists and teachers, and their child. Care must be taken to make parents feel sufficiently empowered and motivated. This study provides a preliminary framework to develop a more comprehensive model for virtual learning that may help ameliorate parental stress and concerns that were repeatedly brought out through the FGDs.

### **425.038** (Poster) Pilot Study to Improve Access to Early Intervention for Autism in Africa

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**Background:** By 2050 Africa will be home to 2 in 5 of the world's children. This demographic shift highlights the importance of developing feasible, contextually appropriate early ASD intervention, that can be integrated into existing systems of care. Naturalistic Developmental Behavioral Intervention (NDBI) is a class of early intervention emerging as best practice. Caregivers can be coached in NDBI strategies, which they incorporate into caregiver-child routines. Non-specialist-delivered NDBI caregiver coaching is a key implementation strategy and responsive to low resource environments.

**Objectives:** Community-Early Start Denver Model (C-ESDM) are web-based open access materials, designed to support families in low-resource settings learn NDBI strategies. In our South African study, we adapted a C-ESDM coaching approach for non-specialists and assessed implementation and caregiver-child outcomes. We utilized the apprenticeship model for lay counselor supervision in mental health for ongoing non-specialist support.

**Methods:** Implementation and clinical data from an ongoing longitudinal pre-post study with one study arm will be presented. A qualitative process evaluation was conducted following a pre-pilot of the adapted NDBI coaching approach to identify preliminary implementation determinants. Mean change (post-pre) and 95% confidence intervals were calculated for each outcome to assess the effect of the caregiver coaching.

**Results:** C-ESDM adaptations for non-specialist delivery are documented using the Wiltsey-Stirman framework. Barriers of intervention delivery were identified and adaptations made prior to the pilot study. Data from 10 caregiver-child dyads is included in the abstract. The average (SD) child age was 53 (8.75) months and caregivers were mothers (n=4, 40%), fathers (4, 40%), and grandmothers (2, 20%). Nine children (90%) received ADOS Module 1, and 1 received Module 2; with mean ADOS comparison scores of 6.5 (SD=1.58). Data offers early indications that caregivers can implement NDBI strategies when coached by non-specialists. After 12 sessions ESDM caregiver fidelity mean scores increased from 2.93 (SD=.33) to 3.73 (SD=.31). Furthermore 3/5 Joint Engagement Rating Inventory (JERI) caregiver items showed significant improvement after 12 sessions: Following in on a child's focus (mean change: 1.7, 95% C.I. 0.63 – 2.77), Language facilitation (1.6, 95% C.I. 0.33 – 2.87), and Communication temptations (1.1, 95% C.I. 0.06 – 2.14). Pilot data also shows growth in child social communication - indicated by increases in Vineland Adaptive Behavior Scales, 3rd Edition (VABS-3) Communication (mean change: 7.5, 95% C.I. 2.2 – 12.9) and Socialization Subscale Standard Score (6.4, 95% C.I. 0.4 – 12.4), and Griffiths III Language/Communication (0.05, 95% C.I. 0.03 – 0.07) and Personal, Social, Emotional Developmental Quotients (0.03, 95% C.I. 0.00 – 0.06). Furthermore, caregiver sense of competency increased by 4.7 points after 12 coaching sessions (95% C.I. -1.6 – 10.0).

**Conclusions:** South Africa, a multi-cultural nation marked by stark disparities, provides a unique opportunity to assess feasibility and impact of a scalable intervention, in an environment with significant contextual challenges. This study is timely given growing recognition of the importance of early ASD intervention, emerging policies in low and middle income countries that provide a framework on which to build intervention services, and global programs that support child developmental needs.

### **425.039** (Poster) Predictors of Parenting Stress in Malaysian Mothers and Fathers with and without Children on the Autism Spectrum: Parental Sleep and Depression, Family Functioning, and Child Autism Symptoms and Behavioral Concerns

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Background: Past research highlighted that parenting stress may be experienced differently by mothers and fathers and depends on multiple factors; however, problematically, research with fathers of children on the autism spectrum has been limited globally and locally. Although awareness and acceptance of autism and neurodiversity has been slowly increasing in recent years in South-East Asia, there remains a dearth of local scientific research on the experiences of parents of children on the autism spectrum in Malaysia. The predictors of stress for parents in Malaysia (and their related support needs) may be unique from other Western countries, given the significant lack of resources and support available to help these families and the presence of ongoing stigmas. Research in this region is urgently needed to better understand the needs of diverse families, so that support, services, and policies can be better tailored to their holistic needs and be relevant to their cultures.

Objectives: The current cross-sectional quantitative study examined in a hard-copy survey self-reported parent and child predictors of parenting stress in Malaysian mothers and fathers of primary school-age children (5 to 13 years) on the autism spectrum (ASC), and in an age-matched comparison group of parents/children with typical development (TD). This quantitative survey study was a part of a broader, longitudinal, mixed-methods project that followed a grounded theory approach, adopting Charmaz's social constructivist perspective design.

Methods: Participants included ASC parent-child dyads (69 mothers, 52 fathers;  $M_{\text{parentage}}=38.8, SD=4.87$ ;  $M_{\text{childage}}=7.8, SD=1.86$ ) and TD parent-child dyads (65 mothers, 43 fathers;  $M_{\text{parentage}}=38.7, SD=5.22$ ;  $M_{\text{childage}}=8.43, SD=1.95$ ). All children on the autism spectrum were formally diagnosed with a DSM-IV/DSM-5 autism spectrum disorder. Furthermore, the Social Responsive Scale-2 (SRS-2) was utilized as an additional inclusion/exclusion criteria, with T-scores equal to or  $>60$  used as inclusion criteria for the ASC group and exclusion criteria for the TD group. Measures included: Demographic/family/diagnostic information; SRS-2; Parenting Stress Index Short-Form (PSI-SF); Depression subscale of Depression, Anxiety and Stress Scale (DASS-21); General Functioning Subscale of the Family Assessment Device (GF-FAD); Pittsburgh Sleep Quality Index (PSQI); and Developmental Behavior Checklist (DBC-Parent).

Results: Mothers and fathers in both groups reported comparable parenting stress levels with no significant gender differences in parental stress emerging for the total PSI-SF score and subscale scores (PSI-SF-PD, PSI-SF-DC, PSI-SF-PCDI). Parents of children on the autism spectrum reported significantly more parenting stress (total and subscale scores) and depressive symptoms as well as poorer sleep quality and family functioning than parents of TD children ( $ps < .001$ ). In the ASC group, higher autism symptom severity (specifically, higher social communication/interaction symptoms; SRS-2 Social Communication Interaction Index), higher maternal depressive symptoms, poorer family functioning, and poorer maternal sleep quality (total PSQI score) predicted maternal stress. Higher child behavioral concerns predicted paternal stress in both the ASC and TD groups.

Conclusions: The project concluded with numerous workshops and meetings, discussing recommendations with participants, professionals, and community/government stakeholders. The findings highlight the need to develop programs and supports for wellbeing across the family system. Furthermore, there remains a need to increase awareness and better support understandings of neurodiversity in the region.

#### **425.040** (Poster) Socio-Economic Profiles in a Large European Multinational Autism Study

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Background: Social attention (SA) has been studied in-depth as a potential biomarker of autism - with autistic individuals showing reduced attention to social stimuli - and eye-tracking has been a favoured approach due to its objective measurement. Recent studies have revealed differences in SA with varying Socioeconomic Scores (SES), however, very little focus has been placed on SES in autism studies. The large multi-national autism biomarker study, *LEAP*, provides a timely opportunity to fully explore SES and its relationship with SA across a large sample at multiple sites.

Objectives: We aim to outline representation biases and disparities by describing this population in terms of demographics (e.g. income, education, ethnicity), and examine the SES effect on a candidate biomarker - the attention to faces in a social scene of autistic participants vs control - and its interaction with SES.

Methods: 764 individuals volunteered to participate in the LEAP study, and 418 autistic (females: 114, average age=16.5, SD=5.8, average IQ=116.2, SD=20.2) and 195 controls (females: 60, average age=14.4, SD=4.8, average IQ=116.2, SD=21.1) had available demographic data. Questionnaires included categories (e.g., range of family income), or short answers (e.g., occupation). We calculated the Four Factors Index (FFI) - a composite indicator of SES - as the average of the weighted sum of parental education and occupation, and the percentages/averages by group for each indicator and the FFI (available for N=494). Eye-movements while watching a social scene (multiple photographs of people) for 20 seconds were recorded as part of a composite eye-tracking session. SA was estimated by extracting the average percentage looking time (PLT) to the face for each participant, and investigated with a mixed model including group by site interacting with FFI as predictors, and random intercepts by participant, site and stimulus.

Results: By far, the greatest proportion of participants were white and native to the country of the site, with London showing the greatest diversity, but similarly to other sites, less diversity than population census data. On average, the control group earned more in the higher income range, and more frequently completed tertiary education (Fig. 1A). Fathers employed as directors were twice as common in the control group, that also reported a higher number of children per household. The FFI (Fig. 1B) demonstrated that the sample was not exclusively high SES, but did not include the lowest range; the autistic group had a lower median and minimum FFI across sites. PLT in the autistic group was significantly affected by FFI in the London site, with higher SES associated with lower overall SA ( $\beta=-0.08\%$ ,  $SE=0.03$ ,  $p\text{-value}=0.001$ , Fig. 1C).

Conclusions: Our preliminary results suggest representation imbalance in ethnicity and origin, and undersampling of participants of lower SES. With respect to SA in autism, preliminary evidence suggests that PLT is confounded by SES. These results highlight the importance of including diverse populations and fully describing the samples in autism research.

**425.041 (Poster) The Bamboo Ceiling: A Preliminary Exploration of Autism Spectrum Condition in AAPI Girls**  
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Background: Asian Americans comprise the fastest-growing racial/ethnic subgroup in the United States<sup>1</sup>, but little is known about autism spectrum condition (ASC) in the Asian American Pacific Islander (AAPI) cultural context. It is widely understood that people of color face systemic challenges when accessing ASC supports, with factors such as maternal race/ethnicity and language spoken at home affecting when a child enters intervention services<sup>2</sup>. Similarly, extant research suggests that girls are diagnosed with ASC less often than boys<sup>4</sup> even when their symptoms are equally severe<sup>3</sup>. This may be due, in part, to insufficient understanding of the way ASC manifests in girls. Importantly, almost nothing is known about how the intersecting factors of race and sex influence ASC detection, diagnosis, and treatment. Autistic girls and boys present distinct symptom profiles in a variety of domains, such as language<sup>6-12</sup> – but prior studies are limited by significant White overrepresentation<sup>13</sup>. Culturally informed research on ASC that considers gendered societal expectations is vital for improving diagnostic methods and providing personalized supports in cultural subgroups in which autism is often stigmatized, misdiagnosed, or undiagnosed.

Objectives: Review prior research on the presentation of ASC in Asian American girls and explore the intersection of culture and gender on the way ASC is perceived and treated in this population.

Methods: A literature search was conducted in PsycInfo, PubMed, ERIC, and Google Scholar, with search terms “autis\*” AND “Asian” AND (“female” OR “girl”). The resulting set of references was augmented with additional materials identified from other sources, including reference lists of included works.

Results: Results of a broad, exploratory literature review revealed significant research gaps in our understanding of ASC in AAPI girls and women, with very few papers focused on the female autism phenotype in these groups. The past 20 years have seen a growing number of papers that explore “the female autism phenotype” in ASC, but few if any had sufficient numbers of AAPI participants to examine differences by race/cultural background. Of papers focused on non-Western “Asian” populations, most were Chinese-focused samples<sup>12</sup>, reinforcing the perception of “Asian” as a monolith. Importantly, few studies collected data on key cultural factors (e.g., religious background, first language, first- or second-generation immigrant status, enculturation, residence in an ethnic enclave neighborhood) that would enable researchers to parse the influence of culture and culturally-specific gendered expectations on ASC.

Conclusions: ASC is poorly understood in girls, and the ways that (anti-Asian) racism and perceived cultural and gender norms<sup>14</sup> interact to erect barriers to diagnosis and services have largely been unexamined by the field. Designing studies that disentangle these complicated interacting effects could inform personalized, culturally relevant treatments and policies. Multi-level changes are needed to improve the experiences of AAPI girls with ASC, likely incorporating family- and community-focused approaches. Finally, research on Asian American subpopulations is important for designing targeted governmental programs, such as

language assistance for mental health and disabilities support. This suite of approaches will move us closer to developing best practices to support AAPI communities.

**425.042** (Poster) The COVID 19 Crisis and the Support of the Program Parents Taking Action for Parents of Pre/Adolescents with Autism Spectrum Disorder in Colombia

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Background: the current crisis related to the COVID 19 has impacted every country and every population around the world. The most vulnerable populations have not been an exception, and in fact, they have dealt with significant challenges in terms of their economic situation, their employment status, access to health care services, and social connections. In Colombia, this crisis has struck families of children with disabilities in many aspects too. Specifically, families of children with Autism Spectrum Disorder (ASD) have dealt with changes in the routines of their children, such as schooling, eating habits, therapies, and extracurricular activities, and this have triggered difficult behaviors and situations that they were not prepared for. In addition, pre/adolescents with ASD have extra challenges in terms of the management of their emotions and mental health, sexual inappropriate behaviors, and adapting to new routines. The program Parents Taking Actions, that was initially designed to be “in person,” was modified to a hybrid model in which 50% of the program was online and 50% in person. This educational program covers topics of pre/adolescence, puberty and sexuality and the management of these topics.

Objectives: this study aims to show the impact of the program Parents Taking Action (PTA) during the crisis of the COVID 19 and how strategies provided in this program helped parents to support their children in the transitions related to school, habits, therapies and overall routines. This program also aimed to increase overall empowerment and self-efficacy of parents.

Methods: using semi-structured phone interviews, Colombian parents of pre/adolescents with ASD were asked questions related to the challenges that their family was going through, and the changes in behavior that their children were experiencing. The interviews also included questions about how the PTA program provided knowledge and support for them to manage these challenges and changes in the routine, and how empowered they felt after receiving the program. Each interview had an average duration of 40 minutes.

Results: in this study, 11 Colombian parents of preadolescents between 10 and 17 years old participated in the interviews. They reported that the program helped them feel empowered to manage the new challenges that the COVID 19 crisis brought to their homes. Through a deductive qualitative analysis, data showed that the information, resources, and strategies taught in the program were important tools for parents to deal with difficult situations, such as changes in their children’s overall routines, lack of contact with the exterior world (public transportation, therapy location, etc.), virtual school, increases of inappropriate sexual behaviors, increases in difficult behaviors, and overall mental health challenges.

Conclusions: the program Parents Taking Action, provided knowledge, resources, and tools for parents to manage difficult situations related to the changes related to the COVID 19 confinement, as well as challenges related to puberty and sexuality, and behaviors that their children experience during this transition. Therefore, the program is an effective tool for community organizations and health providers to offer extra supports to these families during their children’s stage of puberty and pre/adolescence.

**425.043** (Poster) The First Years Inventory for Spain: An Linguistic and Conceptual Analysis of Translation Methods  
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Background:

Early identification of autism spectrum disorder (ASD) is imperative for access to early intervention. The *First Years Inventory v3.1* (FYIv3.1; Baranek et al., 2013) is designed to detect behavioral symptoms of ASD around one year of age, demonstrating good psychometrics properties (Chen et al., 2019). In Spain, there is a lack of validated ASD screening tools for children under 18 months of age. The goal of this project is to translate and culturally adapt the FYIv3.1 with a Spanish population.

Sufficient translations are equivalent to the original version linguistically, conceptually, and psychometrically, so that the instrument measures the same latent variables in the new population (Beaton et al., 2000). A rigorous cultural adaptation approach is required to achieve this equivalence, including multiple translators, quality assurance measures, and pre-testing (DuBay et al, 2019). Insufficient translation and cultural adaptation methods may result in psychometric differences between

language versions, possibly resulting in poor quality assessments (Soto et al., 2015). More information is needed regarding which specific methods are effective for identifying and addressing which threats to equivalence.

#### Objectives:

This project presents and describes the translation and cultural adaptation process for the FYIv3.1, highlighting difficulties identified during the process. We will qualitatively and quantitatively analyze the challenges identified during the 1) forward translation and 2) pre-testing phases, describing which threats to equivalence were identified and addressed during each step in the process, with the goal of informing future translation teams.

#### Methods:

Four Spanish translators, strategically selected for their background and expertise, independently translated the FYIv3.1 to Spanish. Translations were collaboratively synthesized into a single draft. This draft will go through several rounds of pre-testing with 20 target population members (Spanish parents of children 8-16mo across a range of demographic groups). During pre-testing, a cognitive interview format reveals item interpretations and cognitive processes of participants, exposing conflicts between original FYIv3.1 items and their translations. A final version will be developed based on qualitative and quantitative data from throughout the process.

#### Results:

Preliminary results suggest that during the forward translation, semantic and/or grammatical agreement between the translators was absent or minimal for half of the items. A third of all items required conceptual modifications to maintain construct equivalence between translations. Preliminary pre-testing results indicate that at least 15% of items were misinterpreted by participants. Semantic difficulties related to conceptual complexity were observed in 60% of these items. Items describing RRBIs were frequently difficult for participants to understand. We found a limited correlation between items presenting difficulty in the forward translation as compared to pre-testing. A complete linguistic analysis with specific examples will be included.

#### Conclusions:

These results demonstrate both the complexity of the forward translation process and the potential misinterpretations by target population members, highlighting the need to directly confirm a translation's equivalence during the translation process. This evidence reveals the specific methods that effectively identify and address relevant threats to equivalence between versions, which will inform future translation work for similar ASD assessment tools.

**425.044** (Poster) The Impact of the Lockdown Due to COVID-19 on ASD People in Argentina: A First Person Point of View. M. Nunez<sup>1</sup>, D. Valdez<sup>2</sup>, A. Wilches<sup>3</sup>, A. Rattazzi<sup>4</sup>, S. H. Cukier<sup>5</sup>, N. Barrios<sup>6</sup>, C. S. Paula<sup>7</sup>, G. Garrido<sup>8</sup>, A. Rosoli<sup>9</sup>, G. Perez Liz<sup>10</sup>, R. A. Garcia<sup>10</sup> and C. Nava<sup>11</sup>, (1)Faculty of Psychology, Universidad Autonoma de Madrid, Madrid, Spain, (2)Universidad de Buenos Aires- FLACSO, Buenos Aires, Argentina, (3)FLACSO, Buenos Aires, Argentina, (4)PANAACEA, Buenos Aires, Argentina, (5)Fleni, Capital Federal, ARGENTINA, (6)Developmental Disorder Program, Universidade Presbiteriana Mackenzie, São Paulo, Brazil, (7)Universidad de la República, Montevideo, Uruguay, (8)Projects, Organizacion Estados Iberoamericanos, Santo Domingo, Dominican Republic, (9)A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA, (10)Clínica Las Condes, Santiago, Chile., Santiago, CHILE, (11)Psychological Science, University of Texas Rio Grande Valley, Edinburg, TX

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#### Background:

Argentina has been severely affected by COVID-19, with 2,737 infected for every 100,000 inhabitants; the country had a severe five months lockdown. This situation may be particularly challenging for people with ASD. In order to understand how people with ASD have experienced the lockdown it is paramount to count with their own testimony first hand, rather than simply rely on the view of their families or the professionals working with them; their testimony must also be placed within their socio-economic, cultural context and health provision context.

#### Objectives:

Describe the impact of the COVID-19 lockdown on people with ASD in Argentina from their own perspective in relation to: (1) any changes in feeding and sleep habits, anxiety and behavior and (2) the different types of treatment and schooling, their possible discontinuity, the telematic intervention and its scope and limitations.

#### Methods:

Twenty-seven ASD people (15 men and 12 women) took part in an online survey of the network REAL (Red Espectro Autista Latinoamérica). Participants are on the high-functioning end of the spectrum, including 60% with an Asperger Syndrome diagnosis; 56% had a degree in higher education. The survey enquired about 8 aspects, as follows: Place of residence, Pre- and post-lockdown schooling, Situation in the household, Treatment and support at the time of the start of the pandemic, Behavioral changes from home isolation, Outings, Treatment and support during the pandemic, Main concerns during quarantine.

#### Results:

Before the lockdown, most participants were receiving some type of therapy/treatment, as follows: 22% reported psychoanalytic therapy, 22% medication treatment, 15%, behavioral therapy and 8%. During the lockdown, 15% of the participants had their treatment totally suspended due to the closure of either the therapy centers (26%) or the health-service providers (26%). Forty-two percent of participants report to have received some counselling through video-calls, and 19% over the phone. When in need of help, 44% of participants report to resource to a therapist. Sixteen percent report not to have needed any help. The main problems experienced during the lockdown include: sleep disturbances (55%), feeding problems (54%), concentration difficulties and irritability (54%), mood alterations (69%), aggressivity (19%), wandering (32%), anxiety (74%), therapeutic setbacks (81%). Additionally, participants reported difficulties in understanding why they could not leave the house (26%) and an increased concern to become ill (41%). During the lockdown, 78% acknowledges to have increased the use of electronic devices outside their educational use. As for the perceived improvements, 52% of participants report a behavioral improvement when the outings began.

#### Conclusions:

Results indicate that the lockdown experienced by Argentinian high-functioning ASD adolescents and adults has put a considerable strain on their daily habits, mood and emotional welfare and their therapeutic support and progress. Further analysis on the relationship between the different aspects reported are in progress. Nevertheless, these descriptive findings provide an initial step into understanding the impact that the lockdown in people with ASD within a socio-economic and cultural context where research and health provision in ASD is significantly under-resourced.

#### 425.045 (Poster) The Importance of Socio-Cultural Context on the Quality of Life of Autistic Adults: A Comparison between France and Quebec

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**Background:** Quality of life (QoL) is a multidimensional concept based on a person's subjective assessment of the positive and negative aspects of their life in several areas related to physical and psychological health, environment, and social interactions. Many studies reported a poorer QoL in autistic individuals as compared to typical individuals. Scientific literature is inconsistent in terms of what predicts QoL. Since QoL is indissociable from sociocultural context, the factors associated with QoL might differ between France and Quebec.

**Objectives:** This research aims to explore whether the socio-cultural context 1-has an effect on quality of life of autistic individuals, and 2- moderates the association between autism-specific quality of life and socio-demographic and health characteristics.

**Methods:** An online survey was developed in collaboration with autistic expert collaborators. In this survey, QoL was measured by the autism-specific quality of life scale (ASQoL), which was developed to cover what matters most in terms of QoL according to autistic people. Autistic traits were self-evaluated using the short version of the Autism Spectrum Quotient (AQ). Physical health conditions, mental health diagnosis and sociodemographic parameters were also assessed.

**Results:** 226 participants living in Quebec and 204 living in France took part in the study. A majority of participants (Quebec 79%, France 59%) had received a formal diagnosis of autism and the others were self-diagnosed. On average, participants from Quebec reported significantly better QoL, as measured by the ASQoL ( $M = 2.92$ ,  $SD = 0.71$ ), than participants from France ( $M = 2.50$ ,  $SD = 0.67$ ),  $t(428) = -6.324$ ,  $p < .001$ . According to a general model ( $R^2$  adjusted = 27.7%), it appears that living in Quebec is a positive predictor of QoL in autistic individuals, standardized  $\beta = 0.204$ ,  $p < .001$ . In Quebec, experiencing violence whether verbal, physical, on the Internet or elsewhere, because they are autistic (referred to as specific violence), having chronic pain, having a high school diploma or less, and having anxiety disorders all significantly predicted a lower quality of life. In France, negative predictors of QoL in autistic individuals were having an AQ score of 6 or higher, experiencing specific violence, having mood, bipolar or depressive disorders. Still in France, positive predictors of QoL were being employed, being male and having a university degree.

**Conclusions:** In this research, most predictors of QoL (measured with ASQoL) are different in France and in Quebec suggesting that sociocultural context does influence autism-specific QoL. This confirms the importance of taking into account the sociocultural context when investigating QoL and its predictors in autism. Social representations of autism in the given population (in this case Quebec or France) might influence QoL. However, further studies are needed to explore such possible differences between France and Quebec and to explore whether they indeed influence the QoL of autistic adults. As for specific violence, it emerges as an equally or even more important predictor of autism-specific QoL than medical conditions or mental health diagnosis, demonstrating the importance of addressing specific violence and implementing programs to reduce its prevalence.

## Interventions - Non-pharmacologic - Infant, Toddler, and Preschool

### PANEL SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - INFANT, TODDLER, AND PRESCHOOL

#### Panel 216 - The State of Autism Intervention Research for Young Children

**Panel Chair:** Micheal Sandbank, *The University of Texas at Austin, Austin, TX*

This panel highlights findings from several recent (published and in-progress) systematic reviews and meta-analyses of nonpharmacological intervention research involving autistic children. The first presenter will summarize new findings about the effectiveness of common intervention approaches (i.e., behavioral, developmental, naturalistic developmental behavioral interventions [NDBIs]) for supporting development in this population, taken from a comprehensive meta-analysis known as Project AIM (Autism Intervention Meta-analysis; Sandbank et al., 2020), as well as the extent to which intervention effectiveness varies by different intervention parameters, such as implementer and intensity. The second presenter will highlight findings from secondary analyses of this data examining participant characteristics that may differentially influence intervention effectiveness for supporting development in important domains (i.e., play, language, adaptive behavior, etc.). The third presenter will review findings regarding the quality of studies supporting different intervention approaches, and report new findings in trends in quality indicators over time in this literature. The final presenter will discuss ethical issues that continue to pervade autism early childhood intervention research, namely the prevalence of undisclosed conflicts of interest (COIs), in both group and single-case design studies. Each presenter will highlight questions that remain unanswered, and options for improving the quality and utility of future research.

**216.001** (Panel) *The Influence of Intensity and Implementer on Intervention Effectiveness*

*M. Sandbank*<sup>1</sup>, *S. Crowley*<sup>2</sup>, *K. Bottema-Beutel*<sup>3</sup> and *T. G. Woynarowski*<sup>3</sup>, (1)*The University of Texas at Austin, Austin, TX*, (2)*Lynch School of Education, Boston College, Chestnut Hill, MA*, (3)*Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN*

**Background:** Although relatively rare a decade ago, the number of group studies testing interventions for young autistic children has dramatically increased (French & Kennedy, 2018). These studies represent a diverse set of intervention approaches designed to support a wide range of outcomes. A scoping systematic review and meta-analysis recently summarized available group studies of interventions for autistic children up to age 8, reporting results in a manner that permitted comparison of summary effects within intervention approach and outcome type (Sandbank et al., 2020). However, even within intervention approach, varied intervention parameters (i.e., implementer, intensity) may differentially influence intervention effectiveness, and this influence may even vary by outcome domain. Understanding how intervention parameters influence intervention effectiveness can facilitate intervention refinement to encourage the development of maximally effective therapies.

**Objectives:** The purpose of this study was to identify whether intervention implementer (e.g., caregiver, clinician, both working in concert) and cumulative intervention intensity (i.e., intervention dose x frequency x duration) significantly moderated intervention effects on key outcomes (i.e., adaptive behavior, cognition, core features of autism, language, and play).

**Methods:** Using data from the main meta-analysis (Project AIM; Sandbank et al., 2020), which features effects for 1615 outcomes extracted from 150 reports of 130 studies representing 6,240 participants, we tested the influence of intervention implementer and cumulative intensity using a series of meta-regression models conducted within subsets of data from each outcome domain (i.e., adaptive behavior, cognition, core features of autism, language, and play), relying on robust variance estimation to control for the intercorrelation of outcomes within studies. We also separately examined whether cumulative intensity moderated effects of behavioral interventions, developmental interventions, and NDBIs.

**Results:** For adaptive and cognitive outcomes, intervention effects were significantly larger for interventions implemented by clinicians alone relative to those implemented by caregivers and clinicians combined or caregivers alone. For outcomes derived from measures of the core features of autism (e.g., ADOS, CARS, etc.), intervention effects were significantly moderated by implementer and cumulative intensity, though our confidence in these results is low due to the prevalence of poorly-designed studies in this subset of data. Intervention effects on language outcomes were significantly moderated by intervention implementer, favoring interventions implemented by clinicians alone or by clinicians and caregivers working in concert, compared to interventions implemented by caregivers alone. Intervention effects on play outcomes were not moderated by any intervention parameters. When examining the influence of intensity within subsets of data from studies of behavioral, developmental, and NDBI interventions, we found no evidence to support the notion that cumulative intervention intensity influences the effectiveness of these intervention approaches.

**Conclusions:** Interventions — specifically those that support adaptive behavior, language, and cognition — may be more effective when delivered directly by clinicians, or by caregivers working in concert with clinicians. At present, there is little evidence to support the notion that a greater number of intervention hours is uniformly associated with greater improvements (compared to low-intensity interventions), regardless of intervention approach. Studies which embed systematic, randomized comparisons of these parameters are needed.

**216.002 (Panel) Participant Characteristics That Influence the Effectiveness of Intervention**

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**Background:** Intervention is widely recommended as important for supporting development in young autistic children (Boyd et al., 2010), but evidence suggests it may be differentially effective depending on individual child attributes. Scholars have routinely asserted that intervention is more effective when delivered at an early age (e.g., below 4 years), although evidence supporting this assertion is mixed. Other potentially important child attributes that may influence intervention effectiveness include biological sex, language ability at intervention onset, and level of autism-related challenges.

**Objectives:** The purpose of this study was to examine the extent to which the summary effects of interventions on a variety of outcomes were significantly influenced by specific participant characteristics (i.e., age, sex, level of autism-related challenges, language ability) in early childhood.

**Methods:** Participant characteristics were coded as part of the main meta-analysis (Project AIM; Sandbank et al., 2020). Age was coded as the sample mean age in months at study entry. Sex was coded as the percentage of males in the sample. Level of autism-related challenges was categorized as either high or moderate based on sample means on diagnostic measures of autism characteristics. Language ability was coded as the sample mean language age equivalent in months when reported. Meta-regression models tested whether participant characteristics significantly moderated intervention effects on each outcome that was sufficiently represented across group design studies (i.e., adaptive behavior, cognition, core features of autism, language, and play).

**Results:** For cognitive outcomes and language outcomes, intervention effects were significantly larger for participant samples with higher mean participant entry-level language age. Intervention effects on play outcomes, adaptive outcomes, and measures of the core features of autism were not moderated by any participant characteristics.

**Conclusions:** Language ability at intervention onset may influence the effectiveness of therapies for supporting language and cognitive development, providing a developmental foundation upon which intervention can more effectively build. We did not find evidence that intervention effectiveness differed by participant sex or level of autism-related challenges at pre-treatment. However, true moderating effects of these child attributes may have been obscured by restricted range for the percentage of samples that were male, and by underrepresentation of samples with high levels of autism-related challenges. Notably, we failed to find evidence to support the notion that younger children make greater improvements compared to children that begin intervention at a later age. Although multiple studies attest that very young children can benefit from intervention, these results suggest that advancing age (up to 8 years) does not meaningfully limit intervention effectiveness.

**216.003 (Panel) The Quality of Studies in Autism Early Childhood Intervention Research**

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**Background:** Although the number of randomized controlled trials testing the effectiveness of interventions for young autistic children has precipitously increased in the last decade, the overall quality of this evidence base remains relatively poor. A previous study (Sandbank et al., 2020) reported the proportion of outcomes from studies of each intervention approach that were subject to threats posed by selection bias, detection bias, reliance on caregiver report for outcome assessment, and high levels of attrition. While some intervention approaches (i.e., developmental, NDBI) boasted relatively high proportions of outcomes that were immune to such threats, studies of other approaches (i.e., behavioral) had high proportions of outcomes that were plagued by selection bias, detection bias, and reliance on caregiver report. In order to assess the state and progress of autism early childhood intervention research, a report is needed which details the prevalence of these threats in the literature over time.

**Objectives:** Our aim was to derive statistics for various quality indicators of group design studies, disaggregated by year, allowing us to identify trends in study quality over time.

**Methods:** Using data from the main meta-analysis (Project AIM; Sandbank et al., 2020), we computed the number and percentage of outcomes from studies published each year from 1989 to 2017 (year of search) which were rated as having low, high, or unclear risk of selection bias, detection bias, and attrition bias, and which were derived from caregiver report.

**Results:** Although the percentage of outcomes from studies that employed randomization increased steadily over time, it was frequently less than 70%, even over the last decade. The percentage of outcomes rated as having low risk of attrition bias ranged from 53 - 100%. Although initially high, this percentage has decreased in recent years, potentially due to increases in sample sizes and better reporting standards. A substantial percentage of outcomes were derived from caregiver report, comprising as much as 90% of outcomes in early years when few studies were published. In the last decade, this percentage has remained relatively stable, ranging from approximately a quarter to half of all outcomes in studies published each year. Similarly, an ever larger portion of outcomes were subject to high detection bias each year (approximately half to three quarters). In most years, even in the past decade, the number of outcomes threatened by detection bias exceeded the number of outcomes that were not.

**Conclusions:** Data indicate that poor study quality, across several indicators, has persisted over time for group design intervention studies for young autistic children. This is unfortunate, as low quality studies increase bias, and may lead to the implementation of inefficacious support strategies. We argue that autism researchers and practitioners should be cognizant of these quality concerns when interpreting the existing evidence base for autism intervention research. Additionally, funding agencies should prioritize intervention research that utilizes high quality study designs, with the aim of increasing the availability of reliable evidence in this area.

**216.004 (Panel) Ethical Concerns in Autism Research: Pervasive Undisclosed Conflicts of Interest**  
*K. Bottema-Beutel and S. Crowley, Lynch School of Education, Boston College, Chestnut Hill, MA*

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**Background:** An ethical concern that has only recently received attention in autism intervention literature is conflicts of interest (COIs). COIs occur in circumstances when researchers stand to potentially gain from their study findings. COIs can introduce bias into the research process through questionable research practices, poor quality designs, and inappropriate interpretation of data. Researchers may then claim positive effects for ineffective interventions. A recent study showed COIs were relatively prevalent, and often undisclosed in group-design autism intervention literature (Bottema-Beutel et al., 2020). However, this report arguably under-represented applied behavior analysis (ABA) research, because ABA studies often use single-case designs. Recent reviews of ABA research have suggested that study quality is generally poor in some subfields of ABA (Bottema-Beutel & Crowley, 2020; Reichow, Barton, & Maggin, 2018), and COIs could potentially contribute to this state of affairs. Because ABA services are routinely provided to autistic children (Xu et al., 2019), this is an important area of investigation.

**Objectives:** In this study, we focus on COIs related to researcher employment as a clinical provider or a training consultant to other providers. We focus on these COIs because they are identifiable even when researchers do not disclose them, and because financial incentives unambiguously constitute COIs. We sought to determine: (a) the proportion of articles with authors with a clinical/training consultancy COI, (b) the proportion of articles with authors who had clinical and/or training COIs that omitted to disclose these roles as COIs in the manuscript, (c) the proportion of articles with authors who had clinical and/or training COIs that erroneously declared in the manuscript that the authors had no COIs, and (d) whether COI omissions were in violation of journal policies.

**Methods:** We tallied author COIs in articles published over a one-year period that tested, commented on, or reviewed autism intervention strategies, extracted from eight journals devoted to publishing ABA research. We located undisclosed COIs via web searches.

**Results:** Of the 180 studies that met inclusion criteria, we found that 84% had at least one author with a clinical/training consultancy COI, but that they were disclosed as COIs in only 2% of studies. Additionally, 87% of studies with statements claiming the authors did not have COIs were authored by researchers found to have clinical/training consultancy COIs. See Table 1 for additional details. Five of the eight journals we examined had policies requiring disclosure of COIs related to employment; clear violations were evident in four of these five journals.

**Conclusions:** Undisclosed COIs are pervasive across both studies of broader autism-focused interventions and, as evidenced by the current investigation, studies of ABA autism interventions. These COIs can introduce researcher bias, and could at least partially account for persistent poor quality research in this area. We recommend that journals hold researchers accountable for failing to disclose COIs and/or falsely claiming that they do not hold such COIs. Further, researchers must extend efforts to ensure that COIs do not influence study findings, through strategies such as partitioning researchers who hold COIs from data collection and interpretation.

**POSTER SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - INFANT, TODDLER, AND PRESCHOOL**

**Poster 426 - Interventions - Non-pharmacologic - Infant, Toddler, and Preschool Posters**

**426.001** (Poster) 1-2-3. First Play, Second Engage, Third Communicate: A Potential Sequential Mediation Model for Preschoolers with ASD

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**Background:**

Social engagement and communication are core developmental challenges for children with ASDs and a focus in early intervention (Mundy et al., 1990; Kasari et al., 2006). Gains in joint engagement (JE) and social communication (joint attention-JA) have been linked to better language outcomes (Kasari et al., 2008; Jones et al., 2006), and JE shows promise as a potential treatment mechanism (Shih et al., 2017). However, many young children with ASD spend very limited time in JE, creating a cumulative deficit in early language learning opportunities JE requires a shared referent which is often a shared activity. Developing play skills may facilitate more opportunities to share an activity. Therefore, increasing play skills may promote JE. However, this sequential mediation process where play skills and JE together act as the mechanism of change in early intervention has yet to be explored.

**Objectives:**

This study (1) examines the mediating effect of play diversity on JE and JA in the context of an early intervention: Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2008; Lawton & Kasari, 2012) delivered by teachers, and (2) explores the sequential mediation effect of play diversity on JA after accounting for JE.

**Methods:**

**Participants.** 66 children were 50 months old (SD=6.47) and 83% were male. Children ranged in developmental level (Mullen Scales of Early Learning) at entry (range: 11.00–57.67 months; M=35.41 months). Parents reported children as 29% Caucasian, 14% African American, 23% Hispanic, 15% Asian, and 20% Other/Mixed.

**Intervention.** Teachers received two weeks of in-vivo JASPER training from the research team. JASPER teachers delivered the intervention for 30 minutes/day for 10-weeks, while waitlist teachers continued their regular school curriculum.

**Measures.** Ten-minute teacher-child interactions were video-recorded and coded at entry and exit. Children's JE (time coordinating the adult and shared activity) and spontaneous JA skills (eye contact, gestures, language) were coded by reliable assessors blinded to time and condition.

The number of unique spontaneous play types (play diversity) were coded (Lifter & Bloom, 1989).

**Results:**

Linear mixed models were used to explore the mediating effect of play diversity on JE and JA in JASPER intervention.

Increased play diversity is associated with increased JE ( $p < 0.001$ ) and JA ( $p = 0.005$ ). Further, significant treatment differences were found between JASPER and Waitlist from entry to exit in total play diversity ( $p < 0.001$ ), JA ( $p = 0.02$ ), and JE ( $p = 0.019$ ) where JASPER children made significantly greater improvement.

Part-1 (Figure-1): Play diversity is a significant mediator of JASPER intervention on JE ( $p = 0.002$ ) and JA ( $p = 0.047$ ).

Part-2 (Figure-2): A significant indirect effect of JASPER intervention on JA was observed ( $p < 0.001$ ) suggesting that JASPER intervention increased JE through increased play diversity and resulted in increased JA.

Conclusions:

Joint attention is a core deficit of ASD, and improving outcomes may depend on improving play skill as one way to increase joint engagement. By helping children increase their range of play skills, we can facilitate gains in JE, a critical factor to foster development in core social communication challenges.

**426.002 (Poster)** A Comparison of Change Trajectories in Parent Sensitivity and Responsivity across Different Intervention Approaches

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Background: Multiple intervention approaches including parent participation are evidence-based practices in autism spectrum disorder (ASD; Schreibman et al., 2015). Structured behavioral interventions, such as Discrete Trial Training (DTT; Lovaas, 1987), are based on applied behavioral analysis (ABA). DTT emphasizes the provision of learning opportunities by utilizing antecedent and consequence strategies to enhance child learning with limited attention to the caregiver/child relationship. More recently, interventions such as the Early Start Denver Model (ESDM; Rogers & Dawson, 2010) blend the learning principles of ABA with relational strategies based on developmental science (e.g., developing sensitive and responsive interactions; Ingersoll et al., 2010). Developmental studies examining the effect of helping parents increase sensitive and responsive parenting behaviors that fit their child's learning needs link increases in these behaviors to more positive outcomes for children with ASD (Gulsrud et al., 2016; Rogers et al., 2014; Siller et al., 2013), but little attention has been paid to how these behaviors vary as a function of intervention approach.

Objectives: Compare change trajectories in sensitive/responsive interactions facilitated by different parent coaching interventions.

Methods: Data were collected as part of a randomized treatment study comparing DTT and ESDM. Participants in the parent study included toddlers with ASD and their primary caregivers. Over the year-long intervention, parents received coaching in parent ESDM or behavior management in the DTT condition. 83 children completed the study (42 DTT, 41 ESDM). Children were, on average, white (53%) males (75%), and 25 months old at entry (range 12-30). Video recordings of parent-child interaction during home toy play were collected monthly for 12 months. This study compares the quality of the parent-child interaction from months 1, 4, 8, and 12 using the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al., 2013), a checklist of 29 observable developmentally supportive parenting behaviors in four domains—Affection, Responsiveness, Encouragement, and Teaching. Repeated measures, random effects models will be used to model change over time in parent sensitivity/responsivity. Secondary analyses will assess the four sub-domain scores as outcomes to probe specific areas that might explain any overall difference. With 83 parents, assuming a two-sided test and alpha = 0.05, we will have 80% power to detect a difference in slope as small as 0.25 standard deviations, assuming the correlation between the repeat assessments is at least 0.2.

Results: PICCOLO coding is almost complete (90% completed at submission). Comparison of preliminary video data from the ESDM condition (128 observations) and DTT condition (128 observations) found statistically significant differences in overall parent behavior between the ESDM dyads ( $M=45.59$ ,  $SD=7.46$ ) and the DTT dyads ( $M=43.03$ ,  $SD=4.45$ )  $F(1, 254)=11.07$ ,  $p=0.001$ , with parents participating in the ESDM condition showing greater supportive parenting behaviors. Final analyses will examine change over time across groups.

Conclusions: Comparing the learning patterns of parents coached in different intervention strategies will lead to a greater understanding of how best to support parents of children with ASD. This information can be used to streamline parent coaching strategies.

**426.003 (Poster)** A Nimble Model of Care: Adapting the Social ABCs Parent-Mediated Toddler Intervention for Group-Based and Virtual Delivery

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Background: Informed by two decades of infant sibling research, our team developed a 12-week, parent-mediated, naturalistic developmental behavioural intervention (NDBI) for toddlers. The *Social ABCs*<sup>1</sup> combines didactic teaching (supported by a parent manual) and individual in-vivo parent coaching, yielding parent implementation fidelity and gains in toddlers' social communication<sup>2</sup>.

Objectives: To improve efficiency of the program and increase access, we adapted the model to **Group-based** didactic teaching and 1:1 coaching in-clinic (vs. home), over 6 (vs. 12) weeks (Phase I). In response to the Covid-19 pandemic we modified the model for virtual delivery (Phase II).

Methods: Phase I: 45 families participated in the in-person Group model (ages: 21-35 months;  $M=30.6$ ; 39 boys). Phase II: 39 families participated in the virtual Group model (ages: 18-36 months;  $M=30.1$ ; 26 boys); 16 enrolled as waitlist controls 6 weeks prior to beginning the program. Data were collected at baseline and week 6 for all participants via videotaped parent-child interactions and parent questionnaires. "Pre-baseline" data were collected for waitlist controls.

Results: Preliminary analyses are reported. Formal comparisons across phases and studies will be conducted once all data are available (Dec/20).

Phase I: Paired samples t-tests revealed significant increases in toddlers' responsivity and parents' fidelity;  $p$ 's  $<.001$ , with gains that appear comparable to those in the original model (Fig.1). Parents reported improved toddler language (words understood/spoken; *MacArthur-Bates Communicative Development Inventories*;  $p$ 's  $<.001$ ), reduced autism symptoms (*Autism Parent Screen for Infants*<sup>3</sup>;  $p <.001$ ), and high satisfaction (33.1 out of 35). Unique to the Group model was decreased parenting stress;  $p <.001$  (Fig.2).

Phase II: Outcomes appear commensurate with the *in-person* Group model for implementation fidelity ( $p =.009$ ; Figure 1a), autism symptoms ( $p =.004$ ), child language skills ( $p$ 's  $=.003$ ,  $.018$ , respectively; words understood/spoken), and satisfaction (32.5/35). We failed to show reduced parenting stress;  $p =.10$  (but note that baseline stress was marginally higher than in Phase I;  $p =.10$ ). Video-coded toddler behaviour from this phase will be available for INSAR.

Conclusions: *Group Social ABCs* is a promising, innovative and cost-efficient way to intervene at the first signs of concern. Moreover, the virtual adaptation appears to yield parent fidelity and child gains commensurate with the in-person version. Parenting stress may not improve in the virtual model, perhaps due to the absence of a key active ingredient (e.g., interpersonal interaction). It also remains possible that the pandemic may be a major driver in increasing overall stress, overshadowing any potential reduction in stress that might otherwise have occurred with the virtual model. Nonetheless, the virtual model holds promise as an effective way to serve families who are harder to reach by traditional methods, both during and beyond the pandemic.

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**426.004** (Poster) Affective Quality and Play in Mother-Child Dyads with ASD: Changes during a Parental Based Intervention **S. Perzilli<sup>1</sup>, G. Bertamini<sup>2</sup>, S. De Falco<sup>1</sup>, A. Pasqualotto<sup>2</sup>, P. Venuti<sup>1</sup> and A. Bentenuto<sup>1</sup>**, (1)Department of Psychology and Cognitive Science, University of Trento, Rovereto, Italy, (2)University of Trento, Rovereto, Italy

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Background: Core symptoms of Autism Spectrum Disorder (ASD) impact on the child 's interplay with parents, inducing maladaptive interactive circuits that need to be restored in order to guarantee effective emotional exchanges (Kasari et al. 2010; Adamson et al. 2010). Recent findings strengthened the importance of involving caregivers during the intervention in order to increase dyadic levels of syntonzation and to extend the acquisition of competencies also in naturalistic contexts (Oono IP et al.

2013; Parsons et al. 2017). However, the evaluation of treatment response is mainly focused on child outcomes, demonstrating the improvements on both child's social engagement and cognitive development (Tiede et al. 2019), often without deepening dyadic and caregivers' variables associated with the response.

**Objectives:** In line with this, we want to investigate longitudinal trajectories of dyadic affective quality and play skills abilities during an intervention with parent involvement. Further, we want to identify which parental and child characteristics and behaviors might be associated with changes in the dyadic competences.

**Methods:** In order to assess the affective quality within the dyad the Emotional Availability Scales (EAS, Biringen et al. 2008) were used to codify ten minutes video-recorded interactions between 29 preschool children and their caregiver. On the same interaction's sequences, the Play code (O'Reilly & Bornstein, 1993) was employed in order to assess the levels of both child and caregiver's exploratory and symbolic play. These measures were also applied after 11 months of an early intensive intervention that provides parent involvement into the therapy room (at least 2 h per week).

**Results:** Results revealed that mothers increased affective quality ( $V(28) = 13$ ;  $p = 0.002$ ;  $r^2 = 0.596$ ;  $BF = 25.097$ ) and awareness ( $V(28) = 0$ ;  $p = 0.026$ ;  $r^2 = 0.454$ ;  $BF = 2.952$ ) in understanding the signals produced by the child. They also seem to structure activities with the child more adequately, ( $V(28) = 0$ ;  $p < 0.0001$ ;  $r^2 = 0.892$ ;  $BF > 100$ ) showing less intrusive behaviors ( $V(28) = 0$ ;  $p < 0.0001$ ;  $r^2 = 0.886$ ;  $BF > 100$ ). The children, in turn, were more responsive ( $V(28) = 21.5$ ;  $p < 0.001$ ;  $r^2 = 0.716$ ;  $BF > 100$ ), more involving ( $V(28) = 0$ ;  $p = 0.002$ ;  $r^2 = 0.613$ ;  $BF = 24.648$ ) and they showed more complex and symbolic strategies of symbolic play ( $V(27) = 79$ ;  $p = 0.0255$ ;  $r^2 = 0.392$ ;  $BF = 3.449$ ). Further, linear mixed effect models revealed that mothers' structuring abilities were linked to their perception of having a difficult child ( $b=0.016$ ;  $t(24)=2.255$ ;  $p=0.034$ ), and their non-intrusiveness skills seemed to be influenced by child's language ability ( $b=0.008$ ;  $t(50)=2.677$ ;  $p=0.010$ ).

**Conclusions:**

From a theoretical perspective this study may enhance knowledge about child and caregiver variables that impact on dyadic outcomes, and help the identification of important target areas to be addressed during intervention. From a clinical standpoint, our results suggest that parental based intervention may support and facilitate improvements and dyadic synchronization in both children and caregiver's affective quality and cognitive abilities.

**426.005 (Poster)** An Umbrella Review and a Meta-Analysis of Pivotal Response Treatment in Autism Spectrum Disorder  
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**Background:** A number of single-subject, small N, non-randomized group-based and more recently randomized controlled trial (RCT) studies have suggested that Pivotal Response Training (PRT) outcomes are quite promising in certain symptom and functional domains. Given the increased adoption of PRT in clinical practice, it is important to systematically appraise existing evidence and achieve current consensus on the effectiveness of PRT for specific outcomes. It is also crucial to identify the limitations of the current PRT treatment literature and highlight crucial areas for future improvements.

**Objectives:** To provide a comprehensive appraisal of the current evidence on the effectiveness of PRT for individuals with autism spectrum disorder (ASD) through an umbrella review of previous systematic examination of the literature and meta-analytic synthesis of all available PRT RCTs.

**Methods:** PsycINFO, Medline, Embase, Cochrane Central Register of Controlled Trials, ERIC and Linguistics and Language Behavior Abstracts were searched for published articles available through May 2020. Review methodology adhered to the steps described in the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement.

**Results:** Six systematic reviews were identified, two with meta-analytic components and four providing a descriptive summary of the findings. Identified reviews varied widely in terms of their aims, outcomes, and designs which precluded a unified and consistent set of conclusions and recommendations. Nine RCTs were identified. Eight of nine identified RCTs reported at least one language and communication-related outcome. Statistically significant effects of PRT for a range of language and communication skills were identified across a majority of identified RCTs. Although some of the identified PRT RCT studies also examined a range of non-language targets behaviors including other core features such as social interaction and associated behaviors and adaptive functioning, a small number of overlapping measures precluded robust effect size estimations for these outcomes. Therefore, evidence for positive treatment effects of PRT on outcome measures assessing non-language domains was less robust and or specific. This systematic review has identified several key limitations that should be addressed in future research. More specifically, future studies will need to (i) include more comprehensive treatment targets, in particular adaptive

functioning, a generalization of treatment effects and longer-term (12-months or longer) outcomes, (ii) use more objective outcome measures, (iii) measure of parental well-being, and (iv) improve trial methodology by adopting factorial and adaptive treatment designs while implementing more advanced individual difference analytical strategies that would enable the identification of subgroups of children who respond well to PRT and understand the profile of treatment responders.

**Conclusions:** Overall, both previous systematic reviews and new meta-analysis of the RCTs suggest that PRT shows promise for improving language and communication. This review has identified several key methodological and design improvements that are needed to enable our field to fully capitalize on the potential of RCT designs and establish not only overall treatment efficacy but also detailed profiles of treatment responders in order to provide evidence-based guidance for clinicians on what works for whom and why.

**426.006 (Poster) Champion: Caregiver Administered Holistic Autism Management Program for Individualised and Optimal Nurturing: Comparison between Weekly and Six-Weekly Follow-up Training Sessions : A Randomised Trial**  
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**Background:** Recent estimated prevalence of ASD in India ranges from 0.15% to 1.01% in various studies, depending on the screening method used, and the areas surveyed. However, this increase in prevalence has not been accompanied by a corresponding growth in the availability of evidence-based intervention services, resulting in high levels of unmet service needs for individuals with ASD and their families. In such resource constrained settings, parent-mediated interventions may be an effective alternative, and the general consensus is that parents, who receive appropriate training, gain skills in the delivery of interventions, thus improving joint attention, social communication and behaviours of their children with ASD.

**Objectives:** To compare the efficacy of caregiver administered intervention program with weekly training sessions versus a program with six-weekly training sessions for children with autism

**Methods:** A standardized parent-administered intervention program was developed for children with Autism including a self-designed culturally appropriate comprehensive checklist of skills to be taught in various domains including social-emotional, receptive and expressive language, play skills, daily living skills and pre-academics.

90 children with Autism Spectrum Disorder, aged 2-6 years were enrolled. At baseline, all participants were administered standardized tools/ checklists for evaluation of IQ/DQ (Leiters/ DP-3), Autism severity (CARS), adaptive functioning (VABS-2), behavioral problems (Aberrant Behavior Checklist) and language levels (Receptive Expressive Emergent Language Scale/ Linguistic Profile Test), followed by the designed checklist to assess the functional levels and the skills to be taught. Parents were psycho-educated regarding Autism, and were given hands-on training for administering the intervention. Patients were randomized into weekly and 6-weekly follow-up groups using stratified block randomisation using random block sizes. Parents were asked to follow the intervention program for at least 4 hours per day at home.

The children were evaluated every 12 weeks using the checklist, to check for the skills achieved, and to set new goals. At the end of 1 year study period, all assessments were repeated, to check the efficacy of the program.

**Results:** Of the 90 children enrolled, 46 were in the weekly follow-up group and 44 in 6-weekly follow-up group. Both the groups were comparable with respect to baseline characteristics. 7 children were lost to follow-up first group and 20 in second group. The baseline characteristics of the children lost to follow-up were similar to those who completed the study.

On comparing final scores with baseline values, there was statistically significant improvement in all parameters including IQ/DQ, Adaptive behavior, language (receptive and expressive) and behavioral problems in both the groups. There was a mean increase of 16.33 points IQ/DQ in the weekly group, and 21.5 points in the 6-weekly group. The CARS score decreased by 4.58 points in weekly vs 3.8 in 6-weekly group. There was no significant difference in the changes observed between groups.

**Conclusions:**

This study reaffirms that parent-administered intervention programs are effective in management of young children with Autism Spectrum Disorder in resource-limited setting, with both 6-weekly and 1-weekly intervention protocols having similar efficacy. However, frequent contact with parents may be necessary to ensure compliance with therapy.

**426.007 (Poster) Comparative Outcomes of Young Minimally Verbal and Verbal Autistic Children Following Receipt of Group-Based Early Start Denver Model (G-ESDM)**

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**Background:** Little research has examined developmental outcomes following intervention of young minimally verbal autistic children compared to their more verbal peers. As approximately 30% of autistic children remain minimally verbal (defined as having a very small repertoire of spoken words - < 20 functional words - or fixed phrases that are used communicatively), and few develop spoken language after the age of five, it is important to understand the very early developmental trajectories of minimally verbal children in order to target interventions for those with the greatest need.

**Objectives:** The aim in this study was to compare the early developmental trajectories of minimally verbal and verbal autistic children who accessed a G-ESDM intervention program for a period of one year.

**Methods:** Data from 141 children (78% male) diagnosed with Autism Spectrum Disorder who participated in a G-ESDM program within an early learning and care centre in Australia was used to address the study aim. Children had a mean age of 34.21 months (Range: 13 - 64 m) at entry into intervention and 45.39 months (Range: 24 - 72 m) at the one-year follow-up. The Autism Diagnostic Observation Schedule was used to confirm diagnoses at entry into intervention. The Mullen Scales of Early Learning was administered at entry and one-year following, and parents completed the Vineland Adaptive Behaviour Scales (VABS) and the Social Communication Questionnaire (SCQ) at both time points.

**Results:** Given their young age, 89 children (63%) were classified as minimally verbal at baseline which reduced significantly to 52 (37%) at follow-up. Children's developmental trajectories were examined as a function of their verbal status at *exit* using 2 (Group: Minimally Verbal; Verbal) x 2 (Time: Baseline; Follow-up) repeated measures ANOVAs, revealing near identical trajectories with no group differences on verbal and non-verbal DQ. Both groups also made equivalent and significant gains in verbal and non-verbal DQ following one year of the G-ESDM intervention. This pattern of findings was repeated with the VABS, with a significant increase in scores over time. Similarly, no group differences were evident on the SCQ at entry and follow-up, with both groups showing significantly reduced scores following one-year of intervention.

**Conclusions:** Autistic children who remained minimally verbal at exit had similar developmental trajectories to their verbal peers when examined from entry to one-year follow-up within a group-based early intervention program. The findings were consistent across the developmental measures used here, including when children's social communication abilities as reported by parents were considered over time. The gains in both verbal and non-verbal developmental quotients is encouraging with both groups showing equivalent leaning outcomes having received the G-ESDM. This finding is particularly important as older minimally verbal autistic children have previously been found to make minimal gains following intervention. Our study, which focused on very young children, found that the G-ESDM is equally suitable for all autistic children despite their verbal ability at entry into intervention. It is possible that the G-ESDM is ideally suited to young minimally verbal children. Further research is required to examine this hypothesis.

**426.008 (Poster) Developmental Outcomes for Young Children with Autism Participating in the Parent-Implemented Early Start Denver Model Whose Parents Received Mindfulness Based Stress Reduction**

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**Background:** Although low-intensity parent-mediated interventions for young children with or at-risk of Autism Spectrum Disorder (ASD) have gained momentum, [1-3], evidence of their impact on child outcomes remains unclear [4, 5]. Offering targeted parent training in strategies to support children with ASD may give parents the skills to support their children during naturalistic, everyday interactions [1, 2, 6-8]. However, little is known about whether directly treating parental distress as part of an early intervention protocol has positive impacts on young children with ASD.

**Objectives:** In a randomized controlled trial of P-ESDM with and without MBSR for parents, [9] we found that parents who received MBSR reported reduced parental distress and increase mindfulness. In this work, we examine overall group impacts of P-ESDM on longitudinal child outcomes and between-group differences in child outcomes.

**Methods:** Participants included 63 children with ASD less than 36 months of age and a primary caregiver. All children received 12 sessions of weekly P-ESDM. Half of their parents were randomized to also participate in 6 sessions of MBSR. Developmental outcomes related to autism symptoms (ADOS-2 severity scores), cognitive skills (MSEL, Early Learning Composite and raw domain scores), and ratings of communication and socialization (VABS-II standardized domain scores) were assessed at baseline (T1), immediately post-treatment (T2; 3 months), and at end of study (T3; 6 months.)

**Results:** Group means were compared at each timepoint. No significant differences emerged on any variables. Groups were then combined to evaluate the impact of P-ESDM participation. From T2-T3, but not T1-T2, ADOS-2 scores significantly decreased (-.94 points,  $p < .001$ ) and MSEL Early Learning Composite scores (3.94 points,  $p < .001$ ) significantly increased. Both groups significantly improved on raw scores of MSEL domains from T1-T2 and T2-T3, which may be consistent with maturation. Standardized VABS-2 Communication scores improved from T1-T2 (6.48 points,  $p < .001$ ) but not T2-T3, whereas VABS-2 Socialization scores remained stable across timepoints.

**Conclusions:** Parental involvement in a stress reduction program did not directly impact commonly used measures of developmental outcomes for young children with ASD. Across groups, children showed modest improvements in autism severity as well as cognitive and adaptive skills. Although statistically significant, the clinical significance of these changes is less clear. Additionally, the lack of a control group makes it difficult to understand the impact of maturation. Our previous work [9] demonstrated that directly supporting parents positively impacted aspects of parental wellbeing. This study demonstrates that adding parental treatment did not negatively impact child progress, supporting comprehensive early intervention programs that address needs of the entire family.

**426.009 (Poster)** Does Early Intervention Improve Long-Term Outcomes in Children with Autism Spectrum Disorder? an 8-Year Follow-up of a Randomized Controlled Trial of a Preschool-Based Social Communication Intervention

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**Background:** There is little knowledge about the long-term (> 2 years) effects of interventions provided for children with autism spectrum disorder (ASD) during the preschool years.

**Objectives:** This study reports on the 8-year follow-up data from a randomized controlled trial (RCT) of a short-term (8 weeks) preschool-based social-communication intervention (adaptation of JASPER) for 2-4-year old children with ASD that was documented as being effective at intervention-end and 1-year follow-up.

**Methods:** All children from the original trial were invited to participate in the 8-year follow-up study. Video-recordings of 10-minutes of parent-child and teacher-child interaction were collected at several time points (four times during the preschool-age and once at 8-year follow-up). The recordings were blind-coded for primary outcomes; child initiation of joint attention (IJA<sub>parents</sub> and IJA<sub>teachers</sub>) and duration of joint engagement between child and interaction partner (JEng<sub>parents</sub> and JEng<sub>teachers</sub>). Secondary outcomes of expressive and receptive language were assessed by blinded testers using the Expressive Vocabulary Test (EVT) and Peabody Picture Vocabulary Test (PPVT). Intention-to-treat analyses were performed using linear mixed models fitted to each of the outcomes.

**Results:** Fifty-one (83.6%) (M<sub>age</sub> = 13.2 years, [SD<sub>age</sub> = 1.1], 82.4 % boys) of the 61 children from the original trial (29 [85.3%] of 34 assigned to the social-communication intervention in addition to treatment as usual (TAU), and 22 [81.5%] of 27 assigned to TAU only) participated in the 8-year follow-up. No significant group differences were identified in gains from baseline to 8-year follow-up on either of the social-communication or language outcomes (Table). The increase in IJA<sub>parents</sub> was 1.61 (95% CI: -1.57, 4.79) for the intervention group and 0.86 (95% CI: -2.52, 4.25) for the control group [mean group difference 0.75 (-3.90, 5.39);  $p=0.75$ ], while the increase in IJA<sub>teachers</sub> was 3.71 (95% CI: 1.08, 6.34) for the intervention group and 0.69 (95% CI: -2.26, 3.64) for the control group [mean group difference was 3.02 (-0.93, 6.97);  $p=0.13$ ]. Additionally, the increase in EVT raw scores was 35.8 (95% CI: 27.0, 44.7) for the intervention group and 30.3 (95% CI: 20.4, 40.2) for the control group [mean group difference was 5.5 (-7.8, 18.8);  $p=0.42$ ].

**Conclusions:** This study adds to the knowledge of long-term effects of early intervention for children with ASD. The findings suggest that despite identified effects of the preschool-based social-communication intervention at treatment-end and 1-year

follow-up, the intervention did not have long-term effects on children's social-communication and language skills. Thus, in contrast to specialist-delivered intervention (Kasari et al., 2014), and more comprehensive parent-mediated intervention (Pickles et al., 2016), the short-term preschool-based intervention was not evidenced to produce similar positive long-term effects on core social-communication skills and language. Possibly, measures (e.g. more training of teachers, longer duration of the intervention, booster sessions) may be taken to strengthen long-term impact.

**426.011 (Poster)** Early Childhood Services and Adaptive Behavior Outcomes for Young Children with Autism and Other Developmental Delays

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**Background:** Interventions delivered in early childhood result in improved, long-term adaptive behavior outcomes for children with autism spectrum disorder (ASD; Estes et al., 2015). Although ASD symptoms emerge before age two (Zwaigenbaum et al., 2015), delays in diagnosis have been associated with family demographics (Mandell et al., 2005), primary care referral practices and wait time for evaluations (Monteiro et al., 2016, 2019). The majority of parents report delays in speech, language, and developmental milestones as their earliest concerns regarding their child's development (Chawarska et al., 2006), which may influence eligibility for early childhood services prior to diagnosis.

**Objectives:** This study aims to characterize the impact of early intervention services on school-age adaptive behavior for a community sample of young children with speech or language delays (SLD), ASD and other developmental delays and disabilities (DD).

**Methods:** Participants included caregivers of young children ( $M=37$  months,  $SD=4.65$ ) classified as having SLDs ( $n=77$ ), ASD ( $n=21$ ) or other DDs ( $n=43$ ) who were recruited in the Northwestern United States. They were enrolled in a longitudinal, caregiver-directed intervention trial during which they reported on their child's receipt of direct interventions at five timepoints until age five ( $M=59$ ,  $SD=4.57$ ; R01 HD059838; PI, L. L. McIntyre). *Vineland Adaptive Behavior Scales, Second Edition* (Sparrow et al., 2005) interviews of child adaptive behavior were conducted at ages three and five. Raw scores were used to account for within-subject change. A hierarchical linear regression evaluated whether early childhood interventions accounted for unique variance in adaptive behavior at age five, controlling for adaptive behavior at age three and randomized study intervention condition. Intervention variables included cumulative number of sessions of evidence-based interventions (EBI; behavioral, speech, occupational, and physical therapy) and the proportion of timepoints enrolled in preschool or early childhood special education (ECE-SPED).

**Results:** Age, number of EBI sessions, and enrollment in preschool or ECE-SPED did not differ based on child diagnosis. Children with SLDs had higher adaptive behavior compared to ASD and other DDs at age three ( $F(2,137)=6.34$ ,  $p=.002$ ) and five ( $F(2,137)=13.588$ ,  $p<.001$ ). Hierarchical linear regression results indicate the total model, including diagnosis, EBIs and preschool and ECE-SPED utilization, accounted for 38.4% of variance in adaptive behavior at age five, with EBI services significantly accounting for 5.4% unique variance in outcome ( $R^2=.384$ ,  $F(2,131)$ ,  $p=.004$ ).

**Conclusions:** Findings suggest that, in the current sample, children's EBI service utilization did not vary as a function of diagnosis. Best practices in early intervention suggest that services should be individualized and sufficient in their intensity, particularly for children who have significant social, communication, and behavioral support needs (McIntyre & Zemantic, 2017). Findings from the present study also underscore that more service utilization during the early childhood period is associated with better adaptive behavior at school entry, providing additional support for the well-established finding that "early" is better (National Research Council, 2001). Future research should include more sophisticated characterization of service utilization, including indices of quality, fidelity, and engagement, as well as investigations of service utilization as influenced by geographical differences.

**426.012 (Poster)** Early Echoic Imitation Predicts Reduction in Autism Symptomatology: A Retrospective Analysis of Toddlers from an Early Intervention Treatment Center

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**Background:**

According to the American Psychiatric Association (2013), the main characteristics of Autism Spectrum Disorder (ASD) include challenges in social interaction and communication skills. Lack of typical speech is a key factor affecting the severity of ASD (Matson, Kozlowski, & Matson, 2012). Many children with autism remain nonverbal and fail to gain language unless intervention is introduced to them (Rice, Warren, & Betz, 2005). In this regard, evidence-based treatment is essential to reduce language delays in children with ASD because their symptoms are complex and set them apart from typical children (Luyster, Lopez, & Lord, 2007). Skinner (1957) proposed that echoic behavior was essential for the development of language and communication skills.

#### Objectives:

The current study was conducted to answer the following question: why do only some children improve as a result of ABA? One possible answer is that the children who improve may have different behavioral capacities, like vocal imitation. The current study tested whether vocal imitation skills at baseline predicted reduction in ASD symptoms with ABA intervention. It was hypothesized that echoic behavior skills reduce the severity of ASD symptoms.

#### Methods:

Participants in this study included 143 children ranging in age from 21-40 months at onset of intervention. Their families had a variety of first languages: English (52%), Chinese (29%), Spanish (17%). Children were enrolled in a Center-Based ABA program in which they received DTT, NET, or both. Prior to enrollment, the children were tested using the Bayley Scales of Infant and Toddler Development-3rd Edition (BSID), the Childhood Autism Rating Scale-2nd Edition (CARS-2), and the Verbal Behavior Milestones Assessment and Placement Program (VBMAPP). Prior to leaving the program, the children were retested.

The children were classified according to reduction in symptoms of ASD upon leaving the program. Thus, 5 groups resulted according to the amount of symptom reduction. These groups were examined for the level of vocal imitation they displayed when entering the program (See Table 1).

#### Results:

These 5 groups were examined retrospectively for the level of echoic vocal behavior, non-echoic vocal behavior and motor imitation they displayed when they entered the program using mixed between groups (5) by repeated measures (2) ANOVAs. Echoic behavior was compared to vocal behavior and it was found that the children who had the greatest reduction in symptoms of ASD showed the highest level of pre-intervention echoic behavior and the largest difference between echoic behavior and non-echoic vocal behavior. These results held for the three groups with the largest reduction in symptoms for ASD See Figure 1. The results show that neither early motor imitation nor non-echoic vocal behavior predict reductions in ASD symptoms in toddlers while early echoic (vocal) imitation did predict reductions in symptoms of ASD.

#### Conclusions:

The findings suggest that early intervention should focus on increasing echoic behavior in toddlers showing early signs of ASD. Absence of speech and language in toddlers is often seen as an early sign of Autism Spectrum Disorder (ASD). Vocal imitation is regarded as a necessary condition for the development of language.

#### **426.013** (Poster) Early Intervention for Autistic Children: Incorporating the Perspectives of Autistic Adults

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Background: While behavioral interventions for autistic children are widely used, a number of autistic adults have spoken out against them. These individuals report trauma as a result of interventions that they feel have emphasized “normalization” and compliance over acceptance and quality of life. Naturalistic Developmental Behavioral Interventions (NDBIs) were developed to combat some issues with earlier interventions, such as use of aversives, and offer a strengths-based approach, emphasizing child choice and naturalistic learning opportunities. However, most intervention research has been conducted without soliciting autistic perspectives, and there is far less evidence to suggest that autistic people themselves find behavioral intervention models acceptable or effective.

**Objectives:** This study aimed to elicit autistic adults' perspectives of common intervention goals, the core components of NDBIs, and the role that autistic individuals should take in informing intervention practices.

**Methods:** Preliminary data include 33 autistic adults (16 F, 10 M, 6 Non-binary, 1 unknown) who were recruited online to take a 26-item survey about intervention goals, strategies, and decision-making factors. Ten statements identified common skill acquisition goals (e.g. building communication skills); nine statements described common behavior reduction goals (e.g. reducing motor/vocal stimming, reducing noncompliance, reducing self-injury); five statements described core components of NDBIs (e.g. using natural settings, incorporating the child's interests); and two statements discussed autistic people's involvement in intervention decisions. Participants were asked to rate their agreement with each statement on a scale from 1=*Strongly Disagree* to 6=*Strongly Agree*. Mean item ratings were examined for each item set, with scores above 3.5 indicating agreement and scores below 3.5 indicating disagreement. Participants were able to expand upon their answers in a textbox; thematic analysis will be used to analyze these data. Data collection is ongoing, with several hundred participants expected, and generalized linear mixed models will be used to analyze ordinal item responses.

**Results:** The overall mean score for statements describing skill acquisition goals was 4.47 ( $SD=1.13$ ). In contrast, the mean score for statements describing behavior reduction goals was 3.28 ( $SD=1.12$ ); when excluding the statements about reducing dangerous behaviors ( $M=5.44, SD=0.58$ ), the mean score was 2.66 ( $SD=1.35$ ). Statements describing NDBI strategies were found to be slightly agreeable ( $M=4.19, SD=0.77$ ). Finally, participants generally supported statements about autistic involvement in intervention decision-making ( $M=5.38, SD=0.83$ ).

**Conclusions:** These preliminary data highlight which aspects of intervention are and are not viewed favorably by autistic adults. Overall, participants viewed involvement of autistic individuals and skill acquisition goals favorably. On the other hand, behavior reduction targets (with the exception of reducing dangerous behaviors) were rated negatively. Overall, participants slightly agreed with the use of NDBI intervention strategies. The present study reveals both agreement and disagreement between autistic adults and practitioners. Bringing interventions more in line with goals that are important to the autistic community could help to bridge the gap between the clinical/academic community and the autistic individuals they seek to serve.

**426.014 (Poster)** Early Reading Comprehension Intervention for Preschoolers with ASD and Hyperlexia  
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**Background:**

Children with combined autism spectrum disorder (ASD) and hyperlexia (HPL) demonstrate advanced word reading skills at a very young age, alongside an associated deficit in reading comprehension. A number of these children also exhibit impaired oral language skills. Taken together, oral language and reading comprehension challenges can have a cascading negative effect on social skills and academic success. Given the documented social and academic challenges for children with ASD, it is critical that early interventions target the integral components of academic success, such as oral language and reading comprehension. Yet, support for reading comprehension at the preschool level or even in the early primary grades is lacking for young children with ASD and hyperlexia (ASD+HPL). To address this gap, we developed a preschool oral language and reading comprehension intervention using written word-, phrase- and sentence-picture matching tasks on an iPad tablet supported by parents at home.

**Objectives:**

To evaluate a novel, parent-supported, tablet-based intervention application aiming to improve oral and reading comprehension skills, at the word-, phrase- and sentence-level, for preschool children with ASD+HPL as compared to typically developing (TD) preschoolers and those with ASD without hyperlexia (ASD-HPL).

**Methods:**

English-speaking preschoolers ( $N=30$ ) with ASD+HPL ( $N=8$ ), ASD-HPL ( $N=7$ ) and TD preschoolers ( $N=15$ ) participated in the study. Children's reading comprehension and oral language skills were evaluated at three timepoints using the Passage Comprehension subtest of the Woodcock Johnson Test of Achievement – 4<sup>th</sup> edition and the Oral and Written Language Scales - 2<sup>nd</sup> Edition – Listening Comprehension Scale (receptive language) and Oral Expression Scale (expressive language). Time 1 assessment occurred six weeks prior to the beginning of intervention. From Time 1 to Time 2, parents were instructed to conduct their typical activities with their child. Time 2 assessments occurred right before the 6-week intervention period during which time children used an experimenter-designed, tablet-based application for 15 minutes daily, five days a week at home supported by their parents. Time 3 assessment occurred after the 6-week intervention. Treatment fidelity was monitored to ensure compliance.

## Results:

Findings revealed that, although there was no significant difference between the groups for reading comprehension scores at Time 1, reading comprehension scores significantly improved for the group with ASD+HPL from Time 1-3 ( $p=.001$ ) and Time 2-3,  $p=.018$ , but not from Time 1-2 ( $p=.382$ ) as compared to the other groups. Gains were also found for receptive language from Time 1-3 ( $p<.001$ ) and Time 2-3 ( $p=.002$ ), but not for Time 1-2 ( $p=.929$ ) for all three groups. No gains were noted for expressive oral language skills for all groups.

Conclusions: Word-picture matching is a successful early intervention to improve both reading comprehension and receptive language for preschoolers with ASD+HPL and receptive language skills for all preschoolers. Findings suggest that interventions aiming to improve reading comprehension for preschoolers with ASD+HPL can begin at the first signs of reading ability, rather than waiting until later primary school. This represents a paradigm shift in current curriculum delivery. Finally, parents can also successfully implement this intervention at home with minimal training while awaiting public services.

**426.015** (Poster) Effect of Project Impact on Joint Attention in Children with ASD: A Randomized Controlled Trial  
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Background: Children with autism spectrum disorder (ASD) show deficits in joint attention skills (Charman, 2003). Joint attention plays an important role in early development, given its associations with language and other social communication skills (e.g. Nowell, Watson, & Craig, 2020). Project ImPACT (Ingersoll & Dvortcsak, 2010) is a parent-implemented intervention, focusing on social communication in children with ASD. One of the intervention targets is the increase of social engagement (including joint attention) through the use of interactive and behavioural strategies during daily routines. Previous studies have shown positive effects on language and communication in parent-child interaction in children with ASD (e.g., Ingersoll & Wainer, 2013; Stadnick et al., 2015).

Objectives: The goal of the present study was to test the effect of Project ImPACT in a community setting on the joint attention skills of children with ASD in interaction with a researcher.

## Methods:

Participants: 41 children between 22 and 51 months (five girls) were recruited through services for home guidance for children with ASD. Participants were randomly assigned to either an ImPACT intervention group ( $n = 20$ ) or a treatment as usual (TAU) condition ( $n = 21$ ). Mean age in the ImPACT and TAU groups were 36 and 35 months respectively.

Intervention: Parents of children in the ImPACT group received 18 weekly individual training sessions. Parents in the TAU condition received regular home guidance, with a frequency of one session every 2-3 weeks, mainly targeting daily living skills.

Procedure: Joint attention skills were assessed with the Early Social Communication Scales (ESCS; Mundy et al., 2003) before and after receiving Project ImPACT or after a similar time interval in the TAU group ( $M= 6$  months in both groups). There was a follow-up assessment 12 weeks after the post-test. Follow-up data was missing for 4 children. Administrators and coders were blind for group assignment. We computed the total number of initiations of joint attention (by means of eye contact, pointing, showing, language or a combination; IJAtotal) and the total number of joint attention bids with eye contact (IJAEC).

Results: Data were analysed by computing a linear mixed effect model in R with restricted maximum likelihood (REML) estimates of the parameters. For IJAtotal there was no time\*group interaction at posttest,  $t(73.35) = 0.23, p = .82$  or at follow-up  $t(74.80) = 1.17, p = .25$ . For IJAEC there was also no significant time\*group interaction at posttest  $t(74.11) = -0.16, p = .88$ . There was however a significant time\*group interaction, favouring the ImPACT group at follow-up,  $t(75.20) = 2.15, p = .035$ . See Figure.

Conclusions: Project ImPACT does not seem to have a differential effect on the total number of initiations of joint attention, compared to TAU. However, children who received Project ImPACT showed an improvement in the number of joint attention bids that were combined with eye contact at follow-up, whereas TAU children showed no sustained improvement in this skill. This shows that Project ImPACT mainly influences the quality of joint attention and helps to sustain this skill after parent training has ended.

**426.016** (Poster) Effectiveness of a Parent-Implemented SCERTS Model-Based Intervention for Toddlers with Autism Spectrum Disorders

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Background: SCERTS has been developed to disseminate NDBI intervention systems through parent implementation at home in collaboration with professionals. In SCERTS model, parents work with professionals to assess children and then choose a set of individual techniques they think will be the most beneficial for their children. Parents help conduct the initial assessment, set intervention goals and play a central part in implementing the teaching support and techniques

Objectives: The purpose of this study is to investigate the effectiveness of parent-implemented SCERTS Model-based intervention for toddlers 23-33 months old with ASD and their parents, ensuring the procedure used to support and engage the parents in home settings where intervention is provided

Methods: A home-based experimental group involving 9 toddlers and their parents was formed investigating the efficacy of a parent-delivered intervention compared to the control group. Parents in the experimental group received two parent education sessions on the characteristics of toddlers with ASD and the developmental features of infants and toddlers.

Results: Results showed that there were statistically significant differences in the degree of change in toddlers' joint attention skills, functional play skills, and parenting efficacy between the two groups. The experimental group showed improvement in both initiating joint attention and responding to joint attention skills

Conclusions: This study provide an initial basis for parent-implemented intervention using SCERTS Model in the family routines as the context for early intervention services for children with ASD. The results of this study is an extension of previous at-home parent-implemented intervention by demonstrating feasibility with younger children, using a limited number of sessions.

**426.017** (Poster) Effectiveness of Responsivity Intervention Strategies on Prelinguistic and Language Skills of Children with ASD: A Meta-Analysis of Randomized Controlled Trials

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Background: Investigations of the effectiveness of communication and language interventions vary across multiple facets and have yielded widely varying results. One organizational approach to synthesizing prior results is to evaluate the effectiveness of interventions that include specific intervention components to identify active ingredients. Interventionists can then implement these essential strategies.

Objectives: This systematic review and meta-analysis aims to describe the current state of the literature for the role of responsivity intervention strategies (i.e., support turn-taking conversations through responding systematically to children's vocalizations and communicative attempts, following the child's lead, and providing targeted input) to influence the direction of future research studies and clinical practice. Multiple converging theories provide theoretical support for responsivity intervention strategies. Research questions: Is the mean effect size for interventions that use responsivity strategies on prelinguistic and/or language skills in children with ASD greater than zero for randomized controlled trials (RCTs)? Does the mean effect size vary by interventionist, length of intervention, proximal versus distal outcome, context-bound versus generalized characteristic outcome, risk for correlated measurement error (CME), or publication status? What percentage of included studies exhibit low, moderate, and high risk of bias?

Methods: We conducted a systematic review to identify records of RCTs of children with ASD comparing an intervention that used responsivity intervention techniques to one that did not. Reports had to include prelinguistic and/or language outcomes.

Results: Of 5671 reports screened, 45 reports from 33 RCTs met inclusion criteria (single case research design studies [ $n = 91$ ] presented at a later date) and included 293 relevant effect sizes. The mean treatment group sample size was 26.7 (range: 5-82) and mean age of 42.1 months (range: 20.6-110.7 months). RQ1: The mean standardized group difference using robust variance estimation with random effects is  $g = .37$ , 95% CI [0.22, 0.52]. The Galbraith plot (Figure 1) and  $\tau^2$  value (0.18) indicate substantial heterogeneity. RQ2: Context-bound outcomes exhibited a larger mean effect size (mean  $ES = 0.47$ ) than generalized or possibly context-bound behaviors combined (mean  $ES = 0.25$ ). No other moderator analyses yielded significant results. Of note, the mean effect size was greater than zero for effect sizes at-risk for CME (mean  $ES = 0.39$ ), but not for those free from

CME risk (mean  $ES = 0.14$ ). Although a publication bias was not detected via the moderator analysis, the Egger's test suggests publication bias against small studies with negative results (Figure 2). RQ3: Twenty-five studies were coded at overall high risk versus seven at moderate risk and one at low risk. A primary reason for studies being high risk was risk for CME.

Conclusions: We identified a significant, positive mean effect size for interventions that include responsivity strategies increasing prelinguistic and language skills in children with ASD compared with randomly assigned control conditions. Context-bound outcomes exhibiting a larger mean effect size than generalized or possibly context-bound behaviors. The majority of studies exhibited overall high risk for bias. Future directions include testing of additional putative moderators to explain heterogeneity and synthesizing single case research design studies.

**426.018 (Poster)** Effectiveness of World Health Organization Caregiver Skills Training Programme for Families of Children with Developmental Disorders or Delays in Taiwan: The First Year at Implementation Stage

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Background: Though several effective early intervention models for autism spectrum disorder (ASD) were developed, many children with ASD can't get them where resources are limited. Caregiver Skills Training Programme for Family of Children with Developmental Disorders or Delays (CST), developed by World Health Organization (WHO) and Autism Speaks (AS) for the resource gap, just meets the huge needs of children with ASD globally. Taiwan CST team already presented the adaptations and results of their pilot study to show CST's effectiveness in an international meeting, and started implementation stage in 2019.

Objectives: This study aimed to examine the effectiveness of CST-Taiwan in the first year of the post-pilot stage.

Methods: The CST-Taiwan consists of a combination of nine group sessions for caregivers, three individual sessions for home visiting, and seven phone follow-ups in five months, executed by 2 facilitators (FT) fully trained and under the supervision of Master Trainers (MT). We analyzed data of 35 families (most of them having children with ASD) enrolled from 7 sites, including northern/southern Taiwan and an offshore island, with parent-reported questionnaires before and after intervention. Paired t-test was used to evaluate the parenting skills and confidence of the caregivers with the Caregiver Skills Training Test for Caregivers, and the adaptive function and health problems of their children with the Autism Treatment Evaluation Checklist (ATEC) and Adaptive Behavior Assessment System (ABAS-II).

Results: The result showed that the intervention outcomes of caregivers' skills and confidence were facilitated significantly (knowledge  $t=6.72, p<0.001$ ; confidence  $t=7.37, p<0.001$ ; empowerment  $t=4.83, p<0.001$ ) and children's symptoms and adaptive function were also improved significantly (concept  $t=4.94, p<0.001$ ; social cognition  $t=3.53, p=0.001$ ; functional skill  $t=5.42, p<0.001$ ; motor  $t=2.76, p=0.010$ ; speech communication  $t=3.56, p=0.001$ ; sensory/cognitive awareness  $t=3.10, p=0.004$ ; health/physical behavior  $t=-3.20, p=0.003$ ).

Conclusions: The results revealed that CST-Taiwan continued to show its effectiveness for the first year of the implementation stage, and many children with ASD and their caregivers got significant benefit from it. It is suggested that CST-Taiwan is worthy of being adopted as a nationwide policy in Taiwan.

**426.019 (Poster)** From Clinic Room to Zoom: Deploying an Evidence-Based Parent-Mediated Intervention in the Community before and during the Pandemic

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Background: The Research Units in Behavioral Intervention (RUBI) protocol is an evidence-based, parent-mediated intervention (PMI) for young children (4-8 years old) with autism and disruptive behaviors (e.g. Bearss et al., 2015). PMIs engage parents as agents of change and their effectiveness for children with autism has a solid evidence base (e.g. Pickles et al., 2016).

The initial goal for this study was to examine the efficacy of RUBI in a community-implemented, group format with Jewish and Arab Israeli families. With the onset of the Covid-19 pandemic, in-person groups shifted to online delivery, and all subsequent groups have been virtual. While logistically challenging, this shift allows us to examine the efficacy of the intervention virtually and affords us the ability to directly compare between in-person and virtual groups.

**Objectives:** In addition to examining the efficacy of RUBI in a community-delivered, group format, the current study seeks to elucidate the differences or similarities between in-person and virtual groups, with focus on immediate and short-term (2-month) follow up when possible, and to examine outcome predictors in both modalities.

**Methods:** The RUBI protocol was delivered to 60 families of children with a recognized diagnosis of autism between the ages of 4-8 in a group format. Of these families, 34 participated in-person and 28 did so virtually. The intervention is a 12-week, structured protocol. Data collection took place at week 1 and 12, with follow-up data collection one and two-months afterward. Primary outcome measures were the parent-report Aberrant Behavior Checklist (ABC; Aman, Singh, Stewart, & Field, 1985a, b), and the Home Situations Questionnaire (HSQ; Barkley and Murphy 1998). Secondary outcomes were parent stress, assessed with the Parenting Stress Index-Short Version (PSI-SR; Abidin, 1990) and repetitive behaviors, assessed with the Repetitive Behavior Scale-Revised (RBS-R; Bodfish, Symons, & Lewis, 1998).

**Results:** Results indicated significant reduction of DBs in in-person groups ( $p=0.003$ ). ABC total score indicated slightly reduced efficacy in virtual groups ( $p=0.15$ ), although the Irritability sub-scale was significant (virtual:  $p=0.012$ ). Gains following the intervention were maintained in in-person groups for two months following the intervention, with no significant regression at two-month follow-up ( $p=0.46$ ). Follow-up data for virtual groups is currently being collected.

Secondary outcome measures indicated reduced parenting stress in in-person groups (PSI Total;  $p=0.002$ ), with specific subscales indicating improvement in virtual groups (Defensive Responding:  $p=0.002$ ; Parental Distress:  $p=0.007$ ).

Child improvement in the in-person and virtual groups was predicted by child- and not parent-characteristics (e.g. PSI). Higher ABC-TOTAL scores prior to the intervention were associated with greater improvement (in-person:  $p=0.001$ ,  $r=0.59$ , virtual:  $p=0.004$ ,  $r=0.54$ ). In virtual groups, symptom severity predicted outcome as well (RBS-R; in-person:  $p=0.09$ ,  $r=0.28$ , virtual:  $p=0.002$ ,  $r=0.58$ )

**Conclusions:** This study points to the efficacy of RUBI in a group, community-implemented version as well as when delivered virtually, albeit with slightly reduced significance. Reduction in DBs following the intervention maintained for two months in in-person groups, and higher DBs at intervention onset predicted positive outcomes. Further study with a larger sample, particularly of the virtual group, is necessary, as is longer-term follow-up.

**426.020 (Poster)** Implementation of the Group-Esdm in a Childcare Setting Serving Under-Resourced Communities  
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**Background:** Despite advances in early intervention research, many children with ASD do not have access to effective treatments, especially in under-resourced communities serving low-income families. The Group Early Start Denver Model (G-ESDM; Vivanti et al., 2017) is an early intervention approach based on the adaptation of the Early Start Denver Model (ESDM; Rogers & Dawson, 2010) for delivery within educational group settings such as daycares and preschools. Studies have shown that providing G-ESDM during childcare hours has the potential to maximize efficiency and promote positive treatment outcomes without disrupting parents' workforce participation (Vivanti et al., 2014; Sinai-Gavrilov et al., 2020). However, despite this initial evidence, there is limited knowledge about the feasibility and effectiveness of implementing this intervention in US childcare settings that specifically serve under-resourced communities.

**Objectives:** The current study examines feasibility and implementation indicators of delivering the G-ESDM at the So Love Autistic Center, a US community childcare setting serving under-resourced communities, as well as preliminary indicators of effectiveness.

**Methods:** We used a community-partnered participatory approach (Jones & Wells, 2007) and the RE-AIM Implementation Science Framework (Glasgow, Vogt, & Boles, 1999) to design, implement and evaluate the delivery of the G-ESDM at So Love Autistic Center. Five male children (ages 32-41 months) with a confirmed ASD diagnosis received G-ESDM daily at So Love Autistic Center for approximately 6 months. The intervention was administered by trained staff members under the supervision of certified ESDM trainers. Following the RE-AIM implementation framework, we collected survey measures of perceived acceptability and feasibility of implementation ("adoption"), projected sustainability of implementing G-ESDM after the study's

conclusion (“maintenance”), characteristics of the families who signed up for the program (“reach”) as well as fidelity of implementation using the G-ESDM fidelity tools (“implementation”). Changes in pre and post age equivalence scores on the Mullen Scale of Early Learning (MSEL; Mullen, 1995) and Vineland Adaptive Behavioral Scale-2<sup>nd</sup> Edition (VABS-II; Sparrow et al., 2016) were analyzed to assess preliminary indicators of effectiveness of the intervention in this setting (“effectiveness”).

Results: Demographic data indicated that the study successfully reached the target population of children with ASD from under-resourced communities who may have limited access to care (“reach”). Changes in age equivalence scores on the VABS-II (Figure 1) and MSEL (Figure 2) revealed that most children who received G-ESDM achieved measurable progress in communication, socialization, visual reception and fine motor skills. These results provide preliminary indication that G-ESDM may be effective when integrated in this type of setting (“effectiveness”). Responses on the staff survey indicated a high level of feasibility and acceptability of the intervention (“adoption”) along with intent to continue treatment after the conclusion of the study (“maintenance”). Monitoring of fidelity indicated that staff members were able to integrate the G-ESDM techniques at an acceptable level of fidelity, between 60-88%, across fidelity items following targeted training and supervision (“implementation”).

Conclusions: Findings across all RE-AIM framework domains indicate that incorporating G-ESDM into the daycare setting can be feasible, successfully implemented, and potentially beneficial for children and their families in under-resourced communities.

#### 426.021 (Poster) Interventions for Children on the Autism Spectrum: A Systematic Umbrella Review

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**Background:** Having access to effective intervention during childhood is an important element of the intervention pathway for children on the autism spectrum, providing an opportunity to support early development and promote longer-term quality of life. There are a large number of interventions available within clinical practice, which vary in their theoretical orientation and practical application. However, no previous review has provided a systematic evaluation and synthesis of the evidence for autism interventions across different intervention types. The clear gap in synthesized knowledge has created substantial clinical confusion, and the proliferation of interventions with a questionable evidence base.

**Objectives:** To conduct an umbrella review which synthesises the scientific evidence for the therapeutic (and other) effects of interventions for children on the autism spectrum aged 0-12 years.

**Methods:** The umbrella review was conducted according to the procedures outlined in the Joanna Briggs Institute manual for evidence synthesis and the PRISMA Reporting Guidelines. The review protocol was pre-registered (PROSPERO; Open Science Framework) and focused on systematic reviews that included at least one randomised controlled trial or controlled clinical trial of an intervention designed for use with children aged 0-12 years. Interventions were grouped into nine different theoretically-derived intervention categories: behavioural, developmental, naturalistic developmental behavioural (NDBI), sensory-based, technology-based, animal-assisted, cognitive behaviour therapy (CBT), Treatment and Education of Autistic and related Communication-handicapped Children (TEACCH), and ‘other’ interventions. A systematic and reproducible method was used to collate and synthesise data from the systematic review into a matrix showing evidence for the effects of a given intervention on a wide range of child and family outcomes.

**Results:** The systematic search of 10 academic databases and grey literature (years 2010-2020) yielded 58 eligible systematic reviews, representing 1,787 unique studies. The systematic reviews were of variable quality, and only 4 met all ‘high quality’ indicators. The 58 systematic reviews provided data on at least 111 different practices across the nine intervention categories.

There was evidence for positive effects on a range of child and family outcomes for behavioural interventions, developmental interventions, NDBIs, technology-based interventions, and CBT. Within these categories, the intervention effect on outcomes was variable (null, positive) across intervention practices. Positive intervention effects for sensory-based interventions were reported for certain intervention practices only, and in those cases, positive effects were limited to select child and family outcomes. A mix of inconsistent and null intervention effects on child outcomes were reported for both TEACCH and animal-

assisted interventions. There was either null or inconsistent evidence that child characteristics (age, cognitive ability, communication skills) or intervention characteristics (e.g., intensity, delivery mechanism) moderate intervention effects. Minimal information was provided on adverse effects.

**Conclusions:** This review provides the most comprehensive synthesis to date of the effects of different autism interventions, and represents an important step forward in evidence-based practice for children on the autism spectrum. The findings yield clear conclusions that will inform clinical and policy decision making regarding the most appropriate and evidence-based supports for children on the autism spectrum and their families.

**426.022 (Poster)** Investigate the Parent Learned Specific Skills during 10 Weeks Parent Early Start Denver Model Training Program

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**Background:**

Parent implemented-early start Denver model (P-ESDM) program have been indicated effectiveness in various culture (Rogers et al., 2012; Estes et al., 2014; Zhou et al., 2018; Fan & Tseng., 2020). Parent have been coached using several strategies in P-ESDM program to help Autism spectrum kids to communicate and learn in everyday activities. One study figure out the specific result (Waddington et al., 2019) from western culture background, however, no study to figure out what the specific skill they learn more correlate with children improved from Asian culture perspective.

**Objectives:**

Since we know the culture play a different roles in parenting. The first aims to analysis which domain-general ESDM strategies parent learned correlated with the children's communication improved. The second purpose we also expect that how domain-specific strategies parent learned with individual.

**Methods:**

Six parent-child were recruited. Children's average age is around 27m (SD is 9.3) to conduct the P-ESDM. The main-caregivers are all mothers. All the kids were assessed cognitive/language domains by Mullen scales of early learning , social-interaction domain by Screening Tool for Autism in Toddlers & Young Children (STAT) and Childhood Autism Rating Scale–Second Edition (CARS-2) inventory, and ESDM curriculum to build up individual 10 treatment goals for next 10 weeks. P-ESDM was conducted by a certified ESDM therapist and certified ESDM Parent Coach. And follow up assessment was different therapist whose was a clinical psychologist. Parent stress status from parent stress inventory-forth edition (PSI-4), parenting sense of competence scale (PSCS) and board autism phenotype (BAP) were also measured. Communication and interaction goal score (1-6) are as target to measure with Parent each week fidelity via correlation analyse.

**Results:**

Each child improved their communication and interaction ability from standard assessment result. The parent get less parenting stress after 10 weeks. Each group of families can get different levels of ESDM skills at the end of the course compared to the baseline before intervention; similarly, we measure the communication goals and interaction of young children can be high correlated with parental ESDM strategies and skills.

**Conclusions:**

In conclusion, we could find the general skills most improved parenting skills was multiple varied communicative functions, the parent learn the skill apply to the different daily routine to facilitate the interaction and create the opportunities of receptive and expressive communication. Similarly, some skills are highly correlated with children's progress in different parent styles which will be highly correlated with the abilities that parents have acquired previously. The overall examining parent use specific intervention skills are similar to previous studies. This suggest that parent training should tailor and adapt the current abilities and needs.

**426.023 (Poster)** Linking Social Communication and Disruptive Behaviour in Parent-Mediated Interventions for Toddlers with ASD

Background:

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impaired social-communication and restricted repetitive interests and patterns of behaviour. Furthermore, children with ASD frequently experience behavioural challenges. These disruptive behaviours (e.g., aggression, non-compliance) have a significant impact on learning acquisition and social relationships. Much research has been devoted to understanding how parents can reduce children's challenging behaviour and many parent training programs have been developed to target both parents' skills and children's responses to their parents (Kaminski & Claussen, 2017). For children with ASD, a recent meta-analysis supported the use of parent training for disruptive behaviours and found it to be as effective as parent training for children with disruptive behaviour but no ASD diagnosis (Postorino et al., 2017).

Objectives:

This study expands on research from a randomized control trial (RCT) of a manualized parent-mediated intervention. This intervention primarily targeted functional social communication and positive affect sharing for toddlers with confirmed or suspected ASD. This program also contained many parenting strategies used in the treatment of disruptive behaviour. As such, the current study aimed to: (1) assess whether children receiving the intervention showed decreases in disruptive behaviour following the intervention, and (2) examine the relationship between social communication skills and disruptive behaviour.

Methods:

This study utilized a subset of families who participated in the intervention RCT through a large rehabilitation hospital in Toronto, Canada. The sample consisted of thirty-two toddlers ( $n = 32$ ; age range: 16 to 30 months). In the RCT, continuous 10-minute video clips of parent-child interactions were taken at baseline, post-training, and follow-up. In this study, a video-coding scheme was adapted from the Dyadic Parent-Child Interaction Coding System (D-PICS; Eyberg & Robinson) and used to code the child's disruptive behaviour at each time point.

Results: Analyses were conducted using generalized estimating equations (GEE) as the majority of disruptive behaviour variables did not meet the assumption of normality. Preliminary analyses indicated that toddlers in the treatment group demonstrated significant decreases in refusal behaviours (e.g., going limp in parental hold, moving parents' hand off of toy to regain control) between baseline ( $M = 7.11$ ,  $SD = 1.54$ ) and follow-up (i.e., 24 weeks after baseline;  $M = 2.44$ ,  $SD = 1.04$ ;  $p = .029$ ). In comparison, toddlers in the control group did not demonstrate a decrease between baseline ( $M = 4.71$ ,  $SD = .99$ ) and follow-up ( $M = 4.61$ ,  $SD = 1.40$ ;  $p = .95$ ). Additional analyses exploring the relationship between social communication skills will be available at the time of the conference.

Conclusions: These findings suggest that this parent-mediated intervention has positive effects on both toddlers' social communication and non-compliant behaviours. There are several possible reasons for the decrease in disruptive behaviours, including increased parent-child synchrony, which may lead to a reduction in refusal behaviours, as well as an increased ability for the child to communicate their wants and needs to their parents, resulting in less parental uncertainty. Further analyses will substantially increase our understanding of the reciprocal relationship between communication and challenging behaviours.

**426.024 (Poster)** Micro-Analysis Reveals Increased Parent-Child Positive Affect in Severely Impaired Children Receiving the Esdm

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Background: Shared positive affect (SPA) is a key element of parent-child interaction, which is related to favorable developmental outcomes. Children with autism and their parents tend to show less SPA compared to other populations. SPA is a pivotal component in Naturalistic Behavioral Developmental Interventions (NDBI), one of which is the Early Start Denver Model (ESDM). The ESDM highlights the importance of the interaction partner's positive affect as a way of increasing the reward value of social engagement.

**Objectives:** The current study aimed to assess changes in SPA among children with ASD and their parents following a preschool-based ESDM program with regular parental involvement and training, compared to a the commonly used Multidisciplinary-Integrative Intervention (MDI).

**Methods:** Thirty children receiving PB-ESDM (7 girls) and their parents (4 fathers) and 23 receiving MDI (2 girls, 4 fathers) participated in the current study. Groups were comparable on age, SES and DQ. Overall adaptive behavior levels at pre-intervention were higher in the PB-ESDM group and were therefore entered as a covariate in the analysis.

Children in both groups received the intervention during their 44 weekly hours preschool time, over an 8-month period. The PB-ESDM included two weekly ESDM sessions and one weekly hour of a parent-child joint intervention, in which therapists provided modelling and coached parents on the delivery of ESDM techniques. Parents were encouraged to increase shared positive affect by using strategies such as exaggerated facial expressions, gestures and voice, creating enjoyable sensory-social routines and following the child's lead. MDI consisted of a combination of methods from several approaches such as Floortime™, TEACCH and applied behavioral analysis. Parents of children from the MDI group attended bi-weekly parent counseling sessions with the child's case manager in which various issues were discussed, as initiated by the parent.

Parent-child free-play interactions were video-recorded pre and post intervention. These interactions were then microanalytically coded using the Observer XT software, providing a continuous moment-to-moment measure of overall SPA observed during the interaction. SPA was defined as a period of time in which both child and parent demonstrated positive affect. Children's adaptive functioning was parent-reported using the Vineland Adaptive Behavior Scales, 2<sup>nd</sup> Ed.

**Results:** An interaction effect between group (PB-ESDM/MDI), pre-intervention adaptive behavior functioning (high/low – above/below median), and time (pre/post intervention) was found on dyads' SPA. Post-hoc analysis revealed that dyads from the PB-ESDM group whose children had lower pre-intervention adaptive functioning demonstrated a significant increase in SPA, compared to the dyads from the MDI group, and dyads from the PB-ESDM with higher pre-intervention adaptive functioning (Figure 1).

**Conclusions:** The current findings demonstrate the effect parental involvement in ESDM has on parent-child SPA, especially among children with poorer pre-intervention adaptive functioning. Engagement in dyadic routines characterized by shared positive affect has the potential of extending children's learning opportunities. Furthermore, our findings suggest that SPA may serve as a sensitive treatment outcome measure for children with lower pre-intervention functioning levels, who often show no significant changes on standardized measures. The study's modest sample and non-randomized design are noted as limitations.

**426.026 (Poster)** Outcomes of a Short-Term Low-Intensity Early Start Denver Model Implemented in the Taiwanese Public Health System: 6-Month Follow-up

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**Background:** Early Start Denver Model (ESDM) is one kind of Naturalistic Developmental Behavioral Interventions for young children with autism spectrum disorder (ASD). In the past nearly 10 years, most of the ESDM studies were reported in the west, how to implement ESDM in the Chinese culture such as Taiwan and merged into Taiwanese public health system is an open issue.

**Objectives:** The purposes of this study was to examine 6-month follow-up after implementing the ESDM intervention based on Taiwanese public health policy for young children with ASD in the Greater Taipei area in Taiwan.

**Methods:** A case control study was conducted. A total of 42 children with ASD aged between 25 and 46 months were recruited. A multidiscipline team included child psychiatrists and clinical psychologists based on DSM-5 diagnosis of ASD. The ESDM intervention group (N = 21, mean age = 33.23 months) matched to the control group who got community-intervention (N = 21, mean age = 35.14 months) on chronological age, overall development quotient (DQ) and sex. Children in ESDM intervention group received 9 hours per week of one-on-one ESDM intervention in clinical settings for 24 weeks. Children's outcome measures were administered at pre and post intervention, comprising the cognitive ability, language, adaptive behaviors and symptom severity assessed by the Mullen Scales of Early Learning, Mandarin-Chinese Communicative Development Inventory (MCDI), Adaptive Behavior Assessment System (2<sup>nd</sup> Edition, ABAS-II), and Autism Diagnostic Observation Scales (ADOS), respectively.

**Results:** The results indicated that from pre- to post- intervention, children with ASD in ESDM group showed significantly improvements in nonverbal cognitive ability, verbal cognitive ability, overall cognitive ability, vocabulary production, mean length of utterance and general adaptive behaviors ( $p < .01$ ). The improvements in nonverbal cognitive ability and overall cognitive ability were greater than the children with ASD in control group. However, when following up at 6 months, there was no significant improvements in ESDM group from post-intervention to 6-month follow-up, and there was no significantly difference in improvements between the two groups.

**Conclusions:** This study was the first finding to support the implementation of ESDM in Taiwan. The results suggested that a short-term and low intensity of ESDM intervention directly delivered by a multidisciplinary team in clinical settings may be a promising treatment for young children with ASD. However, the positive effects could not be maintained for 6 months. Relative factors such as child's and parental characteristics influencing long-term effectiveness might be clarified.

**426.027 (Poster) PACE Coaching: Training Community Providers to Support Parents of Toddlers at Risk for ASD**  
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**Background:** There is growing evidence to support the efficacy of parent-delivered intervention based on the Early Start Denver Model (ESDM; Estes et al., 2013; Rogers et al., 2012, 2018). In most ESDM studies, parents are coached in academic settings by graduate-level clinicians who are certified in ESDM. There is a need to train community-based providers to provide parent coaching in order to make this support more widely available.

**Objectives:** The coach training phase of the PACE Coaching project was designed to develop, implement, and evaluate the effectiveness of an adapted version of ESDM training for community providers.

**Methods:** Thirty-nine community providers in 15 child development centres were nominated by their Executive Directors to be trained as parent coaches. All training was provided by three master trainers who are certified ESDM parent coaches and reside locally. Trainees were all women ( $M$  age = 44 years); 66.7% completed college or University undergraduate programs and 33.3% completed graduate degrees. In consultation with ESDM authors, the PACE Coaching team created a coach training approach that consisted of two phases. In the first phase (PACE1), trainees attended an intensive, 3-day workshop and then practiced the social-communication intervention strategies they learned with a toddler in their agency for 12-13 weeks. In the second phase (PACE2), they attended a second 3-day workshop and then practiced the parent coaching strategies they learned with a parent and child in their agency for 16-20 weeks. Mentored practice was delivered remotely via a secure portal that enabled face-to-face conferencing and video recording. Trainees tracked the time spent on various tasks during training, and trainers evaluated coaches' skills following PACE1 and at project completion using checklist tools that were adapted from ESDM training.

**Results:** Twenty-seven trainees completed all training over a 10-month period. Half of withdrawals occurred because of caseload demands that interfered with participation. Post-workshop practice required a mean of 29.5 hours following each workshop; trainees with graduate degrees required significantly less time than those with undergraduate degrees in PACE2 practice. Post-PACE1, trainee skills for working with a young child improved from a baseline mean of 69.1% to a mean of 83.3%, with no significant difference between undergraduate and graduate coaches. At project completion, master trainers observed a final coaching session for each family and completed a coaching skills checklist; inter-observer agreement was 90.8%. The mean score for graduate coaches (83.9%) was significantly higher ( $p < .05$ ) than the mean for undergraduate coaches (66.9%); however, no significant correlations were found between groups for checklist scores or for either parent or child outcome measures.

**Conclusions:** Results suggest that PACE Coaching can be successfully used to train community providers to coach parents in an adapted version of parent-implemented ESDM. Opportunities provided for hands-on practice during the workshops and the remote mentoring provided during post-workshop practice and coaching periods were essential for building coach confidence and for skill development in all areas.

**426.028 (Poster) Parent Therapeutic Factors in Mental Health Treatment for Autistic Children: A Qualitative Analysis**  
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**Background:** Many autistic children and youth experience mental health problems, and cognitive behaviour therapy (CBT) is considered an effective treatment for many (van Steensel & Bögels, 2015). Parents are particularly involved in psychotherapy for autistic children because of the core deficits associated with autism (Reaven et al., 2009), even being asked to attend and assist with therapy sessions (Reaven & Hepburn, 2003). There has yet to be a conceptual framework to identify the variables that contribute to successful parent therapeutic involvement in children's psychotherapy.

**Objectives:** This study aimed to develop a conceptual framework of successful parent therapeutic involvement in CBT for autistic children, and the factors that lead to it.

**Methods:** Seventeen therapists (94% female) and 11 mothers participated in individual semi-structured interviews. All participants were involved in one of two randomized controlled trials of CBT for children ages 8-13 with autism. In the CBT program, parents attended all 10 weekly sessions with their child, and were involved in activities during and outside of session time. Data collection and coding for the current study occurred in overlapping phases, and sample size was determined by theoretical saturation (Corbin & Strauss, 2008). Interview questions included initial open-ended, intermediate, and ending questions (Charmaz, 2006). Reflective memos were recorded immediately following each interview. Interviews were transcribed verbatim, and coding occurred in three overlapping phases: open, axial, and selective (Corbin & Strauss, 2008). To enhance methodological rigor, we employed applied analyst triangulation, constant comparative coding, and member checking.

**Results:** “Very involved/helpful” parents were committed, engaged, supportive, and mindful. The level of parent involvement varied among families. As depicted in the conceptual framework (see Figure 1), the extent of parent involvement considered helpful may depend on child factors (e.g., age, developmental level, temperament), the parent-child relationship, parent factors (e.g., mental health, attitudes, previous experiences with therapy), and family factors (e.g., other children, spousal support, financial resources). The specific ways parents might contribute to the therapeutic process were grouped into five main roles: 1) **logistical coordinator** (e.g., scheduling sessions, organizing materials, arranging transportation), 2) **co-facilitator** (e.g., helping to facilitate session activities, providing information about the child, helping with skill generalization), 3) **coach and cheerleader** (e.g., praising and encouraging the child, helping the child with emotion regulation), 4) **companion and teammate** (e.g., helping the child feel safe, participating in activities with the child), and 5) **complementary helper** -- bridging the gap between the child’s capacity and what is expected of them within the therapeutic context (e.g., being attuned to the child’s needs, helping the child build a relationship with the therapist, managing child behavioural or attention problems).

**Conclusions:** Parents can serve many different roles in helping their child to benefit from CBT and enhance skill maintenance following the end of therapy. Autistic children may benefit from parent involvement in therapy because parents can complement the child’s needs and enable their full participation in the therapeutic context. This is the first study to empirically investigate how parents of autistic children contribute to the therapeutic process in child psychotherapy.

**426.029 (Poster)** Perceptions of Brazilian Parents and Clinicians of a Low-Cost Parent-Mediated Intervention for Autistic Children

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**Background:** Effective support and treatment for autistic individuals is lacking in Brazil. Few centres offer services and those that do are limited in therapeutic options and geographical location. Effective, low-resource interventions for autism are therefore urgently needed in Brazil. Paediatric Autism Communication Therapy (PACT) is a low-resource, evidence-based parent-mediated social-communication intervention and may be useful for this scenario.

**Objectives:** As part of a larger implementation study, we aimed to assess the acceptability of introducing PACT for young autistic children (aged 2-10 years) in Brazil.

**Methods:** Qualitative methods were used to explore parental and clinicians’ perceptions concerning the acceptability of PACT in Brazil. The original PACT protocol includes fortnightly home or clinic sessions with therapists, who support parents in learning strategies to adapt their communication style to their child’s social-communication difficulties using video-feedback of parent-child play interactions. Between sessions with the therapist, parents are asked to practice the strategies with the child at home every day for 30 minutes. Eighteen parents of 2-10 year-old autistic children were recruited from publicly accessible child mental health clinics, and 20 clinicians (psychologists, speech therapists, occupational therapists) who work therapeutically with autistic children were recruited from national clinics offering assessment and/or treatment services for autism. After a detailed explanation about PACT, semi-structured, in-depth-interviews about the intervention and its potential use in Brazil were conducted with the 18 parents and 20 clinicians. Interviews were conducted individually and by telephone due to the COVID-19 pandemic. Interview data were analyzed separately for parents and clinicians using thematic analysis according to Braun & Clarke’s (2006) six stages. In addition, parents completed the validated Brazilian “Communicative Difficulties Questionnaire”, which assesses difficulties parents experience in communicating with their autistic child, to quantitatively evaluate the need for a therapy focused on improving parent-child social communication in Brazil.

Results: All parents and clinicians had favorable opinions about the feasibility and effectiveness of a parent-mediated intervention that would be conducted mainly in the home. This included viewing PACT as an intervention that could result in improvements in social-communication development in the child's daily life, providing parents with the skills to support their child's development, and the low-cost nature of the intervention. However, most parents and clinicians also raised possible obstacles concerning the effective use of PACT in Brazil. These related to cramped and noisy home environments, which would complicate implementation of the intervention strategies by parents, and clinician reports of difficulties engaging Brazilian parents in therapy. Finally, the results of the questionnaire revealed that all parents would like to have more information about how to communicate better with their child and most reported difficulties in communicating with their autistic child.

Conclusions: The current findings support the acceptability and utility of PACT for Brazil, and highlight where adaptations to the original protocol are required before assessment in feasibility research.

**426.030 (Poster)** Pivotal Response Treatment (PRT) with Parent Group Training for Young Children with Autism Spectrum Disorder: A Mixed-Methods Approach

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Background: Pivotal Response Treatment (PRT) is a promising intervention addressing core symptoms of children with autism spectrum disorder (ASD), with parent involvement as key component (Koegel & Koegel, 2006). Parent group delivered PRT is suggested to be an effective treatment model for young children with ASD, but currently the evidence is limited and little attention has been paid to the involvement of multiple important contexts (e.g. home, school, family) of the child. It is also unclear how parents experience these type of intervention models and which facilitators and barriers are identified. Insight in the efficacy and perceived experiences of parent group delivered PRT are needed to optimize treatment outcome of young children with ASD and their family.

Objectives: The current study aims to explore a 14-week protocol of PRT parent group training (PRT-PG), complemented with individual parent-child sessions and involvement of teachers and other child care providers, for young children with ASD and their parents.

Methods: A mixed methods approach was conducted to explore the efficacy and feasibility of PRT-PG. Participants included 20 children aged 2-6 years old with ASD (90% boys; mean age = 4.92, SD= 1.07) and their parents. Social-communicative skills and collateral gains (e.g. adaptive functioning, clinical global functioning, parenting stress) were assessed with parent- and clinician- rated questionnaires and semi-structured observations at baseline and after 14 weeks of intervention. Semi-structured interviews ( $n=15$ ) were conducted at endpoint to understand parents perspectives on facilitators and barriers and perceived effects of PRT-PG. Coding was based on Grounded Theory (Glaser & Strauss, 2017).

Results: As presented in table 1, quantitative analyses showed a significant increase in spontaneous initiations during a semi-structured therapist-child interaction ( $p = .004$ ,  $d = 0.86$ ) together with widespread gains in clinical global functioning as measured with the CGI-severity score (CGI-S;  $p = 0.01$ ,  $d = 0.69$ ) and the CGI-Improvement score (CGI-I; 80% of the participants improved). No significant improvement on parent-rated general social-communicative skills (i.e. SRS-2; Social Responsiveness Scale- Second Edition) was observed. Preliminary qualitative analyses of interviews suggest the following facilitators and barriers; treatment format (e.g. combination of parent group, individual sessions and other contexts), role of PRT therapist (e.g. therapeutic alliance), contextual factors (e.g. time investment), and individual participant characteristics (e.g. child's age). Parental effects included awareness, insight and acceptance of their child's and own behavior, along with raised feelings of competence. Subsequently, parents mentioned improved family cohesion. Perceived child's gains were mentioned on functional and social questions, eye contact and emotion-regulation. Further analyses will be performed and presented.

Conclusions: These exploratory findings suggest feasibility and efficacy of the PRT parent group training on child's social-communicative skills and global functioning. Also, the complementary addition of individual sessions and multiple contexts of the young child with ASD seem to contribute to a patient-tailored approach. Implication of findings and future research will be discussed.

**426.031 (Poster)** Pivotal Response Treatment: Perspectives of Autistic Adults

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**Background:** While behavioral interventions for autistic children are evidence-based and widely viewed by clinicians as best practice, many autistic adults have spoken out against them. Some individuals report trauma as a result of interventions that they feel have been designed to suppress autistic characteristics. Recently developed Naturalistic Developmental Behavioral Interventions (NDBIs), however, aim to offer a more accepting approach by emphasizing child motivation and naturalistic, child-initiated learning opportunities. Nevertheless, research has yet to explore autistic perspectives on NDBIs.

**Objectives:** This study aimed to learn more about how autistic adults view a common NDBI, Pivotal Response Treatment (PRT).

**Methods:** Thirty-five autistic adults (16 F, 10 M, 6 Non-binary, 3 unknown) were recruited to take an online survey that included 5 short video clips of children receiving PRT. Participants were not informed of the intervention type. All videos were judged to meet PRT fidelity. Four videos included children who verbally responded correctly to prompts and who were subsequently reinforced. One video showed an interventionist providing a nonverbal child with a challenging verbal task in which they were unsuccessful and reinforcement was withheld. After each video, participants were asked to rate to what degree they agreed that they (1) found the intervention acceptable and (2) would suggest the intervention for others (1=Strongly Disagree; 6=Strongly Agree). Participants could also type feedback regarding each video into a textbox. To preliminarily analyze data, descriptive statistics were used to evaluate quantitative responses, and thematic analysis was employed to analyze open-ended responses. Recruitment is ongoing and full data will be presented at INSAR.

**Results:** The overall mean scores of all 5 videos were 4.29 ( $SD=1.00$ ) for acceptance and 3.90 ( $SD=1.12$ ) for suggesting. Mean acceptance scores for individual videos ranged from 3.29-4.80 and mean suggestion scores ranged from 2.91-4.54. Themes from the open-ended responses to the highest-rated video included: *child positivity/happiness* ( $n=18$ ); *uncertainty regarding intervention purpose* ( $n=4$ ); and *intervention-related complaints* ( $n=3$ ). Themes from the lowest-rated video (the video in which the interventionist contingently withheld reinforcement) were: *attempts should be reinforced* ( $n=15$ ); *disconnect between child and interventionist* ( $n=5$ ); and *the intervention was acceptable* ( $n=5$ ). Many comments from all videos indicated that intervention choices should be tailored to the individual child.

**Conclusions:** This study provides an initial glimpse into how autistic adults view PRT, a prominent NDBI used with young autistic children. On average, participants found the video clips mildly acceptable and varied as to whether or not they would recommend the intervention to others. This suggests that PRT may be more acceptable than prior iterations of behavioral intervention, though certain commonly-used strategies such as withholding reinforcement may be viewed poorly. Negative comments highlight areas that clinicians should always be attuned to, including sensory issues, appropriateness of physical contact, and appropriateness of pushing for more differentiated language in nonverbal children. This line of research has the capacity to strengthen NDBIs and bring them more in line with the ideals of autism acceptance and promotion of quality of life.

#### 426.032 (Poster) Play Diversity and Complexity in Diverse Young Children with Autism

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**Background:** There are many evidence-based interventions for children with autism. It is important to examine for whom these interventions are most tailored for to maximize optimal outcomes (Schreibman et al., 2011). Play skills are often rote and repetitive for children with autism compared to their neurotypical peers (Jarrold et al., 1996). It is a critical skill for children's development that has been associated with gains in other developmental domains, (Pierucci et al., 2015), including social communication skills (e.g., joint attention).

**Objectives:** The study will 1) examine whether changes in play skills are associated with changes in other developmental skills after participation in intervention and 2) identify potential moderators of the treatment on changes in play skills in a diverse sample of children with autism.

**Methods:** Participants included 174 children with ASD ( $M=46.72$  months;  $SD=.5$  months) from four different studies. Eighty-six percent of the sample was male and 75% reported ethnic minority backgrounds.

Ninety-three children in the sample participated in a play-based social communication intervention, Joint Attention, Symbolic, Engagement, and Regulation (JASPER; Kasari et al., 2006) that took place in community settings. Eighty-one children received treatment as usual.

*Mullen Scales of Early Learning* (Mullen, 1995) was used to measure visual reception, fine motor, receptive language, and expressive language. Children's mental age (MA) scores were calculated by averaging the age equivalent scores of the four domains ( $M=26.34$  months,  $SD=10.99$  months).

*Structured Play Assessment* (Ungerer & Sigman, 1981) was used to measure children's spontaneous play acts. The number of different spontaneous play types and their frequency were coded by raters blinded to condition and time for 16 levels of play ranging from indiscriminant to thematic play (Lifter & Bloom, 1989). Play diversity was the total number of different play acts. Play complexity was defined as the child's mastered play level ( $\geq 2$  different play acts at a specific play level with an overall frequency of  $\geq 5$  acts).

*Early Social-Communication Scales* (Mundy et al., 2003) was used to measure children's spontaneous initiations of joint attention (IJA) and behavior regulation (IBR).

**Results:** Regression analyses were conducted to examine the association of changes in play with mental age and IJA. Children who received JASPER made significant gains from entry to exit in total play diversity associated with increases in MA ( $p=0.005$ ) and expressive language ( $p=0.007$ ) from entry to exit. Increase in play complexity was not significantly associated with increases in MA from entry to exit.

Moderation: Entry IJA moderated the effect of treatment on play diversity ( $p<0.001$ ) and approached significance for play complexity ( $p=0.078$ ). Children with greater IJA had greater improvement in play diversity and complexity if they received JASPER.

**Conclusions:** Children receiving an intervention that specifically targets play development (JASPER), improve significantly in play diversity on independent evaluations, and play gains are associated with improved communication and cognition on a standardized test. Children with more IJA to begin with make more progress, suggesting an important moderator of outcomes. Results also suggest that IJA and play diversity are important targets of developmental outcomes in early interventions.

#### **426.033** (Poster) Preliminary Evaluation to Implement Who Caregiver Skill Training Program in Mainland China – a Pilot Study

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Background: Limited provision of evidence-based behavioral intervention resources is one of the main difficulties faced by children with autism and their families in main-land China. The CST (Caregiver Skills Training) program, developed and promoted by the World Health Organization (WHO), aims to train non-professionals to become guides (FT), fully mobilize local primary health care and community resources, provide more targeted services for families with autistic children, and provide core parenting skills guidance that is easy to impart and operable under the framework of effective intervention strategies.

Objectives: To implement WHO-CST program to families with autism child in main-land China, for promoting caregiver's knowledge and skills, improving parental efficacy, and promoting children's adaptive skills as well as their participation in family life and social activities.

Methods: This pilot study was conducted in one group ( $n=24$ ) in Dongguan urban area. It's delivered by non-specialist facilitators under two specialists' on-site supervision in all group sessions and home visits. Caregiver Involvement and attendance rates, Autism Stigma & Knowledge Questionnaire (ASK-Q), Clinical Global Impressions (CGI), primary target behavior, and fidelity rating data were collected. Pre-program and post-program focus group discussions with caregivers and trainee facilitators were conducted accordingly.

Results: We are here to report the preliminary outcomes of CST in the pilot stage. A total of 24 families with 2-9 years old autistic children were recruited in the Dongguan area, among which has 20 males and 4 females, and their average age is  $5.16 \pm 2.25$  years. Our results showed that at the checkpoint of the second home visit, their parenting knowledge and skills were significantly improved ( $t = 2.89, P < 0.05$ ), and parental efficacy was significantly improved ( $t = 2.13, P < 0.05$ ) comparing to the first home visit. At their third home visit, the child's Clinical Global Impressions (CGI) score was significantly improved ( $t = 2.12, P < 0.05$ ), and the severity for primarily concerned target behavior was significantly decreased ( $t_1=-6.04, P_1<0.05; t_2=-5.56, P_2<0.05$ ). Our result also indicated that the trend of increasing children participated in family and community activities at the endpoint of CST; however, the difference was not yet statistically significant ( $P = 0.06$ ).

Conclusions: WHO-CST program is easily accepted by caregivers of children with autism in main-land China. From this small sample exploratory pilot study, we found that the CST project has good effects on improving caregivers' knowledge and skills, improving parents' sense of efficacy, improving the overall clinical impression of children, and reduce target behavior parents are most concerned about. On-site supervision provided by the specialist for trainee facilitators (non-specialist) to deliver CST for at least one round may help improve their confidence and feasibility. Further research needs to address the high fidelity requirement in adult-child interaction and conduct a full scale of RCT for the efficacy study.

**426.034 (Poster)** Probiotic Intervention May Benefit Preschool Children with Autism Spectrum Disorder Via Gut-Brain Axis  
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Background: Restricted, repetitive patterns of behavior, interests, or activities and persistent deficits in social communication and social interaction are diagnostic criteria for autism. For preschool children with autism spectrum disorder, early intervention is important to improve the behavioral and communication disorders for the accommodation to the following school time. *Lactobacillus plantarum* PS128 (PS128) showed beneficial effects on boys (aged 7-15) with autism spectrum disorder (ASD; ACTRN12616001002471) and younger subjects benefit more from PS128.

Objectives: We carried out a trial investigating the effects of probiotic *Lactobacillus plantarum* PS128 on preschool children (NCT03982290). Our hypothesis is probiotic may be beneficial to children with ASD by improving the gastrointestinal and nervous system functions via gut-brain axis.

Methods: This study is a 2-stage, randomized, double-blind, placebo-controlled trial. Preschool children, aged 2.5-6 years old, fulfilled the inclusion criteria were recruited. At stage 1, the subjects received either probiotic or placebo for 8 weeks. And then all subjects received probiotic for a further 8 weeks. Several questionnaires were used as outcome measurement, including Achenbach System of Empirically Based Assessment-The Child Behavior Checklist (ASEBA), Attention-Deficit/Hyperactivity Disorder Test (ADHDT), Childhood Asperger Syndrome Test (CAST), Penn Interactive Peer Play Scale, (PIPPS), and Social Interaction Assessment Scale.

Results: Seventy six subjects (69 boys and 7 girls) with average age of  $53.78 \pm 14.43$  week-old finished participating this 2-stage trial. No adverse effect was reported neither in probiotic group (33 boys and 4 girls) nor in placebo group (36 boys and 3 girls). At week 8, improvement in anxiety, internal problems and total score of ASEBA were observed in subjects of probiotic group but not of placebo group. At week 16, improvement in ASEBA-total T score, ADHDT-inattention, and PIPPS-Play were observed in both probiotic and placebo group, suggesting the probiotic have positive impacts on subjects mainly on the behaviors. The results of PIPPS showed that subjects in probiotic group showed less play disturbance and more play interaction. To compare the outcomes of baseline, week 8 and week 16, the results showed that 16-week probiotic consumption showed beneficial effects on ASD subjects accumulatively.

Conclusions: Our results showed that the intervention with probiotic benefits preschool children with ASD in behaviors and social interaction. The possible mechanisms may be targeting the gut-brain axis by the psychobiotic, *Lactobacillus plantarum* PS128.

**426.035 (Poster)** Restricted and Repetitive Behaviors, Problem Behaviors, and Outcomes of the PEERS® for Preschoolers Program  
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Background: Restricted and repetitive behaviors (RRB) are a core symptom domain in autism spectrum disorder (ASD) and may impact treatment outcomes. Considering the links between RRB and problem behaviors (i.e., internalizing problems; Factor et al., 2016; Muskett et al., 2019), RRB may play an important role on outcomes of social skill interventions. Moreover, changes in RRB may be a secondary outcome of social skills treatment as social impairments and RRB are intertwined in ASD. Emerging work on the PEERS® for Preschoolers (P4P) Program has demonstrated promising results for young children (Laugeson et al., 2016). As early reciprocal social interactions have been posited to have cascading effects on later social outcomes (Chevallier et al., 2012), understanding RRB on P4P outcomes may elucidate potential mechanisms in treatment trajectories.

**Objectives:** We aimed to examine (1) changes in RRB and problem behavior as secondary outcomes of P4P, and (2) whether RRB impacted social skills and problem behaviors at post-treatment and follow-up. We hypothesized that P4P would produce reliable change within-subjects, and that RRB would predict problem behaviors following treatment.

**Methods:** Twenty-two caregiver/child dyads (13 boys; 77.3% Caucasian) completed P4P groups (6 groups), consisting of 16 1.5-hour group sessions. One hour included separate child/caregiver didactics and 30 minutes were for caregiver-coached play. Children were required to be fluent in English, meet ADOS-2 criteria for ASD, have an  $IQ \geq 70$ , be toilet trained, and able to tolerate a group setting. The SRS-2 was used to examine RRB. SSIS was used to measure Social Skills and Problem Behaviors.

**Results:** Reliable change indices (RCI) were calculated for each child and linear regressions were used to examine RRB on outcomes. On the SSIS Problem Behaviors, RCIs revealed 100% of children demonstrated significant improvement from pre-treatment to post-treatment and 46.15% of children showed improvement at follow-up. On the SRS-2 RRB subscale, 25% of children demonstrated significant improvement from pre-treatment to post-treatment and 31.25% of children demonstrated significant improvement at follow-up.

Pre-treatment SRS-2 RRB subscale was used to predict post-treatment and follow-up SSIS Social Skills and Problem Behaviors. Pre-treatment RRB did not predict social skills at post-treatment,  $p > .19$ . Lower pre-treatment RRB significantly predicted lower problem behaviors at post-treatment,  $\beta = .49$ ,  $t = 2.49$ ,  $p = .02$ , and accounted for 24% of the variance in post-treatment problem behaviors,  $R^2 = 0.24$ ,  $F(1, 20) = 6.20$ ,  $p = .02$ . No significant effects were found for pre-treatment RRB on social skills or problem behaviors at follow-up,  $ps > .28$ .

**Conclusions:** This study allowed for the examination of RRB on child problem behaviors and social skill outcomes. Treatment response indicated that 25% of children showed RRB improvements that increased to 31% at follow-up, and 100% showed problem behavior improvements that decreased to 45% at follow-up. Additionally, rigidity that underlies RRB may play an important role on changes in problem behavior at post-treatment. Future work using larger samples is needed to support this link and to further elucidate the role of specific types of RRB (i.e., insistence on sameness) on treatment outcomes.

**426.036 (Poster) Social Skills, Parenting Styles, and Family Functioning in the PEERS® for Preschoolers Program**  
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**Background:** Social impairments are evident early in Autism Spectrum Disorder (ASD) and tend to worsen (Rao, Beidel, & Murray, 2008). Despite emphasis on early intervention, few evidence-based interventions explicitly address social skills in preschool-aged children with ASD and none actively integrate caregivers (Reichow, Steiner, & Volkmar, 2012). Increase in caregiver-administered interventions and calls to compare child gains with family effects (Lord & Bishop, 2010) necessitate further investigation of how interventions impact family functioning and relationships. The PEERS® program is an evidence-based caregiver-assisted social skills program (Laugeson & Frankel, 2010), recently extended for preschoolers with ASD. Studying child social skills and caregiver and family unit functioning in the context of P4P fills this need.

**Objectives:** This study seeks to analyze improvements in child social skills, caregiver parenting style, and family functioning in the context of P4P compared to baseline in order to take a more holistic view in evaluating the intervention.

**Methods:** Fifteen caregiver/child dyads (11 boys; 66.7% Caucasian) from 4 to 7-years ( $M = 4.87$ ;  $SD = 1.25$ ) participated in four P4P groups (16 1.5 hour sessions twice per week). One hour included separate child/caregiver didactics while the last 30 minutes involved caregiver-coached play. Children were required to have an ASD diagnosis, meet ASD criteria on the ADOS-2, be fluent in English, have an IQ greater than 70, be toilet trained, and able to tolerate a group setting. Measures included the Social Skills Monitoring Form (SSM; measuring child's skill acquisition and at-home practice of social skills), the Parenting Scale (PS, measuring parenting style), and the Confusion, Hubbub, and Order Scale (CHAOS; measuring home environmental confusion), all administered at baselines, each session, post-treatment, and at follow-up.

**Results:** A nonconcurrent multiple baseline design allowed for analysis of changes in child, caregiver, and family variables and Simulation Modeling Analysis (SMA) allowed for examination of slope of symptom change in mean scores of each group between baseline, treatment, and post-treatment/follow-up for all domains. Results suggested mean changes in social skills for Group 3 ( $r = .53$ ;  $p = .035$ ) and all groups demonstrated significant slopes for slopes 2 (flat baseline, increasing treatment), 4 (increasing from baseline throughout treatment), and 5 (increasing during baseline, return to pre-treatment level at initiation of treatment, then increasing throughout treatment). For PS, mean changes were observed for Group 4 ( $r = -0.60$ ;  $p = .017$ ) and

demonstrated significant slopes for slope 2, 3 (increasing baseline, flat treatment), 4, and 5. No significant changes were observed across any groups for family chaos.

**Conclusions:** This novel study allowed for the examination of caregiver, child, and family outcomes within the context of a social skills intervention for preschoolers with ASD. Results directly support the use of P4P, especially regarding child social skill and parenting style improvement, as indicated by improvements from baseline. Family chaos was not impacted. Future work will allow further understanding of specific effectiveness of caregiver-assisted social skills on treatment implementation.

**426.037 (Poster) Stay with Me: The Role of Child-Therapist Interactive Variables and Interpersonal Synchrony in Early Ndbi Treatment Response.**

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### **Background:**

Naturalistic Developmental Behavioral Interventions (NDBI) for Autism Spectrum Disorder (ASD) have been supported by research and highlight the role of interpersonal aspects and interactive quality of child-therapist interplay (Tiede et al., 2019). However, there is a need for process measures able to objectively investigate the role of these variables in longitudinal changes (Fuller et al., 2020).

### **Objectives:**

Quantitatively measuring child-therapist interaction may help in explaining part of the high interindividual variability that emerges from efficacy studies (Wetherby, 2018), as well as identifying specific features that may impact on treatment response.

### **Methods:**

We set up a longitudinal exploratory design on a sample of n=25 children with ASD that underwent early intensive NDBI intervention. Children have been assessed pre- and post- intervention, after about 12 months.

We applied an observational coding system designed by ODFLab on 20-minutes segments of n=50 video-recorded sessions of intervention to quantitatively evaluate interpersonal aspects of child-therapist interaction pre- and post- treatment.

The code is bidirectional and allows to study frequencies, proportions, durations, latencies and the computation of indexes measuring the rate of success of different types of therapist initiatives (e.g. therapist proposals), child's intentionality and engagement levels. Treatment outcomes have been measured through the Griffiths Mental Development Scales (GMDS) and the Autism Diagnostic Observation Schedule (ADOS-2). We investigated longitudinal changes and fitted a linear regression model to investigate the role of interactive variables in treatment response, measured with the learning rate provided by the GMDS (Klintwall et al., 2013). Finally, we applied a preliminary cluster analysis on the interactions considering a 3-dimensional space (proportion of therapists initiatives, child's engagement, latency to initiate the exchange).

### **Results:**

Children showed significant gains in general development ( $t(23)=-2.37$ ,  $p=0.03$ ,  $BF=2.18$ ), especially in the language subscale ( $V=48.5$ ,  $p=0.007$ ,  $BF=19.57$ ), and in symptoms severity ( $t(23)=4.73$ ,  $p<0.0001$ ,  $BF=294.57$ ). Further, children's engagement level increased significantly over time ( $V=24$ ,  $p=0.005$ ,  $BF=16.25$ ).

The regression model ( $F(3,44)=5.751$ ,  $p=0.002$ ,  $BF=18.52$ ,  $adj-R^2=0.23$ ) has been fitted with the therapist's success rate ( $b=0.84$ ,  $p=0.02$ ), the proportion of therapist's initiatives with respect to child's intentionality signals or proposals ( $b=-0.52$ ,  $p=0.03$ ) and the frequency of child's dysregulation episodes ( $b=-0.04$ ,  $p=0.04$ ).

The cluster analysis identified two clusters of interactions characterized by significantly different therapist's success rates ( $t(46)=2.15$ ,  $p=0.04$ ,  $BF=1.57$ ) and durations of the exchanges ( $t(46)=5.12$ ,  $p<0.002$ ,  $BF=185.55$ ). Interestingly, the clusters significantly differed in terms of learning rate ( $t(38.197)=3.012$ ,  $p=0.005$ ,  $BF=9.86$ ).

### **Conclusions:**

These preliminary results may highlight interactive features that impact on treatment response. Quantitatively measuring these variables during ASD intervention may eventually help in disclosing optimal and individualized strategies to maximize response. This study will expand these preliminary findings by adding a mid-point to better investigate response trajectories. It will further exploit more sophisticated computational techniques like hierarchical density-based clustering (HDBScan) for longitudinal analysis, dimensionality reduction (UMAP) and techniques to identify the best number of clusters. Finally, deep learning techniques (i.e. OpenPose) for behavioral imaging and body motion tracking will be applied to employ automatic, quantitative and non-invasive measures of interpersonal synchrony (i.e. Dynamic Time Warping) for time series analysis.

**426.038 (Poster)** The Effects of Brief Parent Coaching in Pivotal Response Treatment on Minimally Verbal Preschoolers with Autism Spectrum Disorder

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**Background:** Minimally verbal children with autism spectrum disorder are typically considered hardest to treat. Few studies have looked at the effectiveness of naturalistic developmental behavioural interventions, such as Pivotal Response Treatment (PRT), for this population. Nova Scotia's public Early Intensive Behavioural Intervention program (EIBI) uses the PRT model. In a child's first week, parents receive PRT coaching for two hours a day for four consecutive days.

**Objectives:** Study objectives are to identify whether: 1) parents trained in PRT reach treatment fidelity after brief coaching; and 2) parents' post-coaching PRT fidelity is associated with their children's immediate- and long-term communication and socialization gains.

**Methods:** Caregivers of 39 children (27 mothers, 10 fathers, 1 grandfather, and 1 aunt) were included in analyses. Children were aged 4 to 5 years ( $M = 4.8$ ,  $SD = .19$ ) and were eligible if they were nonverbal (38%), used only single words (21%), or used two-word combinations (41%).

We assessed parents' ability to provide developmentally appropriate language opportunities with shared control (frequency count). We also assessed the quality of language opportunities: whether parents followed their child's lead, attained appropriate attention, and were contingent (interval recording). Child outcomes were measured by determining (1) frequency of initiations and percentage of correct responding to parent-provided language opportunities pre-and post-training and (2) age-equivalent scores on the Communication and Socialization domains of the Vineland-II at EIBI start and exit (an approximately 10-month long, intensive treatment beginning right after training).

**Results:** The number of language opportunities parents provided to their children significantly increased after coaching ( $t(38) = 8.02$ ,  $p < .001$ ). Parents also improved in their ability to attain children's attention when providing language opportunities ( $t(38) = 7.43$ ,  $p < .001$ ) as well as being contingent with correct responding ( $t(38) = 9.71$ ,  $p < .001$ ). Parents followed their children's lead well before coaching, and maintained this skill ( $t(38) = 1.22$ ,  $p = .23$ ). At post-coaching, 31% of parents met full criteria for PRT fidelity.

During parent training, there were immediate mean gains in children's responding to language opportunities ( $t(38) = 5.13$ ,  $p < .001$ ), but not in frequency of initiations ( $t(38) = 0.06$ ,  $p = .95$ ). In the 10 months following parent training, children made important gains on Vineland outcomes ( $p \leq .03$ ). Preliminary analyses suggest that parent gains in fidelity are associated with some child outcomes. For example, increases in developmentally appropriate language opportunities parents provided post-coaching were significantly associated with gains in initiations by their children ( $r = .21$ ,  $p = .02$ ).

**Conclusions:** Parents of minimally verbal preschoolers made important gains in implementation of PRT strategies with brief coaching. However, additional coaching would be needed for many families to meet intervention fidelity. Children showed immediate gains in correct responding to language opportunities. Importantly, parent gains in fidelity were associated with child gains in frequency of verbal initiations. Further analyses will examine the impact on children's outcomes of their parents' effectiveness in implementing PRT strategies throughout the course of EIBI. Parent coaching may be helpful in maximizing benefits from clinician-delivered intervention for this group of children.

**426.039** (Poster) The PACE Coaching Cost Analysis: An Incremental Analysis Comparing the Costs of Parent Coaching to Assessment and Monitoring in Toddlers at Risk for ASD

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**Background:** A parent coaching intervention based on the principles of naturalistic developmental behavioural interventions (NDBIs) may offer benefits to toddlers with suspected autism spectrum disorder (ASD) but the costs are not well understood.

**Objectives:** The study objectives were to: a) determine the costs of a parent coaching (PC) intervention and b) to measure the incremental costs of PC compared to assessment and monitoring (A&M) in families with a child at risk for ASD aged 15-36 months, from public payer and societal perspectives.

**Methods:** The cost of the intervention included coach training costs and costs associated with intervention delivery. Training time related to attending workshops (39 trainees) and for labour and travel for three master trainers was collected. During intervention, time allocated to direct coaching, telephone follow-up, session preparation, administrative tasks, and master trainer support was recorded for each family receiving coaching. Costs for training and intervention delivery were calculated by multiplying hours reported for each activity by hourly wages. Eligible families of children at risk for ASD were randomized to receive PC or A&M services for 6 months. Families completed a detailed resource use questionnaire at baseline and post-6 months, reporting use of behavioural, educational, health, social, and other services. Out-of-pocket costs and productivity (time) losses were also reported. Each cost item was mapped to a public payer (Ministry of Children and Family Development or Ministry of Health). Costs were calculated by multiplying volumes of resource use by unit prices obtained from public sources. The societal perspective included all public payer costs, out-of-pockets costs, and time losses monetized using average national wages. An incremental analysis compared the mean cost per family in the PC group to the A&M group by major cost category.

**Results:** The mean training cost per coach was CAD\$11,822. The mean cost per family for intervention delivery was CAD\$3,118 for coaching and CAD\$2,056 for master trainer support, for a total intervention cost of CAD\$5,174 per family. At baseline, a majority of families in both groups reported receiving services from a speech language pathologist, occupational therapist, and health professional. Most families (>60%) also reported time losses related to caring for their child. During the 6 months of coaching, PC families greatly reduced their use of speech language pathologist and occupational therapist services compared to controls, but reported more time losses. The mean cost per family to the MCFD public payer was CAD\$199 ( $SD=358$ ) in the PC group compared to CAD \$923 ( $SD=760$ ) in the control group. When the intervention costs were factored in, the net cost to the MCFD was CAD\$4,350 per family (95% confidence interval 3587, 5,149).

**Conclusions:** While PC families used fewer public services, intervention costs resulted in a net cost to the public payer. Policy decision makers should consider these additional costs in terms of added benefits to families to inform investment in coaching interventions for toddlers with suspected ASD. Investments in coach training and parent coaching are likely to yield long-term benefits for both service providers and families of young at-risk children.

**426.040** (Poster) The PACE Coaching Project for Toddlers at Risk for Autism: Understanding Implementation

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**Background:** One of the major translational gaps in the research community is how to go about implementing evidence-based practices in community settings.

**Objectives:** The objective of this arm of the study was to identify promising practices that will optimize future implementation of a community-based parent coaching model, particularly in relation to achieving and maintaining high quality coaching (i.e., effective implementation) for families of children at risk for autism across diverse communities in BC.

**Methods:** Interview data were collected with project participants in 15 child development centres across the province prior to, during, and toward the end of the project. Interviews were transcribed and coded deductively using NVivo 12, according to constructs included in the Consolidated Framework for Implementation Research (CFIR; Damschroder, Aron, Keith, Kirsh, Alexander, & Lowery, 2009). The CFIR provides a menu of 36 constructs across five key domains: Intervention Characteristics, Inner Setting, Outer Setting, Characteristics of Individuals, and Process of Engaging Participation and Conducting the Implementation. Research team members independently coded the transcripts and then met regularly to review codes, discuss differences, and refine definitions of CFIR constructs to fit the PACE Coaching implementation context. This process was followed by construction of case summaries and ratings of each CFIR construct as negative, positive, neutral, mixed, or missing with regard to implementation. Transcripts were also coded inductively, to develop themes that might influence challenges or successful future implementation of the model.

**Results:** PACE Coaching program characteristics that positively influenced implementation included evidence of strength and quality, relative advantage of the program, and program design quality and packaging. Characteristics that negatively influenced implementation included intervention source, adaptability, complexity, and cost. Limited community networking was a deterrent to recruitment, while participants' deep understanding of families' needs and resources contributed to success. The processes of implementing coach training positively contributed to implementation. Participants described the coach training as "top tier," "superb," and "hands down, the best training I have ever had." Themes that emerged from the implementation experience included: (a) an opportunity for "working differently" including reflective practice, data driven decision making, and family empowerment; (b) meeting the needs of individual children and families is paramount; (c) the importance of moving beyond how to implement PACE Coaching with children at risk for autism to implementing PACE Coaching with other young children with developmental needs; (d) imagining implementation ownership and the intention to sustain what has been started; and (e) recognition of the tension between commitments to serve families and to participate in a research project.

**Conclusions:** Numerous common and unique community and agency factors contributed to project outcomes. Future implementation considerations include the need to accommodate a broader range of children and families, develop strategies to increase coach efficiency and create a community of coaching practice within each agency, address funding and staffing challenges, and expand the use of technology to engage in remote coaching and outreach activities.

**426.041 (Poster)** The PACE Coaching Randomized Controlled Trial  
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**Background:** Previous research has demonstrated the effectiveness of interventions based on the Early Start Denver Model (ESDM) for children with autism spectrum disorder (ASD). Half of the studies were conducted in community settings using quasi-experimental designs. There is a need to assess the effectiveness of community-based ESDM using a more rigorous randomized controlled trial (RCT) and to examine its effectiveness for toddlers at risk for ASD.

**Objectives:** The study objective was to measure the effectiveness of a parent-implemented version of ESDM for toddlers identified at risk for ASD.

**Methods:** Sixty-four parents/caregivers of children ages 15-36 months who screened positive on the Modified Checklist for Autism in Toddlers-Revised with Follow-up participated in a hybrid, modified intent-to-treat RCT. Thirty-two families were assigned to the parent coaching (PC) group and 30 were assigned to the Assess & Monitor (A&M) group. All parents were provided with resources designed for parents of at-risk children, including a book and access to four online modules. They could also receive any locally-available services, with the exception of speech-language therapy for the PC group. In addition, a coach trained in the project provided PC parents with 1 hour/week of parent coaching plus a brief telephone follow-up for 24 weeks. Professionals at each site were trained to administer child cognitive and language measures and measures of parent stress, quality of life, and satisfaction at Time 1 (T1) and post-intervention (Time 2, T2). At both time points, they also recorded brief parent-child interactions corresponding to four scenes from the *Communication Play Protocol* (Adamson & Bakeman, 2016), using toys provided by the project. Videos were scored by the research team using an adapted version of the *Joint Engagement Rating Inventory* (JERI; Adamson et al., 2018).

**Results:** Forty-nine families (24 PC and 25 A&M) completed the study; withdrawals were primarily due to adverse family circumstances. PC families received a mean of 7.35 hours/month of service (including parent coaching), and A&M families received a mean of 6.47 hours/month. Repeated measures ANOVAS indicated no significant change over time ( $p > .05$ ) from T1-T2 for either group on the child cognitive measure or the parent stress measure. For both groups, there were significant gains over time ( $p < .05$ ) for words produced by the child. In addition, significant gains ( $p < .05$ ) in favour of the PC group were found for words understood by the child, parent quality of life, parent intervention satisfaction, and parent self-assessment of skills learned in the study. JERI scores indicated parent and child improvements from T1 to T2 for both groups, with trends toward larger effect size trends for the PC group across six out of seven scores. At study completion, 52% of children had received an ASD diagnosis, 11% had not, and 37% were waiting for a diagnostic assessment.

**Conclusions:** Although children and parents in both groups showed gains over time on some measures, overall results suggest the effectiveness of a community-based parent coaching intervention for toddlers at risk for ASD.

**426.042 (Poster)** The Relationship between Child's Play Level and Use of Parent Strategies in Preschoolers with Limited Language

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**Background:** There are a number of active ingredients of effective parent-implemented early interventions. These generally have focused on parent responsiveness (Mahoney & Powell, 1988), parental ability to synchronize with the child (Green et al., 2015), and pacing of their interactions (Gulsrud et al., 2015). Parent-mediated interventions can improve parent's use of strategies, which leads to improvements in social communication skills in children with ASD (Kasari et al., 2015; Wetherby et al., 2014). However, there is great heterogeneity among parents and children with ASD. Especially for children with ASD who are responding slowly to early interventions, the child's initial abilities in play skills may correspond to parent strategy use and provide useful information for treatment targets.

**Objectives:** Investigate the correspondence between children's play abilities and parent strategy use in preschool aged children with ASD with limited spoken language abilities.

**Methods:** This study is a secondary data analysis of baseline data from 153 preschoolers with ASD (M<sub>Age</sub>=45.08 months, SD=5.54, 85.5% Males, 37% White, NVIQ=55.56) using limited language (<30 functional words at baseline) enrolled in a randomized social communication intervention trial. Parent strategies and child's mastered play levels (simple, combination, pre-symbolic, and symbolic) were coded from a 10-minute parent-child free play interaction (Lifter et al., 1993). Parents were rated on their use of environmental arrangement (EA), prompting, pacing, and responsiveness strategies using a 5-point Likert scale. Higher ratings indicate more fluent and more appropriate strategy use. We used Kruskal-Wallis tests to determine if baseline parent strategy usage differed by child's mastered play level, followed up with post-hoc pairwise Wilcoxon tests as necessary. The next step was to fit an ordinal logistic regression controlling for NVIQ.

**Results:** There was no difference in quality of parent pacing or responsiveness based on child play level. There was a significant relationship between play level and parent EA (p=.05), driven by lower quality strategy use in parents of children with mastered simple play compared to combination play (p=.03). There was a trend towards significance for parent prompting (p=.12), driven by lower quality prompting strategies in parents of children who mastered simple play vs. pre-symbolic play (p=.055).

The probability of parents using higher quality EA strategies remained significant for those whose children mastered combination play compared to simple play (p=.03) when controlling for NVIQ. Children's NVIQ was associated with higher quality parent prompting (p=.01) and pacing (p=.05), with higher NVIQ related to higher strategy use. No relationship was found between mastered play level and either pacing or prompting.

**Conclusions:** It may be easier for parents to use higher quality EA strategies if their children are playing at more developmentally complex levels and parents are more likely to use higher quality prompting and pacing strategies if their children have higher cognitive abilities. These findings indicate that certain parent strategies at baseline may be affected by different child characteristics. This is a first step in identifying the types of dyads that may need individualized support in implementing core strategies for early parent-mediated interventions, especially for children who are minimally verbal.

**426.044 (Poster)** Treating Disruptive Behavior in Children with ASD: Bridging Implementation of the Rubi Parent Training Program from Research to Practice

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**Background:** Disruptive behaviors are among the most common and impactful challenges in children with autism spectrum disorder (Carroll et al., 2014). Up to half of children with ASD exhibit disruptive behaviors, such as tantrums, defiance, and aggression, and these behaviors have been associated with significant impairment across multiple domains of functioning (Brown et al., 2019; Mazurek et al., 2013; Simonoff et al., 2008). Research Units in Behavioral Interventions (RUBI) is a low-intensity, manualized intervention for parents of children with ASD and co-occurring disruptive behavior. Although the results of three large scale trials have shown RUBI to significantly decrease child disruptive behavior, RUBI has yet to be implemented and tested in a community setting (Bearss et al., 2015).

**Objectives:** This study examined the preliminary effectiveness of the RUBI parent-training intervention delivered in a community setting on behavioral problems in children with ASD.

**Methods:** Participants were 29 children (ages 2-12) with ASD, who were referred for treatment for disruptive behaviors, and their parents. Participants in this sample were more diverse than in previous trials in terms of age, race/ethnicity, and IQ. Parents received twelve sessions of RUBI on average, which were delivered by both doctoral-level and graduate student clinicians. Pre- and post- levels of disruptive behavior were measured via the Aberrant Behavior Checklist (ABC) and the Home Situations Questionnaire (HSQ; Aman et al., 1985; Altepeter et al., 1989). Additionally, treatment drop-out rates were examined as a preliminary measure of feasibility.

**Results:** Dependent samples t-tests were conducted to determine the difference in parent-reported disruptive behaviors and behavioral noncompliance before and after participating in RUBI in a community care setting. Results indicated that parent ratings of challenging behavior across three out of five domains on the ABC (Irritability, Agitation, & Crying  $t(28)=5.34, p < .001$ ; Hyperactivity  $t(28)=2.20, p = .46$ ; Inappropriate Speech  $t(28)=2.45, p = .02$ ) and noncompliance as rated by the HSQ ( $t(28)=5.62, p < .001$ ) significantly decreased following intervention. Results for ABC domains of Lethargy and Social Withdrawal were not significant. Levels of disruptive behavior post-intervention were similar to results presented in initial RCTs. Additionally, 84% of parents completed the intervention, compared with 89% in the RCT, indicating adequate feasibility of RUBI in a clinical setting.

**Conclusions:** Findings support the preliminary effectiveness and feasibility of RUBI in a community setting. This investigation was the first to examine a parent-training intervention for disruptive behaviors developed specifically for children with ASD in community care, which could help expand the reach of RUBI throughout the country. Future directions include randomized-controlled implementation studies of RUBI in community care and other settings.

**426.045 (Poster)** Treatment Experiences Prior to World Health Organization's Caregiver Skills Training Programme May Moderate Outcomes

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**Background:**

Caregiver Skills Training Programme for Children with Developmental delays (CST), developed by World Health Organization (WHO) and Autism Speaks (AS) for the resource gap, intend to meet the huge needs globally, including children with Autism Spectrum Disorder (ASD) and their families. Taiwan CST team have presented the adaptations and results of their pilot study to show CST's effectiveness in an international meeting, and started implementation stage in 2019. As a parent-mediated intervention, a range of individual and family factors may influence the outcomes.

**Objectives:**

The aim of this study is to analyze the effectiveness of CST-Taiwan and some key child and caregiver factors which may have influence on outcomes of CST-Taiwan.

**Methods:**

Forty-four families (most of them having children with ASD) were recruited from the pilot and implementation stage of CST-Taiwan. The demographic data of caregivers, including age, sex, education level and family income as well as treatment prior to the intervention, were collected. Caregiver outcomes assessed by WHO caregiver skills test and child outcomes assessed by Autism Treatment Evaluation Checklist were collected before and after the intervention. Paired-t test were applied to examine the effectiveness of the intervention. Linear regression model was used to examine the impact of child/caregiver factors on changes made by the intervention. The covariates were child age, caregiver age, caregiver sex, caregiver education level, family income and treatment prior to the intervention.

#### Results:

All indices of caregiver and child outcomes showed significant differences between pre- and post- intervention (knowledge  $t=-3.45$ ,  $p=0.001$ ; confidence  $t=-7.41$ ,  $p<0.001$ ; empowerment  $t=-4.67$ ,  $p<0.001$ ; communication  $t=-3.14$ ,  $p=0.003$ ; sociability  $t=3.74$ ,  $p=0.001$ ; sensory/cognitive awareness  $t=-2.13$ ,  $p=0.039$ ; health/physical behaviors  $t=2.42$ ,  $p=0.02$ ). Although no examined covariates showed significant effect on the outcome variables, however, treatment prior to intervention showed its effect on communication at a trend level ( $F=4.12$ ,  $p=0.050$ ).

#### Conclusions:

CST-Taiwan significantly improved the caregivers' knowledge and confidence on skills and empowered the family. The program also showed promise in improving children's communication, sociability, cognition and health/physical behaviors. The treatment experiences prior to CST intervention may have positive impact on the improvement of the communication but only at a trend level.

## Interventions - Non-pharmacologic - School-Age, Adolescent, Adult

### PANEL SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT

#### Panel 213 - Promoting Pre-Employment Skills in Autistic Transition Age Youth

**Panel Chair:** Kari Sherwood, *School of Social Work, University of Michigan, Ann Arbor, MI, Department of Psychology, University of Michigan, Ann Arbor, MI, School of Social Work, University of Michigan, Ann Arbor, MI, Department of Psychology, University of Michigan, Ann Arbor, MI*

**Discussant:** Denise Juliano-Bult, *National Institute of Mental Health, Bethesda, MD*

Vocational experiences are associated with quality of life in adulthood. Despite the growing population of adolescents and adults with autism spectrum disorder, only 32% of autistic young adults obtain a job the first two years after high school. Transition-age autistic individuals experience difficulties in both obtaining and sustaining employment. Few research studies have examined skills and interventions focused on promoting skills essential for employment. This panel will focus on topics related to pre-employment skills and interventions in autistic transition-age youth, including executive function, social cognition, job interview skills, implementation of interventions in schools, and longitudinal employment outcomes.

**213.001 (Panel) Transition Age Youth (TAY) Success RCT Feasibility Study Targeting Executive Functioning and Social Cognitive Skills to Improve Outcomes**

*M. Baker-Ericzen<sup>1</sup>, A. Tran<sup>2</sup>, K. Scarvie<sup>1</sup>, B. Kraemer<sup>3</sup>, L. Brookman-Frazee<sup>4</sup> and C. Sax<sup>5</sup>, (1)Rady Children's Hospital San Diego, San Diego, CA, (2)Child and Adolescent Services Research, Rady Children's Hospital, San Diego, CA, (3)Special Education, San Diego State University, San Diego, CA, (4)Psychiatry, UC San Diego, La Jolla, CA, (5)College of Education, San Diego State University, San Diego, CA*

**Background:** Over 50,000 students with autism are completing High School (HS) yearly and more than 50% of these youth are not employed or attending college within 2 years afterwards. Devastatingly, these rates are higher than any other disability and continue years later with 50% unemployed and 70% without higher education even though they may be intellectually capable. Autistic individuals will be adults for significantly greater time compared to childhood yet there are far fewer intervention studies targeting teens and young adults. Autistic TAY are in need of functional cognitive and social skills necessary for positive livelihood; those with these skills demonstrate increased vocational and educational outcomes.

**Objectives:** This study tested through a pilot RCT an adapted, public school-based intervention teaching executive functioning (EF) and social cognitive and communication (SCC) skills required for self-determination, independence and attainment of post-secondary outcomes. TAY SUCCESS is a manualized group program delivered in HS and transition educational settings for autistic TAY. Multiple outcomes were assessed (ratings and performance scales) across informants (self, parent, teacher) and satisfaction.

**Methods:** A total of 31 teen/adults ( $\mu = 17.55$  SD=1.91 yrs; 13-21 yrs) participated. The participants were male (84%), race/ethnically diverse (48% Hispanic, 13% black/AA, 13% Asian, 19% Native American/Hawaiian/PI), 32% teens (<18 yrs), 55% in High School and 44% in transition program. The TAY SUCCESS curriculum was delivered over 7.5 months with ~90minutes active group sessions. The curriculum teaches cognitive enhancement, social cognitive and social communication strategies through 27 chapters including targeting executive functioning (EF) skills of prospective memory, working memory, sustaining attention, shifting attention, cognitive flexibility, problem-solving, inhibition, goal-oriented thinking and behaviors and contextual awareness. Social cognitive and communication skills targeted perspective-taking, social observations and evaluations, gaining social knowledge, social adaptation, decision-making, exchanging help, compliments & feedback, self-advocacy, social networking and social media usage. Pre and post assessments include a full battery of assessments on EF, SCC, adaptive living, MH, self-determination, self-efficacy, educational & employment outcomes and satisfaction.

**Results:** Analyses consisted of calculating Intent-to-treat ANCOVAs (Group) by (Time). Findings reveal significant differences by group on cognitive skills by informant report- BRIEF-2/A Inhibit  $p=.01$ , Working Memory  $p=.03$ , Plan/Organize  $p=.01$ , Task Monitor  $p=.03$ , and GEC  $p=.01$  and performance- DKEFS Inhibition,  $p=.02$ , sorting,  $p=.01$ , and sorting description,  $p=.01$ . Significant differences between intervention and control were also found for social cognitive and communication skills by informant report- SRS-2 SOC,  $p=.01$ , SCL,  $p=.00$  and Total Score,  $p=.03$  and performance-SSPA ranging from  $p=.04$  to  $p=.00$ . Adaptive living parent report revealed significance (scheduling,  $p=.04$  and attending activities,  $p=.01$ ) and educational outcomes measures rated by self and teachers ranging ( $p=.01$  to  $p=.03$ ). (Refer to Figures 1-3). No significant differences between groups

on self-efficacy, self-determination or work motivation or skills. All informants rated high satisfaction and indicated positive feasibility and accessibility.

**Conclusions:** This study demonstrates that TAY SUCCESS intervention is feasible and acceptable within public school settings and positively impacts teens/ adults with ASD towards obtaining skills necessary for successful post-secondary outcomes.

**213.002 (Panel) Virtual Interview Training for Autistic Transition Age Youth: A Randomized Controlled Feasibility and Effectiveness Trial**

**M. J. Smith<sup>1</sup>, K. Sherwood<sup>1,2</sup>, B. Ross<sup>1</sup>, J. D. Smith<sup>3</sup>, L. E. Smith DaWalt<sup>4</sup>, L. Bishop<sup>5</sup>, L. Humm<sup>6</sup>, J. Elkins<sup>6</sup> and C. Steacy<sup>6</sup>,**  
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**Background:** Autistic transition-age youth struggle with obtaining employment, and interviewing is a critical barrier to getting a job. Currently, the field does not have an evidence-based practice that facilitates training the job interview skills for autistic transition-age youth. We used community-engaged methods to adapt an efficacious virtual reality job interview training intervention to meet the needs of autistic transition-age youth, called Virtual Interview Training for Transition Age Youth (VIT-TAY).

**Objectives:** This study evaluated whether VIT-TAY can be feasibly delivered in high school special education settings and whether VIT-TAY improves job interview skills, job interview self-efficacy, job interview anxiety, and access to employment.

**Methods:** We recruited five special education programs representing rural, suburban, and urban communities. Overall, we recruited n=71 autistic transition-age youth receiving school-based pre-employment transition services (Pre-ETS). We randomized n=48 students to the Pre-ETS + VIT-TAY group and n=23 students to the Pre-ETS only group. We trained and supervised local teachers to implement VIT-TAY. We conducted descriptive statistics to assess the feasibility of VIT-TAY implementation (i.e., process, adherence, and acceptability). We also conducted repeated measures analyses of variance to evaluate group-level difference between pre- and post-test assessments. Additionally, we conducted a Chi-Square analysis and confirmatory Firth logistic regression (covarying for prior employment) to evaluate employment rates by 6-month follow-up. Lastly, we conducted Pearson correlations among the VIT-TAY process data and primary outcomes (i.e., job interview skills, anxiety, self-efficacy, and employment).

**Results:** Students successfully adhered to VIT-TAY training (78.2% completed the minimal requirements) and students found the tool to be highly acceptable (m=20.4, sd=4.2, range=7 to 25). The Pre-ETS + VIT-TAY group, compared to Pre-ETS only, had significant group-by-time interactions reflecting better job interview skills ( $p<0.001$ ), lower job interview anxiety ( $p<0.05$ ), and greater access to competitive employment (25.0% vs. 0.0%,  $\chi^2=6.9$ ,  $p<0.01$ ) and (OR=16.0;  $p<0.05$ ; 95% CI 1.35, 189.17). We did not observe between-group differences in job interview self-efficacy between pre- and post-test ( $p=0.30$ ). We observed that the mean virtual interview performance score (across all trials) was correlated with the post-test job interview skills ( $\rho=0.39$ ,  $p<0.01$ ), which in turn were correlated with competitive employment ( $\rho=0.37$ ,  $p=0.01$ ) by six month follow-up.

**Conclusions:** VIT-TAY appears to be effective at teaching job interview skills and reducing job interview anxiety. Moreover, enhanced job interview skills were associated with accessing competitive jobs. Overall, youth enjoyed and adhered to VIT-TAY and teachers feasibly implemented the tool within special education Pre-ETS. Future research needs to validate these findings and evaluated enhanced job interview skills as a mechanism of employment in a fully-powered trial.

**213.003 (Panel) Mixed-Methods Implementation Evaluation of School-Based Virtual Interview Training for Transition Age Autistic Youth**

**K. Sherwood<sup>1,2</sup>, M. J. Smith<sup>1</sup>, J. Johnson<sup>1</sup>, M. Harrington<sup>1</sup>, B. Ross<sup>1</sup>, S. Blajeski<sup>1</sup>, L. E. Smith DaWalt<sup>3</sup>, L. Bishop<sup>4</sup> and J. D. Smith<sup>5</sup>,**  
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**Background:** Although recent studies suggest that a large proportion of employed youth with autism are interviewing to get hired (Smith et al., in press), few practices to support this skill are being implemented in pre-employment transition services (Pre-ETS). Although technology-based interview interventions have recently demonstrated efficacy among autistic youth and adults, these interventions need to be more rigorously evaluated with the goal of implementing such tools at scale. As part of a recent randomized controlled trial (RCT) evaluating Virtual Interview Training for Transition Age Youth (VIT-TAY) effectiveness

among autistic youth, we conducted a mixed methods, multi-level evaluation to understand implementation of VIT-TAY across 5 schools.

**Objectives:** This study sought to evaluate implementation feasibility, acceptability, usability, and sustainability of VIT-TAY across five schools using teacher and student reports.

**Methods:** Schools (n=5) were recruited from Michigan and Ohio as part of the RCT. Teachers (n=21) were recruited from these schools as trainers, along with transition-age students with autism (n=71). The intervention was implemented over six to eight weeks to 48 students in the intervention group. Following the implementation of VIT-TAY, we used a mixed methods approach (via self-report surveys and semi-structured interviews) to evaluate the acceptability, usability, feasibility, and sustainability of VIT-TAY. Descriptive statistics characterize the acceptability, usability, and expected implementation feasibility of VIT-TAY. Meanwhile, we conducted a thematic network analysis (Attride-Stirling, 2001) of the qualitative data from the teacher semi-structured interviews and student acceptability and usability surveys, revealing a network of global themes, organizing themes, and basic themes.

**Results:** Teachers reported that VIT-TAY was highly acceptable (M=26.91, SD=2.17) and that VIT-TAY implementation would be sustainable (M=7.36, SD=2.01). Additionally, students reported VIT-TAY to be acceptable (M=23.32, SD=4.69) and usable (M=37.67, SD=6.51). Teachers mentioned introductory materials and in-depth training for teachers and students as important facilitators of implementation. Meanwhile, teachers identified scheduling VIT-TAY within their curriculum, space to implement VIT-TAY, and staff training as potential barriers to future implementation. Approximately 84% of teachers were confident they would be able to deliver VIT-TAY training with fidelity. Regarding implementation feasibility and sustainability, 95% of teachers reported that VIT-TAY would be easy for educators to deliver, while 64% of teachers reported their schools were “somewhat” to “very” well equipped to support continued delivery of VIT-TAY.

**Conclusions:** Student and teacher-reported acceptability and usability and teacher-reported feasibility collected in 5 schools revealed agreement that VIT-TAY was user-friendly, provided useful feedback, and allowed students an opportunity to practice their job interview skills independently. Implementation of evidence-based interventions in schools is a critical component of measuring their ecological validity. Previously identified challenges of implementation in schools include school organizational factors, scheduling constraints, level of implementation support, and training of school professionals, among other factors. The results of this evaluation align with this prior research. Despite these limitations, schools are a vital setting for interventions for transition-age youth with autism. Particularly during this time of a global pandemic, technology-based interventions such as VIT-TAY could play a crucial role in helping youth practice job interview skills somewhat independently.

**213.004 (Panel) Longitudinal Employment Outcomes for Young Adults with Autism: Follow up to a High School-Based RCT**  
*K. Hume<sup>1</sup>, B. Tomaszewski<sup>1</sup>, S. L. Odom<sup>2</sup>, J. R. Steinbrenner<sup>1</sup>, L. J. Hall<sup>3</sup>, L. E. Smith DaWalt<sup>4</sup> and B. Kraemer<sup>3</sup>, (1)Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill, Chapel Hill, NC, (2)Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill, San Diego, CA, (3)Special Education, San Diego State University, San Diego, CA, (4)University of Wisconsin-Madison Waisman Center, Madison, WI*

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**Background:** Adolescents and young adults with autism spectrum disorders (ASD) have among the poorest post-school employment outcomes of any disability group. The Center on Secondary Education for Student with Autism (CSESA), was designed to address the needs of adolescents enrolled in public high school programs. CSESA investigators developed a comprehensive intervention model that focused on academics, independence and behavior, peer social interaction, and transition/families and implemented this program within an RCT in 60 high schools across 3 states (N=547 adolescents with ASD). The CSESA model had a significantly positive impact on the quality of high school instructional programs for students with ASD and on individual progress towards IEP goals, when compared to the Services as Usual control group. Given that a goal of high school is to prepare students for post-secondary life, including employment, the ultimate test of a model like CSESA will be the post-school employment outcomes,

**Objectives:** The purpose of this session is to provide follow up data on the employment outcomes for students involved in the CSESA study 1-4 years after exiting high school.

**Methods:** We will present employment findings using a mixed methods approach. Data are being collected at one time point for each parent and young adult through parent report, self-report, and includes both the Vocational Index and a follow up interview that addresses employment outcomes. Descriptive data from the described measures, demographic data, and qualitative data from individual interviews with parents and young adults will be presented, along with comparisons between young adults who received the CSESA intervention and those who were in the SAU group.

**Results:** Data collection is ongoing. We currently have data from 181 young adults and/or their parents and we anticipate having data from 250+ young adults at the time of INSAR 2021 when data collection concludes. Early descriptive analyses from the Vocational Index and parent and young adult interviews indicate that 86% have been engaged in any work or vocational experiences since leaving high school, and 60% of the sample have worked for pay without employment support. Almost 70% of the sample had completed job applications and 65% had interviewed for positions. Only 7% of the sample were engaged in work in a sheltered work environment, and 11% were employed with an adult day program. Detailed data about satisfaction with each employment activity, will be provided, along with links between high school experiences that were deemed helpful in post-high school employment preparedness.

**Conclusions:** This is a follow-up to the largest, most diverse randomized treatment study of adolescents with ASD to be conducted to date. The sample and their high school experiences are well characterized, which allows for one of the first examinations of the longer-term impact (employment status) of a high-school based intervention. Early data indicate higher rate of competitive employment than previous studies for this population (e.g. NLTS-2) and higher rates of job satisfaction and job match (e.g. working in an area of interest). Links to these outcomes and the CSESA intervention/sample characteristics will be discussed.

## ORAL SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT

### Oral 317 - Behavioral Treatments for ASD

**317.001 (Oral)** Effects of Short-Term Low-Intensity Early Start Denver Model on Young Children with Autism Spectrum Disorder in Different Cognitive Ability Levels

**T. L. Lin<sup>1</sup>, C. H. Chiang<sup>2</sup>, S. Y. Ho<sup>3</sup>, H. C. Wu<sup>4</sup> and C. C. Wong<sup>3</sup>,** (1)Research Center for Education and Mind Sciences, National Tsing Hua University, Hsinchu City, Taiwan, (2)Department of Psychology, National Chengchi University, Taipei City, Taiwan, (3)Child Developmental Assessment & Intervention Center, Zhongxing Branch of Taipei City Hospital, Taipei City, Taiwan, (4)Department of Rehabilitation, Taipei Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, New Taipei City, Taiwan

**Background:** Several early intervention studies for children with Autism Spectrum Disorder (ASD) have indicated that better pre-intervention cognitive function can predict more positive post-intervention outcomes. However, a limited number of studies have directly compared the intervention outcomes among children with ASD who are with different cognitive ability levels, and the results from these few studies are inconsistent.

**Objectives:** The Early Start Denver Model (ESDM) is one kind of naturalistic developmental behavioral intervention, which is the early intervention trend for young children with ASD in the past decade. This study aimed to compare the effects of 24-weeks low-intensity ESDM intervention among young children with ASD and severe to borderline intellectual disabilities.

**Methods:** A case control study was conducted on 42 children with ASD aged 25–46 months. Children receiving one-on-one ESDM intervention for 9 hours per week in the ESDM group,  $n = 21$ , mean age = 33.23 months, mean overall developmental quotients (DQ) = 55.42 (range = 36.65-77.59), were matched with children receiving community intervention in the control group,  $n = 21$ , mean age = 35.14 months, mean overall DQ = 58.43 (range = 37.82-76.95), in chronological age, overall DQ and sex. In each group, two subgroups were further divided based on pre-intervention overall DQ: lower cognitive level (DQ < 55) and higher cognitive level (55 < DQ < 80). Four outcome indications: cognitive abilities, language abilities, adaptive behaviors, and symptom severity were measured pre- and post-intervention respectively by the Mullen Scales of Early Learning (MSEL), Mandarin-Chinese Communicative Development Inventory (MCDI), Adaptive Behavior Assessment System (2nd Edition, ABAS-II), and Autism Diagnostic Observation Scales (ADOS).

**Results:** On the base of no difference in intervention hours per week among four subgroups, there were three main findings after 24-weeks intervention. First, in both ESDM and control groups, higher cognitive level children made significantly more progress in overall cognitive ability and language abilities (vocabulary production and mean length of utterances) than lower cognitive level children did. Second, both lower and higher cognitive level children in ESDM group showed significantly post-intervention improvements in nonverbal cognitive ability, verbal cognitive ability, overall cognitive ability and language abilities. However, in control group, only higher cognitive level children showed significantly improvements in verbal cognitive ability and language abilities, while the symptom severity in lower cognitive level children became even worse significantly. Third, for both lower and higher cognitive level children, the post-intervention gains in ESDM group were significantly greater than control group in nonverbal and overall cognitive abilities. Moreover, lower cognitive level children in ESDM group had significantly greater improvements in verbal cognitive ability, vocabulary production and symptom severity than control group.

**Conclusions:** Our results suggest that young children with ASD who have pre-intervention higher cognitive function can benefit more from early intervention no matter the intervention styles. However, short-term low-intensity ESDM may positively impact the cognitive development for both lower and higher cognitive level young children with ASD; furthermore, lower cognitive level children may benefit more in symptom reduction and language development from ESDM intervention than the community intervention.

**317.002 (Oral)** Caregiver Ndbi Strategy Use and Language Input Supports Structurally-Specific Lexical Diversity in Minimally-Verbal Children with Autism

*E. Clark-Whitney, C. B. Klein, A. Lemelman, J. Winter and S. H. Kim, Psychiatry, Center for Autism and the Developing Brain, White Plains, NY*

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**Background:** Structurally-specific lexical diversity (i.e., variety of unique subject-verb combinations [SVs]) is a robust measure of language development (Hadley & Walsh, 2014). Caregiver input, specifically use of varied SVs through Toy Talk (e.g., giving toys a name and talking about the toy; “The tower fell!”), supports children’s development of lexical diversity. Intervention can increase caregiver Toy Talk (Hadley et al., 2017), producing growth in child language. Given that caregiver-mediated naturalistic developmental behavioral interventions (NDBI) are a core evidence-based treatment known to improve social communication in children with ASD (Schreibman et al., 2015), the current study investigated whether improving caregivers’ NDBI strategy use enhances the impact of caregiver Toy Talk on children’s lexical diversity.

**Objectives:** To examine the moderating role of changes in caregiver NDBI strategy use over time on the impact of caregiver Toy Talk on lexical diversity in minimally-verbal children with ASD.

**Methods:** Participants were drawn from past studies of various caregiver-mediated NDBIs for minimally-verbal children with ASD (50 dyads). Using Systematic Analysis of Language Transcripts software (SALT; Miller & Iglesias, 2012), reliable coders transcribed caregiver and child speech from two interaction videos recorded an average of 5.88 months apart, and coded child unique SVs and caregiver use of Toy Talk. Caregiver NDBI strategies during the same recorded interactions were rated using the Measure of NDBI Strategy Implementation-Caregiver Change (MONSI-CC; Vibert et al., 2020). All coders were blind to video timepoint. Given that many children were not yet using SV combinations (70%-T1; 48%-T2), a zero-inflated negative binomial mixed model was utilized. Main effects of timepoint, MONSI-CC changes (T2-T1), and baseline toy talk were assessed while controlling for age, gender, non-verbal IQ and autism symptom severity. Baseline Toy Talk was used because Toy Talk was not specifically targeted in the current intervention and therefore was not expected to change over time, whereas NDBI strategies were the main target of the caregiver-mediated NDBI. The moderating role of caregiver NDBI strategy changes on the impact of Toy Talk on child SVs was assessed by examining the interaction effect between MONSI-CC and Toy Talk.

**Results:** Greater baseline Toy Talk significantly predicted children’s use of more diverse SVs over time (Table 1). A significant interaction of baseline Toy Talk and NDBI strategy change was also found. The interaction indicated that the relation between baseline Toy Talk and child lexical diversity was stronger when caregivers had greater improvement in NDBI strategy use (Figure 1). Timepoint, age, non-verbal IQ, and gender were also significant.

**Conclusions:** The current study showed that SV combinations in children with ASD increase over time, and that caregiver language input, specifically Toy Talk, and improvement in caregivers’ NDBI strategy use both play a key role in children’s lexical diversity development. Notably, the impact of Toy Talk on child SVs was stronger for dyads with greater improvement in NDBI strategy use. As such, the current results demonstrate that improving caregivers’ overall NDBI strategy use can provide a strong foundation for more specific intervention models that target language acquisition in children with ASD.

**317.003 (Oral)** National Clearinghouse on Autism Evidence & Practice: Examining the Participation of Individuals with ASD across Racial and Ethnic Groups in High Quality Intervention Studies

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Background:

The National Professional Development Center on ASD (NPDC) completed a review of literature published between 1990-2011 and identified 27 evidence-based practices (EBPs) for individuals with ASD from birth through age 22 (Wong et al., 2014). A team of researchers analyzed data reported about race, ethnicity, and nationality (REN) from articles included in the previous

review (West et al., 2016) and found that few articles reported information on REN (17.9%). The National Clearinghouse on Autism Evidence & Practice (NCAEP) recently completed an update to the previous review of literature to include articles published from 2012-2017 (Steinbrenner et al., in review). In addition to determining any new and emerging EBPs, it is also important to assess the reporting and inclusion of individuals with ASD across different REN, and to determine whether there are changes in reporting and inclusion over time.

#### Objectives:

The objectives of this session are to (1) determine the proportion of studies that reported data on REN between 1990-2017, (2) examine the proportions of studies and participants within studies based on REN characteristics, and (3) examine trends in reporting over time.

#### Methods:

The NCAEP team used the same search strategy as the 1990-2011 systematic review, using key search terms related to autism (e.g., ASD, Asperger, autistic) and intervention (e.g., education, treatment, strategies) with participants aged birth through 22 years (Steinbrenner et al., in review; Wong et al., 2014). The research team followed a rigorous systematic review process including initial search, screening, full-text reviews, quality reviews, and data extraction. During data extraction, the research team used the procedures of West et al. (2016) to extract REN data from all high-quality studies (1990-2017). Research assistants were trained to reliability; 29.7% of those articles were coded for reliability ( $r=0.80-1.0$ ).

#### Results:

Of the 1001 articles coded for participant information, 244 of 1001 articles report information on REN (24.3%), with reporting rates of 20% in SCD studies and 42.9% in group studies. The total proportion of participants who were reported as white was 63% (SCD = 52.8%; group = 64.3%). Table 1 has additional information about reporting rates of individual REN categories by study type and inclusion of participants from various REN categories by study type. Over 27 years, REN reporting has risen from a low of 0% of studies in 1991 to a high of 37% of studies in 2014, with variability from year to year but a clear trend of increased reporting of REN. In the current review period (2012-2017), group studies fluctuated between 35-71% reporting while SCD studies remained more stable at 20-32% reporting.

#### Conclusions:

Overall, there has been an increase in the reporting of REN data between the 1990-2017, with group studies accounting for more of the increase since 2012. However, the proportion of articles reporting REN data is still strikingly low. While group studies are more likely to report REN, they are also less likely to include non-white participants. Moving forward, to ensure generalizability of intervention results, it is important to recruit and report on more diverse samples.

#### **317.004 (Oral) Critical Time Points When Accessing Diagnosis and Early Treatment Among Children with ASD: A Comparison between Immigrant Children and Children of US-Born Parents**

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**Background:** Numerous researches have shown that early detection, treatment and services are crucial in advancing outcomes and reducing symptoms. Center for Disease Control's report on ASD was based on 11 states, which does not include the State of Illinois (Biao et al., 2018). As one of the top immigrants receiving states, Illinois hosts approximately 1.8 million immigrants (US Census Bureau, 2017). While emerging literature has documented the barriers faced by immigrant families of children with ASD when accessing diagnosis and treatment, little is known about the timeline or critical time points of their experiences as they seek diagnosis and therapy.

**Objectives:** Therefore, this paper sought to compare the timeline of diagnosis and early therapy access between immigrant families and US born families of children with ASD in the state of Illinois.

**Methods:** 213 parents of children with ASD who were under the age of 18 at the time of data collection completed a survey on diagnosis and service access. Among them, 21 were immigrant parents. Using immigrant vs US-born as the grouping variable,

we conducted independent sample t-test comparing children's age (in months) when parents first noticed something different in their child, when parents first talked to a doctor or clinician about their concerns, when child gets their diagnosis, and when child first received any kinds of therapy services. We also examined the subsample of 74 children with ASD who requires substantial support using the same aforementioned grouping variable and test variables.

**Results:** Comparing immigrant children with ASD's timeline for diagnosis and treatment with children with ASD of US born parents, we found no significant differences in all critical time points except marginally significant differences in children's first access to any kinds of therapy ( $t=1.148, p=0.058$ ), children of US born parents' first access to therapy earlier ( $M=37.7, SD=28.1$ ) than children of immigrant parents ( $M=46.1, SD=41.6$ ). When only children who requires substantial support were included ( $N=74$ ), children of immigrant parents ( $N=12$ ) were significantly older for all four critical time points compared to children of US born parents ( $N=52$ ). Specifically, immigrant parents first notice something different when their children were significantly older ( $M=29.3, SD=25.4$ ) compared to the other group ( $M=16.5, SD=10.3, t=1.63, p=0.000$ ). Immigrant parents also brought up their concern to a doctor or clinician when their children were much older ( $M=34.6, SD=33.9$ ) compared to US born counterparts ( $M=18.9, SD=13.2, t=1.58, p=0.001$ ). Children of immigrant families also had later diagnosis ( $M=52.9, SD=42$ ) compared to children of US born parents ( $M=40.1, SD=22, t=0.944, p=0.005$ ). Similarly, children of immigrant families also accessed any kinds of therapy at an older age ( $M=54.2, SD=51.3$ ) compared to children of US born parents ( $M=26.7, SD=15, t=1.84, p=0.000$ ).

**Conclusions:** It is alarming that children of immigrant families who requires substantial support had a significantly delayed timeline at every single critical time points as their parents seek diagnosis and therapy. Our findings underscore the importance of targeting immigrant families of children with ASD with more profound functional limitations to facilitate early detection and access to treatment.

## POSTER SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT

### Poster 427 - Interventions - Non-pharmacologic - School-Age, Adolescent, Adult Posters

**427.001** (Poster) A 12-Week Cognitive Behavioral Therapy (CBT) Protocol Specifically Modified for ASD  
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Background: Restricted, repetitive behaviors or interests make up one of the two core symptom areas of autism spectrum disorder (ASD). While up to 95% of children with ASD have restricted interests, our ability to target these interests and their related behaviors in treatment has been limited (Boyd, McDonough, & Bodfish, 2012; Poustka et al., 2014; Turner-Brown, Lam, Holzclaw, Dichter & Bodfish, 2011). In practice, it is not uncommon for clinicians to use the child's restricted interests to bolster motivation, rapport, and to ultimately enhance treatment outcomes (e.g., Kryzak & Jones, 2015).

Clinical trials to date have revealed promising results using cognitive behavioral therapy (CBT) based treatment approaches to decrease symptoms of anxiety in children with high-functioning ASD (for reviews see Sukhodolsky, Bloch, Panza, & Reichow, 2013; Ung, Selles, Small, & Storch, 2015). However, few studies to date have attempted to target the underlying emotion regulation processes in autism which, in turn, may be used to treat a wider array of co-occurring symptoms (Scarpa & Reyes, 2011).

Objectives: The purpose of the present pilot study is to begin to explore the feasibility, satisfaction and efficacy of a 12-week cognitive behavioral therapy (CBT) protocol specifically modified for ASD in that it targets both social communication and emotion regulation skills using restricted interests as a primarily vehicle for therapy.

Methods: Participants included 34 children (6-11 years old) with ASD recruited from a multidisciplinary autism clinic randomized to either the treatment group ( $n=18$ ; CBT) or a waitlist control group ( $n=16$ ; WLC). Participants in the CBT group received 12 weeks of therapy. Pre- and post-assessment measures for both groups included the Social Skills Improvement System (SSiS; Gresham & Elliot, 2008) and a parent-completed home data collection measure of the Frequency and Duration of Emotion Dysregulation Episodes. Feasibility measures included homework compliance and attrition data. Finally, a satisfaction questionnaire was completed by parents in the CBT group at the conclusion of the 12-week therapy.

Results: Data collection was just recently completed. Entry and analysis are in process at this time. Results will include sample descriptive data and primary outcomes (SSiS and Frequency and Duration of Emotion Dysregulation Episodes) will be compared

between groups using univariate and multivariate linear and Poisson regression models as appropriate. We will also compute standardized effect sizes and unstandardized effect sizes with 95% confidence intervals to examine the magnitude of these differences. Qualitative data and quantitative descriptive statistics, including confidence intervals, will be utilized to indicate the extent to which the treatment was found to be feasible and satisfactory by families.

**Conclusions:** These findings will significantly contribute to our limited knowledge of restricted interests and will directly inform subsequent intervention design and implementation. Results will contribute to a small but emerging body of evidence that a new approach to addressing restricted interests in therapeutic interventions for individuals with ASD may be warranted. We will also explore the extent to which a CBT-based individual treatment approach may be used to target emotion regulation and social skills in children with ASD.

**427.002 (Poster)** A Pilot RCT Investigating the Feasibility of Delivering an Individualised, Modular Psychological Treatment for Anxiety Experienced By Autistic Adults: Personalised Anxiety Treatment – Autism (PAT-A).

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**Background:** Anxiety is common in autistic adults and significantly limits opportunities and quality of life. Evidence-based psychological therapies currently offered by mental health services often fail to meet the needs of autistic adults. This is reflected in sub-optimal treatment efficacy and widely reported dissatisfaction among autistic people. The development of appropriate treatments for anxiety is a key priority of the autism community. Current clinical guidance recommends that psychological therapies should be personalised to best meet autistic people's needs.

**Objectives:** To investigate the feasibility and acceptability of delivering a novel individualised, modular psychological treatment for anxiety experienced by autistic adults (Personalised Anxiety Treatment for adults, PAT-A<sup>a</sup>).

**Methods:** PAT-A<sup>a</sup> is a pilot randomised controlled trial. Thirty-four autistic adults (aged 18-62, 65% male) with clinically diagnosed anxiety were recruited via UK clinical services and randomised to either PAT-A<sup>a</sup> or current clinical services). All participants received a personalised assessment and formulation of anxiety using the newly developed Personalised Anxiety Interview Supplement – Autism (PAIS-A<sup>a</sup>) prior to randomisation. Both groups initially received two sessions of emotional literacy. PAT-A<sup>a</sup> group participants then received a 12-session intervention including a bespoke, modular, needs-based treatment approach utilising one or more of the following modules: Mindfulness, Coping with Uncertainty in Everyday Situations (CUES), social anxiety, and graded exposure. Control group participants received usual NHS care through their local clinical team. Data regarding anxiety experiences, mental health and related constructs were collected at baseline and at 3 and 12 months following intervention. The main outcomes were recruitment, retention, treatment adherence, completion of outcome measures and acceptability (assessed with a semi-structured interview at 3-months).

**Results:** 31 participants have completed three-month follow-up (87.1% participated in interviews; 82.4% of control group, 92.9% of PAT-A<sup>a</sup> group). The remaining 3 participants will complete follow-ups in January 2021. All participants reported the duration of baseline and follow-up assessments was acceptable. Several commented that the personalised assessment made them feel listened to and understood more than during previous healthcare appointments. 88.2% (n=15) of participants in the PAT-A<sup>a</sup> group, completed all treatment sessions, and reported positive experiences, including that the treatment met their needs more than previous experiences of psychological interventions. Some participants reported they would have preferred more sessions. 82.4% (n= 14) in the control arm attended the psychoeducational sessions; some control arm participants expressed disappointment regarding the outcome of randomisation. However, many commented they were pleased to have a role in the development of a novel anxiety treatment that may have future utility. Preliminary evidence indicates that the PAT-A<sup>a</sup> intervention was associated with improved anxiety outcomes for many participants.

**Conclusions:** The PAT-A intervention is acceptable and feasible to deliver. Autistic adults were willing to be recruited, randomised, and provide follow-up outcome data. Participants reported satisfaction with both the research methods and intervention. Participants valued this personalised approach to mental healthcare. The PAT-A trial methods and materials are suitable for use in an RCT to investigate clinical and cost effectiveness.

**427.003 (Poster)** A Systematic Review and Meta-Analysis of Group Interventions Targeting the Social Competence of Autistic Adolescents

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**Background:** Social skills group training (SSGT) interventions are amongst the most frequently employed interventions aiming to increase the social competencies of autistic youth.

**Objectives:** Given the variability of available SSGT and the measurement frameworks employed in their evaluation, a systematic review and meta-analysis was undertaken to explore efficacy of SSGT delivered to autistic adolescents via Randomised Controlled Trials (RCT), identifying their intervention targets and providing a summary of the measurement frameworks employed and their outcomes.

**Methods:** The methodological quality and theoretical fidelity of studies was assessed, with a random effect meta-analysis conducted to summarise the efficacy of SSGT in improving autistic symptomology, behavioural/emotional challenges, adaptive functioning, and social outcomes.

**Results:** Database searches identified seventeen studies meeting the study's inclusion criteria. Despite good methodological quality, most studies had a medium to small intervention fidelity, limited by standardised and replicable approaches to training and opportunities to practice taught social skills in everyday contexts. There was a medium overall positive aggregated effect of SSGT on adolescent outcomes ( $g=0.76$ ,  $p<0.001$ ), with significant effects observed only for improving adolescent social outcomes ( $g=1.69$ ,  $p=0.004$ ).

**Conclusions:** While findings suggest that SSGT successfully improve the social competence of autistic youth, the variability in outcome measures and limitations relating to study design and intervention fidelity, limit understanding of the generalisability of these improvements to everyday contexts.

**427.004 (Poster) ADHD Symptoms Moderate the Effect of an Executive Function Skills Training in Children with ASD**  
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**Background:** Executive functioning (EF) is impaired in children with ASD. Compared to traditional behavioral therapy, preliminary work suggests that computer game-based EF training may be more engaging, individualized, and more easily implemented for children with autism spectrum disorder (ASD). Yet, children with ASD present with heterogeneity both within core ASD symptoms and with respect to psychiatric comorbidity. Co-occurring attention deficit/hyperactivity disorder (ADHD) and anxiety symptoms may affect children's ability to benefit from intervention.

**Objectives:** We explored whether co-occurring ADHD or anxiety symptoms moderate the efficacy of an EF training for children with ASD. We asked, "for whom is training effective?"

**Methods:** We conducted a secondary data analysis of a randomized control trial (RCT) of EF training with 70 7- to 11-year-old children with ASD. All children had FSIQ $\geq$ 80, which did not differ by group ( $M=105$ ). Children in the training group received 1 1-hour training session per week for up to 10 weeks. They played 4 computer games designed to improve working memory, set shifting, and inhibition, and received metacognition and emotion regulation coaching from a supervised trainer. Both the training and the waitlist control group received baseline ADOS, ADI-R, and cognitive testing (WASI-II). All parents filled out the CBCL, BRIEF, and SRS at baseline, measuring mental health, EF, and social communication challenges, respectively. CBCL Anxiety Problems and ADHD Problems scale T-scores were moderators of interest. All participants completed an EF battery pre- and post-training. Stop Signal Reaction Time (SSRT) during the Change Task, a lab-based measure of inhibition and set-shifting, was the outcome of interest. All analyses controlled for baseline SSRT.

**Results:** ADHD and anxiety symptoms were both prevalent in our sample (20 and 30% fell above clinical cutoff, respectively), and did not differ by group,  $t(67)=-1.60$ ,  $p=.12$ , and  $t(67)=-0.42$ ,  $p=.67$ . We found significant moderation by ADHD symptoms such that EF training improved reaction time to a stop signal (SSRT) to execute a nondominant response, compared to waitlist, only for children with clinically significant ADHD symptoms,  $\beta= -.33$ ,  $p= .047$ , Johnson Neyman region of significance = T-score of 70.69 or higher (Figure 1, Table 1). Children with elevated ADHD symptoms who received EF training had post-training reaction time latencies that were 98ms faster, on average, than children with elevated ADHD symptoms in the waitlist group. These children also differed from the overall sample in that they had greater challenges with at-home EF (BRIEF GEC,  $t(67)=-3.91$ ,  $p<.001$ ) and ASD symptoms (SRS-2 Total,  $t(66)=-2.69$ ,  $p<.01$ ). Anxiety symptoms did not moderate the effectiveness of training for children with ASD.

Conclusions: EF training may only improve behavioral outcomes for children with ASD and comorbid ADHD symptoms. Exploratory analyses suggest additional potential characteristics of children for whom this training may be effective, including higher nonverbal cognitive ability. Future trials with larger samples should continue to explore moderators of treatment efficacy. Also, future work should examine whether brain-based outcomes function as measures of target engagement for generalized, behavioral EF training outcomes.

**427.005 (Poster)** Acceptability of an Online Executive Function Coaching Program for Parents in a Community Sample  
**E. Wilkinson, A. Milgramm, M. Rinaldi and K. V. Christodulu, Center for Autism and Related Disabilities, Albany, NY**

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Background: Executive function (EF) deficits are common among children with ASD and impact functioning across multiple domains (Pellicano, 2012). *e-Unstuck and On Target* is an online course for parents that uses evidence-based strategies to improve flexibility, planning, and organization in children (Kenworthy et al., 2014, 2018). The current study seeks to apply a hybrid delivery model to the *e-Unstuck and On Target* course by combining the online training with professional coaching. This approach has shown success with other intervention programs but has not been studied in this context (Taylor et al., 2008).

Objectives: (1) To pilot an EF online training and coaching program and compare outcomes to training only and control groups in a community sample. (2) To examine the acceptability of the coaching program in a larger sample.

Methods:

**STUDY 1:** Thirty-six parents of school-age children with ASD were randomly assigned to a training, training + coaching, or waitlist control group. Parents in both the training and training + coaching groups completed *e-Unstuck and On Target* (Kenworthy et al., 2014, 2018) over nine weeks. Parents in the training + coaching group also attended weekly 30-minute clinician-led telehealth coaching sessions in small groups. The *Parenting Stress Index, Fourth Edition Short Form (PSI-4-SF)*; Abidin, 2012), *Behavior Rating Inventory of Executive Function – Second Edition (BRIEF-2)*; Gioia et al., 2015), and an EF knowledge test were completed pre- and post-intervention. Parents also reported on their completion of course modules, worksheets, and use of strategies.

**STUDY 2:** Sixty-one parents completed *e-Unstuck and On Target* and weekly coaching sessions. Parents completed the same measures described in Study 1.

Results:

**STUDY 1:** A repeated-measures ANOVA was conducted with time (pre, post) as the within-group variable and group (training, training + coaching, wait-list) as the between-group variable. Results revealed no significant main effects or interactions ( $p$ 's  $>.05$ ). Analysis of only the intervention groups (training, training + coaching) revealed a main effect of time for Knowledge ( $F(1,14)=8.95, p=.02$ ) but no main effect of group or group x time interaction. A chi-square test of independence revealed that the coaching group was more likely to have completed all or most modules, worksheets, and strategies ( $\chi^2(2, N=17)=7.97, p=.03$ ).

**STUDY 2:** Paired samples t-tests revealed significant changes in *PSI-4-SF* Total Stress ( $p=.04$ ) *BRIEF-2* Global Executive Composite ( $p=.01$ ) and knowledge ( $p<.001$ ) (see table 1). Over 95% of parents reported overall program satisfaction. Parents reported feeling more competent using accommodations (70%), feelings identification strategies (67%), “can’t not won’t” thinking (83%), and flexibility words (80%). Average attendance was 7.15 sessions.

Conclusions: Results indicate that coaching sessions may increase engagement with the *e-Unstuck and On Target* course. While there were no outcome differences between groups, the study was limited in power. In a larger sample, we found improvements in parent stress, child EF, and knowledge. High satisfaction ratings combined with high levels of retention and attendance, indicate that the program was acceptable and feasible for families. Overall, these findings support the utility of *e-Unstuck and On Target* and associated coaching sessions in a community sample.

**427.006 (Poster)** Adaptation and Preliminary Evaluation of an Intervention Targeting Intolerance of Uncertainty in Autistic Children with Co-Occurring Intellectual Disability (CUES:ID)  
**J. Maxwell<sup>1</sup>, V. Grahame<sup>2</sup> and J. Rodgers<sup>3</sup>, (1)Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, (3)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom**

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**Background:** Anxiety is common in autistic children with co-occurring Intellectual Disability (ID) and can cause distress for the child and family. There is a well-supported association between anxiety and the transdiagnostic construct of Intolerance of Uncertainty (IU) in autistic individuals without ID, and interventions targeting IU as a means of managing anxiety have been developed in this group. However, a high proportion of autistic children also have an intellectual disability, and interventions targeting IU have not yet been explored in this population.

**Objectives:** To adapt and undertake preliminary evaluation of the acceptability and feasibility of “Coping with Uncertainty in Everyday Situations” (CUES), a parent mediated group intervention for IU, for delivery to parents of autistic children with co-occurring ID.

**Methods:** Adaptations were made to the CUES intervention materials, informed by consultations with parents and professionals. The adapted intervention was subsequently implemented with parents of five boys with confirmed diagnoses of ASD and an intellectual disability, aged 8 years – 11 years, 9 months. Parents attended eight, two-hour, weekly group sessions. Measures of child IU, child anxiety, child Restricted and Repetitive Behaviours (RRBs), parent IU and parent well-being were taken at baseline, 3 months, 6 months and 12 months following the intervention. Semi-structured satisfaction feedback interviews were carried out 1-2 weeks following intervention.

**Results:** Feedback from parents suggested that they found the intervention to be helpful and appropriate, feasible and acceptable for their children, and that they had learned new strategies and gained confidence. Preliminary analyses of individual change using the Reliable Change Index (RCI) indicated reliable improvement at 6- and 12- month follow up for all participants on the primary measure of parent reported child IU, and all but one on the secondary IU measure. At 6- and 12- months post-intervention, two participants reliably improved on parent reported child anxiety. No reliable improvement was detected for child RRBs or either of the parent measures.

**Conclusions:** Findings from this preliminary study, which was of an adapted version of CUES made suitable for delivery to parents of autistic children with intellectual disability, indicate that the adapted programme is acceptable and feasible to deliver. Initial evidence of effectiveness based on reliable change indices indicates that this programme is promising in relation to a reduction in child IU and anxiety up to twelve months post intervention. Further work to determine the effectiveness of the programme in a fully powered trial is now needed.

**427.007 (Poster) Co-Designing a Primary Care Health Check for Autistic Adults**

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**Background:** Autistic people experience elevated rates of physical and mental health conditions, causing premature morbidity and mortality. They also experience greater barriers to accessing healthcare than the general population (Mason et al., 2019). These barriers likely contribute to problems identifying and treating the health conditions of autistic people. One possible way to improve health outcomes is through primary care health checks for autistic adults.

**Objectives:** 1. To gauge autistic people’s views about a primary care health check for autistic adults. 2. To co-design a primary care health check for autistic adults that addresses their expressed needs and preferences.

**Methods:** We undertook: 1. A survey of 461 autistic adults (N=444), and relatives of autistic people who lacked capacity to consent for themselves (N=17), to capture quantitative and free text views about adjustments needed to health care (Brice et al., 2021 in press), and a NHS primary care health check for autistic adults; people were contacted through the Adult Autism Spectrum Cohort-UK, a UK cohort study of autistic adults. 2. Primary care health check co-design was undertaken through seven consultation groups with autistic people (N=25), two of whom had a learning disability, non-autistic adults with a learning disability (N=10), relatives and carers (N=7), and five interviews with NHS primary care staff (N=5). The consultation groups and interviews focused on participant’s previous experiences of health checks and healthcare appointments, the reasonable adjustments needed, the health check itself, the use and content of a pre-health check questionnaire and the potential future implementation of the health check in the NHS.

Results: Most autistic people (83.4%) thought a primary care health check was needed for all adults on the autism spectrum. There was less agreement about the details of how and what a health check might offer (e.g. the frequency of the health check and how long it should last). Most people rated the need for staff training about autism (89.9%) and delivering health checks (79.8%) very important and this view was reflected in the consultation groups and interviews. There was agreement in the consultation groups and interviews between all stakeholders on a number of key issues including: that the health check should be biopsychosocial covering physical and mental health, and emotional and social wellbeing; that collecting information by online or paper questionnaire beforehand was beneficial; that offering reasonable adjustments was key to increasing healthcare access and that these should be tailored to an individual's needs; and that changes were needed in the communication methods of GP practices with greater use of text, email and online methods.

Conclusions: Our findings clearly demonstrate autistic people are positive about a primary care health check and provide insight into what might enhance, or reduce, autistic people's views on acceptability. Through our co-design process, we have developed a primary care health check for autistic people in collaboration with key stakeholders. The effectiveness of the health check at identifying and meeting new health needs and conditions, and its cost effectiveness will now be investigated in a randomised controlled trial.

**427.008 (Poster)** Cognitive-Behavioral Family Therapy As Psychoeducation for Adolescents with Highfunctioning Autism Spectrum Disorders: Aware and Care for My Autistic Traits (ACAT) Program for a Pragmatic Multisite Randomized Controlled Trial

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Background: An autism spectrum disorder (ASD) diagnosis aims to obtain exceptional support for the disorder, though this does not guarantee practical support. We developed a psychoeducational program using cognitive behavioral therapy (CBT), "Aware and Care for My Autistic Traits" (ACAT) for Japanese adolescents with high functioning ASD and their parents.

Objectives: This study aimed to examine the efficacy of the newly developed psychoeducation program for parents and individuals with HF-ASD, or ACAT, by comparing with the treatment-as-usual (TAU) group. Multisite, randomized, controlled trials have conducted to investigate and assess the relative efficacy of COMB compared to TAU. The primary outcome was the increased awareness of ASD measured by the child/youth version of the Autism Knowledge Quiz (AKQ).

Methods: This multisite study was a randomized controlled trial. In total, twenty participants were assigned to the ACAT group and twenty-three to the treatment-as-usual (TAU) group. The ACAT group received a weekly 100-min session for six weeks and one follow-up session. They answered behavioral and clinical measures at pre-, post-intervention, and follow up. The primary outcome was the Autism Knowledge Questionnaire for young people (AKQ-C). Secondary outcome measures included the Strengths and Difficulties Questionnaire (SDQ), the Vineland Adaptive Behavior Scales second edition (Vineland-2), and the Depression Self-Rating Scale for Children assessments (DSRS-C) for children, and the Parenting Resilience Elements Questionnaire (PREQ), the General Health Questionnaire 12 (GHQ-12), Autism Knowledge Questionnaire for parents (AKQ-P) for parents/guardians. The longitudinal change of each outcome was tested by linear mixed effect model analysis (LME). The LME model included fixed effects of time, i.e., pre, post, and follow up, group (COMB and TAU), time by group interaction, age, sex, and the random effect of the subject on intercept.

Results: In this study, the ACAT group had a significantly higher score of self-understanding of ASD (AKQ-C) ( $F(1,41)=15.50, p<.01$ ) and had a lower score of maladaptation (SDQ) ( $F(1,41)=12.23, p<.001$ ) than the TAU group. Additionally, the ACAT group showed an increase in the adaptive behavior (Vineland-2) ( $F(1,41)=6.01, p<.05$ ) compared to the TAU group. For parents/guardians, parent's resiliency significantly increased (PREQ) ( $F(1,41)=4.90, p<.05$ ), and their general health significantly increased (GHQ) ( $F(1,41)=7.38, p=.01$ ) compared to the TAU group. There were no significant differences between two groups for the DSRS-C ( $F(1,41)=7.15, p=n.s.$ ) and AKQ-P ( $F(1,41)=13.32, p=n.s.$ ).

Conclusions: The results showed that the ACAT is an effective treatment for adolescent with HF-ASD by increasing the awareness of ASD. Although a randomized placebo-controlled trial will be needed in future studies, this study may help establish a new evidence-based psychoeducational treatment strategy for child/adolescent patients with HF-ASD and their parents/guardians. The ACAT may afford more treatment options as an after-diagnosis service and improve the dissemination of psychoeducation and CBT for HF-ASD.

Trial registration: UMIN Register 000029851.

**427.009 (Poster)** Combined Data from the Application of the Computerized Progressive Attentional Training (CPAT) across Brazil and the UK Shows Generalized Improvements in Academic Performance and Fluid Intelligence

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**Background:** Although not a core symptom in Autism Spectrum Disorder (ASD), attention atypicalities are found in ASD since early infancy. Attention processes are important for successful interaction with the environment and are also linked to academic performance. Two separate recent pilot studies (Spaniol et al., 2018; under review) tested the efficacy of an attention training program: the Computerized Progressive Attentional Training (CPAT), in small groups of children with ASD compared to active control groups. While both studies reported significant academic and cognitive improvements in the experimental group, there are substantial differences in the settings and populations tested, one study conducted in Brazil and the other in the UK.

**Objectives:** Results from both previous pilot applications of the CPAT, which followed a similar protocol and methodologies, were combined to test: 1. Whether the potential efficacy of CPAT depended on the site it was delivered; and 2. If the efficacy obtained in each study separately also holds when the two cohorts are combined. Thus, we ask whether attention training in the context of the Brazilian public health system yields similar outcomes compared to attention training in the context of the school system in the UK.

**Methods:** The studies were conducted at the Autism Unit CAISM linked to the public mental health system from São Paulo - Brazil, and in special and mainstream primary schools in Birmingham – UK. Combined, 41 participants from 6 - 14 years old took part in the study (26 from Brazil and 15 from the UK). Participants were randomly assigned to either the CPAT (n=22) or active control group (n=19). They were assessed before and immediately after the intervention/active control period (2 sessions per week over 8 weeks). Cognitive and academic performance were assessed using the tests: Raven's Coloured Progressive Matrices for fluid intelligence, and academic tests in math, reading and writing - School performance test in Brazil, and tests from primary schools database in the UK. Assessment was done blindly with the participants unaware of the group affiliation.

**Results:** Performance in the cognitive test and writing differed between the sites. However, regardless of site differences the CPAT intervention yielded similar significant improvements across the three academic assessments and the cognitive measure, compared to the active control group. Thus, while no group differences were recorded before the intervention, the CPAT group showed superior performance in math, reading and writing tests, as well as in the cognitive/intelligence measure following the intervention compared to the active control group and this effect was not mediated by site.

**Conclusions:** Our results show that attention training with CPAT is an effective approach to aid school performance and cognition in ASD and provide support to the pilot studies reported in Spaniol et al. (2018, under review). Furthermore, it points to the generality of the approach, which leads to similar outcomes across different cultural or social contexts. Future large scale studies are necessary to further support the efficacy of cognitive training like the CPAT in promoting academic performance among children with ASD.

**427.010 (Poster)** Coping with Uncertainty in Everyday Situations: Adolescent (CUES-Ad)

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### **Background:**

Anxiety disorders are very common in autistic individuals (Kerns et al., 2016; Wise et al., 2018) and the presentation of anxiety symptoms may be more complex for autistic people (Kerns et al., 2016; White et al., 2009). Intolerance of uncertainty (IU) is a transdiagnostic factor underlying many anxiety disorders and research suggests that autistic people experience high levels of IU (Boulter et al., 2014; Wigham et al., 2015).

Trembath et al. (2012) report young autistic adults describe their experiences of anxiety in ways which indicate that 'unexpected or sudden change' and 'uncertainty/making decisions' are potential triggers for increasing anxiety. In addition, Ozsvadjian et al. (2012) found change or disruption in routine were specific triggers for autistic individuals' anxiety.

Coping with Uncertainty in Everyday Situations (CUES) is a specific CBT based intervention targeting intolerance of uncertainty which has been developed for autistic children (Rodgers et al., 2017) and autistic adults (Rodgers et al., 2018). CUES has shown promise. A single case experimental design study of CUES Adult (CUES-A, Rodgers et al., 2018) reported significant increases in participants' confidence in uncertain situations, reduction in anxiety and a significant reduction in restricted, repetitive behaviours (RRB).

### **Objectives:**

This study aimed to adapt CUES-A and provide preliminary evaluation of the feasibility and acceptability of an intervention designed to address IU in autistic adolescents (CUES-Ad).

### **Methods:**

A single case experimental design (SCED) was used to test the Coping with Uncertainty in Everyday Situations – Adolescent (CUES-Ad) intervention. Four autistic adolescents seeking treatment for anxiety (14-18 years) were recruited from Child and Adolescent Mental Health Services and attended an initial session, eight sessions of Cognitive Behavioural Therapy (CBT) targeting IU and a follow-up session.

Participants completed daily diaries throughout the intervention, which were used to measure the degree and process of therapeutic change in relation to participant selected target uncertain situations. Secondary standardised outcome measures assessed self-reported and parent reported IU, anxiety, worry and RRB at three time points; initial meeting, first therapy session and four weeks' follow-up and reliable and clinically significant change was assessed.

### **Results:**

Results showed some significant improvements. Aggregated change scores from participant selected target uncertain situations (TAU-U) indicated significant reductions in worry, and significant increases in confidence during uncertain situations and management of uncertainty. Anxiety in anticipation of uncertainty did not significantly decrease. Feedback from follow-up interviews was positive and 100% of participants stated they would recommend CUES-Ad to other autistic adolescents.

### **Conclusions:**

CUES-Ad demonstrates promise as a feasible and acceptable intervention to reduce IU in autistic adolescents, in line with our main objective. The SCED findings indicate some individual variability, with evidence of improvements related to confidence in and management of uncertain situations and reduction in worry.

Future evaluation on CUES-Ad should include delivery via a range of therapists, among adolescents with a wider age range, co-morbidities, or intellectual disability and ensure further support for identifying and targeting the most personally salient target situation.

**427.011** (Poster) Discrete Electroocortical Predictors of Anxiety during Follow-up Period after Social Skills Intervention for Youth with Autism Spectrum Disorder

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Background: Approximately 40% of youth with autism spectrum disorder (ASD) experience an anxiety disorder in their lifetime (Van Steensel et al., 2014; 2017). Recent innovations in outcome assessment for evidence-based interventions have focused on using neural and other obligatory constructs, which provide unique insight into physiological states of anxiety (De Los Reyes & Aldao, 2015; Kang et al., 2019). Two electroencephalogram (EEG) metrics, error-related negativity (ERN) and right-dominant frontal brain activity (rRFA), have been linked to anxiety symptoms (Meyer, et al., 2016; Reznik et al., 2018). Social Skills Interventions (SSI) have shown some indirect improvements in anxiety symptoms for some individuals with ASD (White et al., 2010; Wood et al., 2015). Previous research demonstrated predictive utility of these metrics in anxiety-related treatment response, wherein larger baseline ERN predicted improvements in anxiety and larger rRFA predicted worsening of self-reported anxiety

over the course of SSI (Kang et al., 2019). However, it is unclear if the effects are maintained after the SSI, when youth no longer receive clinical support and *in vivo* reinforcement. The use of neural metrics can allow for identification of those who would benefit from close monitoring and additional support after SSIs in order to prevent negative outcomes.

**Objectives:** We sought to test the utility of ERN and rRFA in predicting changes in anxiety symptomatology during the follow-up period of SSI.

**Methods:** Fifty-four youth with ASD (72% male,  $M_{age}=12.3$  [at baseline],  $SD_{age}=2.9$ ;  $IQ\geq 70$ ) participated in a 1.5 hr/week SSI for 10 weeks and was followed up after 10 weeks post-SSI. Youth and their parents completed a measure of anxiety (MASC-2; March, 2013). ERN was measured during the flanker task and rRFA was measured during resting state. ANCOVA-of-change models controlling for immediate endpoint anxiety scores and intervention condition were conducted to examine if baseline rRFA and ERN amplitudes independently predicted changes in anxiety from endpoint to follow-up.

**Results:** Larger ERN amplitude predicted increased self-reported total anxiety, performance anxiety, social anxiety, and obsessive-compulsive symptoms (all  $Bs < -.19$ ,  $ps < .04$ ) at follow up (Table 1). Larger rRFA (indicating more relative right than left frontal brain activity) predicted increased self-reported tense/restlessness symptoms ( $B=.3$ ,  $p=.002$ ), and increased parent-reported humiliation/rejection, physical, and tense/restlessness symptoms (all  $Bs > .2$ ,  $ps < .04$ ) at follow-up.

**Conclusions:** Results indicate that ERN and rRFA can predict participants whose anxiety symptoms may improve or worsen post-SSI and provide important clinical implications for using ERN and rRFA as a predictive measure of changes in anxiety not only over the course of SSI but also after the SSI is completed. Surprisingly, whereas larger ERN predicted improvements in anxiety over the course of SSI (Kang et al., 2019), it predicted worsening of symptoms during the follow-up period. Larger rRFA consistently predicted a worsening of anxiety symptoms during and after follow-up. These results highlight the importance of identifying individuals (e.g., those with larger ERN or rRFA) who would benefit from being further monitored and tailoring support during and after the SSI, and provides avenue for future research on the utility of neural indices of anxiety in ASD.

**427.012 (Poster)** Does a Novel Group Parenting Intervention Reduce Emotional and Behavioural Problems in Young Autistic Children? Results from the Autism Spectrum Treatment and Resilience (ASTAR) Pilot Randomised Controlled Trial (RCT) **M. Palmer<sup>1</sup>, T. Charman<sup>2</sup>, D. Stringer<sup>3</sup>, V. Hallett<sup>4</sup>, J. Mueller<sup>5</sup>, R. Romeo<sup>6</sup>, J. Tarver<sup>7</sup>, J. Paris Perez<sup>1</sup>, L. Breese<sup>1</sup>, M. Hollett<sup>1</sup>, T. Cawthorne<sup>1</sup>, J. Boadu<sup>1</sup>, B. Beresford<sup>2</sup>, M. Knapp<sup>6</sup>, V. Slonims<sup>7</sup>, A. Pickles<sup>4</sup>, S. Scott<sup>1</sup> and E. Simonoff<sup>1</sup>**, (1)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, (2)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)South London and Maudsley NHS Foundation Trust, London, United Kingdom, (4)Aston University, Birmingham, United Kingdom, (5)University of York, York, United Kingdom, (6)PSSRU, LSE, London, United Kingdom, (7)Guy's & St Thomas' NHS Foundation Trust (Evelina Children's Hospital), London, United Kingdom

**Background:** Most young children with autism display co-occurring emotional and behaviour problems (EBPs) that tend to persist over time and impact the lives of the child and their families. There is some evidence that behavioural parenting interventions are effective for reducing parent-reported EBPs in autistic children (Postorino et al., 2017; Tarver et al., 2019). Most RCTs have evaluated individual parenting interventions, even though groups are more scalable and provide a support network. Previous trials also vary in the intervention focus on externalising behaviours versus anxiety. Furthermore, conclusions about the effectiveness of these approaches cannot be drawn as many RCTs do not employ an active control condition or use blinded outcome measures. Cost-effectiveness is also unknown.

**Objectives:** The ASTAR pilot RCT tested the feasibility and pilot efficacy and cost-effectiveness of the ASTAR group parenting intervention against an active control.

**Methods:** As part of the Improving Autism Mental Health (IAMHealth) research programme ([www.iamhealthkcl.net](http://www.iamhealthkcl.net)), 62 parents/carers (91.9% mothers) and their 4–8 year old autistic children participated in the ASTAR pilot RCT (ISRCTN91411078). Participants were randomised 1:1 to the ASTAR group behavioural parenting intervention (Predictive Parenting) or an attention control consisting of psychoeducation parent groups (Psychoeducation). Predictive Parenting provided strategies to manage both externalising behaviours and anxiety and ways to promote parental self-care and reduce stress, whereas Psychoeducation focused on providing knowledge about autism and social support. Both involved 12 weekly groups with 6 to 8 parents/carers. Content was adapted based on child verbal ability (minimally verbal versus verbal). The primary outcome was a blinded observational measure of the rate of child behaviours that challenge displayed during a structured parent- and researcher-child interaction, called the Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting. Secondary outcomes included observed child compliance, facilitative parenting and non-facilitative parenting behaviours, parent- and teacher-reported child EBPs and parental self-report of parenting practices, stress, self-efficacy and wellbeing (see Table 1 for

baseline sample characteristics). Adverse events, costs and service utilisation were recorded. Feasibility was assessed through recruitment, retention, fidelity and satisfaction. Bivariate linear mixed models were used to obtain estimates of pilot efficacy on the intent-to-treat sample. Pilot cost-effectiveness compared costs and outcomes from three perspectives.

**Results:** Feasibility was demonstrated, with retention, completion of measures, fidelity of implementation and parental satisfaction high for both interventions. There was no group difference in primary outcome but differences in relative observed rates of child compliance, facilitative parenting and parent-defined target symptom change favouring Predictive Parenting were found (see Figure 1 for forest plot of effect sizes). Groups did not differ on other measures but there was a general pattern of favouring toward Predictive Parenting. Predictive Parenting was more expensive than Psychoeducation and had low probability of being more cost-effective.

**Conclusions:** This pilot RCT will add to the growing literature on the effects of behavioural parenting interventions for co-occurring EBPs in autism. It highlights the need for blinded objective measures along with the use of active control intervention conditions to be included in future trials.

**427.013 (Poster)** Double-Blind Placebo-Controlled Trial for the Effects of Propranolol on Anxiety in Autism Spectrum Disorder  
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#### Background:

Autism spectrum disorder (ASD) is often characterized by co-occurring anxiety. Propranolol is widely utilized for the treatment of performance anxiety and public speaking anxiety. We conducted a double-blinded placebo-controlled trial of the beta-adrenergic antagonist propranolol in ASD.

#### Objectives:

Due to its effects on anxiety in a variety of settings, we wished to determine the effects of propranolol on anxiety in ASD.

#### Methods:

ASD patients (age 7-24, mean =14, standard deviation =5 years) were enrolled, and randomized to a 12 week course of propranolol, titrated to 100mg daily in divided doses over 12-weeks (body weight adjusted in children), or placebo. Clinicians and staff were blinded as to treatment group assignment. Anxiety assessments were performed at baseline, at 6-weeks and at 12-weeks. Seventy two participants (53 males, 20 females) completed the 12-week visit. A primary outcome was the Clinician Global Clinical Impression-Improvement (CGI-I) ratings at six and twelve weeks. In this initial analysis, CGI-I scales are reported for anxiety. Ordinal logistic regression was used to analyze CGI-I ratings with respect to anxiety, as well as other outcomes. Separate analyses were performed for self/family ratings and clinician ratings with the relevant baseline CGI severity score used as a covariate. Results are presented as odds ratios (OR), with the control group as the reference category. The odds ratios reflect the change in odds of improvement in the propranolol group relative to the placebo group.

#### Results:

The clinician rating of improvement on anxiety was statistically significant at the 12 week time point ( $p = 0.045$ ) with an OR = 2.58 (95% CI = 1.02, 6.52). The patient or family rating of improvement on anxiety was consistent with physician's, OR = 2.47 (95% CI = .91, 6.71),  $p = 0.077$ . While not statistically significant at the  $p=0.05$  level, self/family and clinician ratings of overall ASD severity were positive at all time points, suggesting a beneficial effect of propranolol. Further analyses will attempt to identify sub-groups of responders and to examine other outcome measures in this trial.

## Conclusions:

Initial analysis examining CGI-I supports a significant beneficial effect of propranolol on anxiety. To our knowledge, this is the first such finding targeting anxiety in ASD. It will be critical to identify best responders, which might occur in individuals with the greatest degree of arousal as measured by psychophysiological markers of stress, and to examine subsequent outcome measures in this manner, as well as examining brain imaging markers that might predict best response. These findings can then guide a larger multicenter trial for the effects of propranolol while also incorporating these markers to confirm predictors of best response.

**427.014 (Poster)** Emotion Dysregulation in ASD: An Examination of an RCT of CBT for Anxiety in Public Schools  
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**Background:** Youth with ASD often experience difficulties with emotion dysregulation which may underlie and/or exacerbate anxiety (Mazefsky et al., 2013). Although limited, previous research indicates that emotion dysregulation is associated with emotional and behavior difficulties (Rieffer et al, 2011), and is correlated with social competence (Reyes et al., 2020). Recent findings suggest improvements in emotion regulation after youth with ASD participated in CBT (Weiss et al., 2018; Scarpa et al., 2011). These studies were conducted in clinic settings, and there is little examination of whether emotion dysregulation improves after participating in CBT for anxiety in schools.

**Objectives:** The purpose of this study is to (1) examine the relationship between emotion dysregulation and social competence (i.e., peer problems, prosocial behavior) prior to participation in school-based CBT for anxiety and (2) evaluate the impact of the intervention on symptoms of emotion dysregulation and externalizing behaviors (i.e., hyperactivity, conduct) based on parent and child self-report.

**Methods:** This study included 81 youth (M age=10.71 years, SD=1.76 years) with ASD (i.e., SRS-2 T-Scores  $\geq 60$ ; Constantino & Gruber, 2012) and clinically significant symptoms of anxiety who participated in a randomized control trial of a school-based CBT program for anxiety (Facing Your Fears-School Based Program, FYF-SB). Thirty-nine youth were randomized to FYF-SB and 42 youth were randomized to Usual Care (UC). Parents completed The Emotion Dysregulation Inventory (EDI, Mazefsky et al. 2018) and the Strengths and Difficulties Questionnaire (SDQ; Goodman et al. 2000) at pre/post FYF-SB and UC. Youth also completed the SDQ Self-Report at both time points.

**Results:** A significant correlation was found between EDI and SDQ social competence and hyperactivity subscales at baseline. Specifically, increased scores on the SDQ peer problems subscale were associated with higher scores on the EDI reactivity subscale ( $r=.30, p=.005$ ) and EDI dysphoria ( $r=.46, p<.001$ ). Also, decreased scores on the SDQ prosocial behavior subscale were inversely associated with increased scores on the EDI reactivity subscale ( $r=-.20, p=.048$ ) and EDI dysphoria ( $r=-.22, p=.03$ ). To evaluate treatment effects, repeated measures ANOVA were conducted with the treatment and waitlist control groups. A significant time by group interaction was found on parent report for the EDI reactivity subscale,  $F(1,64)=4.32, p=.04$  and a marginally significant interaction effect for the SDQ Hyperactivity subscale,  $F(1,65)=2.92, p=.09$ . These significant interaction effects suggest that youth that received FYF-SB exhibited significant improvements in emotion regulation and hyperactivity compared with the UC group. There was a significant group by time interaction for the SDQ emotional problems subscale on both parent ( $F(1,65)=4.07, p=.05$ ) and child report ( $F(1,67)=8.03, p=.006$ ). There was no significant group by time interaction for the EDI dysphoria subscale, or on the SDQ Conduct subscale (all  $p>.1$ ).

**Conclusions:** A strong association was found between emotion dysregulation and social competence, although causality between constructs is unclear. Nonetheless, results also indicated that CBT for anxiety has the potential to impact a broader constellation of symptoms than anxiety alone (i.e., emotion dysregulation and hyperactivity). Limitations and future directions will be discussed.

**427.015 (Poster)** Examining Gender Differences in Improvement in Loneliness and Social Responsiveness Following PEERS® for Young Adults

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**Background:** Previous research has shown that young adults with autism spectrum disorder (ASD) experience elevated difficulty with socialization as compared to typically developing young adults (Ee et al., 2019). Among individuals with ASD, females demonstrate increased functional social behavior as compared to males (Halladay et al., 2015). Given these observed differences in social performance, it is essential to better understand baseline gender differences and to confirm that social skill interventions produce similar gains for males and females. Previous research has shown that the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson, 2017), a caregiver-assisted social skills intervention, is equally efficacious in improving social skills knowledge, social engagement, and social responsiveness in males and females with ASD (McVey et al., 2017); however, the extent to which loneliness and specific aspects of social responsiveness differ across genders following treatment has yet to be extensively explored.

**Objectives:** This study examines gender differences in loneliness and various facets of social responsiveness in young adults with ASD as a result of the PEERS® for Young Adults intervention. We hypothesized that male and female young adults with ASD would show equivalent baseline levels of reported loneliness and social responsiveness, as well as equivalent improvements across these domains following treatment.

**Methods:** Participants included 170 young adults (76.5% male,  $M_{age}=22.25$  years,  $SD=3.78$ ) who completed the UCLA PEERS® for Young Adults program (Laugeson et al. 2015). Participants presented with a previous diagnosis of ASD or heightened ASD symptomatology as demonstrated by a Total Score  $\geq 60$  on the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012). Self-reported loneliness was assessed using the Social and Emotional Loneliness Scale for Adults (SELSA; DiTommaso & Spinner, 1993). Distinct elements of social responsiveness were examined using the five subscales of the SRS-2 (i.e. Social Communication, Social Cognition, Social Motivation, Social Awareness, and Restricted Interests and Repetitive Behavior). ANOVAs and MANOVAs were conducted to compare baseline and change scores following treatment by gender on the SELSA and SRS-2.

**Results:** An ANOVA revealed no significant gender differences in baseline loneliness on the SELSA total score,  $F(1,154)=0.003$ ,  $p>.05$ . Similarly, a MANOVA examining SRS-2 subscale scores showed no significant differences in baseline social responsiveness by gender,  $F(5,152)=1.71$ ,  $p>.05$ . Although loneliness significantly improved following the PEERS® intervention,  $t(107)=5.18$ ,  $p<.001$ , there were no significant differences in improvements in loneliness by gender,  $F(1,106)=0.003$ ,  $p>.05$ . Likewise, overall social responsiveness on the SRS-2 improved following treatment,  $t(110)=9.30$ ,  $p<.001$ , however no significant gender differences were observed across the five subscales,  $F(5,105)=1.25$ ,  $p>.05$ .

**Conclusions:** Results suggest that there are no significant gender differences in loneliness or social responsiveness at baseline or following treatment, confirming our hypotheses. These findings demonstrate that both males and females with ASD benefit similarly from an evidence-based social skills intervention. Future research might investigate differences in maintenance of treatment gains between genders. Additionally, exploration of the efficacy of PEERS® for gender nonconforming and/or transgender individuals would be an important extension of the current research.

**427.016 (Poster)** Examining the Association between Self-Concept and Treatment Outcomes in Social Skills and Social Engagement for Adolescents with Autism Spectrum Disorder Following the UCLA PEERS Intervention

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**Background:** Youth with autism spectrum disorder (ASD) are known to often struggle with poor self-concept, beliefs held about oneself, as well as impaired social functioning (McCauley et al. 2019). While research suggests that self-concept among adolescents with ASD may predict outcomes in academic performance (McCauley et al. 2018), little is known about the impact of self-concept on social skills training. The UCLA Program for the Education and Enrichment of Relational Skills (PEERS®) is a 16-week evidence-based, caregiver-assisted social skills intervention for adolescents with ASD and other developmental disabilities (Laugeson 2012). Previous research has demonstrated the efficacy of the PEERS intervention in improving social skills and self-concept following treatment (Laugeson 2012). Although research may suggest enhanced self-concept as a result of social skills training, self-concept has yet to be evaluated as a predictor of social skills intervention gains.

**Objectives:** The objective of this study was to evaluate the relationship between baseline self-concept and social skills improvement for adolescents with ASD following the UCLA PEERS intervention. The researchers hypothesized that adolescents

with ASD who endorse more favorable self-concept prior to intervention will exhibit greater improvement in social skills following treatment.

**Methods:** Participants included 99 adolescents between the ages of 10 to 18 ( $M=13.94$ ,  $SD=1.94$ ) presenting for social skills treatment through the UCLA PEERS Clinic. All participants had clinically elevated ASD symptoms at baseline as evidenced by a total score  $\geq 60$  on the Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber 2012). To measure self-concept prior to intervention, adolescents completed the Piers-Harris Children's Self Concept Scale-Second Edition (PH-2; Piers et al. 2002). In order to assess improvement in social engagement and social skills following intervention, adolescents and caregivers completed the Quality of Socialization Questionnaire (QSQ; Frankel and Mintz 2008) and caregivers completed the Social Skills Improvement System (SSIS; Elliott & Gresham 2008) pre- and post-intervention.

**Results:** Pearson correlation coefficients were calculated to assess the relationship between baseline adolescent self-reported PH-2 total scores and change in scores from pre- to post-treatment on the adolescent self-reported QSQ, caregiver-reported QSQ, and caregiver-reported SSIS-Social Skills subscale. Results did not reveal a statistically significant correlation between baseline self-concept and social skills improvement in any case ( $r=.014$ ,  $p=.888$ ;  $r=.076$ ,  $p=.457$ ; and  $r=.128$ ,  $p=.207$  respectively).

**Conclusions:** Findings did not support the original hypothesis that there would be a positive correlation between baseline self-concept and social skills gains following the PEERS intervention for adolescents with ASD. The lack of a statistically significant correlation between these factors suggests that the PEERS intervention may be successful in improving social skills among adolescents with ASD regardless of baseline self-concept. Future studies might investigate the potential relationship between social skills improvements in PEERS and other areas of self-concept such as those measured on the PH-2 subscales (Physical Appearance and Attributes, Freedom from Anxiety, Intellectual and School Status, Behavioral Adjustment, Happiness and Satisfaction, and Popularity) in order to identify whether specific aspects of baseline self-concept may play a role in social skills improvement for adolescents on the autism spectrum.

**427.017 (Poster)** Experiences of Young Adults with Autism Spectrum Disorder with Employment Readiness Skills Training: A Qualitative Analysis  
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**Background:** Although employment is fundamental to the well-being of individuals with autism spectrum disorder (ASD), less than 20% of young adults with ASD are employed resulting in their limited employment-readiness. While employment-related intervention studies exist that focus on soft and hard skills development across employment preparation, obtainment and retention, there is no intervention that focuses on both soft and hard skill development specifically applicable to employment preparation, obtainment and retention for individuals with ASD. Employment Preparation and Application Skills Support (EPASS) is an employment readiness training program designed to improve the employment-readiness of young adults with ASD. Specifically, EPASS focuses on teaching skills important for obtaining and maintaining employment, including: searching for a job, conducting informational interviews, personal branding, applying for a job, developing a resume and cover letter, pre-employment screenings, developing job interview skills, practicing mock interviews, learning disability law and accommodations, and maintaining a job. The 12-session EPASS intervention was delivered during spring semesters at a community center conference room to three cohorts of eligible participants over the course of three years.

**Objectives:** The purpose of this study was to understand the experiences of transition-aged youth with employment readiness pre and post participation in the three-year pilot EPASS intervention. We explored participants experiences to assess the impact of the pilot EPASS intervention on their employment readiness

**Methods:** Following approval from the university's Institutional Review Board, convenience sampling was used to recruit transition-aged youth with ASD (17-25 years of age) from a university disability resource center and a local school district. A qualitative descriptive design (Sandelowski 2010) was employed with 25 transition-aged youth with ASD and data were collected using semi-structured interviews. The data were analyzed to identify themes as they emerged

**Results:** Using Braun and Clark's (2006) thematic analysis, five major themes were identified: (a) Self-Efficacy Pre EPASS-Intervention; (b) Self Efficacy Post the EPASS Intervention; (c) Expectation Outcomes; (d) Personal Goals Post the EPASS Intervention; and (e) Recommendations for the EPASS Intervention. Overall, transition-aged youth with ASD reported significant improvement in both soft and hard skills for employment readiness post-intervention. Participants also provided recommendations that might further advance the impact of the EPASS intervention.

Conclusions: Employment-related interventions such as EPASS is significant to the employment achievements of transition-aged youth with ASD. Future intervention studies could focus on applying experiential learning strategies and video-based instruction to address additional work related and training gaps for transition-aged youth with ASD (e.g., managing personal expenses; conflict management in the workplace; securing volunteer, internships and actual job opportunities). In addition, developing instruments that measure work-related social function, job readiness and performance-based skills could assist professionals in making placement decisions relating to participation in EPASS or other employment related interventions. Finally, encouraging families and caregivers to support the employment and training needs and programs for transition-aged youth is significant to their optimal quality of life.

**427.018** (Poster) Exploring Outcomes of the PEERS Intervention for Adolescents with Autism Spectrum Disorder  
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Background: Many individuals with autism present with problematic emotional regulation as well as elevated negative emotions (Samson, Hardan, Podell, Phillips & Gross, 2015). The ability to control one's emotions in social situations is vital, as this behavior can greatly alter the course of a friendship. Therefore, emotion regulation skills that promote positive mental health functioning are equally crucial, in addition to social skills, for optimal social functioning. While it has been well established that PEERS is an effective treatment protocol to address the social skill challenges (Laugeson et al., 2009), other novel aspects of participants' mental health functioning and emotion regulation warrant further exploration and understanding.

Objectives: This study aims to investigate collateral improvements in mental health and emotion regulation relating to the PEERS intervention for adolescents with autism. Additionally, this study aims to analyze participants' satisfaction within the current treatment protocol.

Methods: Adolescents with high functioning autism and their parents were randomized to either the PEERS group (PEERS) or the waitlist control group (WL). For more information on the PEERS intervention, please see previous published studies. Participants completed outcome measures relating to mental health, emotion regulation and treatment satisfaction. Data were collected at both pre- and post-treatment. Repeated measures ANOVAs for analyzing group differences were conducted. Please note that the current study is ongoing and these are preliminary results ( $N = 17$ ; 10 PEERS & 7 WL). The average age of participants was 14.5 years old.

Results: Significant improvements in social anxiety (SAS-A) ( $F = 4.5, p = .05$ ) were observed in the PEERS group over time. Significant improvements in general anxiety (SCARED) ( $F = 4.5, p = .05$ ) were observed in both the PEERS and WL groups over time. No other significant group differences emerged in any of the measures (ERICA, Kidcope, CNCEQ & The Flexibility Scale). Satisfaction forms were collected after the PEERS program. When asked about things that need improvement relating to the program, multiple parents commented inquired about further support relating to anxiety management (e.g. "My child was hard to motivate within PEERS due to her anxiety" and "Tips on how to help my child's individual, emotional struggles were needed").

Conclusions: The results suggest that while adolescents' perceptions of their anxiety levels decreased over time, other mental health and emotion regulation measures remained unaffected by time and/or engagement in the treatment program. Additionally, parental requests to bolster anxiety management training in order to augment social skill development were prominent. While many treatments for autism remain siloed, leading to excessive financial and time expenditures for families, the possibility of providing a treatment that targets two, highly interdependent areas of deficit rather than one may allow for greater efficiency and clinical utility. This study is the first to investigate collateral mental health and emotion regulation improvements associated with PEERS, thereby laying the foundation for future modifications and enhanced clinical effectiveness of the PEERS intervention.

**427.020** (Poster) Feasibility and Attendance in an 8-Week Physical Exercise Program in Underserved Children with ASD  
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**Background:** Physical exercise is well-established for its health promoting as well as stress reducing effects and may be an effective intervention for children with Autism Spectrum Disorder (ASD). Physical exercise rates are lower in children with autism compared to peers from the general population. However, little is known about the feasibility of physical exercise in

children with ASD and practical implications for low-income families who experience greater difficulty with access to intervention.

**Objectives:** The objective of this study was to explore the feasibility of a structured 8-week physical exercise intervention for low income families as part of a larger Randomized Clinical Trial (RCT) on fitness and anxiety improvements.

**Methods:** One hundred forty-eight children with ASD, ages 6 – 12 years old from low-income families with a primary focus on Latino and rural populations were recruited at two sites and assigned to an exercise intervention group (N = 76) or a sedentary LEGO/Minecraft control group (N = 72). The physical exercise program was offered 3 times per week and incorporated key guidelines from the Centers for Disease Control (CDC) including aerobic, muscle strengthening, and bone strengthening activities.

**Results:** The average age of participants was 9 years  $\pm$  2 years. The majority of participants were male (84% in the physical exercise and 83% in the control group) and Latino (58% in the physical exercise and 69% in the control group). The average BMI was  $22.0 \pm 6.1$  in the physical exercise group and  $22.7 \pm 6.9$ . The average attendance rate (proportion of sessions attended of the 24 scheduled) was similar between the physical exercise and control group (i.e.,  $50\% \pm 25\%$ -pts versus  $55\% \pm 21\%$ -pts). However, the completion rate was 70% (53/76) in the physical exercise group compared to 89% (64/72) in the control group ( $p = .005$ ). No differences were found in the participant characteristics between the physical exercise and control group.

**Conclusions:** Although the completion rate was higher in the control group, the attendance rate and program completion rate in the physical exercise group were on average higher compared to previous physical activity after school programs in children from the general population. This is the first study that revealed the feasibility of successfully conducting a physical exercise program in children with ASD from low-income families.

**427.021 (Poster)** Implementation of a Robot-Based Intervention for Students with Autism in Public Elementary Schools  
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**Background:** The use of technology-aided interventions is on the rise including for students with autism (Odom et al., 2015). Research supports using technology as a tool to support learning in multiple domains, including social skills, receptive language, and academics (Grynszpan et al., 2014). One new intervention approach includes a robot-based curriculum developed to teach students with autism social and communication skills. The humanoid robot, called Milo, models human facial expressions, speaks, and moves and delivers a social-communication curriculum to students with autism. This study examines the implementation of this new robot-based intervention in Midwestern public schools.

**Objectives:** The purpose of this study was to determine the perspectives of educational professionals on the introduction of Milo for students with autism in elementary schools in a Midwestern state.

**Methods:** The research questions for this study are: 1) What are teachers' concerns about implementing a robot-based intervention? Are teachers who are more comfortable using technology, more likely to accept and integrate a robot-based intervention into their classroom? 2) Does exposure to the training provided by RoboKind provide teachers with support and does it influence teacher perceptions, attitudes and comfort levels? 3) What are the strengths and pitfalls of using a robot to teach students with autism? Thirteen schools enrolled in the current study. Each school was provided a half-day, in-service training for Milo implementation. Pre- and post-training surveys were sent to teachers, paraprofessionals, and other school specialists who attended the training. Survey questions explored participants' perceptions and attitudes about implementing the intervention within a school-based setting, including issues of administrative support, time constraints and scheduling concerns, and level of enthusiasm.

**Results:** Fifty-eight school-based professionals participated in the study. Survey results were that facilitators overwhelmingly agreed that technology can be a useful tool to enhance the social skills of students with autism. Nearly all facilitators indicated enthusiasm when asked if they believe the robot-based curriculum would help their students with autism learn and agreed that their schools had appropriate resources to implement the curriculum. One teacher wrote in: "I believe Milo will be instrumental in teaching our younger students' social skills in a manner that is more appropriate for them." However, they were less sure about mastering the potential pitfalls of adapting new technology to the classroom environment. Facilitators raised concerns regarding the time commitment required to use Milo and thought it might be challenging to schedule enough time in the school day. Although some facilitators felt prepared to implement the Milo curriculum after the training, several expressed concerns about not having enough experience and some had apprehension about using a humanoid robot.

**Conclusions:** This study sought to examine the perceptions and attitudes of teachers and school personnel regarding adopting a new robot-based intervention for students with autism. Results indicate that although there are concerns regarding the amount of time required by the intervention, participants were excited to integrate and implement this new technology. Next steps are to re-survey these professionals in a few months to evaluate the efficacy of this robot-based intervention.

**427.022 (Poster)** Implementing Social Skills Group during Covid-19 Pandemic in an Ethnically Diverse Population  
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**Background:** Social Skills Groups, involving Social Thinking methodology (developed by Michelle Garcia Winner), are often recommended to improve social deficits in individuals with autism. In late March 2020 due to the COVID-19 pandemic and lockdown, in-person visits stopped at our Center, and all therapeutic services were switched to telehealth. Although there is empirical data supporting the use of Social Skills Groups in children with autism, the feasibility and effectiveness of this therapy via telehealth is unknown. Moreover, the Covid-19 pandemic represents a major life stressor for families, and the impact of parental stress in response to interventions is also worthy of examination.

**Objectives:** 1) to assess feasibility of Social Skills Groups via telehealth in children with autism in an ethnically diverse population during the COVID 19 pandemic and lockdown; 2) to assess preliminary effectiveness of social skills groups delivered via telehealth on social competence

**Methods:** Pilot trial assessing feasibility and preliminary efficacy of Social Skills Methodology via telehealth on social competence in all children with autism participating in a program of social skills groups in a university affiliated multidisciplinary developmental center. Intervention included Social skills using the Social Thinking methodology 1/week for 6 months. To measure changes in social competence, the Social Responsiveness Scale-2 (SRS-2) was used at baseline and after 6 months of intervention. Other data collected and analyzed included: demographics, attendance at the program, level of parental stress using the Parent Stress Index short form (PSI). Statistics included paired and t independent test, chi square.

**Results:** Of 31 patients participating in the program, outcome measures (pre and post) were available in 18 patients, 15 boys (83%) and 3 girls (17%) age  $11 \pm 4$  y.o, 2 White (11%), 8 Hispanic (44%), 6 African American (33%), 12 (66%) bilingual households, Childhood Autism Rating Scale:  $31 \pm 4$ ; 2 children with borderline IQ, rest average. Of the 18, 13 started in person and moved to telehealth, while 5 children started via telehealth; 15 families (83%) attended at least 75% of sessions or more. Overall, 9 children showed improvement in SRS-2 social competence subscale (50%) and 7 (39%) showed improved total SRS-2 Scores. 13 parents (72%) reported significant levels of parental stress on the PSI ( $>75$ ) at the end of the program. Children whose parents reported significant stress were less likely to improve in their SRS-2 social competence subscale (4/13 31% vs. 5/5 100%  $p=0.009$ ) and in the total SRS-2 score (3/13 23% vs. 4/5 80%  $p=0.02$ ) than children whose parents did not experience significant stress. In the group of children whose parents did not experience significant stress ( $N=5$ ) there was a significant improvement of the parental ratings of SRS-2 social competence subscale (baseline:  $37 \pm 9$ ; after 6 months:  $32 \pm 6$   $p=0.05$ ). There were no other differences in demographics or autistic severity between these 2 groups.

**Conclusions:** In this pilot study, social skills via telehealth was feasible and well attended by families. Preliminary efficacy was reported in roughly half the children and appeared to be, influenced by parental stress during COVID 19.

**427.023 (Poster)** Improving Social Media Competence and Confidence: The Acceptability, Feasibility, and Preliminary Efficacy of the Selfi Program

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**Background:** COVID-19 have expedited the move to a primarily digital society, making online social skills critical. While there are many benefits to social media, there are also many consequences if one does not handle themselves appropriately online. Individuals with autism spectrum disorder (ASD) struggle with in-person interactions, however little is known about their social experience online. While targeted social skills interventions have been demonstrated to improve social competency in those on the spectrum, no intervention has been developed that specifically targets the skills necessary for successful online interactions. To address this emerging area of social skill need, the 8-week Socialization and Education Learning for the Internet (SELFIE) program was developed to evaluate and improve the social media experience of those with ASD in an increasingly digital world.

**Objectives:** The present study explores existing vulnerabilities in those with ASD compared to typically developing peers and the acceptability, feasibility, and preliminary efficacy of a novel social media skills program. The objectives were to 1) explore the

feasibility of this type of intervention 2) assess the participant's experience in the SELFI program and 3) understand if one's social media experience was impacted after participation in the program.

**Methods:** The study's sample consisted of 6 males with ASD (mean age= 23.67 years;  $SD = 4.93$ ) and 17 typically developing males (mean age = 21.44,  $SD = 1.042$ ). A cross-sectional design was utilized to understand the social media behavior of those with and without ASD. A pretest-posttest design was utilized to evaluate the SELFI program. Facebook data from participants in both groups were collected at pre-intervention to gain an understanding of baseline vulnerabilities in those with ASD. Data was collected at post-intervention to assess changes in social media activity after participation in the SELFI program. Facebook data were evaluated for post type and frequency. Analysis of treatment acceptability and feasibility were assessed using participant feedback and review of the program's implementation.

**Results:** Before intervention, those with ASD (6.67 mean actions/week) engaged in fewer social media posts than their TD peers (16.12 mean actions/week). After participation in the SELFI program, those with ASD engaged in almost twice as much Facebook behavior than before intervention (13.17 actions), a rate approaching the TD group. Regarding the program's acceptability, participants reported a high level of satisfaction and increased social confidence online. All participants completed the program and sessions were delivered with high fidelity (85.15%), indicating program feasibility.

**Conclusions:** The SELFI program is the first of its kind to explore a social skills program for individuals with ASD on social media. Preliminary results indicate that those with ASD experience vulnerabilities online and that the SELFI program may help those on the spectrum increase their social media use. Information gathered from participant feedback and treatment delivery indicate promise as it relates to acceptability and feasibility. Future directions include an ongoing randomized controlled trial to systematically assess the SELFI program when implemented virtually in a social skills group setting.

**427.024 (Poster)** Influence of ASD Symptom Severity on Treatment Outcome in Young Adults with ASD: The UCLA PEERS® Intervention

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**Background:** Social skill deficits, a hallmark feature among individuals with autism spectrum disorder (ASD), often result in social isolation and problematic relationships (Gantman, Kapp, Orenski, & Laugeson, 2011). Consequently, there is a need for effective social skills training programs for adults with ASD. Severity of social impairment varies widely among this population (Constantino, 2011); therefore, it is important to understand how severity of ASD symptoms may differentially impact treatment outcome.

**Objectives:** This study examines the treatment gains of young adults with mild, moderate, and severe ASD symptoms following the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson, 2017), an evidence-based social skills intervention.

**Methods:** Participants included 91 young adults (males=70, females=21) ranging from 17-35 years of age ( $M=22.77$ ,  $SD=3.66$ ) and their caregivers, presenting for treatment at the UCLA PEERS® program. Young adult participants exhibited clinically elevated ASD symptoms, as determined by a total score  $\geq 60$  on the Social Responsiveness Scale–Second Edition (SRS-2; Constantino & Gruber, 2012). Participants were grouped based on ASD symptom severity according to baseline caregiver-reported total scores on the SRS-2. Participants with T-scores between 60-65 were in the mild ASD group ( $N=28$ ), 66-75 in the moderate group ( $N=38$ ), and 76 or higher in the severe group ( $N=25$ ). Treatment outcome was assessed using pre and post caregiver-reported total scores on the Social Skills and Problem Behavior Subscales of the Social Skills Improvement System (SSiS; Gresham & Elliott, 2008). A paired samples t-test determined outcome measure significance. Group differences were assessed using a one-way ANOVA and Tukey post hoc tests.

**Results:** Results reveal significant improvements in SSiS social skills for participants in the moderate [ $M=5.79$ ,  $SD=9.27$ ],  $t(37)=3.85$ ,  $p=.001$ ] and severe [ $M=16.56$ ,  $SD=10.89$ ],  $t(24)=7.60$ ,  $p<.001$ ] groups, and significant decreases in problem behaviors for participants in the mild [ $M=-5.14$ ,  $SD=9.83$ ],  $t(27)=-2.77$ ,  $p<.001$ ], moderate [ $M=-4.74$ ,  $SD=10.94$ ],  $t(37)=-2.67$ ,  $p<.001$ ], and severe [ $M=-12.12$ ,  $SD=12.69$ ],  $t(24)=-4.77$ ,  $p<.001$ ] groups. Significant between-group differences were observed in treatment outcome for social skills [ $F(2,88)=11.90$ ,  $p<.001$ ] and problem behaviors [ $F(2,88)= 3.82$ ,  $p=.026$ ], such that participants with severe ASD symptoms exhibited greater improvements on both scales compared to those in the mild and moderate groups ( $p<.05$ ). No other statistically significant differences were found.

**Conclusions:** Results suggest that young adults with varying levels of ASD symptomatology are able to improve their social skills and associated behaviors when presenting for social skills treatment. Specifically, findings reveal significant decreases in problem behaviors for young adults across the three ASD symptom severity groups, and increases in social skills in the moderate

and severe symptom groups. Interestingly, there were higher overall treatment gains for participants with severe ASD symptoms, suggesting that young adults with poorer social responsiveness benefit the most from the PEERS® social skills intervention. This may be due to the fact that individuals with milder ASD symptoms might already possess fundamental social skills, and thus need more assistance with other social skills domains. Future studies might examine other factors that influence differential treatment outcome within this population in order to create more effective targeted interventions for adults with ASD.

**427.025 (Poster) Intervention Services for Autistic Adults: An Asdeu Study of Autistic Adults, Carers, and Professionals' Experiences**

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**Background:**

Among autistic adults, some of the most relevant challenges that prompt interventions arise from core symptoms and poor adaptive functioning that may impede independent living, attendance at university/college and employment. Although intervention services guidelines for autistic adults have been developed (e.g., National Institute for Health and Clinical Excellence (NICE, 2012), Autism Europe (2013), National Audit Office (2009)), it is unknown to what degree the guidelines are applied within local communities. The Autism Spectrum Disorders in the European Union (ASDEU) project administered a survey in 2017 on services availability and experiences related to autistic adult interventions in 11 European countries and targeting 3 groups: autistic adults, carers of autistic adults and professionals in adult services.

**Objectives:**

The present project aimed to investigate the degree of alignment between user experiences and published autistic adult intervention guidelines based on the ASDEU survey.

**Methods:**

The ASDEU survey was translated into 11 languages and distributed by ASDEU partners via electronic media hosted by ASD organizations and in-country adult services facilities. This study examined the following survey items: recommended factors to consider when deciding on an intervention and intervention implementation, recommended factors to consider when deciding on an intervention for challenging behavior such as self-harm or injury to others, use of psychosocial and pharmacological interventions, and family interventions for members of adult's family. Distributions of responses from the three respondent groups were analyzed separately.

**Results:**

697 persons responded to the survey: 263 autistic adults (68% female; 34% 26-35 years old), 302 carers of autistic adults (carers were 85% females; autistic adults were 28% female; 54% 18-25 years old), 132 professionals in adult services (78% female; 81% worked in non-medical services). At least 59% of respondents across all groups experienced eight of thirteen recommendations prior to deciding on an intervention and during the intervention plan and implementation. Psychosocial interventions were the most commonly experienced interventions (autistic adults: 66%, n=161; carers: 65%, n=189, Figure 1), while pharmacological interventions NOT recommended for core autistic symptoms were also reported by fairly large proportions (autistic adults: 15%, n=36; carers: 21%, n=60). Family interventions were experienced by less than 23% of carers or less than 10% adults versus over half of professionals. Adult responders reported experiencing self-harm behaviors (38%; n=181) or harm to other behaviors (12%; n=58), but of these only 22% (n=39) for self-harm behaviors and 26% (n=15) for harm to other behaviors reported receiving interventions.

Conclusions: Results highlight elements of intervention services that are more likely to adhere to published guidelines and those areas that warrant improvement. The results also underscore the need to consider the autistic adults', carers' and providers' experience and perceptions in order to gain a complete view of the services' needs of a community. In Europe, as elsewhere, further development of adult intervention services is a current priority for many stakeholders ranging from autistic adults themselves, their parents and carers, professionals, professional advocacy organizations, and European countries governments and the health and social care sector.

**427.026 (Poster)** Investigating Vocal Variables for Assessing Progress for Children with ASD and Minimal Verbal Skills  
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Background: Effective measures of incremental progress of spoken language development are needed for children with autism spectrum disorder (ASD) that are minimally verbal to make decisions about whether to change intervention strategies. Distal measures (e.g., standardized vocabulary assessments) are insufficient for measuring short-term progress. Prior work provides evidence of convergent and divergent validity as well as sensitivity to change of multiple vocal variables for young children with ASD with relatively diverse language skills.

Objectives: Building upon this work, we test the usefulness of vocal variables collected during a structured communication sample (Scripted Communication Complexity Scale [CCS]), for assessing progress of children with ASD, including those with minimal verbal skills, who participated in an intervention designed to improve production of spoken words. We tested whether the vocal variables correlate with one another (RQ1; concurrent validity) and the accuracy of elicited speech attempts of target words predictively and concurrently (RQ2). We also assessed the vocal variables' sensitivity to change across the intervention (RQ3).

Methods: Of the 52 participants in the larger study, preliminary data analyses include 11 participants at pre- and post-intervention and nine others at one time point. Additional coding is on-going. The preliminary participants had a mean age of 79 months ( $SD=18$ , range: 62–129), understood a mean of 190 words ( $SD=111$ , range: 19–395), and used a mean of 50 words ( $SD=79$ , range: 0–276). Many had minimal verbal skills at entry. The participants completed 4-16 weeks of intervention that included speech sound practice, joint book reading, and augmentative and alternative communication practice for target words.

For the current study, we coded the following variables from the CCS:

- Number of total vocalizations
- Number of communicative vocalizations
- Proportion of communicative vocalizations
- Consonant inventory
- Diversity of key consonants used in communication acts
- Number of different words

The participants also completed elicited speech probes for words taught during the intervention. Probes were scored for accuracy of place, manner, and voicing for each phoneme.

Results: For RQ1, all vocal variables correlated with one another ( $r \geq .4$ ) pre- and post-intervention (Table 1), except for the proportion of communication variables, which showed mixed results. For RQ2, all vocal variables correlated with the accuracy of elicited productions ( $r_s = .44-.57$ ) post-intervention and none were significant pre-intervention. Although pre- and post-

intervention differences were non-significant differences for all variables, mean values post-intervention were higher for all variables except for consonant inventory (Table 2).

Conclusions: As expected, vocal variables generally correlated strongly with one another. Correlations with the elicited speech production task were more variable with stronger correlations observed post-intervention than pre-intervention. Results suggest that these vocal variables are evaluating skills related to, but distinct from, the elicited production task. Thus, the vocal variables have the potential to contribute meaningful results for identifying and/or predicting children who benefit from the intervention, including those who are exhibiting little or no progress on elicited probes. The sample size will be increased prior to presenting as coding is ongoing. Additional data will be especially beneficial for examining sensitivity to change.

**427.027 (Poster)** Life-Skills Coaching for Adults with Autism.

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Background: The lack of services for adults on the autism spectrum is of growing concern. Given the huge variation in how autism impacts people, individualized approaches might be particularly effective. This study evaluated a community-based life-skills coaching program for adults with autism “LifeMAP.” LifeMAP is structured around individualized meetings between a client and their coach where they identify, prioritize, and make progress towards self-selected goals. LifeMAP was established in 2008 and has since served around 1,500 clients.

Objectives: We aimed to examine the LifeMAP program model, the types of goals adults with autism prioritized, whether clients felt less anxiety and greater confidence towards reaching their goals over time, and progress towards reaching goals.

Methods: Participants were 265 LifeMAP clients with an average age of 26.5 years old with the majority identifying as white (n=186) and male (n=172). Goal Reports were used to collect data describing the goals clients were working on, their self-reported anxiety and confidence towards these goals, and progress made towards these goals. Client’s anxiety concerning their current goal was measured on a 6-point scale (from “not at all anxious” to “extremely anxious”), and confidence from “extremely confident” to “not at all confident”. Level of progress was identified in stages: “Awareness”, “Developing Strategies”, “Applying Strategies with Help”, and “Applying Strategies Independently”. Coaches and clients completed the Goal Reports every 3-6 months. Data was collected over a four and a half year period from January 2016 to June 2020.

Results: Participants had set a wide variety of goals with those categorized to “Employment” being the most common (27.8% of identified goals). Combined with the categories of “Independent Living” (19.7%) and “Education” (15%), over half of goals were categorized within these groups. The categories of “Life Skills” (13.8%) and “Social” (13.1%) were also commonly reported. The remaining categories of “Regulation”, “Communication”, and “Self-Awareness” collectively accounted for around 10% of all goals set. Participants demonstrated a significant reduction in anxiety across goal categories when comparing the first to final Goal Reports ( $t(375)=-4.76, p=0.0001$ ), and a significant increase in confidence ( $t(375)=-6.02, p=0.0001$ ). Comparing stages of progress at time of first report to final report came close to reaching significance ( $t(326)=-1.953, p=0.052$ ).

Conclusions: The LifeMAP program is unique in its focus on the adult age range, the highly individualized approach at the center of the model, and the relatively large number of clients served. Findings indicated that LifeMAP was effective in supporting progress towards goals, increasing confidence towards goals and reducing anxiety. Given the scope of the LifeMAP program these findings are unique in providing pertinent information to others looking for effective strategies to support adults with autism. This study provides a realistic perspective on how programs are applied in community-based settings, outside a structured, formal lab setting. Individualized intervention approaches might be key to successful outcomes for adults with autism and provide an authentic approach where the ideas, perspectives, and priorities of adults with autism themselves are at the center of the model.

**427.028 (Poster)** National Clearinghouse on Autism Evidence & Practice (NCAEP): Updating a Systematic Review to Identify New Evidence-Based Practices for Children and Youth with Autism

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**Background:** The National Professional Development Center on ASD (NPDC) completed a review of literature published between 1990-2011 and identified 27 evidence-based practices (EBPs) for individuals with ASD from birth through age 21 (Wong et al., 2015). These findings have had a broad impact on the field since their publication in 2015 (e.g. most cited manuscript in JADD in 2017; identified by IACC as one of the top 20 scientific advances in ASD research). These findings are dated, however, and the National Clearinghouse on Autism Evidence and Practice (NCAEP) conducted an updated review of the literature to include six additional years of research.

**Objectives:** The objectives of this session are to (1) identify new practices that have met the criteria for identification as an evidence-based practice, and (2) identify study, participant, and intervention characteristics to identify gaps in the literature base.

**Methods:** The NCAEP team used the same search strategy as the 1990-2011 systematic review, for peer-reviewed articles using variations of the terms (1) autism (e.g., ASD, Asperger) and (2) intervention (e.g., treatment, program, education). The inclusion criteria are high quality single-case design and group design studies that examine a behavioral, educational, or developmental (i.e., non-medical) intervention for individuals with ASD from birth through 22 years old. The following steps were completed for the systematic review: (1) search of 9 databases, (2) title/abstract review, (3) full-text review for inclusion, (4) quality review, determination of effects, and preliminary data extraction, (6) consensus decision for quality and presence of effects as needed, and (7) final data extraction on study participants, outcomes, and interventions.

**Results:** The 2012-2017 review started with over 31,000 articles in the initial search. A total of 545 articles met quality criteria and demonstrate at least some positive effects, resulting in 972 total articles (1990-2017). There is an increasing trend of high-quality peer-reviewed research (see Figure 1). The review identified five new EBPs (augmentative and alternative communication, behavioral momentum, direct instruction, music-mediated interventions, and Sensory Integration®), and identified 10 manualized interventions meeting criteria that are within broader EBP categories (e.g., PEERS in social skills treatment). Several other EBP categories were expanded or reconceptualized.

The participant data indicates that more studies include 6-11.9 year-olds (59%) and 3-5.9 year-olds (45%) participants, with fewer studies including 12-14.9 year-olds (27%), 15-18 year-olds (18%), and the fewest studies including children under 3 years old (9%) and 19-22 year-olds (5%). The data also shows differences in frequencies of the types of intervention targets or outcomes (see Table 1). Additional data on study characteristics and implementation characteristics will also be reported.

**Conclusions:** The updated systematic review of behavioral, developmental, and educational interventions is an important step as research and practice continue to move forward to facilitate the best outcomes for children and youth with ASD, especially given the increasing trends in published research. Despite growth from the previous review period, there remain gaps in research related to age (less research in adolescents/young adults) and outcomes (e.g., mental health, self-determination) which can inform future research efforts.

**427.029 (Poster) Parent Perceptions of Adolescents with ASD in the PEERS Program**

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**Background:** As youth with ASD struggle with an array of problem behaviors, parents experience associated stress and family problems (Lecavalier et al., 2006; Blacher & McIntyre, 2006; Sander & Morgan, 1997). Researchers have examined aspects of child impact that affect parent perceived benefits from intervention as well as parent's overall stress and well-being (Blacher & Baker, 2017; Karst et al., 2015; Solish & Perry, 2008). In the current study, parent perceptions of their adolescent and family impact are examined following the PEERS® Program.

**Objectives:** Although PEERS® has been shown to improve social behaviors in adolescents with ASD (e.g., Laugeson et al., 2012), this paper focuses on factors that predict parent perception and family impact following a social skills intervention. We hypothesized that parent report of adolescent problem behaviors before intervention would predict parents' positive and/or negative perception of the youth at post-intervention as well as at four-month follow up, over and above improvement in social skills.

**Methods:** Thirteen adolescents with ASD and their parents ( $M=14.17$ ,  $SD=2.09$ ) participated in the PEERS® intervention. Behavior problem measures were taken at pre- and post- intervention and at a four-month follow up. Standard scores of parent-reported problem behaviors were used from the Social Skills Improvement System (SSIS; Gresham and Elliott, 2008). Subscales of positive parent perceptions and negative family impact (a composite score of negative parent perception and negative impact

of the adolescent on family social life) were assessed through parent completion of the Family Impact Questionnaire (FIQ; Donenberg and Baker, 1993).

Results: A repeated-measures ANOVA revealed a significant change in social skills across time,  $F(1,9)=14.80, p<.01$  such that social skills improved from pre- to post- intervention. A second repeated-measures ANOVA revealed no significant changes across time in either positive or negative impact on the family's life ( $p's >.05$ ). Five separate linear regressions were conducted to test if pre-intervention SSIS problem behaviors predicted impact (positive or negative) at post-intervention and at a four-month follow up. In all five regressions, a significant portion of the variance (ranging from 32.1% to 68.3%) was accounted for by SSIS problem behaviors, such that the higher the problem behaviors pre-intervention, the greater the negative impact and the lower the perception of positive impact. These findings were consistent at both post-intervention and at the four-month follow-up, despite gains in overall adolescent social skills.

Conclusions: This is the first study to measure parent perceptions of adolescents' negative and positive impact on family life following the PEERS® intervention. Findings suggest that parent-reported SSIS problem behaviors at pre-intervention predicted both positive and negative parent perceptions of their adolescents at two later timepoints. These results highlight that broader family life, as determined by parents' perceptions of the impact of their adolescent (both in positive as well as negative ways) does not improve or change following a social skills intervention. Furthermore, the adolescents' challenging behavior problems appear to be the driving factor, suggesting that combining behavioral intervention with social skills training may lead to greater benefit.

**427.030 (Poster)** Parenting Teens with Strong Emotions: A Pilot Study of a Group Intervention for Caregivers of Teens with Autism Spectrum Disorder and Depressive Symptoms  
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Background: Individuals with autism spectrum disorder (ASD) are four times more likely than their peers to experience depression in their lifetime (Hudson et al., 2019). Additionally, suicide rates in adolescents with ASD are increasing, and youth with ASD currently have double the risk of suicide compared to their peers (Kirby, et al, 2019). Despite this concerning trend, few treatments have been developed specifically for adolescents and families struggling with these issues. Recently a group curriculum targeting caregivers of typically developing adolescents with depression and suicidality (Parenting Teens with Strong Emotions) has shown promising results (Gurtovenko et al, 2020). This curriculum combines techniques from parent management training (PMT) (e.g. Barkley & Robin, 2014) and Dialectical Behavior Therapy (DBT) (Linehan, 1993) to give caregivers effective strategies to support their depressed teenager and improve their relationship without reinforcing problematic symptoms or suicidality.

Objectives: The aim of this study was to pilot an adaptation of the Parenting Teens with Strong Emotions curriculum for caregivers of teens with ASD and co-occurring depression and suicidality, and to examine the group's effectiveness and caregiver satisfaction.

Methods: Caregivers attended weekly Parenting Teens with Strong Emotions groups for 10 weeks at an outpatient clinic or via telemedicine due to the COVID-19 pandemic. Caregivers were taught techniques from DBT (e.g. mindfulness, validation, dialectics) and PMT (e.g. positive time, labeled praise, behavior analysis) to support their adolescent. Caregivers of 24 patients participated in groups; of these, 7 caregivers completed both pre- and post-group measures. Caregiver-report of adolescent total symptom severity (Strengths and Difficulties Questionnaire [SDQ], 2005), caregiver-teen conflict (The Conflict Behavior Questionnaire [CBQ], 1979), and caregiver mindfulness (The Five Facet Mindfulness Questionnaire [FFMQ], 2006) were collected before and after 10 weeks of group. Paired sample t-tests were used to analyze differences in outcomes pre and post group. Caregivers also completed a post-group satisfaction questionnaire.

Results: Caregiver report of total difficulties for their teen on the Strengths and Difficulties Questionnaire significantly reduced after 10 weeks,  $t(6)=3.343, p=.016$ . Caregivers also reported a significant reduction in parent-teen conflict on the Conflict Behavior Questionnaire,  $t(5)=2.779, p=.039$ . A similar but non statistically significant pattern was also observed for caregiver mindfulness,  $t(5)=-2.371, p=.064$ . See Table 1 for descriptive statistics on all measures. The post-group satisfaction questionnaire (using a 5-point Likert scale) indicated caregivers were generally satisfied with group (4.6/5), learned strategies that were helpful in responding to their teen's emotions and behaviors (4.6/5), felt more confident in their parenting (4.3/5), and would continue to use strategies from group (4.7/5).

Conclusions: Results of our pilot study on Parenting Teens with Strong Emotions group for caregivers of teens with ASD and depression and suicidality demonstrated preliminary effectiveness for use of this treatment with the ASD population. Though the teenagers did not directly receive treatment, their caregivers reported reduced teen difficulties, reduced caregiver/teen conflict,

and overall satisfaction with the group. Despite a small sample size, this pilot demonstrated significant, positive change in the lives of depressed teens with ASD and their caregivers.

**427.031 (Poster)** Perspectives of Primary Caregivers and Neurotypical Siblings on a Prospective Sibling-Guided Motor Intervention for Children with Autism Spectrum Disorder

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**Background:** The long-lasting relationship and the large amount of time siblings spend together may present unique advantages when siblings act as intervention agents. However, the involvement of neurotypical (NT) siblings is limited in the existing literature of Autism Spectrum Disorder (ASD) interventions and existing interventions mostly focus on social and communicative skills. Many individuals with ASD also experience motor delays and abnormalities that are not therapeutically addressed. Therefore, motor interventions with NT siblings acting as intervention agents in the natural setting of their home may be a viable option. But without adequate knowledge and strategies, NT siblings of children with ASD may experience some difficulties in providing instructions and interacting appropriately with their siblings with ASD. Thus, to better assist NT siblings and promote skills of children with ASD, there is a need to first understand the difficulties, needs, and expectations from the perspective of both NT siblings and caregivers.

**Objectives:** This study aimed to gain an in-depth understanding of the perspectives of NT siblings and primary caregivers related to sibling relationships, NT siblings' knowledge about ASD, NT siblings' teaching experiences, and preferences in a prospective sibling-guided motor intervention.

**Methods:** A phenomenological qualitative design guided this study. Ten neurotypical siblings of children with ASD ( $9.00 \pm 2.98$  years) and their primary caregivers ( $36.00 \pm 4.71$  years) were recruited and interviewed. The semi-structured interviews were conducted online with each family to elicit the perceptions and experiences of primary caregivers and NT siblings. Data were analyzed using thematic content analysis.

**Results:** Firstly, most families reported NT siblings and children with ASD share a positive relationship, although NT siblings may experience some barriers in interactions with their siblings with ASD related to the core characteristics of ASD. Secondly, all of the families in our sample stated that they discussed ASD at home. However, NT siblings still lacked comprehensive knowledge of ASD, and their recourse to access information about ASD was limited. Thirdly, we found a majority of NT children indicated they are willing to help their siblings with ASD, but only about half of the NT siblings currently had experience and confidence in teaching or showing things to their siblings with ASD. Lastly, we gained knowledge about the preferences of caregivers and NT siblings on the characteristics of prospective sibling-guided motor interventions.

**Conclusions:** The results of this study will guide the design of a feasible and effective sibling intervention for children with ASD with NT siblings acting as intervention agents, and inform development of targeted NT siblings training sessions (e.g. comprehensive knowledge of ASD, behavioral strategies) prior to the implementation of the intervention. Specific implications for both research and practice will be discussed in the presentation.

**427.032 (Poster)** Randomized Controlled Pilot Study of a Parent-Based Crisis Prevention Institute (CPI) Physical Management Training Program (P-CPI): Safety and Parental Satisfaction

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**Background:**

Aggression, self-injury, and property destruction are among the most impairing and severe behaviors in ASD (Doehring, Reichow, Palka, Phillips and Hagopian, 2014) and often require acute intervention (Akram, Batool, Rafi, and Akram, 2017; Mandell, 2008; Matson and Nebel-Schwalm, 2007). Despite the need for parent training (e.g., Bultas, Johnson, Burkett, and Reinhold, 2016; Doehring, 2014), a paucity of research addresses management of these challenging behaviors at home. Given the significant impact on families and systems of care, the lack of evidence-based and widely available physical management training for parents is a significant omission. Concern about the safety of parental application of such strategies is one significant barrier.

**Objectives:**

The purpose of this pilot study was to investigate the safety, feasibility, acceptability, and efficacy of a novel Crisis Prevention Institute parent training program (P-CPI) to better equip caregivers to manage severe behavior problems. This study reports results on parental satisfaction immediately following training and safety outcomes two weeks post intervention.

#### Methods:

Parents of children 5-12 years old with ASD and irritability recruited from a multidisciplinary autism clinic were randomized in a 1:1 allocation to either P-CPI training or waitlist control (WLC). Participants and staff were unblinded following randomization. P-CPI training consisted of one full-day in-person program, broken into two 3-hour sessions, and facilitated by a CPI-certified Board Certified Behavior Analyst (BCBA). Participants recorded all instances of aggression, self-injurious behavior, and property destruction in the two weeks before and after training. A P-CPI Course Evaluation Assessment (self-reported satisfaction) was also completed at the conclusion of training.

#### Results:

Forty-one parents were randomized to P-CPI and 39 to WLC, of whom 33 and 27 respectively remained in the study two weeks following training.

All 34 participants completing the workshop (100%; 95% CI: 90%, 100%) rated the course as very good or excellent overall, with 30 participants (88%; 95% CI: 73%, 95%) assigning ratings of excellent. All agreed or strongly agreed that the workshop met their expectations and that they would recommend it to others (100%; 95% CI: 90%, 100%), and 32 agreed or strongly agreed they intended to use the techniques (94%; 95% CI: 81%, 98%). See figure for additional results.

Nineteen of 31 participants randomized to P-CPI who completed safety event logs post-training (61%; 95% CI: 44%, 76%) reported using CPI techniques. Estimated aggression, self-injurious behavior, and property destruction rates before and after training are compared between children of parents randomized to P-CPI and WLC in the table. For P-CPI, self-injurious behavior and property destruction rates decreased, and aggression rates were similar, before and after training. For WLC, rates for each of the three behavior categories were similar before and after training. There were no significant differences in changes between P-CPI and WLC, and no events resulted in a 911 call.

#### Conclusions:

Preliminary results of this study suggest the P-CPI workshop is both safe and well-received by parents of children with ASD. Limitations and future directions will be discussed.

This study is registered on ClinicalTrials.gov (identifier NCT03537261) and was funded by CPI.

#### **427.033** (Poster) Self and Parent Reported Treatment Gains Following PEERS: A Replication Study with Latinx Adolescents with ASD

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Background: Adolescents with ASD struggle with developing and maintaining friendships (Reichow & Volkmar, 2010). Group social skills interventions (e.g., PEERS) have demonstrated effectiveness based on adolescent- and parent- report (e.g., Gates et al., 2017, Laugeson et al., 2009, 2012). However, social skills research has been limited by methodological weaknesses and lack of skill generalization (Wolstencroft et al., 2018). Additionally, though several cross-cultural validation studies have been conducted on PEERS in Asia and Europe (e.g., Yoo et al., 2014), Latinx families have been consistently underrepresented in ASD intervention research (Bernal & Domenech Rodríguez, 2009; Ratto et al., 2017), and social skills research in particular.

Objectives: This study aims to: 1) Replicate previous PEERS studies by examining self- and parent- reported treatment gains at pre- and post-intervention and at a 4-month follow-up; and 2) Extend these studies by a) including a diverse sample of predominantly Latinx families and an age- and gender-matched control group of typically developing (TD) adolescents not participating in intervention, and b) examining family impact following treatment.

**Methods:** Participants included 13 adolescents with ASD (ten males; 69% Latinx), ages 11-17 ( $M=14.17$ ,  $SD=2.09$ ), with average cognitive abilities (WASI-2;  $M=99.54$ ,  $SD=15.6$ ). Adolescents and parents attended weekly 90-minute PEERS sessions over 16 weeks. Adolescent groups were held in English; parent groups were conducted in English and Spanish simultaneously. Adolescents and parents completed measures of social skills, social anxiety, and family impact at pre- and post-intervention and at a four-month follow-up. 11 control TD participants completed the same measures at three timepoints, each four months apart, to assess the stability of scores over time. Repeated measures ANOVAs were conducted to assess the effect of time on each measure for ASD and TD participants separately, and Bonferroni posthoc tests were conducted to examine differences between timepoints.

**Results:** For the ASD group, three-way repeated-measures ANOVAs demonstrated significant main effects of time for adolescent PEERS-specific social skills knowledge (TASSK), perceived loneliness and social satisfaction (L&SD), parent-reported social skills (SSIS), and social responsiveness (SRS-2). Bonferroni posthoc tests showed significant improvements on the TASSK and SSIS from pre- to post-treatment ( $p's < .01$ ), which remained stable at follow up ( $p's > .05$ ). Though posthoc tests revealed no significant differences between timepoints on the L&SD and SRS-2, two-way repeated-measures ANOVAs showed significant improvements from pre- to post-treatment on the SRS-2 ( $M$  change = -6.0,  $SD = 8.49$ ,  $p < .05$ ), and from pre-treatment to follow-up on the L&SD ( $M$  change = 3.83,  $SD = 5.72$ ,  $p < .05$ ). TD adolescents had stable scores across time. No significant differences were found in social anxiety, family impact, or parenting stress across time (all  $p's > .05$ ).

**Conclusions:** Consistent with previous PEERS studies, adolescents with ASD showed improved social skills and social knowledge after treatment, which were maintained four months later. This is the first study to replicate these findings with a sample of predominantly Latinx teens. Interestingly, adolescents did not perceive greater social satisfaction until four months after treatment, suggesting that some treatment benefits may be delayed. The lack of improvement in adolescent anxiety, family impact, and parenting stress may inform the development of more comprehensive, family-centered interventions.

**427.034 (Poster) Service Dog's Impact Is Mediated By the Severity of Autism Spectrum Disorder Related Symptoms**  
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**Background:** The training and allocation of service dogs for children with autism spectrum disorder (ASD) is gaining in popularity. The documented benefits relate to both physiological and behavioral aspects: stress and anxiety reduction, increased social interactions, and language development among others. However, other variables, such as the severity of symptoms, may have an impact on these benefits and have yet to be tested.

**Objectives:** This exploratory study investigates 1- the effect of introducing a service dog in families of autistic children between the ages of five and nine and 2- how this effect is mediated depending on the severity of the autistic symptoms.

**Methods:** Ninety-one parents of children who received a service dog completed a questionnaire on the challenging behaviors of the child one month before and three months after their dog was awarded. The questionnaire contains 13 domains of potential challenging behaviors: (1) sleep ; (2) undesirable behaviors ; (3) family climate ; (4) social interactions ; (5) sensory perceptions ; (6) outings ; (7) daily activities ; (8) going out to various professionals appointments ; (9) temper tantrums ; (10) bolting ; (11) somatic discomfort ; (12) language comprehension and (13) anxiety. The results were analyzed based on the severity of child's symptoms according to two groups (Low and Moderate-Severe), established using the *Childhood Autism Rating Scale* (CARS) (Schopler et al., 1980).

**Results:** Using the Wilcoxon's Signed Ranks Test to compare the median scores in the 13 domains, it was found that children with moderate to severe symptoms of autism appear to benefit more significantly in 11/13 domains (except for family climate and temper tantrums) from the presence of the service dog than children with milder symptoms.

**Conclusions:** Our study adds to the body of evidence supporting the beneficial effect related to the use of a service dog. The dog represents an attachment figure in the child's various environments (e.g. home, community, etc.) and seems to lower the stress that generates various challenging behaviors. It also acts as a social catalyst in the reduction of numerous difficulties observed by parents. Taking the severity of autistic symptoms into consideration could improve the optimal pairing of child and service dog.

**427.035 (Poster) Service Provider Knowledge, Confidence and Treatment Adaptations in the Delivery of Psychotherapy to Autistic Youth and Youth with ADHD**

**Background:** Despite evidence for the efficacy of various psychotherapeutic approaches to address mental health problems in autistic youth (e.g., cognitive behaviour therapy; Weston et al., 2016), they often struggle to receive these interventions (Brookman-Frazee et al., 2012). Evidence suggests therapists' decisions to provide care are impacted by their experience and self-perceived skills (Maddox et al., 2019). However, more studies are needed to explore therapists' knowledge and confidence in treating autistic youth, compared to clients with other neurodevelopmental disabilities (e.g., ADHD), who may also require adaptations to psychotherapeutic practice.

**Objectives:** To examine mental health service providers' knowledge, confidence and treatment adaptations towards working with youth with mental health problems who were autistic or with ADHD.

**Methods:** Data were collected from 163 service providers across 11 agencies in Ontario, Canada, who provided psychotherapy to youth. Participants were 20 to 63 years of age ( $M = 38.24$ ,  $SD = 10.14$ ; 80% female). Most participants were employed full time (91%) and received post-secondary education (84%). Professions included social workers (38%), child/youth workers (27%), registered psychotherapists (15%), or other designations (20%). The following measures were used and asked separately about autistic clients or those with ADHD and were counterbalanced across participants. The 14-item Therapist Confidence Scale – Autism Spectrum Disorder Adapted (Cooper et al., 2018) assessed confidence in delivering therapeutic activities common across psychosocial interventions using a 5-point Likert scale (1 = not confident; 5 = highly confident). Participants self-rated their knowledge about six topics related to mental health problems, using a 5-point Likert scale (1 = not at all knowledgeable; 5 = extremely knowledgeable) (Maddox et al., 2019). Participants identified adaptations they have implemented from a list of treatment modifications (Angus et al., 2014; Burke et al., 2017; Cooper et al., 2018).

**Results:** Paired sample t-tests revealed significantly lower confidence in delivering different psychotherapy components for autistic clients than clients with ADHD,  $t(161) = -10.41$ ,  $p < .001$ . For example, 33% of participants reported feeling *not confident* or *slightly confident* in their abilities to identify therapeutic approaches that would be effective for autistic clients compared to only 6% for clients with ADHD. Knowledge was also significantly lower when referencing autistic clients than clients with ADHD,  $t(161) = -10.81$ ,  $p < .001$ . For instance, 38% of participants felt *not at all* or *slightly knowledgeable* in providing psychotherapy for autistic clients compared to 9% for clients with ADHD. Participants indicated using similar modifications in their psychotherapy work for autistic clients and those with ADHD, including implementing structure and predictability, incorporating youth interests into therapy, using simplified language and making abstract concepts more concrete.

**Conclusions:** Results indicate potential barriers or challenges to treatment delivery for autistic youth with mental health problems. Compared to clients with ADHD, service providers felt less confident and knowledgeable. Simultaneously, the majority of participants endorsed delivering evidence-based approaches and adapting their practices to their service provision. This research suggests that targeted training around autism and mental health care may be a useful initiative for agency staff.

**427.036 (Poster)** Sex Differences of Early School-Aged Children in Clinical Presentation and Treatment Response to Pivotal Response Treatment

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Background:

Compared to females, males are 4.3 times more likely to be diagnosed with autism spectrum disorders (ASD) (Maenner et al., 2020). Moreover, there is a paucity of research investigating differences in treatment responses of females diagnosed with ASD in comparison to their male counterparts.

Objectives:

The present study examines sex differences in clinical presentations and treatment response to Pivotal Response Treatment (PRT) in young children with ASD.

Methods:

The study was comprised of sixteen children, including six girls ( $M = 74.67$  months;  $SD = 15.63$ ) and ten boys ( $M = 61.1$  months;  $SD = 7.01$ ). All children had an ASD diagnosis as confirmed by the Autism Diagnostic Observation Schedule (ADOS).

Participants received 6 hours of PRT for 16 weeks. Clinical outcome measures were administered before and after treatment including the SRS-II, Vineland-III, and ADOS. Additionally, participants received the DAS-II prior to study participation. Paired-samples t-tests were used to examine sex differences of clinical presentations and change in measures of ASD symptom severity.

#### Results:

At baseline, boys had significantly higher General Conceptual Ability (GCA) scores on the DAS-II compared to girls (boys M = 92.7, SD = 14.92; girls M = 81.17, SD = 5.12;  $p < 0.05$ ). Boys also had stronger adaptive behavior skills, as assessed by the Adaptive Behavior Composite (ABC) of the Vineland-III (boys M = 83.3, girls M = 75.5), SRS-II (boys Total t-score M = 71.5, girls Total t-score M = 77), and lower ASD symptomology as measured by the Calibrated Severity Scale (CSS) of the ADOS (boys M = 7.67, girls M = 8.17). Following PRT, there were no significant differences between girls and boys in adaptive functioning (boys M = 81.2, girls M = 77.83) or ASD symptom severity, SRS-II (boys Total t-score M = 69.1, girls Total t-score M = 71.17) and ADOS CSS (boys M = 7.3, girls M = 8.0). However, both male and female groups individually improved across all outcome measures post-treatment. The magnitude of change within each group varied, as girls exhibited larger gains in their adaptive functioning abilities and social abilities evident in the Vineland-III ABC (boys DM = -2.1, girls DM = 2.33) and SRS-II (boys Total t-score DM = 2.4, girls Total t-score DM = 5.83), and boys exhibited an increased change in their CSS of the ADOS (boys DM = 0.37, girls DM = 0.17).

#### Conclusions:

These results indicate both boys and girls show improvement in social communication and adaptive functioning following PRT, supporting the efficacy of PRT as an effective treatment for children with ASD. The exact nature of these improvements differed wherein boys maintained improvements in core social communication skills and girls improved in the real-world application of these skills. This study demonstrates that although boys and girls maintain varying clinical presentations that diverge significantly as they age into later school-age, PRT remains a valid treatment for both young boys and girls with ASD.

#### References:

Maenner MJ et al. Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years MMWR Surveill Summ 2020;69(No. SS-4):1–12.

**427.037 (Poster)** Skolkontakt - Social Validity of Social Skills Training in School Settings

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**Background:** Social impairments are associated with Autism spectrum disorders (ASD). Individuals with ASD are at increased risk for mental disorders and are overrepresented among school absenteeism. Little is known about social skills group training for adolescents in naturalistic treatment settings. Furthermore, there is a lack of qualitative elements in experimental research designs.

**Objectives:** This exploratory study examines the feasibility and social validity of SKOLKONTAKT, a social skills training program for educational settings derived from the scientifically well-ensured clinical training KONTAKT. The current study builds on our previous experience, seeking to systematically enlarge it in terms of further feasibility assurance, students' satisfaction and controlled training efficacy.

**Methods:** Participants are recruited from an on-going RCT of social skills group training. The study is a multi-responders study where participants are the students, the facilitating teachers and the school management. This triangulation will increase the validity through the convergence of information from different participants. Data collection are semi structured interviews. Social validity is measured by interviews with the students (both in control and active group), the facilitating teachers and the school management. At present the sample size is  $n = 17$  (i. e. students  $n = 11$ , teachers  $n = 4$  and school management  $n = 2$ ). Larger sample sizes are preferable and this study will continue with data collection after the third RCT session. Data is handled with the NVivo 12 (QSR and Ltd.), and thematically analyzed.

**Results:** The preliminary results based on the completed interviews ( $n = 17$ ) show high levels of satisfaction. According to the responses, the school setting is beneficial for several reasons: the closeness, typically developed peers to interact with and

develop friendship, the environment is less vulnerable though teachers and students have a reciprocal relationship. Teachers expressed better quality of life for adolescents as well as enlarged possibilities for academic achievement due to increased attendance at school. Students (n = 11) expressed enhanced social skills, where students in the training group expressed broader and more detail improvements. Furthermore, students expressed developed social skills valuable for future employment and overall more happiness and engagement. The school management saw overall improvements in students' social skills. However, according to facilitating teachers (n = 4), the training is time demanding, especially at initial phase.

### **Conclusions:**

These findings show advantages in implementing social skills group training in naturalistic settings for generalization and reflection of reality. Methods originally designed to support individuals on the autism in clinical settings are feasible and effective in school settings. Interventions targeting social skills can successfully be implemented in real-world settings like school and improves inclusion. As more student on the autism are attending inclusive environments, there is a need for interventions to increase social interactions and possibilities for enhanced participation.

This study contributes to stakeholders and educators as well as to the society as a whole. Students's well-being and safety in the school environment reduces school absenteeism and enhances academic achievement.

### **427.038 (Poster) Social and Emotional Outcomes of the Autism Mentorship Program (AMP)**

**R. L. Hudock, L. Weiler, D. Wood, K. Kremer and W. Terrill, University of Minnesota, Minneapolis, MN**

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**Background:** Research shows that relationships with caring, non-parental adult mentors are critical to healthy development and can positively influence a range of outcomes, such as peer and parent-child relationships, identity development, academic achievement, self-confidence, the prevention of problem behaviors, and reducing mental health problems (DuBois et al., 2011; Haft et al., 2019; Raposa et al., 2019; Taussig et al., 2019; Wyman et al., 2010). While youth and adolescents with autism spectrum disorder (ASD) often experience challenges related to communication, social relationships, and co-occurring emotional and behavioral concerns (Vasa et al., 2019), there are limited targeted mental health interventions or mentoring opportunities available for youth with ASD.

**Objectives:** The aim of this study was to examine the social and emotional outcomes for AMP participants.

**Methods:** AMP involves one-to-one mentorship of youth with ASD by adults with ASD. Mentoring sessions consisted of 22 weekly 60-minute meetings within the teens' high school. Fall sessions were in person and spring sessions were virtual due to COVID-19. Pairs participated in semi-structured activities centered around common interests. Participants included 14 mentees (ages 14-17), 14 mentors (ages 19-34), and 17 parents of the mentees. Mentees were recruited from a local high school, and mentors were recruited from a local community transition program for young adults with ASD. All participants had a diagnosis of ASD without co-occurring intellectual disability or language impairments. The majority of participants had co-occurring diagnoses of anxiety, depression, or ADHD. Multi-informant data was collected throughout the study. Participants completed a variety of standardized questionnaires including the Social Skills Improvement System (SSIS), the Achenbach Rating Scales (YSR, ASR, CBCL), the Rosenberg Self-Esteem Scale, and a study developed survey evaluating self-concept, quality of life, and daily activities. Descriptive and associational statistics were used to meet objectives.

**Results:** Participants reported improvements in social and emotional functioning during AMP. Mentees experienced emotional and behavioral outcomes including an increase in pride in their autistic identity ( $g=.80$ ), improved self-esteem ( $g=.62$ ), decreased internalizing ( $g=-.24$ ) and externalizing behaviors ( $g=-.16$ ), and increased satisfaction with life ( $g=.60$ ). Mentors reported by mentors included improved quality of life ( $g=.58$ ) and reduced problem behaviors ( $g=-.27$ ). Mentees and mentors also experienced a slight increase in internalizing behaviors in the spring, which many reported as related to COVID-19. Mentees experienced increased initiation of social interactions with friends ( $g=.88$ ), increased social interactions in person ( $g=.50$ ) and online ( $g=.62$ ), and increased communication ( $g=.59$ ). Mentors reported increased electronic communication with peers ( $g=.50$ ) and increased satisfaction with peer relationships ( $g=.19$ ). Mentees and mentors described the quality of their mentoring relationship as an average 4.12 on a scale from 1-5 with 5 being the strongest.

**Conclusions:** AMP can positively impact the social and emotional functioning of mentors and mentees. AMP has promise as a social-emotional intervention for students and young adults with ASD. This program can be implemented within a community setting, making it accessible to a range of participants. A virtual pilot of AMP is taking place to explore additional outcomes. The program aims to expand to additional school districts in the future.

**427.039** (Poster) Step It up: Increasing Physical Activity for Adults with Autism Spectrum Disorder and Intellectual Disability Using Supported Self-Management and Fitbit Technology  
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Background:

Individuals with ASD often do not engage in recommended levels of physical activity and levels continue to drop as individuals with ASD move into adulthood. The promising results of using strategies such as goal setting, self-monitoring, and reinforcement to increase engagement in physical activity for individuals with ASD and ID and the report of family members being a facilitator to engagement in physical activity led to the current study.

Objectives:

To determine if a supported self-managed exercise program, implemented by a caregiver, was an effective and feasible program to increase engagement in physical activity for adults with ASD and ID.

Methods:

The study used a randomized control trial to evaluate the effectiveness of a self-management intervention package with coaching component on daily step counts, health measures, and perceived quality of life for adults with ASD and ID. Coaches included a family or community member who had, at a minimum, weekly contact with the participant. Forty adults with ASD and ID were randomly assigned to a control group (n=20) or an intervention group (n=20). Both groups received Fitbits, Fitbit training, and participated in pre- and post-assessments. The intervention group participated in the self-management exercise program, which included weekly goal setting meetings. Weekly goal setting meetings were video-taped and coaches collected data on the level of participant independence throughout the goal setting meeting and integrated self-management components (self-monitoring, self-evaluation, and self-reinforcement).

Members of the research team watched videos to evaluate fidelity. Members of the research team verified goal attainment through access to the Fitbit database and evaluation of the weekly step count goal setting template filled out by the participant each week. Coaches filled out a feasibility and usage rating profile at the end of intervention. Members of the research team also conducted an interview with each coach.

Results:

Participants in the intervention group took, on average, greater weekly steps across the intervention period controlling for their baseline weekly step count (adjusted Post-Test  $M=61,548$   $SE=5,471$ ) compared to the control group (adjusted Post-Test  $M=46,377$ ,  $SE=46,377$ ). Participants in the intervention group, on average, lost more weight from baseline to posttest ( $M$  weight loss=3.25 pounds), whereas the control group made a slight gain in weight. The BMI model did not have a statistically significant main effect of Time, Group, or Time X Group intervention nor were their statistically significant main effects of Time, Group, or Time X Group Interaction for the overall quality of life model.

Participants reported high feasibility and acceptability for the Fitbit. Coaches reported high feasibility for the training and overall project as well as high ratings on the usage rating profile.

Conclusions:

These results provide some support for parents and community members implementing self-management strategies with adults with ASD and ID to increase engagement in physical activity. The intervention improved health outcomes above and beyond just having access to the Fitbit alone (control). Limitations and challenges that surfaced throughout the study will also be discussed.

**427.040** (Poster) The Development and Acceptability Testing of 'Empower-ASD': A Psycho-Educational and Psycho-Therapeutic Group-Based Programme for Parents of Children Recently Diagnosed with Autism  
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#### Background:

Parents of autistic children face many practical, emotional and social challenges. Parental responses to the diagnosis are diverse and complex. 20-50% of parents show clinically-elevated mental health needs in the post-diagnostic period (Davis & Carter, 2008; Casey et al., 2012). Parental wellbeing is of public health importance in and of itself. It is also important for effective uptake of parent-mediated interventions known to bring long-term benefits. Best practice guidelines recommend provision of timely post-diagnostic support. However, current UK provision is patchy, a source of increasing dissatisfaction and, crucially, lacks an evidence-base for effectiveness. There is a pressing need for an evidence-based programme of post-diagnostic support for parents, focussed on both psycho-education and mental health.

#### Objectives:

- Through co-design and co-production, to develop a high-quality autism psycho-education programme that draws upon Acceptance & Commitment Therapy (ACT) to boost parental wellbeing and adjustment
- To evaluate the acceptability of the programme to parents

#### Methods:

**Development:** Two pre-existing approaches formed the foundation of the intervention development: the Central Manchester Post-diagnostic Workshop (Mockett et al., 2011) and a Brief ACT programme devised by Whittingham, Sofranoff and colleagues (Whittingham et al., 2016). Multiple stages of co-design and co-production were undertaken with various stakeholder groups to: integrate and further develop the foundational approaches and understand likely feasibility and acceptability of different aspects of the programme. Session materials and practitioner guidelines were produced in draft and then subject to acceptability testing.

**Acceptability testing:** We recruited a diverse sample of 29 parents/caregivers of children (aged 2-15 years) recently diagnosed with autism from a UK NHS autism clinic. Participants were invited to attend one of three intervention programmes (two in-person; one online). Acceptability was assessed through attendance and satisfaction ratings. Qualitative feedback was obtained through: (a) post-session feedback forms; (b) interviews with 17 parents sampled purposively on attendance.

#### Results:

The resulting programme consisted of 5 3-hour sessions of group-based delivery blending (1) autism psycho-education (etiology, prevalence, characterisation, lived experience, communication, interaction, sensory experiences, emotion regulation, cognition, behaviour); (2) ACT content linked to their parenting experience (e.g. mindfulness, acceptance, values, committed action); (3) ACT-informed reflection and discussion; (4) peer support.

**Attendance:** 22/29 participants attended  $\geq 3$  sessions (3 sessions=satisfactory dosage). 3 participants attended  $< 3$  sessions and 4 participants attended none. Non-attendance was due to external circumstances (illness, caring responsibilities, employment).

**Satisfaction:** 72% of sessions were rated 'very satisfied' and 28% of sessions 'satisfied'. No sessions were rated unsatisfied/very unsatisfied. Ratings looked similar across sessions and delivery modes.

Feedback and interview data were analysed with thematic analysis. Five main themes were identified: (1) a positive experience for all; (2) the richness of the therapeutic approach; (3) the value and impact of peer support; (4) resources and technology; (5) room for improvement.

#### Conclusions:

EMPOWER-ASD is feasible and acceptable to deliver in-person or online within a UK clinical context. Attendance was satisfactory; satisfaction was excellent. Parents described beneficial processes and outcomes. Constructive criticism served to

further modify the programme. The EMPOWER-ASD programme is now being tested within a large randomised-controlled effectiveness trial.

**427.042 (Poster)** The Floreo Police Safety Module: Results of a Randomized Control Trial

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**Background:** Approximately one fifth of adolescents with ASD will be stopped and questioned by a police officer before their early twenties (Rava, Shattuck, Rast, & Roux, 2016). Individuals on the spectrum often have difficulty with sensory stimulation, novel problem solving, and rapidly processing social situations in real time, which can make police interactions particularly challenging (Channon et al., 2001; Salerno-Ferraro & Schuller, 2020; Vanmarcke et al., 2016). Police interactions are unique, unscheduled, and unplanned social situations that can introduce a high level of stress and are experienced by individuals across a wide range of functioning. Therefore, it is important to prepare individuals for this type of encounter. Virtual reality (VR) can be a useful tool as it provides individuals with the opportunity to practice interacting with police officers in a safe, simulated environment. Therefore, VR-based intervention is a promising complement to help individuals with ASD prepare for police interactions. In the current study, we compare the efficacy of an immersive VR-based intervention (Floreo PSM) versus a video-modeling intervention (BeSAFE) for increasing key police interaction skills in adolescents and adults with ASD.

**Objectives:** Compare the efficacy of two different intervention formats by assessing masked behavioral ratings of a filmed live interaction with a police officer.

**Methods:** Forty-seven verbally fluent adolescents and adults with ASD were randomly assigned to three sessions of either an immersive VR-Based intervention (Floreo PSM) or a video modeling-based intervention (BeSAFE) designed to increase knowledge and skills necessary for interacting with police officers. To measure behavior change, participants engaged in a 3- to 5-minute live interaction assessment before and after intervention. Pre-intervention, participants interacted with a novel study staff member who presented as a police officer. Post-intervention, participants interacted with an actual police officer or a uniformed security officer. Interactions were recorded and scored in 15-second segments. Each segment was coded for: appropriateness of verbal response, orienting behavior, fidgeting behavior, and overall behavior. Scores were averaged across each behavioral category and compared pre- and post-intervention. 20% of videos were double-coded (kappas in the moderate-to-good range).

**Results:** Linear mixed effects regression revealed significant conditional main effects of time (pre-/post-intervention) on ratings of overall behavior (estimate: 0.29,  $t=3.04$ ,  $p=.004$ ), appropriate verbal response (estimate: 0.21,  $t=3.14$ ,  $p=.003$ ), and fidgeting (estimate: 0.44,  $t=3.86$ ,  $p<.001$ ), after controlling for IQ, age, and sex. There was no significant effect of time on orienting ( $p=n.s.$ ). A significant condition-by-time interaction emerged for fidgeting (estimate: -0.47,  $t=0.16$ ,  $p=.005$ ). Pre-planned pairwise comparisons of Tukey-corrected estimated marginal means revealed significant improvements from pre- to post-intervention in the Floreo PSM condition as compared to the BeSAFE condition on three out of four variables (Figure a-d).

**Conclusions:** VR has great potential to serve as a comfortable and motivating platform for individuals with autism to safely practice interacting with police officers. In this study, participants' behaviors when interacting with a live police officer were rated as more appropriate after completing VR-based or video modeling-based interventions, with some evidence that VR-based practice was particularly effective at reducing anxiety-related (fidgeting) behavior.

**427.043 (Poster)** The Impact of COVID-19 on Anxiety Symptoms Among Children with ASD Entering Group CBT Treatment

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**Background:** Nearly 40% of individuals with autism spectrum disorder (ASD) are diagnosed with at least one comorbid anxiety disorder (van Steensel, Bögels, & Perrin, 2011). The onset of the COVID-19 pandemic and subsequent containment procedures resulted in high levels of anxiety for many people worldwide (e.g., Shaw et al., 2020). Additionally, individuals with pre-existing anxiety disorders may have experienced an increase in anxiety symptoms (Taylor & Asmundson, 2020). Little is known, however, about how the pandemic impacted anxiety levels in children with ASD. Our study sought to clarify whether children with ASD presenting for group cognitive behavioral therapy (CBT) demonstrated higher levels of anxiety after the onset of the global pandemic.

**Objectives:** To determine anxiety symptom severity among children with ASD presenting for Facing Your Fears (FYF) group CBT intervention in an outpatient clinic, and examine group differences in baseline child anxiety symptoms between pre and post-pandemic groups. We hypothesized that children presenting for FYF after the onset of the COVID-19 pandemic would demonstrate significantly greater overall anxiety symptoms compared to children presenting for FYF prior to COVID-19.

**Methods:** A total of 56 children and their parents presented for FYF group anxiety treatment. These were divided into those who presented for in-person group ( $n = 42$ ) before the onset of the pandemic versus telehealth ( $n = 14$ ) after the onset of the pandemic. All children had a confirmed diagnosis of ASD, cognitive functioning broadly within the average range, and at least one anxiety diagnosis. Twenty-five patients ( $M_{Age} = 10.24$ ,  $SD_{Age} = 1.66$ ) were included in this analysis; individuals who did not complete measures were excluded ( $n = 31$ ). Pre-treatment (baseline) anxiety symptoms were measured via parent-rated Multidimensional Anxiety Scale for Children, Second Edition (MASC-2; March, 2012); total anxiety  $T$ -scores were examined.

**Results:** Children entering FYF presented, on average, with anxiety symptoms in the *Very Elevated* range on the MASC-2 ( $M = 72.92$ ,  $SD = 10.49$ ). Independent samples  $t$ -tests were conducted to compare parent-reported MASC-2 total scores across pre- and post-COVID groups. Results indicated there were no significant differences in baseline MASC-2 total scores pre-COVID ( $n = 16$ ;  $M = 71.87$ ,  $SD = 11.68$ ) and post-COVID ( $n = 9$ ,  $M = 74.77$ ,  $SD = 8.27$ ),  $t(23) = -0.65$ ,  $p = .51$ .

**Conclusions:** In our sample, parent-reported anxiety severity among children with ASD did not significantly change after the onset of the COVID-19 pandemic. While some research suggests parent-reported anxiety about the pandemic and containment procedures is higher among children with ASD than typically-developing peers (Amorim et al., 2020), this may not be a significant departure from already-high baseline anxiety symptoms common among this population. In fact, others suggest that children with ASD and average cognitive skills may demonstrate improvements in overall mental health without the social and sensory demands of pre-COVID-19 learning environments (Reicher, 2020). Though our findings did not demonstrate an exacerbation of baseline anxiety symptoms in children with ASD relative to pre-COVID-19 cohorts, it does indicate a continued need to prioritize anxiety treatment for this population, as anxiety remains clinically significant.

**427.044 (Poster)** Virtual Emotion Regulation Treatment for Children Ages 8-12 with ASD: An Intensive, Video Based, Parent-Assisted Program Pilot

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**Background:** Regulating Together is an evidence-based intervention for youth with ASD and co-occurring emotion dysregulation (ASD+ED; (Shaffer et al., 2018). Youth with ASD+ED have higher rates of psychiatric hospitalizations, school disciplinary action, failed transitions, and use of psychotropic medications compared to their typical peers (Mazefsky et al., 2013). Due to the severity of these concerns, school- and outpatient-based programs are often not equipped to deal with this population, and specialized services often have extensive waitlists. There is a pressing need for interventions that can be widely and easily accessed for individuals with ASD given the relative lack of resources in many rural and underprivileged areas, a need that was further exacerbated by the COVID-19 pandemic.

**Objectives:** To assess satisfaction, feasibility, and efficacy of a virtual treatment for ASD+ED.

**Methods:** A virtual group program was offered to 8-12-year-old children with ASD+ED, with synchronous caregiver groups via Zoom and caregiver facilitated child videos with children ( $n=12$ ; 72.2% males). We completed a within-subjects trial with a screening visit, 5-week baseline period, 5-week intervention period, post treatment, and 5- and 10-week follow up. Adaptations were made to the curriculum and delivery based on family feedback and expert consultation. All participants received caregiver and child workbooks before the start of the group. Child videos taught the material with guided pauses for caregivers to discuss the material covered and complete activities. Caregivers completed satisfaction surveys post-treatment. Feasibility was assessed with enrollment and attendance rates. Initial efficacy was assessed with the Aberrant Behavior Checklist-Community (ABC), Emotion Dysregulation Inventory (EDI), Flexibility Scale (FS) and clinician rated CGI-I.

**Results:** At submission, two groups completed treatment, with 10-week follow-up visits completed for one group and post-treatment visits completed for the second group. Both groups will have completed 10-week follow-ups at the time of the conference. Caregiver education included: 25% high school graduate, 41.6% college graduate, and 33.3% advanced graduate degree. Annual household income included: 8.3% \$20,000-40,000, 33.3% \$40,001-60,000, 25% \$60,001-90,000, and 33.3% over \$90,000. At the completion of treatment, 41.7% were Much Improved and 58.3% were Minimally Improved on CGI-I. No significant changes from screen were demonstrated during the baseline period for any measures. However, comparisons between baseline and post treatment showed improvement (EDI-Reactivity:  $t(11)=2.09$ ,  $p=0.04$ , Cohen's  $d=0.86$ , trending; EDI-Dysphoria:  $t(11)=1.87$ ,  $p=0.07$ ,  $d=0.76$ ; Flexibility Scale Total:  $t(11)=2.32$ ,  $p=0.03$ ,  $d=0.95$ ; ABC-Irritability= $t(11)=1.72$ ,  $p=0.10$ ,

$d=0.70$ ). There was a 100% retention rate of youth who started the program, 93.3% attendance rate, and 82.5% completion of video material with children. Additionally, 100% of parents reported being very satisfied with the program.

**Conclusions:** We created a virtual version of an established intervention for ASD+ED. Satisfaction by caregivers was high and the retention rate was 15% improved for virtual versus in-person. Participants demonstrated improvement in ED, similar to our in-person treatment results. Despite very promising preliminary findings, our initial sample only included 12 children with ASD, which limits our ability to determine efficacy of our virtual program. In addition, because data was collected during the COVID-19 pandemic, participants' stress response, and emotion dysregulation in general, were likely impacted.

## Interventions - Pharmacologic

### PANEL DISCUSSION — INTERVENTIONS - PHARMACOLOGIC

#### Panel 217 - Mechanistic Biomarkers of E:I Dynamics and Nextgen Clinical Trials with Arbaclofen

**Panel Chair: Paul Wang**, *Simons Foundation / CRA, New York, NY*

Arbaclofen is a GABA-B receptor agonist and is hypothesized to have beneficial effects in ASD by moderating excitatory:inhibitory dynamics. It shows rescue effects in multiple animal models of ASD, from the cellular to the behavioral level, but a first generation of clinical trials failed on their primary endpoints. These trials were limited by their failure to include biomarker measures of drug action, and by their broad inclusion criteria. In fact, post-hoc analyses of the trial data suggested that the drug might be beneficial in a subset of individuals. In this symposium, we will present the results of new, clinical biomarker studies that explore the effects of arbaclofen on sensory phenomena that are known to be mediated by the dynamic interplay of excitatory and inhibitory neurotransmission. These investigations use psychophysical, electrophysiologic, and neuroimaging experimental approaches. In addition, we will describe two new clinical trials of arbaclofen that incorporate refinements in trial design, to better address placebo effects and to account for the restricted range of sensitivity of standard outcome measures. Together, these mechanistic biomarkers and refinements in "NextGen" clinical trial design have potential to identify a subset of individuals with ASD for whom arbaclofen may be beneficial.

**217.001** (*Panel Discussion*) GABA-B Gating of Perceptual Awareness during Binocular Rivalry  
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**Background:** During binocular rivalry, two dichoptically-presented images are suppressed from perceptual awareness in alternation. Computational models of rivalry (Laing and Chow, 2002; Seely et al., 2011; Said and Heeger, 2013) and magnetic resonance spectroscopy research (Robertson et al., 2016) suggest that the depth of perceptual suppression is governed, in part, by the strength of interocular inhibition in visual cortex. Further, rivalry dynamics are altered in the brains of adult individuals with autism (Robertson et al., 2013; Spiegel et al., 2019; Robertson et al., 2016). As a result, rivalry has been suggested as a noninvasive perceptual marker of inhibitory signaling in visual cortex, and its putative alteration in autism.

**Objectives:** Here, we present causal, pharmacological tests of the impact of GABAergic inhibition on rivalry dynamics, and the contribution of specific GABA receptors to these dynamics.

**Methods:** Neurotypical adults participated in three separate studies investigating the effects of GABA modulators on binocular rivalry dynamics: Study 1 GABA A modulator clobazam, N = 21; Study 2 GABA B modulator arbaclofen, N = 22; Study 3 (arbaclofen replication study), N = 22. Each study took part over 3 days: practice session / health assessment (day 1) and two experimental days (day 2-3). On each of the experimental days, a participant was given either a drug or a placebo (within-subjects, crossover design), and participated in a short binocular rivalry experiment after the drug had come into effect.

**Results:** We found that drugs that modulate the two dominant GABA receptor types in the brain, GABAA (clobazam) and GABAB (arbaclofen), increase perceptual suppression during rivalry relative to a placebo. Crucially, these results could not be explained by changes in reaction times or response criteria, as determined through rivalry simulation trials, suggesting a direct and specific influence of GABA on perceptual suppression. A full replication study of the GABAB modulator reinforces these findings.

**Conclusions:** All in all, these results provide direct evidence for a causal link between GABAergic inhibition and binocular rivalry and implicate specific GABA receptors (GABA A and GABA B) in perceptual suppression. More broadly, these results identify binocular rivalry as a simple yet powerful perceptual tool to index GABAergic drug response in the brain, which may further research on psychiatric conditions in which neural inhibition is thought to be affected.

**217.002** (*Panel Discussion*) Brain Response to Gabab Receptor Modulation with Arbaclofen in Adults with and without ASD  
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**Background:** Differences in pathways controlling neural excitation (E) and inhibition (I), especially GABAergic circuits, in ASD are thought to contribute to differences in sensory sensitivities, repetitive behaviours and social communication difficulties in ASD. However, the evidence has been largely indirect, coming from preclinical models, genetics and correlational studies carried out at a single (cross-sectional) timepoints.

**Objectives:** Here we directly tested the hypothesis that GABAergic neural pathways are *functionally* distinct in individuals with ASD.

**Methods:** We examined the brain response to GABA<sub>B</sub> modulation with the agonist arbaclofen in 48 adults with (n = 24) and without ASD (n = 24) at 3 levels: i) 'Local' sensory processing in visual cortex was examined using a visual contrast EEG task; ii) Regional tissue levels of GABA metabolites were quantified using Magnetic Resonance Spectroscopy (MRS); iii) Network level functional connectivity was assessed using BOLD fMRI. Data were collected following a single oral dose of either placebo, low (15mg) dose arbaclofen or high (30mg) dose arbaclofen. The order of administration was randomized and double blind.

**Results:** In neurotypical controls, in the visual task, the response to foreground stimuli increased with increasing foreground contrast and decreasing background interference. In ASD all stimuli had equal salience regardless of contrast or background interference. In addition, the neurotypical relationship between MRS measured occipital GABA and SSVEP elicited by maximum foreground contrast during maximum background interference was absent in autistics. This implied that GABA modulates visual perception differently in people with and without ASD. We confirmed this by showing that visual processing differences in ASD were abolished by (high dose) arbaclofen. In contrast, arbaclofen disrupted the control response profile. A differential group response to arbaclofen was also evident at the brain network level. Arbaclofen significantly lowered intrinsic functional connectivity in a subnetwork comprising regions within dorsal attention and salience networks, including the medial prefrontal cortex, in individuals with ASD but not in neurotypical controls.

**Conclusions:** Thus, the autistic brain is differentially responsive to GABAergic pharmacological challenge. This has implications for development of pharmacological interventions in ASD. We show for the first time that a visual processing mechanism which is GABA dependent in neurotypicals, is altered in ASD. We also show that targeting the GABA<sub>B</sub> receptor removes these differences in visual processing between adults with and without ASD and alters the activity of brain networks in ASD. We will discuss the utility of these approaches to improve our understanding of brain biology in ASD and capture individual pharmacological responses to candidate interventions. How our results have application to clinical trials will be considered.

**217.003 (Panel Discussion) Tactile Perception As a Potential Target for Gabaergic Intervention in Neurodevelopmental Disorders**

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**Background:** Sensory difficulties are common in autism and are being increasingly recognized. 70-90% of those with ASD report having sensory difficulties with tactile difficulties being most common. Sensory difficulties are described as severely debilitating and present across the lifespan. Touch plays an important role in perception of the world, as well as in early social development. It is well-established that encoding of tactile information relies on homeostatic balance between excitation and inhibition (E-I balance). The excitation-inhibition (E-I) balance theory of ASD suggests that an increase in excitatory and/or decrease in inhibitory signaling in key brain-regions in ASD results in a hyper-excitabile system which may be less efficient at processing sensory signals. Given the well-known role of E-I in driving the neuronal response to touch, early emergence, and potential impact on social difficulties, the tactile domain is a promising domain for establishing stratification and intervention.

**Objectives:** Interestingly, alterations of tactile processing have also long been identified in other neurodevelopmental disorders, including attention-deficit/hyperactivity disorder (ADHD). However, the extent to which these alterations are disorder-specific,

rather than disorder-general, and how they relate to the core symptoms of each disorder, remains unclear. Furthermore, it remains unclear how differences in E-I balance lead to differences in perception, and subsequently, to altered reactivity and social difficulties. In this talk I will provide an overview linking difficulties in tactile processing in ASD (and ADHD) to differences in E-I balance and to the core symptoms of ASD, motivating the tactile domain as a promising target for targeted intervention.

**Methods:** First, I will describe psychophysical work measuring tactile detection, discrimination, and order judgment thresholds between a large sample of children with ASD, ADHD, ASD + ADHD combined and typically developing controls. Then, I will present work by our lab and others, linking differences in tactile processing to brain measures of E-I balance as obtained using Magnetic Resonance Spectroscopy (MRS). Edited MRS can be used to provide measures of the relative concentration of GABA and Glx (Glutamate + glutamine) in specific brain regions as proxy markers of excitation and inhibition respectively.

**Results:** We show that difficulties at the perceptual level are disorder-specific and are specifically related to higher-level clinical symptoms of each disorder, with clear links to different inhibitory mechanisms (such as lateral inhibition, and feed-forward inhibition). Imaging data shows that region-specific alterations in MRS-markers of excitation and inhibition are associated with both difficulties in tactile perception (as measured through psychophysics) and tactile hyper- and hyporeactivity.

**Conclusions:** These data provide strong empirical support for increased excitation and reduced inhibition in ASD and provide a clear link between measures of E-I and the sensory symptoms of ASD at the behavioural and perceptual levels. Together, these data motivate GABAergic mechanisms as a mechanistically-informed target for intervention with clearly delineated perceptual and clinical outcomes.

#### 217.004 (Panel Discussion) Clinical Trial Design for Evaluating Arbaclofen in Children and Adolescents with ASD

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**Background:** Current pharmacological treatments for ASD are focused on comorbid conditions such irritability, ADHD, and others. However, treatment for the core symptoms of ASD remains a challenge. To date, approximately only 20 RCTs have looked into bio-treatments for the core symptoms in ASD, with just a handful of those correlating positively with changes at the biochemical/imaging level (Parellada et al., in prep). An excitatory-inhibitory imbalance at the neural level has been pointed out as a plausible cause for the condition. Therefore, restoring this equilibrium could potentially improve core deficits in ASD.

**Objectives:** To study the efficacy and safety of arbaclofen, a GABA<sub>B</sub> agonist (which inhibits presynaptic release of glutamate, and postsynaptic transmission), for the treatment of social function in ASD within a network of academic centers.

**Methods:** In the format of a randomized, double-blind, placebo-controlled study, we will test arbaclofen in a sample of 210 high functioning individuals (130 + 90 from our Canadian counterpart, the POND consortium) from 5-17 years of age. We will a) use measures of EEG to explore potential predictive biomarkers of change, or surrogate outcome measure, b) explore genetic markers of response to treatment, and c) explore the use of digital technologies to monitor treatment changes.

*Results:* Three European countries have successfully been approved by their respective ethics and medical agencies to conduct the trial. At the moment, recruitment is ongoing, with almost a third of the sample already recruited. The protocol works well, showing good compliance from the families. No serious adverse events have been reported.

*Conclusions:* The successful setup and running of this RCT is a world-wide class success from an academic perspective. Results will inform future treatments for core ASD symptoms in high functioning individuals, which ultimately may lead in to an improved quality of life.

## ORAL SESSION — INTERVENTIONS - PHARMACOLOGIC

### Oral 303 - Pharmacological Treatment Studies

#### **303.001** (Oral) Oxytocin Increases Amygdala Response to Emotional Faces Among Autistic Women

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**Background:** Oxytocin administration has attracted interest for its potential to alleviate the social challenges experienced by autistic people, including its ability to enhance eye contact and emotion recognition as well as to reduce social anxiety. The influence of oxytocin on the amygdala—a region considered a hub of the social brain—may underlie such behavioural effects. The effects of oxytocin on the amygdala are well-documented in neurotypical individuals, individuals with anxiety and trauma-related disorders, and animal models. By contrast, few studies have examined the effects of oxytocin on amygdala activation in autistic individuals, and those that have involved only male participants.

**Objectives:** To examine the effect of oxytocin on amygdala activation among autistic and non-autistic women during a socially-relevant fMRI task known to induce a robust amygdala response (i.e. Hariri task). Furthermore, we explored how effects of oxytocin on amygdala response varied with autism diagnosis and trait social anxiety.

**Methods:** Thirty-seven women (aged 18-50 years; 16 with an autism diagnosis) completed a modified version of the Hariri task once after receiving placebo and once after receiving 24IU intranasal oxytocin. The task required participants to match emotions or shapes (6 blocks of shape-matching, 5 blocks of face-matching, each block comprised 6 trials). Participants were scanned on a 3T Siemens MRI scanner using a multi-echo sequence (TR = 2400 ms, TE = 12, 29, 46 ms, interleaved, 140 volumes, slice thickness 3.8 mm). Pre-processing was carried out using the ME-ICA pipeline to optimally combine echoes and denoise data. Subsequent task analysis was performed using FEAT (FMRIB Software Library v6.0, cluster-corrected  $p = 0.05$ ,  $z > 2.3$ ). Left and right amygdala were defined from the Harvard-Oxford subcortical atlas, and voxel-based analyses were carried out to compare activation was compared between groups and drug conditions. The relationship was also explored between change in amygdala activation between drug conditions and Liebowitz Social Anxiety Scale (LSAS) questionnaire score.

**Results:** Relative to matching shapes, matching emotional faces induced strong bilateral amygdala activation in both autistic and non-autistic women. A significant Group  $\times$  Drug interaction was observed (left amygdala: 102 voxels,  $Z$ -max = 3.8, cluster-corrected  $p = 0.008$ , MNI coordinates of peak activation: -32 -4 -24; right amygdala: 87 voxels,  $Z$ -max = 4.1, cluster-corrected  $p = 0.012$ , MNI coordinates of peak activation: 18 -4 -16), such that autistic women showed increased left amygdala activation (Figure 1a) whereas non-autistic women showed decreased right amygdala activation (Figure 1b). Among all participants LSAS score was positively correlated with change in left amygdala activation, meaning that activation increased in the oxytocin relative to placebo condition among women with higher social anxiety ( $r=0.32$ ,  $p=0.06$ ). As autistic women had higher average LSAS scores than non-autistic women, this correlation was confirmed among non-autistic women only ( $r=0.44$ ,  $p=0.05$ ).

**Conclusions:** Oxytocin differentially affected amygdala reactivity to emotional faces in autistic compared to non-autistic women, which is consistent with findings from studies involving autistic men. Interestingly, our results suggest that oxytocin also differentially influences amygdala response to emotional facial stimuli in women with high versus low social anxiety.

**303.002** (Oral) Social and Non-Social Effects of Oxytocin: Enhancement of Approach Motivation Towards All Emotionally-Evocative Stimuli

**J. Prinsen**<sup>1,2</sup>, **A. Taillieu**<sup>1</sup>, **N. Daniels**<sup>1,3</sup>, **J. R. Soriano**<sup>1</sup> and **K. Alaerts**<sup>1,3</sup>, (1)Rehabilitation Sciences, KU Leuven, Leuven, Belgium, (2)Leuven Autism Research Consortium (LAuRes), KU Leuven, Leuven, Belgium, (3)Leuven Autism Research Consortium (LAuRes), Leuven, Belgium

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**Background:** The neuropeptide oxytocin is suggested to exert a pivotal role in a variety of complex social behaviors, for example by modulating approach-avoidance motivational tendencies during perception of social events. Recently however, its social specificity has been challenged by the General Approach-Avoidance hypothesis of Oxytocin (GAAO) in order to account for several observations of non-social effects of oxytocin.

**Objectives:** To investigate the effect of a single dose of intranasal oxytocin (24IU) on behavioral (adjustment of viewing time) and neural (EEG-based frontal alpha asymmetry) indices of approach-avoidance motivation during perception of social and non-social affective stimuli, in order to test predictions based on the GAAO account.

**Methods:** 52 healthy adult men (18-35 years) participated in this placebo-controlled study with parallel design. Before and after nasal spray administration, participants were presented with a series of pictures (selected from the Nencki Affective Picture System database), while frontal alpha asymmetry (indexing neural approach-avoidance) was obtained from EEG recordings. Additionally, participants were able to prolong (approach) or shorten (avoid) the viewing time of each picture, allowing to obtain a measure of behavioral approach-avoidance. The presented pictures were individually rated in terms of valence (positive or negative) and sociality (social or non-social) on a visual analog scale. Ratings of sociality of the stimuli were subjected to a median split, yielding for each participant a self-rated social and non-social category. Ratings of valence were subjected to a quartile split, yielding for each participant a set of negative and positive stimuli with high versus low emotional evocativeness (i.e. valency intensity).

**Results:** Irrespective of the stimulus' social nature (or valence intensity), intranasal oxytocin maintained behavioral approach towards negatively valenced pictures (compared to decreased viewing time of negative stimuli in the placebo group). At the neural level, oxytocin specifically amplified approach-related motivational saliency of stimuli that were self-rated to have high personal relevance, but irrespective of their social nature or direction of rated valence (positive or negative).

**Conclusions:** These findings further challenge the social specificity of oxytocin and provide further evidence for a general role of oxytocin in modulating approach-avoidance motivational tendencies. In particular, our data indicate that oxytocin may specifically promote approach-related motivational tendencies towards sensory input that is of high personal relevance, irrespective of the stimulus' valence or social/non-social nature. This mechanism may provide an entry point for reconciling prior observations of oxytocin's social, non-social or even anti-social effects.

**303.003** (Oral) Functional Connectivity Differences in Autism Spectrum Disorder Associated with SSRI Medication

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**Background:** Over half of children with autism spectrum disorder (ASD) are prescribed psychotropic medication; Selective Serotonin Reuptake Inhibitors (SSRIs) are one of the most commonly prescribed, at 25%. SSRIs are primarily used in ASD to treat commonly comorbid anxiety or depression with variable effectiveness, but they may also be effective in managing some core symptoms of ASD, including RRBs. Despite evidence that SSRIs have different impacts on brain function across psychiatric disorders and evidence for changes to brain connectivity in individuals with ASD associated with psychotropic medication use, the impact of SSRIs on brain function in ASD is not known.

**Objectives:** Our goal was to identify associations between SSRI medication use and functional connectivity of select brain networks involved in emotion processing and regulation in individuals with ASD.

**Methods:** Three samples matched on age, sex, and IQ were identified from the Autism Brain Imaging and Data Exchange. 1) ASD+SSRI (N=28) individuals were taking an SSRI and no other psychoactive medications, and had no comorbid disorders; 2) ASD-Unmedicated (N=27) individuals reported no medications or comorbidities and were matched with the ASD+SSRI individuals on ASD severity; 3) typically developing (N=28) individuals had no psychiatric or developmental issues. Network analysis using GIMME (Group Iterative Multiple Model Estimation) was used to identify differences in directed, weighted functional connectivity between groups at rest in bilateral prefrontal cortex, including dorsomedial (dmPFC), ventromedial (vmPFC), dorsolateral (dlPFC), and ventrolateral (vlPFC) areas, anterior cingulate dorsal (dACC) and rostral (rACC) divisions,

and two subcortical ROIs in dorsal striatum (DS) and ventral striatum (VS). We report pathways that showed significant functional connectivity in  $\geq 50\%$  of at least one subject group, and for pathways common to all groups, we compare the strengths of individuals' connections between groups.

**Results:** All three groups showed directed functional connectivity in dACC-rACC, vmPFC-rACC, dlPFC-vlPFC, and VS-DS pathways. The TD and ASD+SSRI groups each showed dmPFC-dACC functional connectivity, but the ASD-unmedicated individuals did not show connectivity of this pathway. In contrast, the ASD-unmedicated group showed dmPFC-rACC connectivity whereas neither the TD or ASD+SSRI individuals showed connectivity of this pathway (Figure 1). The strength of the vmPFC-rACC connection was lower for the two ASD groups compared to TD, with no difference between ASD+SSRI and ASD-Unmedicated.

**Conclusions:** These results indicate that SSRI use in ASD is associated with differences in PFC-ACC functional connectivity. Findings that dmPFC-dACC functional connectivity is reduced in unmedicated but not medicated individuals with ASD suggests that this pathway, which is involved in cognitive control, may be normalized by SSRIs. In contrast, findings that vmPFC-rACC connectivity is reduced in both ASD groups relative to TD individuals suggests that this pathway is unaffected by SSRIs in ASD, which is dissimilar to findings from non-ASD individuals using SSRIs. These results highlight the need to assess the unique impacts of medication use on brain function in individuals with ASD.

### 303.004 (Oral) Clinical and Biological Characterization of a New, Biologically-Defined, Subgroup of Patients with ASD: ASD Phenotype 1 (ASD-Phen1)

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#### Background:

Autism Spectrum Disorder (ASD) is the umbrella term for diseases and disorders with considerable clinical and pathophysiological variability. Such heterogeneity is a major hindrance to the development of diagnostic tests and pharmacological treatments. The identification of novel clinical and biological criteria for the stratification of patients with ASD represents a way to address this issue and thereby increase the likelihood of success in the development of therapeutics. Using systems biology analyses and integration of network analysis, machine learning and in-silico modeling techniques, we identified a new subgroup of patients with ASD, referred to as ASD Phenotype 1 (ASD-Phen1).

#### Objectives:

The goal of our study was to validate the capacity of STALICLA's computational system biology platform to accurately identify association of pathological or physiological features predictive of clinically and biologically distinct subgroup of patients with Autism when compared with non-phenotypically enriched populations with idiopathic ASD and typically developing (TD) individuals.

#### Methods:

The clinical set of signs and symptoms identified by STALICLA to define ASD-Phen1 has been used and applied in an observational clinical study conducted at the Greenwood Genetic Center (GGC) in an original cohort of 313 patients with idiopathic ASD out of which 90 patients were further selected based on full availability of early life health records. Blood samples were also collected during this study and lymphoblastoid cell lines (LCLs) were derived from patients with ASD-Phen1, patients with ASD not meeting clinical criteria for ASD-Phen1 (ASD-nonPhen1) and TD individuals. The Phenotype MicroArray technology was used to determine the energy metabolism profile of the different LCLs. RNA-Seq experiments were also performed to compare gene expression profiles in the three groups (ASD-Phen1, ASD-nonPhen1, TD). Such a hypothesis-free approach was designed to allow the unbiased validation of STALICLA's models.

#### Results:

The observational clinical study confirmed the existence of a specific subpopulation matching the clinical enrichment criteria defined by STALICLA's computational biology modeling, counting for approximately 25% of the enrolled participants. Metabolic analyses revealed that LCLs derived from patients with ASD-Phen1 have a distinct bioenergetic profile when

compared to LCLs from patients with ASD-nonPhen1 or TD individuals. The differential gene expression analyses also confirmed that patients with ASD-Phen1 are more homogeneous phenotypically than the wide ASD population, and that ASD-Phen1 has a specific biological signature.

#### Conclusions:

These clinical and experimental data validate the existence of a convergent pathophysiology for the ASD-Phen1 subgroup of patients, significantly different from other idiopathic ASD patients as well as from control individuals. Three independent experiments and data types confirmed this biological validation: metabolic, metabolomic and RNA-seq data analyses. These results supported the development of a precision medicine treatment specifically for patients with ASD-Phen1.

## POSTER SESSION — INTERVENTIONS - PHARMACOLOGIC

### Poster 428 - Interventions - Pharmacologic Posters

**428.001** (Poster) Antipsychotics, Dysphagia, Aspiration Pneumonia, Bowel Obstruction and Related Surgeries in Adults with Severe Developmental Disabilities

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**Background:** Dysphagia, aspiration pneumonia and bowel obstruction are serious side effects of antipsychotic medications. The FDA recently increased warnings for clozapine producing constipation and bowel obstruction, however both typical and atypical antipsychotics can produce such problems, especially in high doses. Individuals with severe developmental disabilities including cerebral palsy or minimally verbal status appear more prone to such side effects, but published information is sparse.

**Objectives:** To examine pharmacologic treatments and dosing, including but not limited to antipsychotics and selective serotonin reuptake inhibitors that inhibit antipsychotic metabolism via CYP2D6, predisposing to such problems in individuals with severe DD. Also to examine outcomes of any drug taper attempts as they impacted dysphagia and food intake.

**Methods:** We extracted cases from our IRB-approved Neuropsychiatry Clinical Database with a history of dysphagia, aspiration pneumonia and/or bowel obstruction. Data extracted includes age, race, gender, intellectual disability (ID) level, minimally verbal status, history of dysphagia/aspiration pneumonia/ bowel obstruction/surgeries for these including ostomy placement and feeding details. Antipsychotic medications and dosing were extracted from time of presentation and following any dosing reductions, and outcomes of such problems and feeding improvements.

**Results:** Thirteen adults met symptom inclusion criteria: 7 males, 6 females. Median age was 59 years, range 29-69 years, all but 2 were < 65 years. Two were African American and 11 Caucasian. One had borderline intellectual functioning and spastic quadriplegia; ID was moderate in 1, severe in 7, and profound in 4. All but 4 were minimally verbal. Nine of 13 (69.2%) had dysphagia, of which 8 had a history of aspiration pneumonia (61.5%). Five of 13 (38.5%) had a bowel obstruction history. Of the 13 cases, 7 (53.8%) had prior surgery for bowel resections/ ostomy placement. All 13 received moderate or high dose antipsychotics: olanzapine in 4: 40mg, 40 mg, 30mg and 25mg daily; clozapine in 3: 750mg (plus paroxetine 20mg), 400mg and 375mg daily; quetiapine in 3: 800mg (plus paroxetine 30mg), 600mg, 400mg daily; and risperidone in 1: 8 mg daily. Two received olanzapine plus a selective serotonin reuptake inhibitor (SSRI) inhibiting CYP2D6, increasing antipsychotic dose: olanzapine 10mg and fluoxetine 80mg daily; olanzapine 20mg and sertraline 150mg daily. Some cases in whom the antipsychotic and/or SSRI was tapered down gradually had improved swallowing on repeat video swallow and restoration of normal feeding or less thickened liquids (n=2) or G-tube removal (n=1). In other cases, guardians were not willing for medications to be tapered. In one case the subject described fear of eating again.

**Conclusions:** Individuals with severe developmental disabilities including those with cerebral palsy or who are minimally verbal receiving high dose antipsychotics are prone to dysphagia, aspiration pneumonia, bowel obstruction and surgeries including at a young age. Subsequent parenteral feeding removes pleasure of eating and drinking normally. Gradual taper of such medications, including of any CYP2D6-inhibiting SSRIs may improve normal feeding outcomes. High doses of antipsychotics should be avoided in such individuals.

# Medical and Psychiatric Comorbidity

## PANEL DISCUSSION — MEDICAL AND PSYCHIATRIC COMORBIDITY

### Panel 232 - Novel Findings to Inform Suicide Prevention for Autistic Individuals

**Panel Chair:** Brenna Maddox, *University of North Carolina-Chapel Hill, Chapel Hill, NC*

**Discussant:** Lisa Morgan, *American Association of Suicidology, Washington, DC*

The last decade has brought substantial progress in understanding the heightened risk of suicide in autistic people. Most research to date has focused on prevalence, risk factors, assessment, and screening. While this work has addressed many important questions, there is a dearth of research on what happens after an autistic person is determined to be at risk for suicide – how do we intervene appropriately and prevent suicide? The current panel focuses on this nascent area of suicide and autism research. Sarah Cassidy will present data from the first psychological autopsy study to identify how many people who died by suicide had an autism diagnosis or high autistic traits. Mirabel Pelton will discuss how the Interpersonal Theory of Suicide can inform suicide prevention efforts for autistic individuals. Anne Huntjens will present on an ongoing trial of dialectical-behavioral therapy for reducing suicidal thoughts and behaviors in autistic adults. Brenna Maddox will share key stakeholder insights about tailoring the Safety Planning Intervention for autistic adolescents and adults. Finally, Lisa Morgan, an autistic adult and suicide loss survivor, will lead a discussion about the practical implications of these novel findings and future directions for reducing suicide risk in autistic people of all ages.

**232.001 (Panel Discussion) Autism and Autistic Traits in Those Who Died By Suicide in the UK**

**S. A. Cassidy<sup>1</sup>, S. Au-Yeung<sup>1,2</sup>, A. Robertson<sup>3</sup>, H. Cogger-Ward<sup>1</sup>, G. Richards<sup>4</sup>, C. Allison<sup>5</sup>, L. Bradley<sup>6,7</sup>, R. Kenny<sup>8</sup>, R. O'Connor<sup>3</sup>, D. Mosse<sup>9</sup>, J. Rodgers<sup>10</sup> and S. Baron-Cohen<sup>1</sup>.** (1)School of Psychology, University of Nottingham, Nottingham, United Kingdom, (2)University of Oxford, Oxford, United Kingdom, (3)University of Glasgow, Glasgow, United Kingdom, (4)Newcastle University, Newcastle, United Kingdom, (5)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (6)Coventry University, Coventry, United Kingdom, (7)University of Bedfordshire, Luton, United Kingdom, (8)University of Cambridge, Cambridge, United Kingdom, (9)Department of Anthropology and Sociology, SOAS University of London, London, United Kingdom, (10)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom

#### Background

Autism and autistic traits are risk factors for suicide attempts, but no studies have yet explored the rate of autism (diagnosed and possible undiagnosed) in those who die by suicide or explored potentially unique risk factors for suicide in this group.

#### Objectives

First, to identify how many people who died by suicide in two regions of the UK between 2014-2017 had evidence of diagnosed autism or possible undiagnosed autism (high autistic traits). Second, to explore whether the circumstances and characteristics of those who died with evidence of autism (diagnosed or possible undiagnosed) were different to those with no evidence of autism. Third, to make recommendations for future suicide prevention efforts.

#### Methods

We conducted the first Psychological Autopsy (PA) study to consider evidence of autism and autistic traits, in two stages. *Stage 1:* 372 coroners' inquest records covering the period 2014-2017 from two regions of the UK, independently judged as likely suicide, were analysed for evidence that the person who died had diagnosed autism or undiagnosed possible autism (high autistic traits). Content analysis of the records identified risk markers. *Stage 2:* 40 interviews were conducted with: a) 29 next of kin of those who died from the coroners' cohort; and b) 11 next of kin recruited from public adverts where the person who died was likely to be autistic (diagnosed or undiagnosed). Interviews assessed the circumstances and characteristics of the person who died, in order to identify possible risk factors, and further evidence of autism and autistic traits was obtained using validated autism screening and diagnostic tools (SRS-2 and ADI-R).

#### Results

*Stage 1:* The total evidence of autism (possible/strong/definite; 10.75%) was significantly higher in those who died by self-harm or suicide than the 1.1% prevalence rate expected in the UK general alive population (including previously unknown [i.e. undiagnosed] cases) ( $\chi^2=31.31, p<0.001$ ; OR 11.08, 95% CI 3.92 – 31.31). This is 11 times higher than the rate of autism in the UK. *Stage 2:* 5 (17.24%) of the follow-up sample had possible/strong evidence of autism identified from the coroners' records in Stage 1. The PA interview/SRS identified evidence of *possible autism* in an additional 7 (24.14%), giving an overall rate of 12 (41.4%). However, *strong evidence* of autism was not confirmed, as none of the 12 met the cutoff for autism diagnosis on the ADI-R. The rate of possible autism in the coroners' cohort (n=12, 41.4%) was significantly higher than expected in the general alive population (1.1%) ( $\chi^2=12, p<0.001$ ; OR 19.76, 95% CI 2.36 – 165.84). Those with evidence of autism diagnosis or high autistic traits were significantly more likely to have experienced social isolation, to have been diagnosed with anxiety, and to have experienced increased recent disengagement from services before they died, compared to those without evidence of autism.

## Conclusion

Elevated autistic traits, in the range of clinical concern for possible autism, are significantly over-represented in those who die by suicide. Suicide prevention strategies must consider increased vulnerability of those with high autistic traits to established risk markers for suicide.

### 232.002 (Panel Discussion) Suicide Prevention in Autistic Adults: What Can We Learn from the Interpersonal Theory of Suicide?

*M. K. Pelton<sup>1</sup>, S. A. Cassidy<sup>2</sup>, A. Robertson<sup>3</sup>, H. Crawford<sup>4</sup>, S. Baron-Cohen<sup>5</sup> and J. Rodgers<sup>6</sup>, (1)Coventry University, Coventry, United Kingdom, (2)School of Psychology, University of Nottingham, Nottingham, United Kingdom, (3)University of Glasgow, Glasgow, United Kingdom, (4)Faculty of Health and Life Sciences, Coventry University, Coventry, United Kingdom, (5)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (6)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom*

## Background

Autistic people are more likely to experience suicidal thoughts and behaviours than non-autistic people but, to date, there is a weak evidence base for intervention. The Interpersonal Theory of Suicide (ITS) posits that suicidal thoughts result from experiencing both 'thwarted belongingness' (social isolation) and 'perceived burdensomeness' (social worthlessness). Existing research associates these concepts with mental health difficulties, social exclusion and poor quality of life in autistic adults, suggesting the ITS may be useful to understand suicide in this group.

## Objectives

This study had three objectives: 1) to explore whether the ITS describes similar pathways to suicidal thoughts and behaviours in autistic and non-autistic adults, 2) to examine whether questionnaire measurement properties were equivalent in autistic and non-autistic people and 3) to explore how symptoms of depression and ITS constructs interact with suicidal thoughts in autistic and non-autistic people.

## Methods

Data from 696 autistic and non-autistic people matched on age and gender (mean age 41.7, 58% female) were extracted from an online cross-sectional survey dataset of self-report questionnaires measuring thwarted belonging and burdensomeness (Interpersonal Needs Questionnaire-10), lifetime suicidality (Suicidal Behaviours Questionnaire revised, item 1), depression (Patient Health Questionnaire-9) and autistic traits (Autism Spectrum Quotient – Short Form). Moderated path analyses explored pathways from autistic traits to suicidal thoughts and behaviours; measurement invariance analysis explored equivalence of measurement properties and network analysis explored pathways through depression to suicidal thoughts in autistic and non-autistic people.

## Results

In both autistic and non-autistic people there was an indirect effect of autistic traits on suicidality through thwarted belonging and perceived burden, however, the association of each of these with suicidality was significantly attenuated by autism diagnosis. Table 1 shows that all items of the burdensomeness subscale and two items of the belonging subscale were non-invariant between autistic and non-autistic people. Network analysis (Figure 1) showed that, in both groups, thwarted belonging was indirectly connected to suicidal thoughts through depression whilst perceived burden was closely, directly connected to suicidal thoughts.

In the autistic group, depression symptoms were more closely, strongly inter-connected and symptoms of restlessness/ moving slowly were more closely, strongly connected to suicidal thoughts than in the non-autistic group.

## Conclusions

Results suggest, firstly, that addressing feelings of thwarted belonging and burdensomeness could help prevent suicide in autistic adults, such as promoting autism acceptance and meeting autistic peoples' support needs. Secondly, autistic people interpreted the questionnaire items asking about burdensomeness and thwarted belonging differently to non-autistic people. Conceptualizing how autistic people experience these feelings will be important for suicide prevention. Thirdly, in autistic and non-autistic people, thwarted belonging is a distal risk factor whilst perceived burden is a proximal risk marker for suicidal ideation. Promoting social belonging may protect against depression with suicidal ideation. In autistic people, depression symptoms interact more strongly than in non-autistic people suggesting suicidal thoughts may develop more quickly. The close connection of symptoms of restlessness/ moving slowly with suicidal thoughts in autistic people could inform autism-specific risk markers.

### **232.003** *(Panel Discussion)* The Effect of Dialectical Behavior Therapy in Autism Spectrum Patients with Suicidality and/or Self-Destructive Behavior: A Randomized Multi-Center Controlled Trial

*A. Huntjens<sup>1</sup>, W. van den Bosch<sup>2</sup>, B. Sizoo<sup>3</sup>, A. Kerkhof<sup>4</sup>, M. Huibers<sup>5</sup> and M. van der Gaag<sup>6</sup>, (1)VU University, Amsterdam, Netherlands, (2)Scelta, Apeldoorn, Netherlands, (3)Dimence, Deventer, Netherlands, (4)CLINICAL PSYCHOLOGY, Amsterdam Public Mental Health Research Institute, Amsterdam, Netherlands, (5)Amsterdam Public Mental Health Research Institute, Amsterdam, Netherlands, (6)Parnassia Psychiatric Institute, The Hague, Netherlands*

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**Background:** Many patients with autism spectrum disorder (ASD) are treated in long-term specialized care. In this population, suicidal behavior troubles patients, families, and specialists in the field because it is difficult to treat. At present, there is no documented effective therapy for suicidal behavior in ASD. Dialectical Behavior Therapy (DBT) is an efficacious treatment program for chronically suicidal and/or self-harm behavior in patients with Borderline Personality Disorder. This study will evaluate the efficacy of DBT in patients with ASD and suicidal/ self- destructive behavior in a randomized controlled multisite clinical trial.

**Objectives:** The primary outcome is the level of suicidal ideation and behavior. The secondary outcomes are anxiety and social performance, depression, core symptoms of ASD, quality of life, and cost-utility. Emotion regulation and therapeutic alliance will be investigated for mediation effects.

**Method:** 128 patients with autism and suicidal and/or self-harming behavior will be recruited from specialized mental healthcare services and randomized into two conditions: 1) the DBT condition in which the participants have weekly individual cognitive behavioral therapy sessions and a 2.5 hour skills training group session twice per week, and 2) the treatment as usual condition which consists of weekly individual therapy sessions of 30-45 minutes with a psychotherapist or social worker. Assessments will take place at baseline, at post-treatment (6 months), and after a follow-up period of 12 months. The mediators will also be assessed at three months.

**Results:** DIASS is an ongoing study and there are no results yet. Based on the positive clinical observations, we have seen that patients and therapist benefits from DBT therapy. Patients build a life worth living and suicidal behavior decreases; therapist experience competence and less fear to treat people with suicidality. DIASS has already led to implementation of new care in the mental health care in the Netherlands.

**Conclusion:** The results from this study will provide an evaluation of the effectiveness of DBT treatment in patients with ASD on suicidal and/or self-harming behavior. The study is conducted in routine mental health services which enhances the generalisability of the study results to clinical practices.

### **232.004** *(Panel Discussion)* Tailoring an Evidence-Based Suicide Prevention Intervention for Use with Autistic Adolescents and Adults

*B. B. Maddox<sup>1</sup>, S. R. Crabbe<sup>2</sup>, K. Myhre<sup>2</sup>, D. S. Mandell<sup>3</sup> and S. Jager-Hyman<sup>2</sup>, (1)University of North Carolina-Chapel Hill, Chapel Hill, NC, (2)University of Pennsylvania, Philadelphia, PA, (3)Penn Center for Mental Health, University of Pennsylvania, Philadelphia, PA*

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**Background:** Suicide is a leading cause of premature death in autistic people. Autistic individuals are significantly more likely to think about and attempt suicide than the general population. Yet no published research has examined the effectiveness of suicide interventions for autistic individuals. The Safety Planning Intervention (SPI), an evidence-based suicide prevention intervention,

may be an ideal intervention, with some modifications, for autistic individuals who experience suicidal thoughts or behaviors. SPI is a brief, individually-tailored, and easy-to-use approach designed to lower the short-term risk of suicide. Little is known about the utility of SPI for autistic individuals, nor has research examined adaptations necessary to best fit this population.

**Objectives:** The objective of this community-partnered study is to learn from autistic adolescents and adults, their family members, and community clinicians about their perceptions of using SPI with autistic clients and their recommendations for tailoring the SPI for this population.

**Methods:** One hundred and twenty-one clinicians (82.6% female, mean age = 37 years) completed an online survey about their clinical experience managing suicide risk in autistic clients. We also completed semi-structured interviews with 17 adolescents and adults on the spectrum (59% male, mean age = 28 years), 12 family members (83% female, mean age = 56 years), and 31 community clinicians (81% female, mean age = 43 years) with a range of experience working with autistic clients. All interviews were audio-recorded and professionally transcribed for analyses.

**Results:** Of the survey participants, only 24% reported feeling very confident in their abilities to intervene when an autistic client is at risk for suicide, and only 17.4% reported using SPI with autistic clients. Clinicians rated SPI as a more acceptable suicide prevention strategy for clients without autism than for autistic clients ( $p < .001$ ). During the interviews, stakeholders discussed advantages of using the SPI with autistic clients (e.g., helpful structure with logical progression of steps, individually tailored). As one young woman on the spectrum said, “I found it helpful having it already written down, not having to think it up on my own.” Autistic individuals and their family members were particularly enthusiastic about a suicide prevention strategy that can be initiated in an outpatient therapy setting, given their negative experiences with inpatient hospitalization for suicidal thoughts and behaviors. Participants also shared their concerns about using the SPI with autistic clients (e.g., difficulties with generalizing the plan outside session, steps that involve introspection may be challenging). Suggested modifications to SPI included making the text more direct and concise, decreasing the emphasis on social supports and settings, increasing education and practice about internal coping strategies, increasing the involvement of family members, incorporating visual supports (e.g., photos for each step), and leveraging technology.

**Conclusions:** Although some aspects of SPI are a good fit for the learning style of many autistic people, other aspects pose challenges given the core traits of autism and other common co-occurring difficulties. Our three stakeholder groups expressed support for modifying SPI for autistic individuals and provided valuable recommendations to guide this process.

## PANEL SESSION — MEDICAL AND PSYCHIATRIC COMORBIDITY

### Panel 218 - The Interpretation and Impacts of Traumatic Life Events for ASD Adults

**Panel Chair:** Freya Rumball, *Adult ASD Assessment Service and Transforming Care Team, Oxleas NHS foundation trust, Kent, United Kingdom*

**Discussant:** Francesca Happé, *Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

Individuals with ASD are known to be at increased risk of experiencing adverse life events, such as peer victimisation. It has been posited that core features of ASD may confer a heightened risk of exposure to traumatic life events and the development mental health difficulties post-trauma. However, such definitions of ‘trauma’ are limited to the neurotypical experience of life-threatening events. An emerging body of research suggests that a range of life events may be interpreted as traumatic, and increase risk of mental health difficulties such as posttraumatic stress disorder (PTSD), depression and anxiety disorders. The aim of this session is to explore the nature of trauma and its impact on adults with ASD and those with high ASD traits, elucidating individual interpretations of what constitutes a traumatic life event, risk and resilience mechanisms associated with post-trauma mental health outcomes, and the types of coping strategies and interventions that may help or hinder recovery for trauma-exposed ASD adults. Talks will focus on a range of stressful and traumatic experiences, from traditional to atypical traumas, as well as elucidating the impact of the COVID-19 pandemic on adults with ASD.

**218.001 (Panel)** Risk Mechanisms for Posttraumatic Stress Disorder in Autism Spectrum Disorder Adults: Exploring the Ehlers and Clark Model of PTSD

**F. Rumball<sup>1</sup>, N. Grey<sup>2</sup> and F. Happé<sup>3</sup>,** (1)*Adult ASD Assessment Service and Transforming Care Team, Oxleas NHS foundation trust, Kent, United Kingdom,* (2)*Sussex Partnership NHS Trust, Sussex, United Kingdom,* (3)*Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

**Background:** Empirically supported general population cognitive models of posttraumatic stress disorder (PTSD), such as the Ehlers and Clark model, implicate pre-, peri- and post-trauma individual difference in the development and maintenance of PTSD. Individuals with autism spectrum disorder (ASD) are known to be at increased risk of developing anxiety and mood disorders, and a growing body of research has illustrated high rates of PTSD. It is posited that ASD characteristics may increase vulnerability to both trauma exposure and subsequent PTSD development.

**Objectives:** The present study aimed to investigate whether similar mechanisms of PTSD development and maintenance, present in the general population, are associated with PTSD symptomatology in trauma-exposed adults with a diagnosis of ASD

**Methods:** The study recruited ASD adults who had experienced an event(s), at some point in their lifetime, which they interpreted as having been extremely stressful or traumatic. Using a cross-sectional design, participants completed a series of self-report questionnaires either online or in person, depending on their preference. Fifty-nine trauma-exposed adults with ASD took part in the study, 33 reported a traditional traumatic event which the DSM-5 criterion A definition of 'trauma' and 35 reported a trauma not meeting DSM-5 criterion A.

**Results:** Adults with ASD were found to be at increased risk of PTSD development, compared to previous general population statistics, following both trauma types. A comparable profile of cognitive, emotional and behavioral risk and resilience mechanisms from the Ehlers and Clark model of PTSD were found to be associated with PTSD symptomatology in ASD adults. Trait suppression and post-traumatic cognitions and appraisals were found to explain the largest amount of variance in PTSD symptomatology following Criterion A traumas, whilst post-trauma responses to intrusive memories, safety behaviours and cognitions and appraisals of the trauma and/or its sequelae explained the largest amount of variance in PTSD symptomatology following non-Criterion A traumas. The amount of variance in PTSD symptomatology explained by factors from the Ehlers and Clark model of PTSD tended to be smaller for non-Criterion A traumas than Criterion A traumas.

**Conclusions:** These findings highlight the importance of routine screening for trauma and PTSD symptomatology in ASD adults presenting to clinical services and provide preliminary evidence that existing evidence-based treatments such as trauma-focused Cognitive Behavioral Therapy, with appropriate ASD adaptations, may be appropriate treatments for the alleviation of PTSD symptoms in ASD adults. Further research is needed to replicate these findings in ASD adults with clinically confirmed PTSD diagnoses, in addition to examining potential novel PTSD risk and resilience mechanisms for ASD individuals. Treatment studies are needed to investigate the feasibility, acceptability and effectiveness of existing PTSD treatments for ASD individuals with PTSD and any necessary adaptations to treatment protocols to support ASD-needs.

**218.002 (Panel) Traumatic Life Experiences and Post-Traumatic Stress Symptoms in Older Adults with High Autistic Traits**  
**G. R. Stewart<sup>1</sup>, R. A. Charlton<sup>2</sup> and F. Happé<sup>1</sup>,** (1)*Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom,* (2)*Psychology, Goldsmiths University of London, London, United Kingdom*

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**Background:** Research with young adults has begun to explore possible associations between autism/autistic traits and vulnerability to Post Traumatic Stress Disorder (PTSD). Large scale studies have not been conducted, however, nor have associations been explored in older adults.

**Objectives:** This study will explore differences in the frequency and types of traumatic experience and symptoms of post-traumatic stress among older adults with/without elevated autistic traits.

**Methods:** Using baseline cross-sectional data from the ongoing online PROTECT study, a total of 20,220 adults age 50 years+ reported whether they experience behavioural qualities commonly observed in the autistic spectrum. Approximately 1%, 251 individuals, were identified as endorsing elevated autistic traits in childhood and currently, referred to henceforth as the Autism Spectrum Trait (AST) group. Differences between the AST and an age mean/range and sex ratio matched Control Older Adults (COA; n = 9,179) group were explored in self-reported traumatic experience throughout their lives and current symptoms of post-traumatic stress.

**Results:** The experience of childhood and adulthood trauma and symptoms of post-traumatic stress were found to be negatively associated with age in the COA group, but not in AST. Individuals in the AST group demonstrated significantly higher rates of self-reported traumatic events both childhood and adulthood, including emotional, physical and sexual abuse. Furthermore, elevated current symptoms of post-traumatic stress were reported by AST when compared to COA. An interaction was also observed between autistic traits and severity of traumatic experience, with those in the AST group reporting elevated rates of current post-traumatic stress symptoms increasing with severity of traumatic experience when compared to COA. This interaction remains significant when controlling for current depression and anxiety symptoms.

**Conclusions:** The findings from the current study suggest that elevated autistic traits may increase the likelihood of experiencing trauma throughout childhood and adulthood. Furthermore, older adults with elevated autistic traits may be at a greater risk for experiencing post-traumatic stress symptoms in later life when compared to those with few autistic traits. Further work is needed to see whether these results extend to individuals meeting diagnostic criteria for autism.

**218.003 (Panel) Impact of the COVID-19 Pandemic on Mental Health in Autistic and Non-Autistic Adults**

**J. Maljaars<sup>1,2,3</sup>, D. Spain<sup>4</sup>, K. Evers<sup>1,2,3</sup>, F. Rumball<sup>5</sup>, F. Happé<sup>6</sup> and I. Noens<sup>1,2</sup>,** (1)Leuven Autism Research (LAuRes), KU Leuven, Leuven, Belgium, (2)Parenting and Special Education Research Unit, KU Leuven, Leuven, Belgium, (3)Child Psychiatry, UPC Z.org KU Leuven, Leuven, Belgium, (4)King's College London, Institute of Psychiatry, London, UNITED KINGDOM, (5)Adult ASD Assessment Service and Transforming Care Team, Oxleas NHS foundation trust, Kent, United Kingdom, (6)Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom

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**Background:** The COVID-19 pandemic is associated with high levels of stress and symptoms of anxiety, depression and post-traumatic stress disorder in the general population (Xiong et al., 2020) and is expected to have a negative impact on mental health in autistic adults as well (Ameis et al., 2020), especially in those with pre-pandemic mental health conditions (Yao, Chen, & Xu, 2020).

**Objectives:** In our questionnaire study, we set out to compare autistic and non-autistic adults experiences of the COVID-19 pandemic and examine perceived stress and mental health problems. In addition, we wanted to explore personal and contextual risk factors for mental health problems.

**Methods:** This online survey study used a longitudinal design with four time points. At T1 (summer 2020), we collected data from 315 participants (43% with autism; 70% female) in Belgium and the Netherlands and from 120 participants (46% autism; 74% female) in the UK. Data collection for T2 is currently ongoing. The Perceived Stress Scale (PSS), Generalized Anxiety Disorder (GAD-7) and Patient Health Questionnaire (PHQ) were used to measure perceived stress, anxiety and depressive symptoms, respectively. The Intolerance of Uncertainty Scale (IUS-12) was also included. The reported results are based on the Belgian and Dutch data only, but the analysis will be run on the complete data at a later stage.

**Results:** The survey enquired about the impact of the pandemic on several areas of life during lockdown. Autistic individuals mainly experienced a negative impact on their contact with health services (65%), while for individuals without autism the negative impact on social life was the most profound (79%). The largest positive impact was found in the area of 'home/family life' (autism = 52%; without autism = 45%). In general, participants experienced other people not following COVID-19 restrictions and the unpredictability of the situation as most stressful. Autistic adults also reported stress in relation to grocery shopping, taking public transport and reduction of restrictions, whereas for individuals without autism other aspects, such as not being able to meet family/friends, home schooling their child(ren), and fear of contamination were experienced as stressful. In both groups, negative experiences during and after lockdown were associated with significantly higher levels of stress, anxiety and depressive symptoms. Based on regression analyses, higher levels of stress, anxiety, and depression were predicted by being younger, having an existing psychiatric condition, higher intolerance of uncertainty, problems in keeping a healthy work-life balance and experiencing less emotional support. In autistic individuals, those with poorer physical health also suffered from more severe mental health symptoms.

**Conclusions:** Although both positive and negative experiences were reported by the participants, autistic and non-autistic adults experienced relatively high rates of mental health problems during the lockdown of summer 2020. Alleviating the negative effects of COVID-19 on mental health has to be a focus of attention in public health policy.

**218.004 (Panel) A Qualitative Exploration of Traumatic Life Experiences Leading to PTSD Symptoms in ASD Adults**

**A. Kumar<sup>1</sup>, F. Rumball<sup>2</sup> and F. Happé<sup>3</sup>,** (1)South London and Maudsley NHS foundation trust; King's College London, London, United Kingdom, (2)Adult ASD Assessment Service and Transforming Care Team, Oxleas NHS foundation trust, Kent, United Kingdom, (3)Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom

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**Background:** Individuals with Autism Spectrum Disorder (ASD) have an increased risk of exposure to traumatic life events, and particular features associated with ASD may serve as risk factors in the development of Post-traumatic Stress Disorder (PTSD). It has been posited that autistic individuals may be at increased risk of developing PTSD due to: 1) increased exposure to traumatic events, 2) potentially experiencing a wider range of life events as traumatic, 3) having a unique perception and experience of trauma and 4) a tendency to use more avoidant coping strategies. However, research into ASD and PTSD remains very limited, particularly concerning individuals' subjective experience of trauma.

**Objectives:** The aim of this study was to qualitatively explore how autistic adults experience and cope with traumatic life events and PTSD related symptomology.

**Methods:** The study used a qualitative design and recruited 12 individuals with a diagnosis of ASD, who had experienced PTSD symptomology in their lifetime following exposure to a traumatic life event. Current and lifetime PTSD symptomology was measured using an adapted version of the PTSD Checklist for DSM-5 (PCL-5). Semi-structured interviews were used to collect data and an inductive thematic analysis was conducted.

**Results:** Eleven themes emerged from the analysis: ‘intertwined ASD and trauma’, ‘memory’, ‘sensory features’, ‘heightened and flattened emotions’, ‘escapism’, ‘self-blame and loss of confidence’, ‘feeling silenced’, ‘social isolation and social connection’, ‘quality of life and practical functioning’, ‘the healing process’ and ‘clinical support’. Participants described experiencing intrusive memories which were highly sensory in nature. Participants commonly reported experiencing multiple traumatic events in their lifetime and felt that the impact of these events often intertwined. It was found that following traumatic exposure, participants often used more avoidant coping strategies such as avoidance and suppression. However, additional areas that were helpful in recovery were identified, for example, music, nature and physical exercise. When seeking support, participants frequently reported not being offered talking therapies in mainstream services and were often prescribed medication as a first line treatment.

**Conclusions:** This is the first study to qualitatively explore how autistic adults experience and cope with traumatic life events and PTSD related symptomology. The findings highlight that autistic individuals may tend to experience multiple traumatic events, often resulting in a severe clinical presentation more akin to complex PTSD (CPTSD). The findings highlight the importance of routine screening for trauma exposure and PTSD symptoms in autistic adults and the use of evidence-based psychological therapies for PTSD, in line with National Institute for Health and Care Excellence (NICE) recommended first line interventions, with appropriate adaptations for ASD. Future research is required to explore the prevalence and presentation of CPTSD in autistic individuals.

## ORAL SESSION — MEDICAL AND PSYCHIATRIC COMORBIDITY

### Oral 318 - Exploring the Origins of Poor Mental Health in Autism

**318.001** (Oral) Behavioral and Neural Mechanisms of Trauma Symptomatology in Youth with Autism Spectrum Disorder  
*E. T. Wood, J. Melbourne, S. A. Green, S. Y. Bookheimer and M. Dapretto, Dept of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, Los Angeles, CA*

**Background:** Previous research has demonstrated that youth with autism spectrum disorders (ASD) are more likely to experience adverse childhood experiences (ACEs) or trauma and may be at greater risk for developing post-traumatic stress disorder (PTSD) following such events. However, the rates and causes of PTSD in individuals with ASD are poorly understood.

**Objectives:** Our research aims to utilize the longitudinal Adolescent Brain Cognitive Development (ABCD) study to assess the prevalence and underlying mechanisms of increased risk of ACEs, trauma, and PTSD in ASD youth. We hypothesized that functional connectivity (fc) MRI in networks implicated in fear learning, sensory processing, and emotion regulation will mediate the relationships between group status, ACEs, and PTSD symptoms.

**Methods:** Sixty-six ASD participants were identified based on parent reports of a clinical diagnosis in the first release of the ABCD Year 1 follow-up. After excluding for missing data and siblings, a typically-developing (TD) control group of 5:1 TD:ASD peers was established using nearest neighbor greedy matching on gender, MRI scanner, composite IQ, and socioeconomic status. Using data from the Youth and Parent Family Environment Scales, K-SADS, Family History, Short Social Responsiveness Scale (SSRS), Youth Life Events Scale (YLES), and Longitudinal Parent Demographics Survey, we compared the relationship between ACEs and PTSD symptoms between groups. fMRI measures provided by the ABCD consortium seeded in the salience network (SN) were linearly regressed with ACEs and PTSD symptoms and compared between groups.

**Results:** Contrary to prior reports, in this group of 55 ASD participants and 275 TD peers, there were no between-group differences in number of ACEs experienced and rates of PTSD symptoms were also similar. For both groups, number of ACEs was positively correlated with both greater PTSD symptoms ( $R^2 = 0.09, p < 0.001$ ) and impairments in social responsiveness (SSRS;  $R^2 = 0.52, p = 0.03$ , figure 1). Interestingly, however, SN functional connectivity was positively correlated with PTSD symptoms and SSRS scores in ASD ( $R^2 = 0.09, p = 0.04$ ) but negatively correlated in TD ( $R^2 = 0.03, p < 0.01$ ), slope difference  $p < 0.01$ , figure 2).

**Conclusions:** These suggest that this well-matched group of relatively high-functioning (average IQ, able to consent to study) youth with ASD in the ABCD dataset are similar to TD peers in both the rates of ACEs and PTSD as well as in the likelihood of developing post-trauma symptoms following early life adversity. Furthermore, greater social impairments were related to more ACEs and PTSD symptoms for both groups. However, social impairments and PTSD symptoms were differentially related to SN connectivity in ASD youth compared to TD peers such that SN connectivity was positively correlated with social deficits and PTSD for the ASD group only. Atypicalities in SN connectivity have been previously reported in ASD youth in multiple studies and associated with ASD-related social impairments. These data suggest that, whereas greater within SN connectivity in TD youth relates to fewer PTSD symptoms, in ASD youth atypical SN connectivity may amplify the potential negative outcomes of aversive experiences.

**318.002 (Oral)** Clinical Characteristics of Autistic Youth in the SPARK Cohort with a Co-Occurring Schizophrenia Diagnosis  
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**Background:** Three to five percent of autistic individuals have a co-occurring schizophrenia diagnosis. Little is known about the clinical characteristics of this group, particularly during childhood and adolescence. To investigate this question, we leveraged the size of the Simons Powering Autism Research for Knowledge (SPARK) study, which to date has recruited 77,017 children and adolescents with an autism spectrum disorder (ASD) diagnosis from across the United States.

**Objectives:** We hypothesized that 1) characteristics associated with schizophrenia in the general population (a history of birth complications, obsessive-compulsive disorder (OCD) and tics) and 2) characteristics associated with severity of impairment in the autistic population (younger age of diagnosis, lower intellectual ability, and neurological problems) would both statistically predict a schizophrenia diagnosis among autistic children and adolescents.

**Methods:** We fit a logistic regression model with history of premature birth, history of serious infection during pregnancy, OCD, tic disorder, age at autism diagnosis, age at study enrollment, intellectual disability, and seizures as predictors of schizophrenia diagnosis. Sex and language level were covariates. We excluded 3,582 participants with missing data for any of the variables described above, leaving a sample of 73,435 ASD youth.

**Results:** The sample was 79% male, with a mean age of 4.47 years (SD 3.10 years) at autism diagnosis, and a mean age of 9.83 years (SD 6.06 years) at study enrollment. 333 participants (0.45%) had a schizophrenia diagnosis. OCD diagnosis was the strongest positive predictor of schizophrenia diagnosis, (odds ratio 6.68, 95% confidence interval 5.06 – 8.75,  $p = 5.1 \times 10^{-42}$ ), followed by tic disorder diagnosis (odds ratio 4.23, 95% confidence interval 2.94 – 5.98,  $p = 1.7 \times 10^{-15}$ ), cognitive impairment (odds ratio 1.75, 95% confidence interval 1.36 – 2.24,  $p = 1.2 \times 10^{-5}$ ) and age at autism diagnosis (odds ratio 1.34 for a two-standard deviation increase in age, 95% confidence interval 1.11 – 1.61,  $p = 0.0021$ ). The strongest negative predictors were male sex (odds ratio 0.50, 95% confidence interval 0.40 – 0.63,  $p = 2.7 \times 10^{-9}$ ) and nonverbal language level (odds ratio 0.41, 95% confidence interval 0.23 – 0.68,  $p = 9.1 \times 10^{-4}$ ). No other predictors were statistically significant.

**Conclusions:** The finding that OCD and tic disorder diagnosis strongly predicted schizophrenia diagnosis in the SPARK sample may highlight the clinical challenge of separating intense rituals or special interests from psychotic symptoms such as delusions. The overlap is also consistent with increasing evidence of genetic overlap among OCD, schizophrenia and ASD. That older, rather than younger, age at ASD diagnosis, and female sex predicted schizophrenia diagnosis were unexpected findings that warrant further study. The small number of participants in our sample with a schizophrenia diagnosis is somewhat surprising given reported rates in ASD, but this likely reflects the young age of our sample at time of enrollment in SPARK. Future longitudinal work with the SPARK cohort may be able to confirm whether, as in the general population, emergence of schizophrenia is highest in ASD during late adolescence and early adulthood.

**318.003 (Oral)** The Development of the Personalised Anxiety Interview Schedule - Autism (PAIS-A) and What the Tool Can Tell Us about the Anxiety Profiles of Autistic Adults  
**S. Brice<sup>1</sup>**, **P. Welsh<sup>2</sup>**, **M. Freeston<sup>3</sup>**, **J. R. Parr<sup>1,2</sup>**, **B. Ingham<sup>1,2</sup>**, **A. LeCouteur<sup>4</sup>** and **J. Rodgers<sup>1</sup>**, (1)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, (3)School of Psychology, Newcastle University, Newcastle upon Tyne, United Kingdom

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**Background:** Autistic people are more likely to experience anxiety than neurotypical people. Anxiety significantly impacts on daily life and predicts poorer quality of life. Evidence suggests that anxiety may have a differential presentation in autistic people compared with neurotypical people (requiring differential conceptualisation and diagnostic criteria). This is likely driven by a number of factors, including the way in which autism characteristics (such as sensory differences) interact with anxiety and the

role of transdiagnostic factors such as Intolerance of Uncertainty (IU). These differences challenge but do not necessarily invalidate existing diagnostic criteria and assessment tools when used with autistic people. One key question is the extent to which evidence-based psychological interventions for anxiety can be targeted and personalised for autistic people. To accurately inform intervention, assessments should be adapted so they accurately capture the anxiety profiles of autistic adults and inform personalised intervention. Anxiety screening questionnaires designed specifically for use with autistic adults have recently been published (e.g. the Anxiety Scale Autism – Adults; ASA-A). However, there is not currently a bespoke anxiety diagnostic interview for use with autistic adults.

### Objectives:

To investigate:

- A set of supplementary questions (PAIS-A<sup>a</sup>) to be used alongside existing clinical interviews to identify anxiety experienced by autistic people and its mechanisms
- The anxiety profiles of autistic adults participating in the Personalised Anxiety Treatment – Autism (PAT-A<sup>a</sup>) clinical trial

**Methods:** The PAIS-A<sup>a</sup> is an addendum that can be used alongside any existing informal or formal diagnostic interview for anxiety. The PAIS-A<sup>a</sup> was developed as part of a feasibility and acceptability trial of a personalised, modular psychological treatment for anxiety in autistic adults (PAT-A<sup>a</sup>). The PAIS-A<sup>a</sup> was administered in conjunction with the Anxiety and Related Disorders Interview Schedule (ADIS-5) with 34 clinically anxious autistic adults (aged 18-62, 65% male). A proportion (25%) of interviews were rated independently by a second clinician to estimate diagnostic inter-rater reliability.

**Results:** The PAIS-A<sup>a</sup> demonstrated good inter-rater reliability (ICC = .82). The PAIS-A<sup>a</sup> allowed anxiety subtypes to be identified as well as the relative contribution of ASD specific features to anxiety in any given situation. 75% of participants were experiencing 3 or more concurrent anxiety conditions. The most common anxiety types were social anxiety (97%) and generalised anxiety (78%). Some participants experienced anxiety that did not map onto existing DSM-5 diagnoses. For example, 12% of those with anxiety in social situations did not meet DSM-5 criteria for ‘social anxiety disorder’ because their anxiety was not primarily driven by a fear of negative evaluation. Additional non-standard patterns were seen across other common anxiety conditions.

**Conclusions:** The PAIS-A<sup>a</sup> has enabled us to assess specific ‘autism-related’ presentations of anxiety and provides an indication of potential underlying mechanisms. These results are consistent with previous research suggesting that anxiety often has a different presentation in autistic people. This information has been used to inform personalised intervention in the PAT-A<sup>a</sup> trial. Further work is needed to replicate and extend these findings. The PAIS-A<sup>a</sup> and related training will be available upon completion of the PAT-A<sup>a</sup> trial in 2021.

## POSTER SESSION — MEDICAL AND PSYCHIATRIC COMORBIDITY

### Poster 429 - Medical and Psychiatric Comorbidity Posters

**429.001 (Poster)** A Longitudinal Look: How Sleep Impacts Suicidal Thoughts and Behaviors in Autism and Social Anxiety  
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**Background:** Suicide research often looks at single risk factors through cross-sectional and longitudinal studies. These studies give snapshots of individual’s experiences, but may not accurately reflect day-to-day experiences. State factors, such as sleep, change over time and are not accurately portrayed in trait-like cross-sectional analysis. Individuals with poor sleep quality, difficulty falling asleep, irregular sleep patterns, and perpetual lack of sleep have between 1.39 and 2.24 increased risk of STBs (Bernert et al., 2014; Bernert et al., 2017). Research also identifies high-risk groups more likely to experience STBs. Individuals with autism and social anxiety have significantly higher rates of suicide deaths than the general population. They are also more likely to experience sleep problems.

**Objectives:** We evaluated sleep quality and sleep duration (state factors) in combination with the trait factor of membership in a high risk-group, specifically individuals with autism or social anxiety, and how these factors impact suicidal thoughts and behaviors. This is an exploratory study that will show trends in longitudinal data collected over a period of six months.

**Methods:** We recruited a sample size of 50+ human participants across three groups (social anxiety, autism, and control) including males and females ages 18-31 (mean=22.5). Recruitment is ongoing with a goal of 25-30 in each group. Group membership was determined by Mini-International Neuropsychiatric Interview (M.I.N.I.), Autism Diagnostic Observation Schedule (ADOS-2), and Columbia-Suicide Severity Rating Scale (C-SSRS). Longitudinal variables include daily self-reported sleep duration and quality; daily self-report of suicide thoughts in prior 12 hours, level of desire for suicide, level of intention, and ability to resist; as well as periodic Insomnia Severity Index, PROMIS adult sleep disturbance short form, Pittsburgh Sleep Quality Index, and C-SSRS questionnaires given every 6 weeks. The study design also includes daily actigraphy and other monitoring with a wrist device over 6 months.

**Results:** Statistical analysis was performed with preliminary data from the first 12 weeks.

We have 3769 observations from 51 subjects who were classified as Controls (18), Social Anxiety(21), or ASD (12). Tracking suicidal thoughts over time, we see that the Social Anxiety group tends to show proportionally more reports of suicidal thoughts than we would expect (standardized residual = 16.1). The autism group did not show a disproportionate pattern of observations of suicidal thoughts. The observations are not independent, and this is a glimpse of the pattern to date. Other analysis show trends in sleep quality increasing with the increase of duration. Responses of “yes” to STBs in the past 12 hours are associated with lower quality and duration of sleep; Significant difference in quality of sleep between participants who reported “yes” or “no” to STBs in prior 12 hours, with some differences by group; Greater sleep duration associated with lower STB intensity. Reports of early bed times had less variable overall with bedtimes.

**Conclusions:** These preliminary data suggest a relationship regarding state and trait factors of sleep and STBs. We are committed to helping individuals with STBs and hope to uncover more treatable factors to aid in their recovery.

**429.002 (Poster)** A Pilot Chart Review of Suicidal Thoughts and Behaviours Among Autistic Adults

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Background: Autistic people think about, and attempt death by suicide at worrying high rates. Two systematic reviews highlight that between 7 and 66% of autistic individuals (Hedley & Uljaveric 2018; Segers & Rawana, 2014) experienced suicidal thoughts and behaviours (STB), and the prevalence of suicide attempts varied between 7-47% (Zahid & Upthegrove, 2017). A high incidence of STB has also been reported at the population level, where Taiwanese autistic adolescents and young adults had higher incidences of suicide attempt, compared to non-autistic people (Chen et al., 2017). Latest registry-based studies in Sweden (Hirvikoski et al., 2020; Hirvikoski et al., 2016) and the United States (Kirby et al., 2019) accentuate that autistic people are at increased risks to die by suicide than non-autistic people.

To date, research examining STB has predominantly used administrative and retrospective self-report approaches. In this vein, there is little research that has examined emergency department (ED) charts regarding STB in autistic adults. There is a need for this work as the depth and nuance of data gleaned from ED charts has the potential to inform our understanding of key factors associated with suicide among autistic people, identify research gaps, as well as inform potential prevention and intervention possibilities.

Objectives: This study describes the characteristics and presentations of STB, associated features, along with the ED care and dispositions received among a group of autistic adults receiving emergency mental health services.

Methods: A retrospective chart review was conducted for visits to a tertiary psychiatric ED in Toronto, Canada. Autistic adults attended the ED for reasons associated with STB during a 10-week period between October 2016 and January 2017. Charts were analyzed qualitatively to identify recurring patterns, deviations, and contraindications.

Results: Sixteen individuals (10 males, 6 females) who ranged in age from 17 to 31 years, had their charts reviewed. The majority (14) described suicidal thoughts, with vague descriptions of plans and intent. Some individuals reported using alcohol and substances such as marijuana, methamphetamine, crack/cocaine, mushrooms and heroin; for three individuals, healthcare providers noted that it was difficult to discriminate whether STB were substance induced. Reported STB were not always the presenting issue, sometimes only being identified following a comprehensive mental health exam. Six autistic adults ruminated about STB, and ruminating about STB was described as emotionally unsettling, fatiguing, and further exacerbated emotional

distress. Individuals with collateral involvement had more detail about broader medical history included in their ED chart, with more detailed discharge and follow-up plans included in their chart records.

**Conclusions:** In this study, STB was not always the initial presenting issue when autistic individuals attended the psychiatric ED. With multiple forms of presentation, efforts are needed to ensure STB among autistic people is not missed. With some individuals ruminating about STB, it may be important to screen for STB as soon as there is any form of visible distress, especially in a standard ED. Visits to an ED can be a pivotal opportunity for prevention and intervention to reduce STB risks in autistic individuals.

**429.003 (Poster)** Adapted Cognitive Behavioral Therapy for School-Aged Children with Autism Spectrum Disorders and Interfering Anxiety: Impact on Caregiver-Defined Goals

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**Background:** It is well documented that for children with autism spectrum disorder (ASD), central challenges can include difficulties with social communication, challenges of emotional dysregulation, as well as pervasive effects of rigid and repetitive behaviors (Matson & Nebel-Schwalm, 2007; Samson et al., 2014). However, with nearly 40% of children with ASD estimated to present with clinically elevated levels of anxiety (Van Steensel et al., 2011), there is a need for interventions that better understand and address this heterogeneity while also targeting improvement of these competencies for productive change over time. Therefore, the purpose of this study was to compare two variants of cognitive behavioral therapy (CBT), specifically, adapted CBT (BIACA; Wood et al., 2009) and standard-of-practice CBT (Coping Cat (CC); Kendall & Hedtke, 2006) in order to explore the most efficacious treatment for addressing specific caregiver-defined goals.

**Objectives:** To categorize the range of caregiver-defined goals for therapy from a sample of caregivers of children with both ASD and concurrent anxiety and explore if the modular/personalized format of adapted CBT is the most efficacious treatment for addressing specific caregiver-defined challenges in these children.

**Methods:** This secondary data analysis used a previous multisite randomized clinical trial (RCT; Wood et al., 2019) conducted at a large metropolitan research institution with a subsample of, children with ASD and clinical levels of anxiety (N=148; aged 7-13 years,  $Mage=9.90$ ,  $SD=1.78$ ). Through descriptive analysis and linear mixed modelling (LLM), this study investigated varying treatment effects of BIACA and CC on caregiver-defined goals via the idiographic Youth Top Problems (YTP) scale (Weisz et al., 2011; 2012). Treatment effects were represented by change in caregiver-defined goals and symptom severity ratings over treatment. In the LMMs, 16 session time points were nested within children, and random intercepts included in all models.

**Results:** Primary outcome analysis revealed BIACA ( $EMM=4.60$ ,  $SE=.20$ ) significantly outperformed CC ( $EMM=5.21$ ,  $SE=.21$ ) in reduction of child's mean YTP symptom severity ratings at the end of treatment ( $p=.005$ ). Investigating differential treatment effects of BIACA and CC on symptom reduction of rigid/repetitive behaviors, Site 3 showed particularly pronounced symptom reduction of rigid/repetitive behavior YTPs in BIACA ( $EMM=3.37$ ,  $SE=.95$ ) compared to CC ( $EMM=5.94$ ,  $SE=.61$ ). Site 2 also showed pronounced symptom reduction of internalizing/anxiety YTPs in BIACA ( $EMM=3.58$ ,  $SE=.40$ ) as compared to CC ( $EMM=4.95$ ,  $SE=.42$ ). Finally, in exploring differential treatment effects of BIACA and CC on the symptom reduction of externalizing symptom YTPs, differences across sites were slight. However, Site 1 showed noticeable decreases in symptom severity of externalizing symptom YTPs in BIACA ( $EMM=4.60$ ,  $SE=.38$ ) as compared to CC ( $EMM=5.21$ ,  $SE=.39$ ).

**Conclusions:** The present study categorized various caregiver-defined goals that parents have for their child's treatment. Results provide additional evidence suggesting CBT is an efficacious treatment for school-aged children with ASD and maladaptive and interfering anxiety, with an adapted CBT approach exhibiting additional advantages on both nomothetic, standardized and idiographic, personalized outcome measures. Meaning, when practitioners match evidence-based therapeutic techniques directly to a child's clinical needs, the modular/personalized approach of adapted CBT may better address caregiver's treatment goals.

**429.004 (Poster)** An Examination of the Buffering Hypothesis of Suicide Risk in Young Autistic Adults: Does Mental Wellbeing Buffer the Effect of Depression on Suicidal Ideation?

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**Background:** Autistic people are at significantly increased risk of suicide, yet few studies have examined resilience factors in this population. Studies in general population samples have shown that mental wellbeing can moderate the effects of depression on suicidal ideation, thereby mitigating the impact of this risk factor. Additionally, while some studies have demonstrated a relationship between autistic traits and suicide risk, results are mixed and no studies to date have examined the relationship over time.

**Objectives:** 1) Test the hypothesis that mental wellbeing moderates the impact of depression on suicidal ideation in a two-year follow-up study of young autistic adults; 2) Examine autistic traits as a predictor of suicidal ideation at 2-year follow-up.

**Methods:** The study was approved by the relevant university ethics committees (HEC14095, HEC20235, HC15001). Participants were 83 (60% male) autistic young adults aged 15 to 25 years ( $M=18.68$ ,  $SD=2.33$ ) at baseline, who were participants in the longitudinal Study of Australian School Leavers with Autism. In addition to age and gender, predictor variables included autistic traits (Autism Spectrum Quotient, 28-item), depression (Hospital Anxiety and Depression Scale), mental wellbeing (Warwick Edinburgh Mental Wellbeing Scale), and suicidal ideation (PHQ-9). Correlational and hierarchical regression analyses were used to examine relationships between predictor variables at baseline (T1) and suicidal ideation at 2-year follow-up (T2). The moderating effect of mental wellbeing on the relationship between depression and suicidal ideation was examined by including the Depression $\times$ Wellbeing interaction term in the regression analysis. This study was pre-registered with Open Science Foundation, <https://osf.io/dhnw8/>

**Results:** Approximately one quarter of the sample reported recent suicidal ideation (T1=26%, T2=28%). Although autistic traits were negatively correlated with mental wellbeing at baseline ( $r=-.35$ ,  $p=.003$ ), neither T1 autistic traits nor age were significantly associated with T2 suicide ideation ( $p>.05$ ) and were thus excluded from the regression model. T1 gender ( $r=.26$ ,  $p=.02$ ), depression ( $r=.53$ ,  $p<.001$ ), mental wellbeing ( $r=-.32$ ,  $p=.005$ ), and the Depression $\times$ Wellbeing interaction term ( $r=.39$ ,  $p=.001$ ) were all significantly correlated with T2 suicide ideation and were entered as predictors into the regression model. Overall, the model explained 30% of the variance in T2 suicidal ideation ( $R^2=.303$ ). However, only T1 depression significantly predicted T2 suicide ideation ( $\beta=1.009$ ,  $p=.015$ ); T1 mental wellbeing and the interaction term were not found to significantly predict T2 suicidal ideation when controlling for T1 depression.

**Conclusions:** Contrary to some recent research, we did not identify a significant relationship between autistic traits and suicidal ideation at 2-year follow-up in a sample of young autistic adults. Although we found significant relationships between baseline mental wellbeing and suicidal ideation at follow up, mental wellbeing was not found to significantly predict suicidal ideation when controlling for T1 depression. We did not find support for the hypothesis that mental wellbeing buffers the relationship between depression and suicidal ideation in young autistic adults. In developing suicide risk models in the autistic population it is imperative that the identification of risk factors is balanced with the identification of protective factors that might mitigate suicide risk, thereby informing suicide prevention strategies and intervention.

**429.005 (Poster) Analyzing the Relationship between IQ, Language Skills, and Anxiety in Autism Spectrum Disorder**  
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Background:

Anxiety is a common condition noted to cause significant impairment in some children with autism spectrum disorder (ASD) (White et al., 2009). Lower intelligence and language impairment have been associated with anxiety in typically developing (TD) children; however, children with ASD tend to show higher levels of anxiety with higher intelligence scores and higher language abilities (Davis et al., 2011; Hodges & Plow, 1990; Sukhodolsky et al., 2008).

Objectives:

Considering the strong correlation between language skills and intelligence scores we decided to investigate whether the shared influence of these constructs on anxiety could be occurring in a mediational relationship. It was hypothesized that a mediational relationship would be seen in children with ASD in which intelligence exerts its influence over anxiety through language skills,

given that only children with higher verbal skills are able to truly express their anxiety. For TD children it was hypothesized that the opposite effect would occur.

#### Methods:

Participants included children between the ages of 7 and 19, 371 with a clinical diagnosis of ASD (n=287 males) and 63 that were TD (n=34 males). Our measures included the Revised Children's Anxiety and Depression Scale (RCADS; Chorpita et al., 2000), the Oral and Written Language Scale (OWLS; Carrow-Woolfolk, 1995; OWLS-II; Carrow-Woolfolk, 2011), the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999; WASI-II; Wechsler, 2011), and the Wechsler Intelligence Scale for Children (WISC-IV; Wechsler, 2003; WISC-V; Wechsler, 2014). The analysis was conducted in SPSS using model 4 from the Process v3 (Hayes, 2013).

#### Results:

The results of this study supported our hypothesized mediation with a small effect in the ASD group ( $b = 0.20$ , 95% BCa CI [0.12, 0.29], Figure 1). In the TD group a mediation effect was not supported ( $b = -0.03$ ,  $p = 0.667$ , 95% BCa CI [-0.19, 0.12]). Our study also supports previously reported findings showing that children with ASD exhibit higher levels of anxiety than their TD peers.

#### Conclusions:

The mediational model investigated in this study should inform further research in ASD that the influence of intelligence and language over anxiety should not be viewed as independent factors but as a set of constructs that exert a shared influence. While our study provides evidence supporting a relationship between intelligence, language, and anxiety, it cannot determine whether higher intellectual and linguistic abilities lead to higher anxiety or if this relationship occurs due to the increased ability to communicate feelings of anxiety. Future research should focus on assessing different presentations and predictors of anxiety in children with ASD that have intellectual disabilities and more severe ASD symptoms.

#### **429.006 (Poster)** Autism Spectrum Disorder (ASD) and Other Neurodevelopmental Disorders As a Risk Factor for Delayed Diagnosis of Catatonia.

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**Background:** Catatonia is a distinct and severe medical syndrome comprised of motor, somatic and psychiatric symptoms seen in range of conditions. Catatonia is reported in upwards of seventeen percent of young patients with autism spectrum disorder (ASD) (reviewed in Ghaziuddin, Andersen, & Ghaziuddin, 2020), and clinical experience indicates catatonia is often under-recognized in this clinical population.

**Objectives:** Here we characterize the clinical presentation of catatonia in patients with and without neurodevelopmental disorders (NDD) including ASD, examining the time from symptom onset to diagnosis, clinical features, and the process to diagnosis.

**Methods:** Pediatric and young adult patients with a charted history of catatonia were identified through retrospective review of electronic medical records (EMR), as any patient with a catatonia listed on their problem list. Patients were 10 to 35 years old at time of diagnosis. Of this initial cohort of 53 patients, 30 patients have intellectual disability or NDD (17 of whom specifically carry an ASD diagnosis), three have no formal diagnosis of ASD but it has been questioned, and 20 patients are neurotypical. We will continue to expand this cohort through EMR review for individuals with an encounter diagnosis of catatonia, ultimately reviewing encounters from the past 10 years, with an additional 5 patients with sufficient clinical data identified to date.

**Results:** We observed a clear and substantial delay in identification and diagnosis of catatonia in the NDD population: delays of months to years (some instances over a decade) for most patients with NDD versus only days to weeks for most neurotypical patients, whose catatonia was typically comorbid with a psychotic disorder and developed more rapidly. Additionally, in NDD patients, catatonia symptoms appeared to persist longer following treatment initiation.

**Conclusions:** Intellectual disability and ASD are risk factors for significantly delayed diagnosis of catatonia, which can lead to notable morbidity. It is unknown if delayed diagnosis contributes to the difficulty in treating catatonia in this patient population,

or if the treatment difficulties relate instead to differential and ongoing biological mechanisms and underlying encephalopathy. Overall, these findings highlight the importance of increased recognition of catatonia symptoms in patients with NDD and ASD.

**429.007 (Poster) Autistic Adults and Psychiatry; Experiences and Barriers to Access**

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**Background:** Autistic adults report high rates of co-occurring mental illness. Suicide rates for autistic adults without an intellectual disability are 9 times the general population rate. Awareness of the prevalence of autism in general adult psychiatry and the needs of autistic adults accessing mental health services is increasing. Mental health is a key research priority for the autistic community.

**Objectives:** This study provides a perspective on barriers faced by autistic adults in accessing and successfully interacting with psychiatric services. A mixed methods analysis identifies issues in the mental health experiences of autistic adults. The qualitative aspect of the study is ongoing.

**Methods:** Participants at Autscope 2019, a conference organised by and for autistic people, were invited to complete a questionnaire about their experiences accessing out-patient and in-patient mental health services, as well as their history of co-occurring psychiatric conditions, self-harm, suicidal ideation & previous suicide attempts. The questions included demographic, quantitative and qualitative elements.

**Results:** Of 101 respondents, 42% were female, 33% male and 25% identified as non-binary. 78% were from the UK, 20% from Europe and 2% from Australia.

99% of respondents identified as autistic, with 92% reporting a formal diagnosis, specifically Asperger Syndrome (48%), Autism Spectrum Disorder (29%), High Functioning Autism (10%) and Autism Spectrum Condition (5%). Median age at diagnosis was 32, range (6 - 66 years).

94% were registered with a GP, whereas 6% were not. 19% of respondents were currently attending a psychiatrist, 64% had attended in the past and 44% expressed difficulty in attending. A good relationship with their current psychiatrist was reported by 21%, and 42% reported current use of psychotropic medication, most commonly for anxiety and depression.

Respondents reported moderate use of alcohol (28%) and illicit substances (12%) to manage mental health issues, with 18% reporting difficulties due to substance use. High levels of self-harm were reported (69%) with 21% requiring medical care. Experience of suicidal ideation (86%) and attempted suicide (46%) were higher than previously reported in autistic cohorts.

67% reported that they would seek support for mental health concerns from their GP, 53% from friends, 42% from the online autistic community and 37% from family. Only 15% reported they would seek support from a psychiatrist and 11% from community mental health services. 55% reported that they would not attend a hospital emergency department for mental health and 39% would not attend a psychiatrist.

27% had used psychiatric in-patient services. 11% had been involuntarily detained (sectioned) and 10% had experienced physical restraint in hospital. Of those aware of their autism diagnosis at the time of inpatient treatment (n=12), 50% reported that their psychiatric team was aware of the diagnosis and 33% reported that it was taken into account in their management plan.

**Conclusions:** Autistic adults self-report a high level of mental ill-health, and significant barriers in accessing psychiatric services. Those who accessed care typically did so late, with negative experiences of seclusion and restraint. Our data suggest a need for improved community mental health support that needs to be investigated further.

**429.009 (Poster) Birth-Assigned Sex, Gender, and Sexual Orientation Are Associated with Depression and Anxiety Scores in Autistic Adults**

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Background: Prior research suggests that autistic women experience notably higher rates of depression and anxiety compared to autistic men (Uljarević et al., 2019). Additionally, recent findings suggest that identifying with a minority group, such as gender and sexual minorities and/or the autism population, is associated with poorer emotional health outcomes (George & Stokes, 2018). More research is needed to understand how birth-assigned sex and gender/sexual orientation identity affect emotional health outcomes within the autistic adult population.

Objectives: We aimed to examine how birth-assigned sex, gender, and sexual orientation relate to depression and anxiety outcomes in a large sample of autistic adults. We hypothesized that participants who were birth-assigned female, non-binary gendered, or who identified as non-heterosexual would endorse higher levels of depression and anxiety.

Methods: Data were collected from  $N=727$  adults with self-reported autism diagnoses recruited through the SPARK registry (63.4% birth-assigned female; 55.2% identified as women; 56.9% heterosexual). The Beck Depression Inventory (BDI-II; Beck, 1996) and Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006) indexed depression and anxiety symptoms, respectively. Univariate analyses of variance with Tukey post-hoc tests were conducted to examine specific patterns of association between sex/identity and emotional health scores.

Results:

Birth-assigned females experienced significantly higher depression ( $F(1,725)=20.83, p<.001$ ) and anxiety ( $F(1,725)=22.59, p<.001$ ) scores compared to birth-assigned males. Findings also indicated a significant difference in depression ( $F(2,723)=16.50, p<.001$ ) and anxiety ( $F(2,723)=13.31, p<.001$ ) scores across gender groups: Depression scores were significantly higher in non-binary participants ( $M=24.88, SD=13.33$ ) compared to women ( $M=20.33, SD=13.80$ ) and men ( $M=15.68, SD=12.48$ ), and higher for women compared to men. Anxiety scores were significantly higher for non-binary participants ( $M=10.47, SD=5.64$ ) and women ( $M=8.89, SD=5.74$ ) compared to men ( $M=7.04, SD=5.60$ ). Finally, significantly higher depression ( $F(3,723)=8.63, p<.001$ ) and anxiety scores ( $F(3,723)=8.71, p<.001$ ) were endorsed by some sexual orientation minorities compared to those attracted to the opposite gender. Post-hoc test indicated higher depression scores for those sexually oriented towards 2+ genders ( $M=22.64, SD=13.10$ ) and those oriented toward other/neither gender ( $M=21.95, SD=15.20$ ) compared to those attracted to the opposite gender ( $M=17.02, SD=13.00$ ). The same pattern was noted for anxiety scores, with those sexually oriented towards 2+ genders ( $M=10.05, SD=5.76$ ) or other/neither gender ( $M=9.58, SD=6.36$ ) endorsing higher anxiety scores compared to those attracted to the opposite gender ( $M=7.53, SD=5.61$ ). We observed no significant differences in depression or anxiety scores for those attracted within their own gender compared to those traditionally considered heterosexual or to those attracted to 2+ genders or other/neither gender.

Conclusions: Sex, gender, and sexual orientation appear to have a significant influence on emotional health in autistic adults, with birth-assigned females, women and non-binary gendered individuals, and those attracted to multiple or “other/neither” genders endorsing higher depression and anxiety scores in compared to birth-assigned males, men, or conventionally heterosexual or homosexual individuals within this large sample. This replicates findings from the general population (Halladay et al., 2015), and may have specific import to the autistic population, which tends to report proportionally higher rates of non-conforming gender and sexual identities (Halladay et al., 2015; Strang et al., 2014).

**429.010** (Poster) Burnout in Women with ASD: An Underexposed Problem.

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Background:

In clinical practice, a substantial number of women with ASD is experiencing burnout. Often, this concerns an ‘autistic burnout’, which is the result of chronic life stress and a lifelong mismatch of expectations and abilities without adequate support (Raymaker et al., 2020). As a result, these women experience physical and mental fatigue, heightened stress, and diminished capacity to manage life skills, sensory input, and/or social interactions. Social camouflaging may play a big role.

When turning to their General Practitioner (GP) with burnout complaints, ASD often is not immediately considered as an underlying factor. This risk is even more likely when the GP has insufficient knowledge about ASD in general and ASD in women in particular. It is important that ASD is recognized in order to really help these women. Therefore, it is important to first gain insight into how burnout manifests itself in women with ASD. Little research has been done into this yet.

Objectives:

Looking at possible differences in burnout complaints between women with and without ASD.

#### Methods:

The research group ( $N = 497$ ) consisted of a convenience sample of women who recently experienced burnout. Two subgroups were formed: a subgroup with and without ASD ( $n = 350$  and  $n = 147$ , respectively). All filled in an AQ-10, a screening tool for ASD symptoms. They also filled in questions concerning the duration of their most recent burnout episode, the experienced burnout symptoms (18 physical symptoms, 17 mental symptoms, 14 emotional symptoms, 19 behavioral symptoms; 5-point Likert scale) and common risk factors leading to burnout (obligations, conflicts, life events, experiences of loss, growing demands, lack of possibilities, lack of social support). Data were collected via social media channels.

#### Results:

There were no significant differences in reported burnout symptoms between both groups (see Table 1). As expected, women with ASD scored significantly higher on the AQ-10 (ASD:  $M = 7.01$ ,  $SD = 1.94$ ; non-ASD:  $M = 3.86$ ,  $SD = 2.39$ ;  $t(230.55) = 14.10$ ,  $p < .001$ ,  $d = 1.51$ ). Correlations between AQ-10 and experienced burnout symptoms (physical symptoms .128,  $p < .01$ ; mental symptoms .283,  $p < .01$ ; emotional symptoms, .156,  $p < .01$ ; behavioral symptoms, .084, ns) were low.

There was a significant difference between both groups in duration of the most recent burnout episode, where the ASD group had the longest duration (see Table 2;  $\chi^2(3) = 22.57$ ,  $p < .001$ ). There was also a significant difference between these groups concerning experienced 'growing demands' prior to the most recent burnout (ASD 50% vs. non-ASD 34%;  $\chi^2(1) = 10.31$ ,  $p = .001$ ).

#### Conclusions:

In this convenience sample of women with and without ASD, we found no difference in experienced burnout symptoms. However, in women with ASD the most recent burnout episode lasted longer and a higher percentage perceived growing demands prior to their burnout. Given these results, it is important that the GP learns to better recognize ASD in women, in order to engage in conversation about the negative effect of experienced growing demands, constant adaptation and social camouflaging.

#### 429.012 (Poster) Core Autism Symptoms Are Connected to Schizophrenia Symptoms: Examination of Autism and Schizophrenia Symptom Overlap Using Network Analysis

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**Background:** Autism Spectrum Disorder (ASD) and schizophrenia (SCZ) are neurodevelopmental conditions with clinically significant rates of co-occurrence and overlapping symptomatology. Both disorders share differences in social functioning, sensory processing, theory of mind, and cognition compared to typically developing controls. Despite this degree of symptom overlap, relations among respective ASD and SCZ symptom domains remain unclear. Network analysis offers a promising tool to examine patterns of symptom organization both within and across diagnostic categories.

**Objectives:** The current study examined relationships among ASD and SCZ symptoms using a novel network analysis approach to inform the nature of symptom overlap and provide insights relevant to differential diagnosis.

**Methods:** Participants included  $N=92$  adults aged 18 to 48 years [ $M(SD)=25.30$  (6.10)] across ASD ( $n=53$ ) and SCZ ( $n=39$ ) diagnostic groups. Diagnoses were confirmed according to gold standard research instruments administered by clinicians skilled in differential diagnosis, and participants were excluded if they met criteria for any other disorder. ASD and SCZ symptoms were assessed via self-report on the Social Responsiveness Scale, 2<sup>nd</sup> Edition (SRS-2) and Schizotypal Personality Questionnaire (SPQ), respectively. Relations among clinical symptoms were modeled using network analysis. Specifically, subscales of the SRS-2 and SPQ served as network 'nodes' connected by 'edges' that corresponded to partial correlations among symptom subscales after conditioning over all other nodes. Separate networks were modeled for each clinical group to examine symptom organization within diagnostic category. Centrality analyses identified the most central and influential variables in each network.

**Results:** Within the ASD group, autism symptoms formed a central symptom cluster (Fig. 1a; ASD Network), with restricted and repetitive behaviors (RBBs) demonstrating the greatest degree of connections with other nodes (node strength=2.25). SCZ symptoms were less influential (Fig. 1c) and situated on the network periphery. RRBs bridged the ASD symptom cluster to cognitive-perceptual (e.g., suspiciousness,  $r=0.17$ ; unusual perceptions,  $r=0.19$ ) and disorganized (e.g., eccentric behavior,  $r=0.31$ ) SCZ symptoms, while ASD-related deficits in social motivation were linked to interpersonal (e.g., no close friends,  $r=0.32$ ; social anxiety,  $r=0.43$ ) SCZ symptoms. The SCZ Network (Fig. 1b) revealed a SCZ-specific symptom cluster of cognitive-perceptual symptoms centered around ideas of reference (node strength=1.27). Notably, ASD symptoms demonstrated high levels of influence in the SCZ network (Fig. 1d). Specifically, social communication was particularly influential (node strength=1.48) and connected to both interpersonal (e.g., constricted affect,  $r=0.32$ ) and disorganized SCZ symptoms (e.g., odd speech,  $r=0.26$ ).

**Conclusions:** Results indicate qualitatively different transdiagnostic symptom networks for individuals with ASD compared to SCZ. Whereas symptom clusters were more distinct for individuals with a confirmed ASD diagnosis, the SCZ network yielded an intermixed network with notable overlap between ASD-related social impairments and SCZ symptoms. The networks were primarily differentiated by the central role of cognitive-perceptual symptoms in the SCZ group, and both RRBs and social communication in the ASD group. Network structures suggest that ASD-related social impairments offer poor specificity in differential diagnosis and are linked to SCZ symptoms in individuals with SCZ and without ASD. Detailed assessment of ASD-related RRBs and SCZ-related cognitive-perceptual symptoms may be instrumental for achieving diagnostic clarity.

**429.013 (Poster)** COVID-19 Pandemic Effects in People with Autism Spectrum Disorder and Their Caregivers: Evaluation of Social Distancing and Lockdown Impact on Mental Health and General Status.

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**Background:** Among the difficulties associated with ASD are those related to adaptation to changes and new situations, as well as anxious-depressive symptoms frequently related to exceeding environmental requirements.

**Objectives:** The main objective of this research is to study the psychological impact of lockdown caused by the social emergency situation (COVID-19) in children/adolescents and adults diagnosed with ASD.

**Methods:** Participants were 37 caregivers of children/adolescents with ASD, also 35 ASD adults and 32 informants. Evaluation was conducted through a web survey system and included clinical standardized questionnaires (CBCL and SCL-90-R), which were compared with results prior to lockdown start, and a brief self-developed survey addressing subjective perception of changes on daily functioning areas.

**Results:** The results found a reduction of psychopathological symptoms in both age groups, but only reaching statistical significance in the adult group, except for Somatization, Anxiety and Obsessive-Compulsive domains. ASD severity level 2 showed greater improvement after lockdown onset in the children/adolescents group when compared to ASD level 1 participants. Younger adults (18-25 yoa) reported greater improvement when compared to older adults ( $\Rightarrow$ 25 yoa). Survey results point to an improvement of feeding quality and a reduction in number of social initiations during lockdown period. Adult ASD participants self-perceived a decreasing in stress levels after lockdown onset, while caregivers reported higher stress levels at the same point in both age groups.

**Conclusions:** Limitations included a small number of participants and a heterogeneous evaluation window between measures. Psychopathological status after two months of social distancing and lockdown seems to improve in ASD young adult population.

**429.015 (Poster)** Exploring the Associations between Polygenic Risk for Autism, Autistic Traits and Psychotic Experiences until Young Adulthood: Evidence from the Alspac Birth Cohort

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**Background:** There is increasing evidence suggesting associations between liability to autism (autism polygenic risk/autistic traits) and psychotic experiences in adolescence. However, the mechanisms for such associations are currently unknown. For

example, it is unclear whether these associations persist into adulthood, are confounded by schizophrenia polygenic risk, and/or mediated by childhood traumatic experiences.

**Objectives:** To investigate:

- i. the associations between autism polygenic risk as well as autistic traits with psychotic experiences until young adulthood,
- ii. the role of genetic confounding by schizophrenia polygenic risk,
- iii. the possible mediating role of traumatic experiences in childhood.

**Methods:** We conducted a longitudinal study in the population-based ALSPAC birth cohort based in the South West of England. Leveraging participant genetic information, we constructed polygenic risk scores for autism across 13 p-value thresholds, using the latest publicly available autism GWAS (Grove et al., 2019), as the discovery sample. We used four dichotomised (upper 10% of the distribution) measures of autistic traits (social communication, assessed at 7 years; coherence, assessed at 9 years; repetitive behaviour, assessed at 5 years; and sociability, assessed at 3 years). Psychotic experiences were assessed at ages 18 and 24 using the semi-structured Psychosis-Like Symptoms interview (PLIKSi) and categorised as distressing or frequent which represents a phenotype more strongly indexing schizophrenia liability). Traumatic experiences (between ages 5 to 11) were assessed by parental questionnaires and interviews about domestic violence, physical abuse, emotional abuse, emotional neglect, sexual abuse, and bullying victimization.

**Results:** The maximum sample with complete data was 4,015 for the autism polygenic risk-psychotic experiences analyses, 3,410 for the autistic traits-psychotic experiences analyses and 3,327 for the mediation analyses. Childhood social communication difficulties were associated with distressing or frequent psychotic experiences measured until age 24 (adjusted OR 1.61, 95% CI 1.01–2.56,  $p = 0.05$ ). This association did not seem to be confounded by schizophrenia polygenic risk. In mediation analysis, traumatic experiences in childhood explained a substantial proportion of the association between social communication and later psychotic experiences (approximately 33%). There was limited evidence to suggest an association between autism polygenic risk and psychotic experiences (OR 1.11, 95% CI 0.97–1.26,  $p = 0.12$ ).

**Conclusions:** We found that the childhood autistic trait of social communication was associated with psychotic experiences by age 24. This association was substantially mediated by childhood traumatic experiences and not confounded by polygenic risk for schizophrenia. Experience of trauma may be an important, potentially modifiable pathway between autistic features and later onset of psychotic psychopathology where interventions could be targeted.

**429.016 (Poster)** Exploring the Links between Perception, Cognition and Anxiety in Autistic Adults through the Lens of Hierarchical Predictive Coding.

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**Background:** Research has discovered a high prevalence of psychological issues in autistic individuals with 79% experiencing at least one psychiatric disorder (Lever & Geurts, 2016). The purpose of this study is to extend the existing work by other researchers which examines the relationship between perception, cognition and anxiety in autistic children to include autistic adults. We investigated the relationship between these variables under a model of autism that proposes all features result from a fundamental perceptual difference: High, Inflexible Precision of Prediction Errors (HIPPEA); excessive prediction errors at low levels lead to sensory sensitivity (SS), resulting in intolerance of uncertainty (IU), increases in anxiety and the employment of coping strategies (Van de Cruys et al., 2014).

**Objectives:** This study had two aims:

Investigate the factor structure of the Sussex Cognitive Style Questionnaire (SCSQ) in an adult autistic population.

Utilise the SCSQ to investigate the relationship between SS, IU, anxiety and cognitive style by testing the hypotheses that:

- 1) SS predicts local processing bias.
- 2) SS predicts IU.
- 3) IU predicts anxiety.
- 4) IU predicts systemising tendency.

**Methods:** This study used an online questionnaire with a sample of four hundred and eighty-six autistic adults (70% with a formal autism diagnosis), 315 females, 89 males and 82 nonbinary genders (18 to 74 years  $M = 39.09$ ,  $SD = 11.77$ ) from 6 continents. The scales used were the Sussex Cognitive Style Questionnaire (SCSQ), (Mealor et al., 2016), Sensory Perception

Quotient (SPQ), (Tavassoli et al., 2014). Intolerance of Uncertainty 12-item Scale (IUS-12), (Carleton et al., 2007) and Generalised Anxiety Disorder 7-item scale (GAD-7), (Spitzer et al., 2006). Two qualitative questions (on more information on responses to scales and formats of Autistic thinking) were also included and are being analysed with completion expected early Spring 2021.

**Results:** Exploratory factor analysis revealed a 6-factor structure with four original and two new (“Local Bias”, “Concrete/statistical Preference”) factors, explaining 41.3% of the variance; F1 “Imagery Ability” explained 15.61%, ( $\alpha = .94$ ), F2 “Technical/Spatial” (8.73%  $\alpha = .87$ ), F3 “Local Bias” 5.10%, ( $\alpha = .73$ ), F4 “Language and Words Forms” (4.29%,  $\alpha = .73$ ), F5 “Concrete/Statistical preference” (3.88%,  $\alpha = .77$ ) and F6 “Systemising Tendency” (3.66%,  $\alpha = .72$ ).

Regression analysis found a medium relationship between SS and local bias ( $r(423) = -.46$ ,  $p < .001$ . 95% CI [-.53, -.38]), a small relationship between SS and IU ( $r(484) = -.20$ ,  $p < .001$ . 95% CI [-.28, -.11]) and a large relationship between IU and anxiety ( $r(484) = .52$ ,  $p < .001$ . 95% CI [.45, .58]). There was no significant association between IU and Systemising tendency ( $r(423) = .04$ ,  $p = .43$ . 95% CI [-.06, .13]).

**Conclusions:** This study offers insight into the relationships between perception, cognition and anxiety in autistic adults. Interpretation of these findings can illuminate the mechanisms underpinning autism. Though results align with the assumptions of HIPPEA, research that can directly test the perceptual mechanisms proposed by the model are needed. Additionally, we highlight a need for research that considers the diversity of the autistic spectrum.

**429.017 (Poster)** Exploring the Relationship between Sensory Processing Atypicalities, Restricted and Repetitive Behaviours and Depression in Autistic Adults

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## **Background:**

Autistic adults are 3-4 times more likely to experience depression compared to neurotypical people. Depression is associated with increased suicidality and lower quality of life. Research investigating anxiety indicates that autism-related constructs (e.g. reactions to the sensory environment, restricted and repetitive behaviours (RRB) and intolerance of uncertainty (IU)) may be important in our conceptualisation of mental health difficulties for autistic people and lead to differential presentations. Our conceptual understanding of depression in autistic adults is currently limited. However, emergent evidence suggests that autism characteristics may interact with depression symptoms in important ways. Developing our understanding of depression in autistic people is vital for the development of effective assessments and interventions.

## **Objectives:**

To explore the relationship between sensory processing atypicalities, RRB, anxiety, IU and depression.

## **Methods:**

Archival data from 420 autistic adults without intellectual disability recruited from the Adult Autism Spectrum Cohort UK (ASC-UK) (age range 18 – 77 years; mean age = 42.8 years; 44.5% male, 52.9% female, 2.6% another gender) were analysed. Participants completed the Social Responsiveness Scale - 2 to determine ‘severity’ of autistic traits (mean = 111.7; 96% scored above clinical threshold for autism). Participants completed measures of depression (Hospital Anxiety and Depression Scale; HADS), anxiety (Anxiety Scale for Autism - Adults), RRB (Repetitive Behaviour Questionnaire-2), IU (Intolerance of Uncertainty Scale-12) and sensory processing atypicalities (Sensory Preferences Questionnaire). The factor structure of the HADS was assessed using confirmatory factor analysis, to provide an indication of construct validity. Correlational analyses were conducted to explore the relationship between the constructs. Additionally, conceptual mediation models were tested. One simple mediation model explored the potential interplay between sensory processing atypicalities and depression via RRB. Three further serial mediation models explored the interplay between sensory processing atypicalities and depression via proposed mediators IU, anxiety and RRB.

## **Results:**

63% of participants scored above the clinical threshold for depression as rated by the HADS. Confirmatory factor analysis indicated satisfactory construct validity for the HADS. Internal consistency for all measures was good to excellent (Cronbach's  $\alpha=.82-.90$ ). Significant positive correlations were identified between depression and all constructs of interest, ranging from  $r=.49$  (anxiety) to  $r=.32$  (sensory processing atypicalities). The simple mediation model (sensory processing atypicalities  $\rightarrow$  RRB  $\rightarrow$  depression) identified that there was a significant direct and indirect effect between sensory processing atypicalities and depression (partial mediation). However, the serial mediation models identified that there was no direct effect between sensory processing atypicalities and depression and that the models were fully mediated via anxiety and via IU and anxiety but not via RRB.

## Conclusions:

Our findings suggest that IU and anxiety play a key role in understanding the relationship between sensory processing atypicalities and depression for autistic adults. Interventions that aim to address IU and anxiety may also have a beneficial impact on depression associated with sensory processing atypicalities. Further research is needed to replicate and extend these findings and use them to develop specific and personalised assessments and intervention for depression in autistic adults.

## 429.018 (Poster) Frontal EEG Asymmetry, Maternal Depression, and Child Internalizing and Externalizing Symptoms in Autism

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**Background:** Frontal asymmetry (FA) in EEG alpha band activity corresponds to affective style and vulnerability to psychopathology, such that relatively stronger right activity portends risk for childhood internalizing and externalizing. Similarly, maternal depression is a powerful familial risk factor for a range of emotional difficulties from very early in life. However, we know little regarding the interaction of FA and maternal depression among youth with autism spectrum disorder (ASD) despite elevated rates of psychopathology in this population.

**Objectives:** We aim to (1) Characterize EEG FA among children and adolescents with ASD relative to those without ASD, and (2) Consider main and interactive effects of FA and maternal depression history on internalizing and externalizing symptoms for youth with ASD.

**Methods:** Data were obtained within a large study spanning four US sites. Current analyses include 280 youth (mean age=12.8 years,  $SD=2.9$ , range=8.0-18.0) with ( $n=142$ ; 43% female) and without ASD ( $n=138$ ; 49% female), without intellectual disability. ASD diagnoses were well-established and confirmed via ADOS-2, ADI-R, and DSM-IV criteria. Parents reported child symptoms with the Child Behavior Checklist (Internalizing and Externalizing broadband scores), and maternal mental health history through clinician interview. High-density EEG was collected during resting state, and alpha band FA was extracted. General linear models were conducted to consider age, sex, and diagnostic effects on FA, as well as main and interactive effects of FA and maternal depression history on child symptoms.

**Results:** Frontal asymmetry did not differ by age, sex, or diagnosis ( $F(4, 275)=.18, p=.95$ ), nor was there an interaction between sex and diagnosis (Figure 1). Within our ASD group, models containing FA, maternal depression history, and their interaction were associated with both internalizing ( $F(4,103)=5.5, p<.001$ ) and externalizing symptoms ( $F(4,103)=4.64, p=.002$ ), with elevated symptoms associated with a positive history of maternal depression. However, subsequent models indicated sex differences in these effects. Whereas these factors accounted for 19% of variance in internalizing symptoms among females ( $F(4,42)=3.74, p=.01$ ), a comparable model among males was nonsignificant. The reverse was true for externalizing, with null effects for girls but approximately one third (32.6%) of externalizing variance accounted for among boys ( $F(4,56)=8.24, p<.001$ ). In particular, the interaction of FA and maternal depression ( $F(1, 56)=8.83, p=.004$ ), as well as their main effects ( $ps<.05$ ), were significant for males. FA was not associated with externalizing in the context of maternal depression, but higher externalizing scores corresponded to stronger right asymmetry (relatively less left frontal activity) for those males whose mothers did not have a history of depression (Figure 2).

**Conclusions:** Maternal depression was a robust risk factor for child psychopathology symptoms across symptom domains and sex in youth with ASD, whereas FA emerged specifically with regard to externalizing among males without maternal depression history. Broadly, findings suggest that risk factors may operate differently for females and males with ASD, despite the absence of sex differences in frontal asymmetry itself. Continued consideration of individual differences across levels of analysis (e.g.,

EEG, family factors) will be essential to parsing out models of risk and resilience among youth with ASD.

**429.019 (Poster)** Gender Nonconformity and the Broader Autism Phenotype in College Students: Links with Mental Health  
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**Background:** Studies have identified higher levels of autism traits and a greater incidence of autism among youth and adults with gender variance (Heylens et al., 2018; van der Miesen et al., 2018). Likewise, gender variance is more common among autistic children and adults and is linked with autism characteristics (George & Stokes, 2018; Nabbijohn et al., 2019). Mental health concerns are common among autistic adults (Hollocks et al., 2019) and gender minorities (Warren et al., 2016). Thus, adults with high levels of autistic traits and nonconformity to social gender norms (i.e., gender nonconformity; GNC) may be at additional risk for mental health concerns. Little research to date, however, has examined broad features of these presentations (i.e., the Broader Autism Phenotype [BAP] and GNC) in a general population sample.

**Objectives:** To explore 1) associations between the BAP and GNC, 2) links between internalizing symptoms (i.e., depression, anxiety) with each BAP and GNC, and 3) the relative contribution of BAP, GNC, and their interaction in predicting internalizing symptoms in a sample of college students.

**Methods:** College students ( $N=181$ ) aged 18–25 ( $M=18.74$ ) (69% female) completed questionnaires for course credit. The BAP was assessed using the Broad Autism Phenotype Questionnaire (BAPQ; Hurley, et al., 2007) including the Aloofness, Pragmatic Language Difficulties, and Rigidity subscales. Internalizing symptoms were measured with the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) and State-Trait Anxiety Inventory (STAI, Trait subscale; Spielberger et al., 1983). GNC was quantified using the Marquette Measure of Gender Conformity (MMGC; Matelski et al., 2016) which includes Behaviors, Physical Presentation, and Attitudes and Values; lower scores indicate less gender conformity (i.e., more GNC).

**Results:** Due to skew of the MMGC subscales, Spearman's rho was used to calculate correlations (Table 1). MMGC Physical Presentation was significantly negatively related to BAPQ Total, Pragmatic Language, and Aloofness. Internalizing symptoms (CES-D, STAI) were significantly positively related to all BAPQ measures as well as negatively significantly related to the MMGC Physical Presentation. Moderation analyses indicated a marginal interaction ( $p=0.10$ ) between the BAPQ and MMGC Total in predicting CES-D; the effect of the BAPQ on CES-D was stronger at lower levels of MMGC (i.e., more GNC). No main or interaction effects were detected when predicting STAI.

**Conclusions:** Our results reveal that those with more BAP features reported less conformity to physical gender presentation conventions (clothing, hairstyle, makeup, etc.) in a college student sample. Additionally, more internalizing symptoms were related to greater endorsement of the physical facet of GNC, as well as higher levels of all BAP dimensions. Importantly, GNC marginally moderated the effect of BAP on depression; the link between BAP and depression was stronger for those with higher GNC. The effect of the BAP on anxiety, however, was invariant across levels of GNC. This study highlights the need to consider both BAP and GNC, even at sub-threshold levels, in supporting mental well-being. Limitations include the homogeneity of the sample with regard to age, race, ethnicity, and gender identity, as well as the limited psychometric evidence of the MMGC.

**429.020 (Poster)** Genetic Etiologies of Catatonia in Patients with Autism Spectrum and Other Neurodevelopmental Disorders: A Retrospective Review and Case Series

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Background:

The association between catatonia and autism spectrum disorder (ASD) is a rare but clinically significant comorbidity. There have been many single case reports of catatonia in patients with ASD identifying an underlying genetic diagnosis; though analysis of larger cohorts of pediatric catatonia is limited.

Objectives:

Here we analyze a cohort of pediatric patients with neurodevelopmental disorders including ASD a diagnosis of catatonia to identify underlying genetic diagnoses in an effort to better understand molecular pathways involved in ASD and catatonia.

## Methods:

Data was collected from medical records at Cincinnati Children's Hospital Medical Center (CCHMC) of patients with catatonia along with well-characterized neurodevelopmental disorder including ASD based on multidisciplinary evaluation. Genetic test results were abstracted from medical records and analyzed to identify the proportion of this cohort that received genetic testing along with the proportion of the cohort that received a specific genetic diagnosis or presumptive diagnosis.

## Results:

Forty-nine patients were identified in the electronic medical records to have a diagnosis of catatonia. Sixty one percent (n=30) had a diagnosis of neurodevelopmental disorder, 18 ASD, 5 idiopathic ID, and 6 with ID in the setting of Down Syndrome. Of these 30 patients, 63% (n=19) received some clinical genetic testing, and of the patients who received genetic testing, 47% (n=9) had a confirmed genetic diagnosis or presumptive genetic diagnosis. Seventy two percent (n= 13) of those patients with ASD received genetic testing, with 22% (n=4) receiving a confirmed or presumptive genetic diagnosis. Two of the 7 patients with ID received testing with 1 receiving a confirmed or presumptive genetic diagnosis.

## Conclusions:

In our retrospective review, patients with catatonia and ASD have a high burden of pathogenic disease variants, consistent with previously reported yields in the literature for NDD cohorts. Variants identified in this retrospective review are detailed in case examples. Molecular pathways of interest identified include genes involved in GABA and glutamate synaptic function, (*NLGN2*, *NRXN1*, *NRXN4*, *NAA15*, *DSCAM*). Opportunities for further investigation include prospective genetic testing of the remaining patients in the cohort in an attempt to identify

### **429.021 (Poster)** Homotypic and Heterotypic Continuity in Mental Health Symptoms in Autistic Youth: Prediction from Childhood to Adolescence

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**Background:** Mental health difficulties are prevalent in autistic adolescents, yet their developmental precursors are not well understood. In neurotypical youth, substantial homotypic (within-disorder) continuity over development is reported, although there is some evidence for specific types of heterotypic (between-disorder) prediction (e.g. behavioural problems in childhood predicting emotional problems in adolescence). In autistic populations, whether a similar pattern of prediction exists, and if these longitudinal pathways are moderated by child and environmental factors, remains unknown.

**Objectives:** To test prediction of mental health symptoms from childhood to adolescence in a population-based sample of autistic youth.

**Methods:** Parents of a stratified sample (T1; N=101; 57/44 male/female; aged 4–8 years) completed a semi-structured psychiatric interview (Preschool Age Psychiatric Assessment), and measures of parental distress (Kessler Psychological Distress Scale). SES was measured using the 2007 English Indices of Multiple Deprivation. Child IQ was measured using standardised instruments. The stratified sample were selected from the larger total sample, consisting of all children who received an autism spectrum disorder diagnosis in a defined geographical area between 2000-2004 (N=477). The stratified sample were followed six (T2; age 11-15 years) and eight (T3; age 13-17 years) years later. At T3, 72 parents completed the Child and Adolescent Psychiatric Assessment.

Structural equation models, weighted for sample stratification and attrition, tested unadjusted univariate and adjusted multivariate (adjusting for co-occurrence between T1 symptoms) prediction from T1 to T3, grouping symptoms into emotional (anxiety and depression), behavioural (conduct and oppositional defiant disorder) and attention-deficit hyperactivity (ADHD) domains. Multi-group models tested for moderation of T1 to T3 prediction by child sex, IQ (<70/≥70), SES (median split) and parental distress (<24/≥24). As symptom data was a count of the number of endorsed symptoms, estimates are given as incidence-rate ratios (IRRs).

**Results:** In unadjusted analyses, there was evidence of homotypic and heterotypic continuity, with T1 emotional, behavioural and ADHD symptoms all predicting T3 emotional and behavioural symptoms (all  $ps < .05$ ; see Table 1 / Figure 1). However, in adjusted analyses, only homotypic continuity was seen; only within-disorder predictions were significant (all  $ps < .01$ ; see Table 1 / Figure 1).

Sex moderated the T1 to T3 ADHD symptoms pathway ( $c^2(1) = 5.10, p = .02$ ); this was significant in females (IRR = 1.28,  $p < .001$ ) but not males (IRR = 1.06,  $p = .262$ ), and parental distress moderated the T1 behavioural symptoms to T3 emotional symptoms pathway ( $c^2(1) = 8.96, p = .003$ ); this was significant in the low parental distress group (IRR = 1.20,  $p = .010$ ), but non-significant in high parental distress group (IRR = .93,  $p = .131$ ). Moderation by SES and child IQ was not significant.

Conclusions: Comparison of the unadjusted and adjusted results suggests that within-disorder continuity in autistic youth may look like cross-disorder prediction if co-occurrence of mental health symptoms in childhood is not taken into account. Results highlight the importance of early focused interventions for mental health difficulties in autistic young people.

**429.022 (Poster)** Impact of COVID-19 on Stress, Anxiety, and Coping in Youth with and without Autism and Their Parents  
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Background: In the wake of COVID-19, the world has become a more uncertain, unpredictable environment – a breeding ground for stress and anxiety, especially for individuals with autism spectrum disorder (ASD) who often respond poorly to change and have heightened stress and anxiety. The overarching objective of the study was to examine stress, coping and anxiety in a data-driven, real-time assessment of adolescents with and without ASD and their parents at the height of the COVID-19 shutdown and three months later.

Objectives: The study had four primary aims: Aim 1, Child: examined stress, coping and anxiety during the height of the pandemic in self-reports of children and adolescents with and without ASD. Aim 2, Parent: examined stress, coping and anxiety on parents of children with and without ASD regarding their own self-reported stress and anxiety. Aim 3, Predictive: examined the effect of adults' self-reported stress and coping style on the perception of their child's stress and coping skills. Aim 4, Longitudinal: examined the impact of COVID-19 longitudinally by comparing stress and coping over two time-points.

Methods: The respondents to the stress and anxiety measures participate in a longitudinal study of stress and physiological arousal in pubertal development in ASD. Participants included 122 fully-characterized adolescents (ASD=61, TD=61), and their parents (96.3% mothers). Four standardized measures were administered via REDCap to ascertain stress and coping explicitly related to the COVID-19 pandemic (RSQ COVID-19-Child, Adult, Parent) and anxiety (STAI-C, STAI-A). Multivariate, univariate analysis of variance and hierarchical regression approaches were used.

Results: Significant differences emerged with ASD youth endorsing more trait anxiety ( $p < 0.05$ ) and response to specific stressors (e.g., virus, access to healthcare) ( $F(14,91)=2.82, p=0.002; \Lambda=0.698, \eta^2=.302$ ). Parents of children with ASD showed higher self-reported anxiety ( $p < 0.05$ ), yet scores were elevated for both parent groups. ASD parents reported more stress ( $F(1,106)=22.38, p < 0.001, \eta^2=.174$ ), especially related to the virus, access to supplies and healthcare, work, and concern for the future. TD youth and their parents used more Primary and Secondary Control Coping whereas ASD youth and their parents use more Disengagement Coping. Using hierarchical regression, child self-reported stress ( $\beta = 0.28, p < 0.001$ ) and parents' adult self-reported stress ( $\beta = 0.55, p < 0.001$ ) were significant predictors of the parent-rated perception of their child's stress. Importantly, it was parents' own stress that was the strongest predictor of child stress accounting for 24% of the model variance ( $\Delta F(1,87) = 55.31, p < 0.001$ ). Finally, longitudinal analyses revealed persistent RSQ Total stress with significantly higher levels in the ASD group for children  $F(1,85)=7.524, p=0.007$ , adult  $F(1,83)=8.584, p=0.004$ , and parent-report of child stress  $F(1,89)=6.997, p=0.01$ .

Conclusions: Results reveal striking differences in youth with ASD and their parents regarding anxiety, stress, and coping. Findings highlight the need for essential support, access to services, and strategies to enhance psychological and emotional well-being.

**429.023 (Poster)** Incorporating ASD Symptoms into a Transdiagnostic Model of Internalizing Symptoms Results in an Improved Model for Youth with ASD  
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**Background:** Youth with autism spectrum disorder (ASD) are at increased risk for co-occurring anxiety symptoms (van Steensel, Bögels, & Perrin, 2011). Factor analytic studies of anxiety often find poor model fit (e.g., White, Lerner, et al., 2014; Magiati et al., 2017), which complicates diagnostic conceptualization and subsequent treatment of anxiety in ASD. Additionally,

there is evidence that ASD symptoms are closely related to anxiety symptoms (e.g., Kerns et al., 2020). Moreover, while the high co-occurrence of anxiety and depression is well-established outside of ASD (e.g., Kessler et al., 2005), the relationship of anxiety and depression is not well-understood in ASD (e.g., Kerns et al., 2015).

**Objectives:** The present study sought to identify an improved model of internalizing symptoms in ASD by examining a broader, transdiagnostic model of internalizing symptoms (e.g., anxiety *and* depression symptoms) that also included core ASD symptoms.

**Methods:** Participants were ages 6-18, diagnosed with ASD in an outpatient clinic ( $N=280$ ;  $M_{age}=10.7$ ,  $SD_{age}=3.4$ ). Anxiety, depression, and ASD symptoms were measured using the parent CASI-4R (Gadow & Sprafkin, 2008), a DSM-IV referenced rating scale.

An exploratory factor analysis (EFA) of CASI-4R anxiety, depression, and ASD symptoms was pursued using WSLMV and Geomin rotation (e.g., Browne, 2001). Factor solution was guided by substantive interpretability (Brown, 2015; Norris & Lecavalier, 2010), scree plot analysis (Cattell, 1966), and evaluation of standard fit indices. Fit indices from a confirmatory factor analysis (CFA) of the CASI-4R original structure (e.g., anxiety, depression, and ASD symptoms fixed to load on their respective, distinct factors) were then compared against fit indices from the EFA-derived model.

**Results:** The EFA supported a 3-factor model as follows (see Table 1): Factor 1: Anxiety, Depression, and 3 ASD symptoms from the restricted interests/repetitive behaviors (RRB) domain; Factor 2: Social anxiety and social ASD symptoms, and Factor 3: ASD symptoms (including social and RRB symptoms). CFA indices suggested that the EFA model demonstrated better fit compared to the original CASI-4R model (see Table 2).

**Conclusions:** The first symptom factor suggests that similar to that seen in the general population (Kessler et al., 2005), anxiety and depression symptoms are likely to co-occur in ASD. Social anxiety however formed a second, separate factor, suggesting that it may present more distinctly in youth with ASD. Overall, modeling ASD symptoms along with internalizing symptoms revealed that no internalizing factor (e.g., factors 1 and 2) was free of ASD symptoms; these factors are consistent with theories stating that internalizing symptoms are influenced by ASD symptoms (e.g., Wood & Gadow, 2010). However, this association may not be bidirectional; ASD symptoms formed their own distinct factor, separate from internalizing symptoms, suggesting that internalizing symptoms may be less likely to influence the presentation of core ASD symptoms. Crucially, incorporating ASD symptoms into a broader internalizing model of comorbidity allowed for identification of an improved structure of symptoms compared to that of a DSM-derived model. Together, findings have important implications for treatment, assessment, and nosological classification systems.

#### **429.024 (Poster)** Insights from Parents and Caregivers: A Systematic Pursuit of Treatable Conditions in Agitated Individuals with Neurodevelopmental Disabilities

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**Background:** Individuals with neurodevelopmental disabilities (NDD) such as autism spectrum disorder (ASD) and intellectual disability (ID) experience deficits in communication that impair their ability to express their needs and wants verbally. Although agitation commonly occurs in individuals with NDD (Lai et al 2014), it cannot be attributed to the disability itself. The effects of many conditions and circumstances converge into the final common pathway of agitation in this population (McGuire K et al., 2016). Providers may rely on parents/caregivers for their insight into affected individuals' emotional and physical state (Selekman et al., 1995). This study used the Sources of Distress ("Sources," an online, branching logic questionnaire for parents/caregivers) to identify potential underlying contributors or causes of distress that commonly occur in the NDD population.

**Objectives:** Describe and report associations among distress manifestations, psychotropic medication use, and psychiatric/medical conditions identified.

**Methods:** Six focus groups consisting of parents (n=6), professional caregivers (n=6), and adults with NDD and expressive language ability (n=5) were conducted on Sources. Following modification based on focus group feedback, male and female versions of Sources (101 and 104 items, respectively) were adopted for clinical use in February 2019. Parents/caregivers of 72 individuals with NDD (53 males, 19 females) with significant behavior and/or mood concerns completed Sources. Symptom thresholds for classifying psychiatric conditions were based upon *Diagnostic Manual - Intellectual Disability 2* and clinical experience. Descriptive statistics, independent samples T-test, and Chi-square tests were conducted in SPSS Version 24.

Results: ASD (77.8%) and ID/cognitive delay (36.1%) were the most common developmental disabilities reported. The most common distress manifestations were agitation (97.2%), aggression (79.2%), increased fixation (79.2%), and moodiness (77.8%). All but one participant had a psychiatric condition classified through Sources. Participants had a mean of 3.6 (SD=1.3, range 0-6) psychiatric conditions; >50% of participants were classified with an anxiety disorder (90.3%), attention deficit hyperactivity disorder (70.8%), or sleep disturbances (66.7%). Endorsed medical concern categories included gastrointestinal (63.9%), general medical (44.4%, including 27.4% with seizures), dental (44.4%), and menstrual-related (42.1% of females). The following distress manifestations were associated with the respective conditions with a significance threshold of  $p \leq 0.01$ : sleep disturbance – bipolar disorder; fixation – unipolar depression; personality changes – psychosis; and eating pattern changes – general medical concern. Among the 66.7% of participants taking antipsychotics, 54.2% had an indication for 1<sup>st</sup> line use of either bipolar disorder and/or psychosis. Of participants classified with bipolar disorder taking antipsychotics, 57.9% were concurrently on an antidepressant, which may reduce antipsychotic mood stabilizing effects.

Conclusions: Individuals with NDD and agitation experience high rates of medical and psychiatric conditions that can contribute to or manifest as distress. Recognizing patients' psychiatric and medical profile allows providers to consider (1) medical conditions that merit non-psychotropic intervention, (2) safer alternatives to antipsychotics in the absence of a 1<sup>st</sup> line indication (e.g., bipolar disorder, psychosis), and (3) iatrogenic interference on antipsychotic efficacy when bipolar disorder is present. If accessed purposefully and systematically, parent/caregiver knowledge can identify underlying conditions that illuminate the path forward for medical decision-making surrounding agitation.

**429.025 (Poster)** Intergenerational Trauma in Autism: An Examination of Adverse Childhood Experiences Among Children with Autism Spectrum Disorder and Their Caregivers  
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Background: Adverse childhood experiences (ACES) are associated with a multitude of negative short- and long-term outcomes in physical health, behavior, and psychological functioning. Although children with ASD have a higher risk of experiencing ACES, little research has also considered caregiver ACES in the context of autism. Parent ACES predict child ACES as well as child behavioral and psychological outcomes among non-autistic children. Thus, examining the intergenerational association between parent and child ACES in the context of autism is a key research priority.

Objectives: The goals of the current investigation were to (1) identify rates of ACES among children with ASD and their parents, (2) evaluate the intergenerational association between parent and child ACES, and (3) explore main and interactive effects of parent and child ACES on parent psychological and child behavioral outcomes, controlling for demographic factors.

Methods: Participants included 109 caregivers of children with diagnoses of ASD who completed an online survey. Caregivers reported on their own and their child's history of ACES using the 10-item ACES checklist used by the Centers for Disease Control and Prevention, which assesses 5 indicators of child maltreatment (abuse and neglect) and 5 indicators of household dysfunction (parental incarceration, substance use, divorce, etc.). Participants also completed measures of parent stress (Perceived Stress Scale) and internalizing symptoms of depression and anxiety (Inventory for Depressive and Anxiety Symptoms (IDAS-2 Dysphoria subscale)). Lastly, participants reported on child autism traits (Autism-Spectrum Quotient, 10-Item Version) and child co-occurring internalizing and externalizing behaviors (Strengths and Difficulties Questionnaire).

Results: Results showed high rates of ACES among children with ASD and their caregivers (see Table 1). Correlational analyses showed that caregiver and child total ACES scores were significantly and strongly inter-correlated. At the item-level, chi-square analyses supported that the parent-child association was significant for all individual ACES except for physical abuse and substance use in the home. Multiple regression analyses indicated that child ACES were associated with higher levels of parent stress and internalizing symptoms and lower levels of autism symptoms (see Table 2). In contrast, parent ACES were only associated with higher levels of parent stress. The interaction between parent and child ACES was not significant for any outcome.

Conclusions: Overall, our results show high rates of ACES among children with ASD and their caregivers and demonstrate that parent and child ACES are strongly inter-correlated. Moreover, parent and child ACES showed differential associations with parent and child psychological and behavioral outcomes. Child ACES were associated with higher parent stress and mental health symptoms, even when controlling for demographic factors and parent ACES. Child ACES negatively predicted autism symptoms, suggesting that children with ASD with lower autism traits are at higher risk for ACES. Future research should consider intergenerational trauma in the context of autism.

**429.026** (Poster) Longitudinal Associations between Signs of Attention-Deficit/Hyperactivity Disorder (ADHD) in Infancy and Toddlerhood and Mid-Childhood Functional Neural Connectivity in Infant Siblings of Autistic Children  
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Background: Infant siblings of autistic children are at elevated likelihood for developing autism and other neurodevelopmental conditions, including attention-deficit/hyperactivity disorder (ADHD). Previous work has indicated that infant siblings who later develop ADHD show atypically increased activity levels and poor inhibitory control in the first two years of life. Yet, how these early-life atypicalities influence development beyond the emergence of ADHD symptoms, such as the formation of functional neural networks, has not been investigated.

Objectives: To investigate (1) if elevated activity levels and poor inhibitory control in infancy and toddlerhood are associated with functional neural connectivity in mid-childhood and (2) whether atypicalities in functional connectivity associated with early signs of ADHD are in turn associated with parent-reported ADHD symptoms in mid-childhood.

Methods: We investigated these objectives in a prospective longitudinal study of infant siblings at elevated and typical familial likelihood for autism (n=104), in which we previously reported increased activity levels and poor inhibitory control measured by parent-report at age 7-24 months to be associated with elevated parent-report ADHD symptoms in mid-childhood (age 6-8 years). The current analyses were conducted on a subset of this sample (n=54) with electrophysiological (EEG) data collected during eyes-open resting-state in mid-childhood. Functional neural connectivity was computed from the mid-childhood EEG data in terms of oscillatory phase synchronisation quantified by the debiased weighted phase lag index (dwPLI) in the theta (4-8Hz) and alpha (8-12Hz) frequency bands. Network based statistic (NBS) and Spearman correlation coefficients were used to test whether activity level measured at 7-24 months and inhibitory control measured at 24 months were associated with over- or under-connected functional neural networks (NBS) and increased or decreased "whole-brain" (dwPLI averaged across all electrodes) functional connectivity (correlations) in mid-childhood. Functional connectivity metrics significantly associated with early signs of ADHD were then correlated with mid-childhood inattentive and hyperactive/impulsive traits using Spearman correlations.

Results: Poorer early-life inhibitory control was significantly correlated with lower whole-brain connectivity in the alpha frequency in mid-childhood ( $\rho(53)=0.28, p=0.03$ , Fig. 1a); in turn, lower whole-brain alpha connectivity tended to be associated with greater inattentive symptoms in mid-childhood ( $\rho(53)=-0.26, p=0.06$ , Fig. 1b). Early-life inhibitory control was not associated with mid-childhood theta connectivity in correlations or with alpha or theta neural networks; early-life activity level was not associated with any mid-childhood connectivity measure. Since we have previously found altered alpha connectivity in infancy to be associated with autism symptoms in this sample, we conducted a post-hoc analysis to test whether the associations between toddlerhood inhibitory control and mid-childhood alpha connectivity remained significant when adjusting for infant alpha connectivity. Multiple linear regression with infant alpha connectivity and toddlerhood inhibitory control predicting mid-childhood alpha connectivity revealed that early-life inhibitory control remained a significant predictor of mid-childhood alpha connectivity ( $\beta=0.51, p=0.008$ ).

Conclusions: Our findings suggest that early-life difficulties with inhibitory control are related to reduced whole-brain functional neural connectivity in the alpha range later in childhood and together these alterations may contribute to the severity of attention problems. These ADHD-related connectivity atypicalities appear to be distinct from infant connectivity alterations associated with autism.

**429.027** (Poster) Longitudinal Examination of Sleep Problems Among Young Children with Autism Spectrum Disorder  
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Background: Sleep problems are more common and severe among young children with autism spectrum disorder (ASD) than typically developing peers. Although sleep is considered to be important for socio-emotional and physical development, little is known about the changes in sleep problems over time among children with ASD. Previous research has mainly been cross-sectional, examining associations between sleep problems and various child characteristics.

Objectives: The goals of this study were: 1) to examine changes in sleep problems over a 1-year period in a large inception cohort of preschoolers with ASD; 2) to examine relations between family-related risk factors and children's sleep problems (i.e., intercept and change); and 3) to examine the associations between child sleep problems change over time and children's internalizing symptoms.

Methods: Data were drawn from the Canadian Pathways in ASD study and included 217 children aged three- to-five year ( $M = 44.86$  months;  $SD = 6.7$ ). Data were collected within four months of diagnosis (T1), 6 months later (T2); and an additional 6 months later (T3). Sleep problems were assessed using the six items from the parent-report Child Behavior Checklist (CBCL, Achenbach et al., 2000), comprising the sleep problem scale. The CBCL sleep composite is strongly correlated with the validated Children's Sleep Habits Questionnaire (Owens, Spirito, & McGuinn, 2000) and widely used as a measure of sleep functioning (Gregory & O'Connor, 2002). The CBCL was also used to assess internalizing and externalizing symptoms. Mothers completed the Symptom Checklist-90-R (Derogatis, 1994) to assess maternal anxiety. We used the Autism Diagnostic Observation Schedule to measure ASD symptom severity (i.e., Social Affect, Restricted and Repetitive Behaviors).

Latent growth curve analysis was employed to examine child sleep problems over a 1-year period and its possible predictors and correlates. The model employed maximum likelihood estimation with robust standard errors using Mplus Version 7.4. Next, children's internalizing and externalizing symptoms at T3 were regressed on latent intercept and slope parameters. Models included child age, ASD severity, family income, internalizing and externalizing symptoms, family functioning, and maternal anxiety at T1.

Results: The unconditional growth model fit the data ( $CFI = 1.00$ ,  $RMSEA = .00$ ,  $SRMR = .01$ ). The intercept mean ( $M = .65$ ,  $SE = .04$ ) and the slope mean ( $M = -.04$ ,  $SE = .01$ ) were both significant, indicating a decrease in sleep problems over time. The variance component of the intercept was significant, suggesting between-subject variability in initial levels of sleep problems. Yet, the variance component of the slope was not significant.

The conditional model demonstrated a significant positive association between ASD symptom severity, maternal anxiety and level of sleep problems at T1. However, no associations were found with change in sleep problems over time.

Last, children with more sleep problems at T1, more persistent sleep problems, showed more internalizing symptoms at T3, even after controlling for T1 internalizing symptoms.

Conclusions: Sleep problems in young children with ASD may represent early and modifiable risk markers for persistent child sleep and emotional difficulties, as well as promising targets for early intervention aimed at improving child (and caregiver) well-being.

**429.028** (Poster) Medical, Developmental, and Behavioral Associations with Sleep Problems in Young Children

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Background: Sleep problems may have a negative impact on behavior, mental health, and physical well-being in young children and their families. About 40% to 80% of children with autism spectrum disorder (ASD) and developmental delay (DD), and about 10% to 50% of children from the general population (POP) have been reported to have sleep problems. The multi-factorial nature of sleep problems makes management challenging. Previous studies evaluating factors associated with sleep problems in children with ASD are limited due to lack of control groups and inability to control for socio-demographic and cognitive abilities.

Objectives: Assess whether selected developmental, behavioral, and medical conditions or symptoms (i.e., those related to sleep problems in existing literature) are associated with sleep problems.

**Methods:** We included 2- to 5-year-old children in the Study to Explore Early Development (SEED), a multi-site community-based study, whose parent completed the Children's Sleep Habits Questionnaire (CSHQ). The CSHQ is a standardized 33-item questionnaire with cut off score greater than 41 representing sleep problems. There were 522 children with ASD, 762 children with DD, and 703 POP children in the analytic sample. Data collection instruments that captured co-occurring conditions were the Child Behavior Checklist (CBCL), Social Responsiveness Scale (SRS), Mullen Scales of Early Learning (MSEL), SEED Gastrointestinal Questionnaire, and height and weight measured during clinic visit in order to calculate body mass index (BMI). The presence of child genetic or neurologic conditions was reported by the mother (i.e., Down syndrome, fragile X syndrome, Rett syndrome, tuberous sclerosis, neurofibromatosis, cerebral palsy, and seizures). Socio-demographic variables were child age and sex, household income, and maternal education and race/ethnicity). A logistic regression model adjusted for socio-demographic variables assessed associations between sleep problems and CBCL clinical risk for anxiety/depression (yes/no), SRS moderate-severe risk for ASD (yes/no), MSEL <70 (yes/no), MSEL below average visual reception, expressive language, or receptive language skills (yes/no), parent reported GI problems (yes/no), BMI z-score (continuous), and parent-reported genetic or neurological diagnosis (yes/no). A second logistic regression model adjusted for study group status (i.e., ASD/DD/POP) to test associations relevant to all children.

**Results:** The first model found the following were associated with sleep problems in our sample of children: CBCL clinical risk for anxiety/depression (aOR=5.08; 95%CI=2.53,10.22); SRS moderate-severe risk for ASD (aOR=1.94; 95%CI=1.39,2.71); MSEL low developmental level (aOR=1.31; 95%CI=0.96,1.80); MSEL below average visual reception (aOR=1.34; 95%CI=0.94,1.92), expressive language (aOR=1.24; 95%CI=0.88,1.75), or receptive language skills (aOR=1.30; 95%CI=0.94,1.81), and parent reported GI problems (aOR=1.65; 95%CI=1.24,2.18). When the model was adjusted for study group status, CBCL clinical risk for anxiety/depression (aOR=4.42; 95%CI=2.08,8.65), parent reported GI problems (aOR=1.61; 95%CI=1.20,2.17), and elevated SRS score (aOR=1.94; 95%CI=1.39, 2.71) remained statistically significant. Post-hoc, we examined the interaction between GI problems and symptoms of anxiety/depression and found no interaction between the variables.

**Conclusions:** Gastrointestinal problems, social problems, and symptoms of anxiety/depression were associated with more sleep problems in all children regardless of study group classification. These results highlight the need to consider gastrointestinal problems and symptoms of anxiety/depression when developing a treatment plan for pre-school aged children with sleep issues.

**429.030 (Poster)** Predictors of Adaptive Functioning in Autism Spectrum Disorders from Early Childhood to Adolescence  
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**Background:** Adaptive functioning refers to how well an individual manages the demands of everyday life and is an important factor in determining outcomes such as independent living. Studies consistently show adaptive functioning to be impaired in individuals with autism spectrum disorders (ASD), relative to cognitive ability, particularly in higher-ability individuals. However, the clinical drivers for this are less well understood. Some studies point to core ASD symptoms impeding adaptive functioning, while others (but not all) suggest an independent effect of co-occurring psychiatric symptoms. Most studies have used cross-sectional designs and focused on higher-ability individuals. The current study takes a developmental approach to examine longitudinal and contemporaneous predictors of adaptive functioning in a sample of young people (YP) with ASD from across the entire ability range.

**Objectives:** Using a longitudinal sample, to identify predictors of adaptive functioning in YP with ASD. Specifically, to test associations between adaptive functioning and ASD symptoms (social communication difficulties and restricted and repetitive behaviours (RRBs)) and co-occurring psychiatric symptoms (emotional, conduct and ADHD symptoms), while controlling for IQ.

**Methods:** Participants were part of the QUEST cohort, a community-based sample of children with a diagnosis of autism. Children were recruited at age 4-8 years (t1, total n=277), and followed at a mean age of 13 years (t2, total n=211). ASD symptoms were measured at t1 and t2 using the Social Communication Questionnaire (SCQ). IQ was assessed at t1 and (on a stratified subsample) at t2. Emotional, conduct and hyperactivity symptoms were measured using the Anxiety, Disruptive/Antisocial and Hyperactivity subscales from the parent-report Developmental Behaviour Checklist (DBC) at t1, and the Emotional, Conduct and Hyperactivity-Inattention subscales from the parent-report Strengths and Difficulties Questionnaire (SDQ) at t2. Adaptive functioning was assessed using the Adaptive Behaviour Assessment System (ABAS-II) at t2. This study focuses on the 179 YP (144 male, 35 female) with complete datasets at both timepoints (see Table 1).

Structural equation modelling was used to test the pathways to adaptive functioning from t1 and t2 predictors, whilst also testing for covariances between symptom domains. Moderator paths (for sex, and  $IQ < / \geq 70$ ) were subsequently added to the significant paths of interest.

Results: Adaptive functioning at t2 was associated with higher t1 IQ ( $\beta = .38$ ,  $p < .001$ ), lower t1 hyperactivity scores ( $\beta = -.32$ ,  $p = .001$ ), lower t2 hyperactivity scores ( $\beta = -.22$ ,  $p = .001$ ), and with lower social communication difficulties ( $\beta = -.34$ ,  $p < .001$ ) and RRBs ( $\beta = -.17$ ,  $p < .001$ ) at t2 (see Figure 1). Neither conduct symptoms at t1 or t2, nor emotional symptoms at t1 or t2 were associated with t2 adaptive functioning. Sex and IQ did not moderate the paths from t1 hyperactivity to t2 adaptive functioning or from t2 hyperactivity to t2 adaptive functioning.

Conclusions: In a model that included ASD symptoms and IQ, hyperactivity symptoms, both contemporaneously and in early childhood, were associated with reduced adaptive functioning at age 13. This highlights the importance of considering co-occurring psychiatric symptoms and their treatment at an early age, as these could have a significant impact on later outcomes.

**429.031 (Poster)** Prevalence of Parent-Reported Feeding Concerns in Children with Autism Spectrum Disorder: A Cross-Sectional Study of Patients Evaluated at a Tertiary Care Center

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Background: Feeding issues are a commonly reported concern for parents of children who have autism spectrum disorder (ASD). Food selectivity - or eating a narrow range of foods - represents the most frequently documented feeding concern in ASD. To date, variability in study design, however, has limited a clear understanding of prevalence of feeding and related mealtime concerns in ASD, yielding a wide range (46-89%) of estimates across the extant literature. Sample bias contributes to lack of clarity regarding prevalence, with most studies identifying rates of feeding issues in children referred to related subspecialty clinics (e.g., feeding teams). The current study aims to address this gap by describing the prevalence of parent-reported feeding concerns in a large cohort of children evaluated for ASD at a tertiary care center.

Objectives: To identify the rate of parent-reported feeding concerns regarding dietary diversity and weight status in children consecutively referred for diagnosis of autism spectrum disorder.

Methods: The study included 935 consecutive patients evaluated for ASD (September 2019-October 2020) ranging from 14 months to 17 years old (Mean=55.9 mos, SD=34.9 mos; Median=43.9 mos). The assessment clinic incorporated a brief, eight-item parent questionnaire screening for general feeding concerns, weight status, and dietary variety.

Results: Of the 935 patients evaluated, 783 (83.7%) patients (74.6% male) received an ASD diagnosis. Of those with a primary ASD diagnosis, 225 parents (29%) endorsed concerns about their child's feeding, 127 (17.1%) reported concerns about their child being underweight, and 53 (7.2%) reported concerns about overweight. Over half of parents (52.8%) indicated that their child rejects all items from at least one food group from their diet.

Conclusions: Our results suggest that feeding concerns in a general ASD population may be less prevalent than previous reports involving children referred to specialty clinics for feeding or weight concerns. Food selectivity, however, may still represent a commonly observed feature in youth who have ASD, with more than half of parents indicating that their child refuses items from at least one food group. Further research in other ASD diagnostic settings and specialty clinics is warranted to understand true and nuanced prevalence rates of feeding and weight concerns.

**429.032 (Poster)** Racial/Ethnic Disparities in Psychiatric and Medical Diagnoses Among Autistic Adults

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Background: Racial and ethnic disparities in access to diagnostic and support services are pervasive for autistic children and youth, which has implications for health and well-being into adulthood. However, few studies have examined racial/ethnic differences in diagnoses and healthcare use among autistic adults, who commonly experience a higher burden of many psychiatric and medical conditions than non-autistic adults.

**Objectives:** To describe racial/ethnic differences in the frequency of health diagnoses in autistic adults.

**Methods:** The study population included adult members ( $\geq 18$  years) of Kaiser Permanente Northern California (KPNC) enrolled in the health plan for at least 9 months of each year from 2008-2012. We ascertained 1,507 adults who had an autism spectrum disorder (ASD) diagnosis documented in their KPNC medical records on at least 2 occasions by December 2012. A control group of adults without any ASD diagnoses ( $N=15,070$ ) was sampled at a 10:1 ratio and frequency-matched to autistic adults on total length of KPNC membership, gender, and age. Our sample was 46% White, 16% Asian, 7% Black, 4% Hispanic, and 26% other race/ethnicity. We examined physician-documented medical and psychiatric diagnoses routinely captured in KPNC's electronic medical records. We first compared the health status of autistic adults with non-autistic controls within strata of race/ethnicity. We next examined racial/ethnic differences in medical and psychiatric conditions among autistic adults only. All analyses were conducted using logistic regression and included adjustment for age, gender, length of KPNC membership, and insurance payer.

**Results:** Among each racial/ethnic group, most conditions, including psychiatric disorders, cardiovascular diseases, diabetes, and epilepsy, were significantly more prevalent among autistic adults compared with non-autistic adults. However, the magnitude of the difference between autistic and non-autistic adults varied widely across racial/ethnic strata for some conditions. For example, the odds ratio of any major psychiatric condition was largest among Asian adults ( $OR=5.5$ , 95%CI: 3.9-7.6) and smallest among Black adults ( $OR=2.0$ , 95%CI: 1.4, 3.0). Among autistic adults, odds of hypertension ( $OR=1.9$ , 95%CI: 1.2, 2.9) and obesity ( $OR=1.7$ , 95%CI: 1.2, 2.5) were elevated among Black adults and odds of non-seizure disorders of the central nervous system ( $OR=2.0$ , 95%CI: 1.1, 3.7) and gastrointestinal disorders ( $OR=1.7$ , 95%CI: 1.0, 3.0) were elevated among Hispanic adults compared with White adults. In contrast, several psychiatric conditions, including anxiety and depression, were significantly less likely to be diagnosed in Asian, Black, and Hispanic autistic adults than in White autistic adults.

**Conclusions:** Our study found that autistic adults generally had higher rates of co-occurring medical and psychiatric conditions compared to their non-autistic counterparts of the same race/ethnicity. However, among autistic adults, Black and Hispanic adults were more likely to be diagnosed with some major medical conditions, including cardiometabolic diseases, and Black, Hispanic, and Asian adults were markedly less likely to be diagnosed with psychiatric conditions than their White counterparts. The observed racial/ethnic differences among autistic adults mirror the racial/ethnic disparities that are widespread in the general population. Future work will examine whether these differences reflect disparities in healthcare utilization, possibly identifying targets for intervention.

**429.033 (Poster) Self-Report of Emotion Regulation Impairment: Initial Analyses of Response Patterns**

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**Background:**

The Emotion Dysregulation Inventory (EDI) is the first measure developed and validated to measure emotion regulation (ER) impairment in youth with ASD<sup>1,2</sup>. The EDI was designed using caregiver-report; however, validating a self-report form of the measure is needed to support multi-method assessment for future research and treatment of ER impairment.

**Objectives:**

We conducted a preliminary investigation of the self-report version of the EDI, including item response frequency, item-total correlations, internal consistency, and convergent validity in an ER treatment-seeking sample.

**Methods:**

Our sample consisted of 53 adolescents and young adults (12-21 years old) with ADOS-confirmed ASD and verbal IQ scores above 80 and their caregivers who participated in a randomized control trial of the EASE program (Emotional Awareness and Skills Enhancement- a mindfulness-based intervention). Parent- and self-report of the EDI and PROMIS depression and anxiety scales were completed at pre-treatment. The EDI provides scores for Reactivity (EDI-R; intense and poorly regulated negative emotional reactivity) and Dysphoria (EDI-D; negative affect)<sup>1</sup>. For the current study, we explored the short form of the EDI-R (7 items) and the EDI-D (6 items).

**Results:**

Overall, internal consistency of self-report EDI-R short form ( $\alpha = .925$ ) and EDI-D ( $\alpha = .882$ ) were high and consistent with prior parent-report studies<sup>2</sup>. Item-total correlations (ITC) for both subscales did not indicate any weak items; all items in EDI-R short

form were correlated  $>.700$  with the total, and all items except for one (item 51 ITC = .402) on the EDI-D were  $>.670$ . Frequency distributions of the response options for each item were examined. Although participants endorsed 'none' at a high rate (generally greater than 50%), the full range of response options were utilized. Convergent validity was strong with both EDI-D and PROMIS anxiety and depression scores ( $r = .787, p < .001$ ;  $r = .853, p < .001$ ) and EDI-R and PROMIS anxiety and depression ( $r = .664, p < .001$ ;  $r = .588, p < .001$ ).

Mean EDI scores were higher for parent-report over self-report on both subscales. Parent- and self-report EDI-R and EDI-D were not significantly correlated at baseline ( $r = .112, p = .44$ ;  $r = .147, p = .31$ , respectively).

Conclusions:

The current results provide preliminary psychometric evidence for using the EDI self-report in adolescents and young adults with ASD, with strong internal consistency, item-total correlations, convergent validity, and a range of item responses. Limitations include a small, ER treatment-seeking sample without co-occurring ID. Next steps including drafting of additional items to enrich the item pool and cognitive interviews with self-reporting adolescents and adults to refine item wording and enhance validity. Further psychometric research will require a large and more diverse ASD sample to better assess the sensitivity of the EDI self-report, as well as how characteristics such as alexithymia affect self-report responses.

**429.034** (Poster) Sex Differences in the Stability of Psychopathology Symptoms in Young Children with Autism

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Background: Sex differences in symptom presentation and developmental trajectories of co-occurring psychopathology in autism are understudied in young children. Previously, we assessed 300 children with ASD (209 males, 91 females; mean age 37 months) and identified 3 subgroups based on DSM-oriented subscales of the Child Behavior Checklist (CBCL), cognitive development, adaptive functioning, and autism severity, using latent profile analysis: high psychopathology with mild impairment (HPMI), low psychopathology with high impairment (LPHI), and low psychopathology with low impairment (LPLI). Autistic girls were over-represented in the HPMI subgroup (Nordahl, 2020).

Objectives: To evaluate the trajectory of psychopathology symptoms across subgroups and sex. We hypothesized that the high psychopathology group would maintain elevated symptoms.

Methods: 148 children (102 males, 46 females) returned for longitudinal assessment 2 years after study entry (mean age 67 months). First, we evaluated correlations between baseline and follow-up CBCL internalizing and externalizing t-scores within subgroup and sex. We also examined changes in CBCL DSM-oriented t-scores (anxiety, affective, attention deficit/hyperactivity [ADHD], and oppositional defiant [ODD]) within subgroups and sex using linear mixed effects models.

Results: In the HPMI subgroup, baseline internalizing and externalizing scores were highly correlated with follow-up scores in females (internalizing  $r = 0.73, p = 0.003$ , externalizing  $r = 0.762, p = 0.002$ ), but not males (internalizing  $r = 0.167, p = 0.569$ , externalizing  $r = 0.232, p = 0.369$ ) (Figure 1A). Fisher's z-tests reveal that these sex differences in correlations were marginally significant for both internalizing ( $z = 1.78, p = 0.075$ ) and externalizing ( $z = 1.90, p = 0.057$ ) scores. In the LPLI subgroup, correlations between baseline and follow-up internalizing t-scores were significant in both females ( $r = 0.591, p = 0.043$ ) and males ( $r = 0.425, p = 0.009$ ), while correlations between baseline and follow-up externalizing t-scores were only significant in males ( $r = 0.491, p = 0.001$ ). In the LPHI subgroup, correlations between baseline and follow-up externalizing t-scores were significant in both females ( $r = 0.692, p = 0.027$ ) and males ( $r = 0.616, p = 0.004$ ), but internalizing scores were not significant in either sex. Sex differences in correlations were not evident for the low psychopathology subgroups.

The trajectory of DSM anxiety t-scores in the HPMI subgroup differed marginally by sex ( $p = 0.054$ ). In females, all three subgroups demonstrated similarly stable trajectories. The HPMI group maintained elevated DSM anxiety t-scores over time. In contrast, male trajectories differed across subgroups ( $p < .01$ ); anxiety scores decreased over time in the HPMI subgroup but remained stable in the other two subgroups. Trajectories for the other DSM-subscales show scores of the HPMI subgroup decreasing toward scores of the other subgroups over time in both sexes. Lastly, none of the DSM-subscale scores differed between returning and non-returning participants, suggesting that participant attrition was not a factor.

Conclusions: In the HPMI subgroup, females, but not males, had internalizing and externalizing scores at baseline that were predictive of follow-up scores, and a trajectory of anxiety scores that remained elevated above the low psychopathology subgroups. Symptoms of psychopathology at age 3 were predictive of higher levels of anxiety at age 5 in females with ASD, but

not males. These results suggest that symptoms of psychopathology may be more stable in females with ASD across early childhood than in males.

**429.035 (Poster)** Sleep Differences Among Autistic Children with and without a History of Suicide

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**Background:** Emerging literature suggests that sleep disturbances are associated with suicidal thoughts and behaviours (hereafter referred to as suicidality) in the general population. Despite this, few studies have examined the relation between sleep and suicidality in children with autism. Suicide attempts range between 7-47%, and 71% of autistic youth experience suicidal ideation, which is far more than non-autistic youth. In addition to this, individuals with autism also experience greater levels of depression, anxiety, social isolation, low self-esteem and peer victimization, which can exacerbate feelings of suicide. Given the limited existing literature in this population, there is a need for more research to clarify the relation between sleep (i.e., disturbances and parameters) and suicidality in children with autism.

**Objectives:** The current study aimed to determine whether subjective 7-day sleep parameters, using a sleep diary and actigraphy, vary between autistic participants with and without recent suicidality in the past 30 days.

**Methods:** In this cross-sectional online study, participants were 25 caregivers of children with autism. On average, participants were 12 years old (range, 7-21 years,  $SD = 3.6$ ), most children were male (68%), white (84%) and had a co-occurring diagnosis (64%) with the most common being ADHD (20%) and anxiety (20%). Caregivers were mothers (84%) with an average age of 41 (range, 32-55 years,  $SD = 7.5$ ). Sleep disturbances, 7-day sleep parameters and suicidality were reported by caregivers of children with autism using a caregiver-reported sleep-diary, the Children's Sleep Habits Questionnaire (CSHQ) and a modified caregiver-report version of the Columbia-Suicide Severity Rating Scale (C-SSRS). Data collection is still underway and anticipate 50 participants by May 2021.

**Results:** The majority of children were "poor sleepers" (84%) and reported suicidal thoughts and behaviours (60%). Four participants (22%) slept less than the recommended amount for their age, based on the National Sleep Foundation's (NSF) recommendations. Preliminary independent samples *t*-test demonstrated a significant difference in quality of sleep, such that those with a history of suicidality experienced worse sleep quality, ( $t(20) = 2.12, p = .047, d = .91, 95\% CI: 0.01, 0.83$ ). Furthermore, a significant difference was found in daytime sleepiness where those with a history of suicidality experience greater daytime sleepiness,  $t(22) = 4.86, p = .036, d = .43, 95\% CI (-2.61, 4.60)$ . The daytime sleepiness index was derived from the CSHQ.

**Conclusions:** These findings are partially consistent with the existing literature highlighting associations between sleep disturbances and suicidality in the general population. Group differences indicated that children with suicidality had significantly lower sleep quality scores (i.e., more fatigued) and greater daytime sleepiness. However, despite our expectation, no other significant differences were found regarding total sleep time, bedtime and length of night making. Findings highlight the importance of assessing for sleep changes in relation to mental health concerns as these changes may indicate vulnerability and may be important for this already at-risk population. Future work should explore this association longitudinally using objective measures such as actigraphy and polysomnography (PSG) which are needed to confirm our findings.

**429.036 (Poster)** Sleep Disturbances in Autism Spectrum Disorder: Relationship with Autism Severity, Executive Function and Psychiatric Symptoms.

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**Background:** Autism Spectrum Disorder (ASD) is a neurodevelopmental condition accompanied frequently with medical and psychiatric pathology. One of the most commonly found problems associated with ASD are sleep disturbances, which are estimated to affect approximately 80% of people with ASD, not only in childhood but also in adolescent and through adult stages. Nevertheless, the relation of these sleep difficulties with autism severity, as well as other associated impairments, such as executive functioning and psychiatric disorders has not been yet widely studied.

**Objectives:** The main objective of the present study is to explore the relation of sleep disturbances and subjective measures of autism severity, executive function and psychopathology in ASD population.

**Methods:** For this, a group of 89 participants with ASD (44 children/adolescents and 45 adults) were recruited and evaluated with ASD gold-standard evaluation measures and self-reported measures of executive function performance and psychiatric pathology.

**Results:** Results showed all total scores exceeding cut-off points in both ASD groups. Regarding association of sleep disturbances with psychiatric disorder, multivariate analysis showed significant association between both variables in both ASD groups, with greater sleep disturbances predicting more severe psychiatric pathology. Also, autism severity only showed significant association with sleep problems in the Adult ASD group. No significant association was found with executive function in any ASD group.

**Conclusions:** Thus, sleep problems seem to be associated with the severity of psychopathology through lifespan, increasing the chance of developing psychiatric symptoms. Improving sleep quality in ASD children/adolescents and adults may result in a preventing and/or decreasing psychiatric pathology in this population.

**429.038 (Poster)** The Comorbidity between Autism Spectrum Disorder and Post-Traumatic Stress Disorder Is Mediated By Brooding Rumination

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**Background:** Autism Spectrum Disorder (ASD) is a neurodevelopmental condition, characterized by social communication deficits and restricted, repetitive behaviors. ASD is highly co-morbid with other neuro-psychiatric disorders, such as ADHD, anxiety, and depression. However, research on post-traumatic stress disorder (PTSD) among individuals with ASD is scarce. Furthermore, the understanding of shared mechanisms underlying ASD co-morbidity with other conditions may assist in both diagnostic and intervention efforts with affected individuals.

**Objectives:** To examine the role of brooding and reflective rumination as mediators between ASD and PTSD.

**Methods:** Thirty-four (34) adults with ASD (with no intellectual impairment) and 66 typically developing controls, comparable on age and gender, filled out the PTSD Checklist for DSM-5 and the Rumination Response Scale.

**Results:** Results indicated increased PTSD symptoms, as well as elevated brooding levels, in adults with ASD, compared to typically developing controls. Brooding, but not reflective, rumination mediated the association between ASD and PTSD symptoms (See Figure 1).

**Conclusions:** Rumination and cognitive inflexibility, which are common in ASD, may exacerbate post traumatic symptoms among traumatized individuals who have ASD. Interventions targeting brooding rumination and cognitive flexibility may assist in alleviating post-traumatic symptoms in individuals with ASD.

**429.039 (Poster)** The Etiology of Comorbid Physical Problems in Autism— a Nationwide Population-Based Twin Study

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**Background:**

Autism is associated with a range of physical comorbidities, including neurological disorders, immune dysregulation, and gastrointestinal (GI) problems. The co-existence of physical health problems is linked to premature mortality and a higher degree of impairment in this population. However, the etiological significance of physical comorbidities in autism is still unclear, and the population-based studies of heritability of overlapping between physical comorbidities and autism have also been sparse.

**Objectives:**

This study aimed to use a Swedish nationwide population-based twin cohort and structural equation modeling to investigate the causes for common physical problems among children and the physical comorbidities in children with autism.

#### Methods:

A total of 10,347 twin pairs from the Child and Adolescent Twin Study in Sweden (CATSS) were included for analysis in this study (mean age  $9.75 \pm 1.23$  yrs). The diagnosis of autism and physical disorders were identified by the International Classification of Diseases (ICD) codes through the Swedish National Patient Register (NPR). Common pediatric physical problems of three physical systems were investigated: neurological disorders (4 disorders included), immune dysregulation (9 disorders), and GI problems (6 disorders). Familial coaggregation between physical comorbidities and autism was examined. Bivariate liability threshold twin modeling was used to estimate the degree of genetic and common and unique environmental influences contributing to the variation in liability to the comorbidities of physical disorders and autism.

#### Results:

Genetic effects accounted for 52% (95% CI=42–60) of the variation in liability for neurological disorders (ADE model, additive and dominance genetic effects), 64% (95% CI=53–74) for immune dysregulation (ACE model), and 57% (95% CI=51–63) for GI problems (ADE model). Monozygotic (MZ) co-twins of children with autism had higher probability of having diagnoses of neurological disorder and GI problems compared with dizygotic (DZ) co-twins (5.9% vs 5.2%, and 15.3% vs 11.4%, respectively), while familial coaggregation was not found between immune dysregulation and autism (MZ vs DZ: 23.7% vs 30.3%). The phenotypic correlation between neurological disorders and autism was 0.23 (95% CI=0.16–0.30), and genetic effects contributed 77% of the correlation (ADE model). For GI problems, the twin-based phenotypic correlation with autism was 0.19 (95% CI=0.13–0.26), and non-shared environmental factors showed protective effects (-5.2%) to the correlation (ADE model).

#### Conclusions:

Our findings suggest that the comorbid neurological disorders and GI problems in children with autism may largely be because of shared genetic influences. Although immune dysregulation was also highly heritable, the etiology of its overlapping with autism did not fit our modeling and thus the contribution of interplay between genetics and environmental factors should be considered. Further studies with larger sample sizes and focusing on specific physical disorders are warranted to validate our results.

**429.040** (Poster) The Hierarchical Taxonomy of Psychopathology as the Next Frontier for Understanding Comorbidity in Autism: An Empirically Based Approach to Delineating the Structure of Autism, Internalizing, and Externalizing Symptoms **M. R. Altschuler<sup>a</sup>**, **G. Michelin<sup>b</sup>**, **J. T. Elison<sup>c</sup>** and **S. Wilson<sup>a</sup>**, (1)Institute of Child Development & Department of Psychology, University of Minnesota, Minneapolis, MN, (2)Semel Institute for Neuroscience & Human Behavior, Department of Psychiatry & Biobehavioral Sciences, University of California Los Angeles, Los Angeles, CA, (3)University of Minnesota, Minneapolis, MN

Background: Individuals with autism spectrum disorder (ASD) are at high risk for developing comorbid conditions, with approximately 70% to 96% of children with ASD having at least one other co-occurring psychiatric condition. Some argue that associations between ASD traits and internalizing and externalizing symptoms suggest measures of ASD are confounded by measurement error and may represent non-ASD behavioral problems; others argue the term “comorbidity” is likely inappropriately named if the “comorbidities” contribute to the cause of ASD itself. Recent efforts leverage an empirically based approach to delineate the structure of psychopathology (in contrast to the field’s traditional case-control approach, e.g., Hierarchical Taxonomy of Psychopathology, HiTOP). HiTOP focuses on continuously distributed and transdiagnostic traits, theorized to form the scaffolding for psychopathology based on hierarchical structural equation modeling approaches, thereby providing a framework for directly testing the relative importance of symptom components, syndromes, spectra, and superspectra. Currently, HiTOP framework includes a *p* factor at the apex, with somatoform, internalizing, thought disorder, externalizing disinhibited, externalizing antagonistic, and detachment factors at the spectra level (see Figure 1). Whether an autism dimension, or a neurodevelopmental dimension more broadly, should be incorporated into HiTOP remains an empirical question.

Objectives: 1) Comprehensively review the empirical support for the existence of a neurodevelopmental or autism dimension in the HiTOP classification framework and 2) provide recommendations for future autism work.

Methods: Database and HiTOP consortium article searches were conducted of the literature examining a neurodevelopmental or autism dimension in the HiTOP classification framework.

Results: Only a handful of studies have examined and found evidence of a potential neurodevelopmental dimension in the hierarchical structure of psychopathology (Bloemen et al., 2018; Holmes et al., 2020; Michelini et al., 2019; Riglin et al., 2019; Waldman et al., 2020), and only one study found evidence of an autism specific dimension (Noordhof et al., 2015). Most studies examining a potential neurodevelopmental or autism dimension of psychopathology did not have any measure specifically designed to assess autistic traits. One exception examined the Child Social Behavior Questionnaire as an index of autistic traits, in addition to the Child Behavior Checklist, and found evidence for five factors, including what they labeled an autism dimension ( $p$ , internalizing, externalizing, attention and orientation, and autism) (Noordhof et al., 2015).

Conclusions: The majority of studies that found initial evidence for a neurodevelopmental dimension in the hierarchical structure of psychopathology did not include measures specifically designed to assess autistic traits. As such, a crucial gap in the field is understanding the extent to which autistic traits can or should be incorporated into the existing HiTOP framework or added as a separate structure (or structures) within the framework. Future work should utilize hierarchical structural equation modeling approaches (e.g., bass-ackwards method) to examine the hierarchical structure of autism and co-occurring symptoms. Understanding where autism and autistic traits fit in the hierarchical taxonomy of psychopathology and the latent structure underlying observed co-occurrence of autism, internalizing, and externalizing symptoms will inform an understanding of the etiology of autism and lead to the development of more targeted treatments.

**429.041 (Poster)** The Impact of the Comorbidity of ASD and ADHD on Social Impairment  
*C. M. Harkins and M. O. Mazurek, University of Virginia, Charlottesville, VA*

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**Background:** Children with autism spectrum disorder (ASD) and children with attention deficit/hyperactivity disorder (ADHD) both experience behavioral and social difficulties. Research has shown that when these disorders co-occur, behavioral symptoms associated with both disorders may be more severe. There is only limited research on the impact of ASD + ADHD comorbidity on social functioning and results have yielded mixed findings.

**Objectives:** To evaluate group differences in social impairment among children with ASD, ADHD, and ASD + ADHD using two assessment tools, clinician- and parent-informed, to examine the impact of the ASD + ADHD comorbidity on social functioning.

**Methods:** Participants included 282 youth age 2-17 diagnosed with ASD ( $n=151$ ), ADHD ( $n=82$ ), or ASD + ADHD ( $n=49$ ) participating in a larger research study. Participants completed a measure of IQ, the Autism Diagnostic Observation Schedule (ADOS-2), and parents completed the Aberrant Behavior Checklist (ABC-C). The ADOS-2 social affect calibrated severity score (SA-CSS) and the ABC-C Lethargy/Social Withdrawal subscale were used to measure social impairment. Multivariate analysis of covariance (MANCOVA) was employed to determine the presence of mean differences across diagnostic groups of measures of social impairment while accounting for covariates, age and IQ.

**Results:** Bivariate correlations were calculated between the ADOS-2 SA-CSS score and covariates, age ( $r=-.396$ ,  $p<.01$ ) and IQ ( $r=-.302$ ,  $p<.01$ ) and between the ABC-C Lethargy/Social Withdrawal subscale and, age ( $r=.011$ ,  $p<.05$ ) and IQ ( $r=-.079$ ,  $p<.05$ ). The hypothesis that children with ASD + ADHD would show greater social impairment than children with ASD or ADHD alone was tested using MANCOVA. The independent variable was diagnostic group status, the dependent variables were the ADOS-2 SA-CSS and the ABC Lethargy/Social Withdrawal score, and covariates included age and IQ. Multivariate results were significant for diagnostic group status,  $F(4,548)=24.59$ ,  $p<.001$ , Wilks'  $\Lambda = .719$ , partial  $\eta^2 = .152$  above the significant effect of age,  $F(2,274)=5.49$ ,  $p<.001$ , Wilks'  $\Lambda = .961$ , partial  $\eta^2 = .039$ . Multivariate results were not significant for IQ,  $F(2,274)=1.49$ ,  $p=.227$ , Wilks'  $\Lambda = .989$ , partial  $\eta^2 = .011$ . Post-hoc multiple pairwise comparisons (Bonferroni adjusted) found significant differences on only one measure of social functioning, the ADOS-2 SA-CSS,  $F(2,275)=50.79$ ,  $p<.001$ , partial  $\eta^2 = .27$ , with the ASD group scoring significantly higher than the ADHD group, and the ASD + ADHD group scoring significantly higher than the ADHD group, both at the .001 level. No significant differences on the ADOS-2 SA-CSS were observed between the ASD and ASD + ADHD groups.

**Conclusions:** Children with ASD versus ASD + ADHD may appear to display similar profiles of social problems when using the ADOS-2 SA-CSS and ABC Lethargy/Social Withdrawal subscale. The ADOS-2 may be helpful in differentiating social challenges in children presenting with ASD and/or ADHD concerns. The lack of significant differences in degree of social impairment observed between the ASD and ASD + ADHD groups may indicate that social challenges associated with both diagnostic groups may benefit from similar social skills interventions.

**429.042 (Poster)** The Relationship between Sensory Reactivity, Intolerance of Uncertainty and Anxiety Subtypes in Preschool-Age Autistic Children

## **Background:**

Sensory reactivity differences are experienced by 60-90% of autistic individuals, such as being hyperreactive (e.g. over-sensitive to sounds), hyporeactive (e.g. under-responsive to touch), or seeking (e.g. fascinated by lights). Sensory hyperreactivity has been linked to anxiety, which is co-occurring in over half of autistic children. It has previously been suggested that this relationship may be mediated by intolerance of uncertainty (IU). However, little is understood about this relationship in preschool-age autistic children, or how sensory reactivity and IU relate to anxiety sub-types, such as generalised anxiety disorder (GAD).

**Objectives:** In this study we aimed to elucidate the relationship between sensory reactivity, IU and anxiety subtypes in preschool-age autistic children.

## **Methods:**

54 autistic children (3-5 years, 41 males, 13 females) were assessed for sensory reactivity, IU and anxiety using observational and parent-report assessments.

Sensory reactivity was measured by the Sensory Processing Scale Inventory (SPSI) and the Sensory Assessment for Neurodevelopmental Differences (SAND). Total anxiety, and anxiety subtypes was measured by the Preschool Anxiety Scale (PAS). IU was measured using the Responses to Uncertainty and Low Environmental Structure (RULES) questionnaire.

## **Results:**

A correlation analysis was conducted to examine the relationship between sensory reactivity differences, IU, and anxiety (Table 1). Correlation analysis revealed significant correlations between sensory hyperreactivity and total anxiety ( $r_s = .56, p < .001$ ), GAD ( $r_s = .50, p < .001$ ), social anxiety ( $r_s = .47, p = .001$ ), OCD ( $r_s = .44, p = .002$ ), physical injury fears ( $r_s = .48, p < .001$ ), separation anxiety ( $r_s = .53, p < .001$ ), and IU ( $r_s = .59, p < .001$ ). IU was also significantly positively correlated with total anxiety ( $r_s = .79, p < .001$ ), GAD ( $r_s = .75, p < .001$ ), social anxiety ( $r_s = .72, p < .001$ ), OCD ( $r_s = .69, p < .001$ ), physical injury fears ( $r_s = .56, p < .001$ ), and separation anxiety ( $r_s = .72, p < .001$ ). Sensory hyporeactivity and seeking were not significantly related to anxiety or IU. The results were independent of the effects of covariates (age, IQ, verbal ability, autism traits).

Mediation analysis (Figure 1) indicated that the relationship between sensory hyperreactivity and anxiety is fully mediated by IU, as the direct coefficient was non-significant and the indirect coefficient was significant, (Direct:  $B = .16, SE = .12, LLCI = -.09, ULCI = .40$ ; Indirect:  $B = .356, SE = .10, LLCI = .27, ULCI = .65$ ), and the relationship between sensory hyperreactivity and IU is partially mediated by anxiety, as the direct coefficient and the indirect coefficient was significant (Direct:  $B = .24, SE = .12, LLCI = .00, ULLL = .47$ ; Indirect:  $B = .42, SE = .12, LLCI = .22, ULCI = .67$ ).

## **Conclusions:**

Our results suggest sensory hyperreactivity is unidirectionally related to anxiety in autistic pre-schoolers and that IU could be an important mediator and outcome in this relationship. These findings have important implications for early clinical interventions that improve outcomes for autistic children.

### **429.043 (Poster) The Role of Fatigue and Social Wellbeing in Depressive Symptomatology in Autistic Older Adolescents and Young Adults**

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## **Background:**

Social wellbeing is an individual's experience of a sense of wellbeing associated with their social context (Keyes, 1998). Social wellbeing encompasses feelings of connectedness to community and while not identical, has some similarity to, or overlap with

quality of life, life satisfaction, loneliness and social support, which are linked to depression. Lack of community involvement has been linked to poor mental health in population studies (van Lente et al., 2012), while adverse childhood experiences have been related to poor psychological wellbeing, reduced life satisfaction, and reduced social wellbeing in adulthood (Mosley-Johnson et al., 2019). However, the relationship between social wellbeing and mental health variables seems to be unexplored in autistic populations, with limited exploration in non-autistic populations.

#### Objectives:

To examine the role of social wellbeing in predicting depression in young autistic adults after accounting for sleep and fatigue which are known to be linked to depression.

#### Methods:

Participants were 113 (48 female) autistic individuals aged 15 to 25 years ( $M = 18.9$ ;  $SD = 2.5$ ) participating in the longitudinal Study of Australian School Leavers with Autism (SASLA). Independent variables included in this study were age, gender, autistic traits, sleep quality, daytime fatigue and social wellbeing (Social Integration, Social Contribution). The dependent variable of interest was depression. A 2000 bootstrap, 4-step hierarchical regression with 95% BCa was conducted predicting depressive symptomatology in a cross-sectional data set.

#### Results:

The additions of age and gender at step 1 ( $p = .623$ ) and autistic traits ( $p = .223$ ) at step 2 were not significant. However, the addition of sleep quality and fatigue at step 3 was significant ( $p = .001$ ) as was the addition of social wellbeing at step 4 ( $p = .008$ ). The final model was significant accounting for 39% of variance in depression scores,  $R^2 = .393$ ,  $F(7,55) = 5.082$ ,  $p < .001$ . Daytime fatigue 95% BCa CI [.137, .453] ( $p = .003$ ) and Social contribution 95% BCa CI [-.725, -.095] ( $p = .014$ ) were the only unique significant predictors in the final model.

#### Conclusions:

Our results support that both fatigue and lack of sense of contribution to one's community impact significantly on depressive symptomatology in older adolescents and young autistic adults. To date, research has focussed on individual factors such as poor sleep, loneliness and social supports as contributors to poor mental health in autism but, fatigue is largely unexplored. Poor sleep quality can lead to fatigue, which can be further exacerbated by daily stressors, while loneliness and lack of social supports can lead to a loss of community connectedness. Our results present new avenues for the exploration of prevention and intervention supports for depression in autism. We need to further understand what factors contribute to fatigue in autistic individuals, and what social wellbeing means for members of the autistic community

**429.044 (Poster)** Understanding Autistic People's Experiences of Anxiety: Findings from a National Cohort Study  
**E. Lomax<sup>1</sup>**, S. Brice<sup>2</sup>, C. Wilson<sup>2</sup>, B. Ingham<sup>2,3</sup>, A. LeCouteur<sup>2</sup>, J. Rodgers<sup>2</sup> and J. R. Parr<sup>2,3</sup>, (1)School of Psychology, Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, (3)Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom

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**Background:** Autistic people are more likely to experience anxiety than neurotypical people. There is also evidence to suggest that anxiety significantly impacts on daily life and is associated with lower quality of life. Previous research suggests that mental health conditions, such as anxiety, may present differently for autistic people, though most of this work has been conducted with autistic children and their families. It is therefore important to understand how anxiety is experienced by autistic adults to inform clinical assessments and plan appropriate and personalised anxiety interventions.

#### Objectives:

- To conduct a thematic analysis of free text data from a UK national survey conducted with autistic adults with anxiety, to determine how anxiety is experienced.
- Use the information to plan a personalised anxiety intervention for autistic adults.

**Methods:** 568 autistic adults (53.7% female, 42.8% male, 3.5% other genders) aged 18-77 ( $M=41.7$ ,  $SD=13.7$ ) were recruited from the Adult Autism Spectrum Cohort- UK (ASC-UK; <https://research.ncl.ac.uk/adultautismspectrum/>). In the survey, participants (or a relative/supporter as a proxy reporter) answered:

1. (childhood) Please describe briefly what made you most anxious at that time.
2. What was it about that situation that was difficult?
3. (adulthood) Please describe briefly what made you anxious at the time?
4. What was it about the situation that was difficult?
5. If you feel able to, please briefly describe the impact that anxiety has had on your life, either now or in the past
6. Everyone copes with their anxiety in different ways. Have you found any successful ways of coping with your anxiety that might be helpful for other autistic adults to try?

Free text data were available from 555 participants and subject to thematic analysis.

**Results:** Three overarching themes relevant to both childhood and adulthood were identified: “sensory issues”, “difficulty socialising” and “intolerance of uncertainty”, as important factors in relation to why autistic people experience anxiety. Themes specific to childhood included “attending school” and “negative family events”, whilst adulthood specific themes included “failing to meet own and/or others’ expectations”, “not fitting in” and “lack of control”. In terms of how anxiety impacts on daily life themes related to “poor mental and physical health”, “limited opportunities” and “isolation”. 82% ( $n=407$ ) of responders identified as coping strategies: “hobbies”, “prescribed and non-prescribed interventions (including medication, substance misuse and non-pharmacological interventions, such as mindfulness)” and “increased responsibility and control over life and the environment”.

**Conclusions:** Anxiety experienced by autistic children and adults may be underpinned by difficulties with uncertainty, social situations and the sensory environment. When present, anxiety has a wide-ranging impact on daily life indicating the importance of a detailed and personalised formulation to guide intervention. These findings have informed our current research programme evaluating three individualised approaches to anxiety interventions for autistic adults and children: Coping with Uncertainty in Everyday Situations; Personalised Anxiety Treatments for Autistic Adults and Virtual Reality Environment interventions for situation specific anxiety.

**429.045 (Poster)** Understanding the Role of Sex in Depression Symptoms in Early Adolescents with and without Autism Spectrum Disorder

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**Background:** Adolescents with Autism Spectrum Disorder (ASD) endorse higher levels of depression than their typically-developing (TD) peers. Enhanced screening for depression is vital given the association between earlier detection, earlier intervention, and improved long-term outcomes. Similarly, adapted interventions informed by empirical study appear more effective than standard delivery in youth with ASD. To date, no studies have examined sex-based differences in prevalence and type of depressive symptoms endorsed by early adolescents with ASD as compared to TD peers, which may inform treatments.

**Objectives:** The primary objective of this study was to examine the role of sex in the prevalence of depression in early adolescents (10:0-13:5 years) with and without ASD based on self-reports on the Children’s Depression Inventory, Second Edition (CDI-2). A secondary aim was to identify specific depressive symptoms endorsed by early adolescents based on diagnosis and sex using item-level analyses of CDI-2 responses.

**Methods:** The sample included 212 early adolescents (144 males, 68 females), of which 125 had ASD (93 males, 32 females, mean age = 11.4 years) and 87 were TD peers (51 males, 36 females, mean age = 11.5 years). Participants rated depressive symptoms on the CDI-2 independently of their parents during the first year of a longitudinal study of pubertal development in ASD (Corbett, 2017). To understand the roles of sex and diagnosis in depression prevalence, a two-way ANCOVA was employed to assess sex- and diagnostic-based differences in CDI-2 Total T-scores with Full Scale IQ and age as covariates. A series of Mann-Whitney U tests were employed to examine the specific depressive symptoms that were differentially endorsed based on sex and diagnosis. The  $p$ -values were adjusted based on a 5% false discovery rate using the Benjamini-Hochberg procedure, and the magnitude of each comparison was measured using probability of superiority effect size ( $PS$ ; Ruscio, 2008).

**Results:** Results from the two-way ANCOVA revealed significant main effects of sex ( $d = 0.365$ , 95% CI [0.089, 0.641],  $p = 0.023$ ) and diagnosis ( $d = 0.587$ , 95% CI [0.308, 0.867],  $p < 0.001$ ). However, the interaction of sex and diagnosis was not significant ( $p = 0.321$ ). Early adolescents with ASD and females reported higher levels of depression symptoms, with the highest symptom severity among females with ASD. Item-level analyses demonstrated diagnostic-based differences on 12 of the 28 CDI-

2 items (PS range = 0.42-0.65), especially in terms of interpersonal problems and negative self-esteem. In terms of sex, there were no significant differences in items endorsed within diagnostic groups. However, males with ASD endorsed 10 items more frequently than their male TD peers (e.g., anhedonia, peer conflict, unlovable), while females with ASD endorsed 2 items more frequently than their female TD peers (e.g., worthlessness, not as good as other kids).

**Conclusions:** Findings indicate that sex and diagnosis may be particularly important in understanding depression prevalence and type of symptoms in early adolescents with ASD. A more nuanced understanding of distinct symptom profiles may uncover salient intervention targets for the treatment of depression in the unique context of ASD.

**429.046 (Poster)** Utility of Complex Trauma Questionnaires for Adults on the Autism Spectrum with Mild Intellectual Disability: A Systematic Review

**I. McKinnon<sup>1</sup>, S. Wigham<sup>1</sup>, K. Reid<sup>2</sup>, D. Milton<sup>3</sup>, R. Lingam<sup>2</sup> and J. Rodgers<sup>1</sup>,** (1)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, (2)Cumbria, Northumberland Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, (3)Tizard Centre, University of Kent, Canterbury, United Kingdom

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**Background:** Identification of trauma in people on the autism spectrum with intellectual disability is difficult as there are few trauma assessment tools available. Trauma questionnaires can support clinical case recognition, information gathering and formulation, and facilitate research evaluations of interventions for trauma-related mental health conditions during clinical trials. However research suggests existing trauma questionnaires may not capture all symptoms of trauma relevant to autistic people with intellectual disabilities. Research suggests some trauma symptoms e.g. avoidance may be difficult to identify in people on the autism spectrum with intellectual disability while emotion dysregulation and interpersonal difficulties may be useful indicators.

**Objectives:** The aims of this two-stage review were to (i) identify questionnaires used in neuro-typical complex trauma intervention evaluations to measure emotion dysregulation and interpersonal difficulties and (ii) evaluate their psychometric properties. Finally, to discuss potential utility of the questionnaires for people on the autism spectrum with mild intellectual disability and co-occurring trauma-related mental health conditions.

**Methods:** In Stage 1 four electronic databases (Medline, Cinahl, Embase, PsychInfo) were searched for neuro-typical complex trauma intervention studies. Second reviewers completed 20% of article sifting. In Stage 2 we used a formal search filter in Embase to identify articles evaluating the psychometric properties of the questionnaires used to measure emotion dysregulation and interpersonal difficulties in the Stage 1 studies. The quality of psychometric evidence for each measure was then assessed using the COSMIN (COnsensus based Standards for the selection of health based Measurement INstruments) risk of bias checklist and this information was synthesized narratively.

**Results:** Twenty-one complex trauma intervention studies were identified in Stage 1 and they utilised four measures of emotion dysregulation and interpersonal difficulties. These measures included the Emotion Regulation Questionnaire, the Difficulties in Emotion Regulation Scale, the Inventory of Interpersonal Problems and the Inventory of Altered Self-Capacities. Thirty-five articles on their psychometric properties were identified during Stage 2 of the review. While unique qualities were identified for all four measures, overall the findings suggested the strongest psychometric evidence was for the Emotion Regulation Questionnaire (ERQ), and the Difficulties in Emotion Regulation Scale (DERS). While evaluations of content validity were scarce, several international versions of the ERQ and the DERS were evaluated and found to have good internal reliability, structural validity and construct validity across a range of clinical and neuro-typical groups.

**Conclusions:** Reviewing the psychometric properties of questionnaires used in neuro-typical complex trauma research is an important preliminary stage in a process of exploring their utility and appropriateness for autistic people with mild intellectual disability. Evaluation of content validity and acceptability of the ERQ and DERS for people on the autism spectrum with mild intellectual disability will be useful next steps to inform future use and/or adaptation in the context of trauma-related mental health conditions.

## Molecular Genetics

### PANEL DISCUSSION — MOLECULAR GENETICS

#### Panel 205 - ASD Genetics: New Data and New Insights

**CoChair: Joseph Buxbaum**, *Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY*

**Panel Chair: Elise Robinson**, *Program in Medical and Population Genetics, Broad Institute of MIT and Harvard, Cambridge, MA*

ASD genetics data sets have grown substantially over the last year, further clarifying the disorder's genetic architecture. In this session, panelists will describe recent work of the Autism Sequencing Consortium, introducing new ASD-associated genes and comparing ASD's genetic basis to that of schizophrenia and intellectual disability. Panelists will also introduce new work characterizing ASD risk subsequent to structural and noncoding variation. Lastly, the panel will consider the heterogeneity of ASD through the lenses of both phenotypic and genetic data.

**205.001 (Panel Discussion)** Identification and Characterization of Noncoding De Novo Variants in Autism  
*T. N. Turner*, *Department of Genetics, Washington University in St. Louis, St. Louis, MO*

**Background:** Large-scale gene discovery in autism has been facilitated by whole-exome sequencing and has led to the identification of protein-coding *de novo* genetic variants relevant in ~30% of individuals with autism. While these discoveries have been critical, there is still an appreciable gap in our understanding of genetic contributions to autism. Recently, whole-genome sequencing has enabled characterization of other forms of genetic variation not detectable with previous technologies. In this talk, I will focus on *de novo* noncoding variants involved in the regulation of genes.

**Objectives:** We and others have previously discovered a role for *de novo* variants in noncoding regulatory regions of the genome and predict that they explain 2-5% of individuals with autism. The objective of this talk is to describe current topics in the study of noncoding variation in autism. In particular, I will discuss our assessment of whole-genome sequencing data in autism, development of new approaches to analyze noncoding variants, and detailed characterization of one enhancer with enrichment of *de novo* variants.

**Methods:** We called single-nucleotide variants, insertions/deletions, and structural variants from whole-genome sequencing data in 2,671 families with autism. To assess statistical significance of *de novo* variants in specific noncoding regions involved in the regulation of genes (enhancers) we modified a statistical model, previously used to test protein-coding variants, to test for significance in these enhancers. We applied this to a discovery cohort of 516 previously published families and a replication cohort of 2,155 families. As we describe in the results, one enhancer was enriched for variation in both discovery and replication cohorts. We performed extensive bioinformatic, functional, expression, and phenotypic assessment of this enhancer.

**Results:** Statistical assessment of enhancers identified one enhancer with nominal significance in both the discovery ( $p = 0.0172$ ) and replication ( $p = 2.5 \times 10^{-3}$ ) cohorts. There were three *de novo* variants in this enhancer all residing in a transcription factor binding site or conserved region. By luciferase assays, we found that the variants each affect the function of the enhancer. Our further assessment found that the enhancer is sensitive to dosage in the population, is active during early embryonic development in the brain, and by Hi-C analysis targets the *EBF3* gene. Protein-coding variants in this gene are genome-wide significant for enrichment in neurodevelopmental disorders. We found that individuals with variants in the enhancer share some phenotypes with individuals with protein-coding variants in this gene, but individuals with noncoding variants tend to have less severe phenotypes.

**Conclusions:** We are beginning to understand the role of noncoding variants in autism. Comprehensive understanding of the functional impact that these variants and the regulatory networks that are involved are critical for the next phase of understanding the genetics of autism and a more thorough model of its underlying genetic etiology.

**205.002 (Panel Discussion)** Cross-Disorder Dosage Sensitivity Mapping in the Human Genome  
*R. L. Collins*<sup>1</sup>, *H. Brand*<sup>2</sup> and *M. E. Talkowski*<sup>1</sup>, (1)Division of Medical Sciences, Harvard Medical School, Boston, MA, (2)Program in Medical and Population Genetics, Broad Institute of MIT and Harvard, Cambridge, MA

**Background:** Rare deletions and duplications of genomic segments, collectively known as rare copy number variants (rCNVs), are important contributors to autism spectrum disorder (ASD) and other neurodevelopmental disorders (NDDs). To date, most studies of rCNVs in NDDs have focused on recognized genomic disorders or on the impact of haploinsufficiency caused by deletions. By comparison, our understanding of duplications in NDDs remains rudimentary as very few individual genes are known to be triplosensitive (*i.e.*, duplication intolerant).

**Objectives:** In this study, we aimed to (1) identify disease-associated rCNV loci, (2) understand the genomic properties of these loci, and (3) develop a statistical model to predict dosage sensitivity for all human genes.

**Methods:** We meta-analyzed rCNVs from 753,994 individuals aggregated from 13 cohorts to create a genome-wide catalog of rCNV association statistics across 30 primarily neurological disease phenotypes. In order to understand the genomic features that drive rCNV-disease associations, we combined all genome-wide significant ( $P=3.72 \times 10^{-6}$ ) regions with a curated list of genomic disorders previously reported in the literature and analyzed this merged dataset for enrichments of known disease genes, mutationally constrained genes, and *de novo* mutations (DNMs) identified in individuals with ASD or NDD in prior exome sequencing studies. Finally, we developed a statistical model to predict dosage sensitivity for all genes.

**Results:** We discovered 114 rCNV-disease associations at 52 distinct loci surpassing genome-wide significance, 42% of which involve duplications. Nearly all loci (87%; 45/52) were associated with at least one neurological phenotype and half (50%; 26/52) were associated with ASD or NDDs. Using Bayesian fine-mapping methods, we further prioritized 38 novel triplosensitive disease genes (*e.g.*, *GMEB2* in brain abnormalities), including three known haploinsufficient genes that we now reveal as bidirectionally dosage sensitive (*e.g.*, *ANKRD11*). We found that disease-associated rCNV segments were enriched for genes constrained against damaging coding variation and identified likely dominant driver genes for about one-third (32%) of rCNV segments based on DNMs from exome sequencing of ASD and NDDs. Finally, we developed a machine learning model to define 3,006 haploinsufficient and 295 triplosensitive genes where the effect sizes of rCNVs in NDDs were comparable to deletions of genes constrained against truncating mutations. These dosage sensitivity scores classified disease genes across molecular mechanisms and prioritized pathogenic *de novo* rCNVs in children with ASD.

**Conclusions:** Our study demonstrates that rCNVs confer substantial disease risk across a range of loci and disease phenotypes, particularly ASD and NDDs. We further show that most rCNVs with strong effects in disease likely act through the direct disruption of one or more protein-coding genes. While the presence of constrained driver genes was a common feature of many pathogenic large rCNVs across disorders, most of the genome-wide significant rCNVs were incompletely penetrant and some appeared not to involve any alterations to protein-coding genes. Collectively, the cross-disorder rCNV maps and metrics derived in this study provide a comprehensive assessment of dosage sensitive loci in disease to date and set the foundation for future studies of dosage sensitivity throughout the human genome.

### 205.003 (Panel Discussion) Genetics and ASD Heterogeneity

**E. B. Robinson<sup>1</sup>**, C. E. Carey<sup>2</sup>, S. S. Kuo<sup>3</sup>, J. Taylor<sup>4</sup>, C. van der Merwe<sup>5</sup> and D. Weiner<sup>5</sup>, (1)Program in Medical and Population Genetics, Broad Institute of MIT and Harvard, Cambridge, MA, (2)Analytic and Translational Genetics Unit, Massachusetts General Hospital, Boston, MA, (3)Stanley Center for Psychiatric Research, Broad Institute of MIT and Harvard, Cambridge, MA, (4)Psychiatry, Brigham and Women's Hospital, Boston, MA, (5)Harvard Medical School, Boston, MA

**Background.** Autism spectrum disorder (ASD) is characterized by social communication impairment and restricted, repetitive behaviors and interests. While impairment in these domains is definitional to ASD, it is far from uniform and ASD is broadly heterogeneous. People with ASD vary enormously in their functional independence, cognitive and language abilities, and medical comorbidities. Many of these differences reflect genetic heterogeneity, as well as broader variation in the causal architecture of ASD.

**Objectives.** This project was designed to clarify heterogeneity within and between ASD research cohorts.

**Methods.** We aggregated phenotype and genotype data from several family-based ASD cohorts (Simons Simplex Collection (SSC); Simons Powering Autism Research (SPARK); the Autism Genetic Resource Exchange (AGP); and the Autism Simplex Collection (TASC)). We compared the data sets in terms of key phenotypic variables (*e.g.* mean case IQ, score on the Vineland Scales of Adaptive Behavior, developmental milestone timing) and genetic architecture (*e.g.* rate of high impact *de novo* variants; over-transmission of polygenic risk for ASD from parents to affected children). Using simulated data, we also estimated the impact of ASD heterogeneity on GWAS and sequencing efforts.

**Results.** The data sets varied in ways that reflected their collection decade and ascertainment approach. Newer data sets (*e.g.* SPARK) most reflect ASD's diagnostic expansion – a larger fraction of probands are functionally independent. Shifts in average

case severity were also induced by study selection criteria. The SSC excluded case individuals with craniofacial dysmorphism or other indicators of syndromic medical conditions. This induced a shift in average genetic architecture, as well as in genotype to phenotype relationships. For example, for probands with a disruptive *de novo* variant in genes associated with ASD and ID, we observed lower rates of gross motor impairment and seizure disorders among SSC cases as compared to TASC cases. Results of the simulated data analysis showed that some genetic influences on ASD risk will be easier to detect in restricted analyses (e.g. GWAS that only include ASD case individuals without co-occurring intellectual disability).

**Conclusions.** As the average ASD phenotype varies between collections, and is changing over time, genetic studies of ASD will need to thoughtfully consider issues of replication. The heterogeneity of ASD produces challenges for genetic research, but is also likely to present opportunities to better identify and understand points of intersection among risk factors. These intersections could highlight genetic results and biological pathways most relevant to large numbers of people with ASD.

**205.004 (Panel Discussion) Large-Scale Gene Discovery in Autism and Comparison to Schizophrenia and Developmental Delay**  
**F. K. Satterstrom**<sup>1,2,3,4</sup>, J. Fu<sup>3,4</sup>, H. Brand<sup>3,4</sup>, S. Dong<sup>3</sup>, S. De Rubeis<sup>6,7</sup>, X. Zhao<sup>3,4</sup>, R. L. Collins<sup>3,4,8</sup>, C. E. Carey<sup>1,2,3,4</sup>, C. van der Merwe<sup>1,2,4</sup>, C. Stevens<sup>2,4</sup>, C. Cusick<sup>2,4</sup>, D. E. Dickel<sup>9</sup>, L. A. Pennacchio<sup>9</sup>, L. Klei<sup>10</sup>, A. D. Borglum<sup>11,12,13</sup>, E. B. Robinson<sup>1,2,3,4,14</sup>, D. J. Cutler<sup>15</sup>, J. D. Buxbaum<sup>6,7,16,17</sup>, M. J. Daly<sup>1,2,3,4,18</sup>, K. Roeder<sup>19</sup>, B. Devlin<sup>10</sup>, S. J. Sanders<sup>5</sup> and M. E. Talkowski<sup>2,3,8,20</sup>, (1)Analytic and Translational Genetics Unit, Massachusetts General Hospital, Boston, MA, (2)Stanley Center for Psychiatric Research, Broad Institute of MIT and Harvard, Cambridge, MA, (3)Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, (4)Program in Medical and Population Genetics, Broad Institute of MIT and Harvard, Cambridge, MA, (5)Department of Psychiatry, Weill Institute for Neuroscience, UCSF School of Medicine, San Francisco, CA, (6)The Mindich Child Health and Development Institute, Icahn School of Medicine at Mount Sinai, New York, NY, (7)Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, (8)Division of Medical Sciences, Harvard Medical School, Boston, MA, (9)Environmental Genomics and Systems Biology Division, Lawrence Berkeley National Lab, Berkeley, CA, (10)Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, (11)iSEQ, Center for Integrative Sequencing, Aarhus University, Aarhus, Denmark, (12)The Lundbeck Foundation Initiative for Integrative Psychiatric Research, iPSYCH, Aarhus, Denmark, (13)Department of Biomedicine-Human Genetics, Aarhus University, Aarhus, Denmark, (14)Department of Epidemiology, Harvard School of Public Health, Boston, MA, (15)Department of Human Genetics, Emory University School of Medicine, Atlanta, GA, (16)Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, (17)Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, New York, NY, (18)Institute for Molecular Medicine Finland (FIMM), University of Helsinki, Helsinki, Finland, (19)Department of Statistics and Data Science, Carnegie Mellon University, Pittsburgh, PA, (20)Department of Neurology, Massachusetts General Hospital, Boston, MA

**Background:** Rare genetic variants, particularly *de novo* (newly arising) mutations, play an important role in individual risk for autism spectrum disorder (ASD). A decade ago, we formed the Autism Sequencing Consortium to collaborate with clinicians and research groups around the world in an effort to identify the types of rare variants that confer risk for ASD and the genes where they occur. As our datasets have grown, so have our findings – from 33 genes identified as ASD-associated at a false discovery rate (FDR)  $\leq 0.1$  in 2014 (De Rubeis *et al.*, *Nature* 515:209-215) to 65 genes in 2015 (Sanders *et al.*, *Neuron* 87:1215-1233) to 102 genes recently (Satterstrom, Kosmicki, Wang *et al.*, 2020, *Cell* 180:568-584).

**Objectives:** We seek to 1) identify novel ASD-associated genes and 2) learn more about the neurobiology of ASD by analyzing the set of ASD-associated genes, as well as by comparing it to genes associated with other neurodevelopmental disorders. To achieve the first goal, we combine our data with publicly available data from SPARK, the Simons Foundation study of ASD, which doubles our sample size and increases our power for gene discovery. To inform the second, we draw upon studies of schizophrenia and more broadly defined developmental delay.

**Methods:** We present the largest autism-focused sequencing study to date. We analyze the exome sequences from over 20,000 individuals with ASD, including *de novo* variants from 14,578 probands and 5,391 unaffected siblings, as well as rare variants from 5,590 cases (primarily from the iPSYCH study in Denmark) and 8,588 controls. We call copy number variants in addition to single nucleotide variants and short insertion/deletions, and we use an enhanced version of a Bayesian model called TADA (He *et al.*, 2013, *PLoS Genetics* 9:e1003671) to integrate the different classes of variation into a single association framework. After analyzing our data on its own, we also analyze it alongside data from the Schizophrenia Exome Meta-Analysis (SCHEMA) study of schizophrenia (Singh *et al.*, 2020, <https://www.medrxiv.org/content/10.1101/2020.09.18.20192815v1>) and the Deciphering Developmental Disorders (DDD) study of developmental delay (Kaplanis, Samocha, Wiel, Zhang *et al.*, 2020, *Nature* 586:757-762).

**Results:** We find 255 genes associated with ASD at a threshold of FDR  $\leq 0.1$ , of which 71 meet FDR  $\leq 0.001$ , approximately corresponding to Bonferroni correction. Analyzing our data and DDD together, we identify 352 genes at the same threshold (86 more than DDD alone). While many genes are associated with both ASD and developmental delay, we identify a set of genes clearly associated with ASD that have little signal in DDD and, among these, a set that overlaps risk signal in schizophrenia.

*Conclusions:* Our analyses provide a significant advance in ASD gene discovery and support both shared and distinct contributions of the genes underlying different neurodevelopmental phenotypes. Next, we plan to expand our analyses to include *de novo* variation from a new wave of 2,000 ASD probands from SPARK whose data has recently been released, and we will share preliminary results at the meeting.

## PANEL DISCUSSION — MOLECULAR GENETICS

### Panel 233 - Large-scale Gene Discovery in Autism and Converging Pathways of Autism Risk

**Panel Chair:** Joseph Buxbaum, *Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY*

Large-scale genetic and genomic studies have identified structural variants and gene mutations that confer very high risk for ASD. These studies have implicated tens of recurrent structural variants and hundreds of genes in autism risk. This etiological heterogeneity is daunting, and it has overturned hopes for a single, primary, molecular and/or cellular pathway for autism risk, hence precision medicine approaches will be critical for novel interventions. This panel will summarize the recent focus on whether the genetic and genomic discoveries converge into a smaller number of pathways, which would greatly facilitate precision treatments. Knowing recurrent pathways to autism will also permit intervention in those that do not have a defined genetic mutation. The speakers will share results on the functional follow up of multiple genetic/genomic discoveries using molecular, cellular and animal model approaches.

**233.001** (*Panel Discussion*) Neuroanatomical Convergence in Autism Related Mouse Models

**J. Ellegood<sup>1</sup>, Y. Yee<sup>1</sup> and J. P. Lerch<sup>1,2</sup>,** (1)*Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada,* (2)*Wellcome Centre for Integrative Neuroimaging (WIN), University of Oxford, Oxford, United Kingdom*

**Background** – Over the past 12 years, we have established a magnetic resonance imaging (MRI) database of mouse models related to autism, which allows us to investigate convergence in the neuroanatomy in a large autism population. This further provides us with a metric by which we can cluster these models and examine commonalities and differences between them in the hope of subcategorizing autism.

**Objectives** – The purpose here is two-fold. 1) Characterize and cluster our dataset of 125 different mouse models related to autism, and 2) Examine the convergence of the neuroanatomy and how it relates to specific biological pathways and disease phenotypes.

**Methods** – The data used in this study was collected from 125 different autism related mouse lines and includes over 4000 mice. Imaging was performed *ex-vivo* using a 7T MRI with a T2 weighted, 3D fast spin echo sequence which acquires data at an isotropic resolution of 40  $\mu\text{m}$  (Spencer Noakes et al. 2017).

**Data Analysis** – To visualize and compare any differences, the images are registered together (Lerch et al., 2011). Voxelwise difference in both absolute ( $\text{mm}^3$ ) and relative volume (% total brain vol.) are calculated from each of the 125 different models. This data is then combined using similarity network fusion to create a fused dataset that incorporates both these differences. Spectral clustering was used to cluster the fused dataset and cluster divisions were determined from 2 to 10 total clusters.

**Bioinformatics** – Online databases, including StringDB ([string-db.org](http://string-db.org)), the Reactome Pathway Database ([reactome.org](http://reactome.org)), Human Phenotype Ontology ([hpo.jax.org](http://hpo.jax.org)), and the gene sets provided by the Bader Lab ([baderlab.org](http://baderlab.org)) (Merico et al., 2010) were used to link specific molecular pathways and disease phenotypes to our clusters to provide more information about potential common determinants that underlie the models.

**Results** – Our data suggests that the autistic phenotype both preferentially affects key regions of the brain, but also divides the autism neuroanatomical phenotype based on directionality and localization of the differences throughout the brain. The data shows that the autism phenotype is broad as there was little overlap between the high confidence autism related genes nor the comorbid/syndromic genes. The clusters represent known connections, like 16p11.2(df/+), Taok2, and Cul3; and Chd8 and Arid1b; but they also highlight unknown connections between Pten, Nrnx1a, and Taok2; and 16p11.2(dp/+), 15q11-13, and Dyrk1a(+/-). Additionally, two clusters were linked specifically to “signaling by wnt”, “MAPK family signaling”, and “signaling by hedgehog” and another two clusters to “transmission across the synapse” and “chromatin organization”.

**Conclusions** – The work presented here shows that, as seen through the lens of brain structure, there is more than one autism. These autism subtypes span related disorders and can in part be identified by the shared pathways of the originating mutation. Clustering autism based on brain phenotypes and linked genetic pathways will help to further categorize the autistic population to aid with a more specific diagnosis and hopefully, in the future, better treatment options.

**233.002** (Panel Discussion) Using 3D Models of Brain Development to Study Convergence in ASD

*A. Gordon, UCLA, Los Angeles, CA*

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**Background:** Genetic studies have connected mutations in hundreds of different genes with autism spectrum disorders (ASD). This genetic heterogeneity highlights the importance of identifying convergent biological pathways and molecular mechanisms. In this regard, studies have identified a common pattern of changes in gene expression in post-mortem brain from individuals diagnosed with ASD. However, it still is not known to what extent do the many different genetic risk variants associated with ASD lead to common dysregulated pathways in brain development and function. The advent of human stem cell-based systems allows for the modeling of typical early human brain development, as well as potential disruptions in ASD. Cortical organoids, which are 3D models of cortical development, were recently shown to model human cortical development more faithfully than the more traditional 2D models. These models can serve as a powerful complement to animal models to interrogate the neurobiological impact of disease-associated common and rare genetic risk variants in ASD.

**Objectives:** To investigate how different genetic developmental disorders associated with ASD affect cortical development and to test the hypothesis as to whether there are convergent phenotypes in distinct genetic forms of ASD during cortical development.

**Methods:** We generated 3D brain organoids from stem cells derived from individuals with one of nine different genetic developmental disorders associated with ASD (16p11.2 deletion, 16p11.2 duplication, 15q13.3 deletion, 22q13.3 deletion, 22q11.2 deletion, PCDH19 mutations, CACNA1C mutations (Timothy syndrome), and SHANK3 mutations). We profiled 30 individuals with one of the known mutations, 8 with idiopathic ASD, and 17 controls and collected 464 samples for analysis at four timepoints during organoid differentiation. We used functional genomic analysis to identify common pathways dysregulated across these multiple forms of ASD during early brain development up to 15 weeks in vitro.

**Results:** Transcriptomic changes implicate the early stages of cortical development during cortical neurogenesis, largely affecting progenitor cell types. The transcriptomic patterns allowed us to robustly cluster the different mutations into subgroups, suggesting that different genetic forms of ASD follow the same developmental trajectory and that there are a number of distinct developmental trajectories that may underlie ASD.

**Conclusions:** Cortical organoids are an effective way to study the early stages of brain development and the changes that occur at these stages in ASD. Combining functional genomics with these cortical organoids allows us to identify shared molecular processes across different genetic forms of ASD during early cortical development and to categorize different groupings of different genetic forms of ASD based on these changes. We believe that this type of analysis may help in the discovery of new drug targets and in improving design of drug trials.

**233.003** (Panel Discussion) Functional Convergence Across Genes Associated with Neuropsychiatric Disorders

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**Background:** The past decade has seen tremendous progress in identifying the genes underlying autism spectrum disorder, neurodevelopmental delay, and schizophrenia. These genes provide an entrée into the underlying neurobiology and the opportunity to access functional similarities and differences within and between conditions.

**Objectives:** To perform parallel analyses of genes associated with neuropsychiatric conditions in the context of functional datasets to provide insights into when, where, and how disruption of these genes may lead to the observed phenotypes.

**Methods:** Genes with genome-wide significant evidence of association from exome and genome sequencing were identified from the literature and ongoing analyses from autism spectrum disorder, neurodevelopmental delay, and schizophrenia. These were integrated with data from gene ontologies, literature on gene function, gene expression in the developing human brain, and single cell gene expression data in the developing human brain

**Results:** There is substantial overlap with genes associated with neurodevelopmental delay and autism spectrum disorder and neurodevelopmental delay and schizophrenia, but no genes overlap between autism spectrum disorder and schizophrenia. Across the gene sets, four major functional groups are apparent: gene expression regulation (e.g., transcription factors), neuronal

communication (e.g., synaptic proteins), cytoskeleton, and cell signaling. All four groups are represented in the gene sets from all three disorders. Almost all genes are expressed in the developing human cortex, many of them starting early during prenatal development. Gene function is more predictive of expression trajectory than phenotype. Single cell analyses strongly implicate neurons across all three conditions based on both enrichment analyses and absolute expression.

**Conclusions:** Convergent patterns of gene function and neuron-specific expression are apparent between all three disorders, even though there is substantial heterogeneity in the individual gene lists and expression trajectories across development.

**233.004 (Panel Discussion)** Parallel In Vivo Analysis of Large-Effect Autism Genes Implicates Neurogenesis and Estrogen in Risk and Resilience

**H. R. Willsey<sup>1</sup>, C. R. Exner<sup>1</sup>, Y. Xu<sup>1</sup>, A. Everitt<sup>1</sup>, N. Sun<sup>1</sup>, T. Nowakowski<sup>1</sup>, R. M. Harland<sup>2</sup>, A. J. Willsey<sup>1</sup> and M. W. State<sup>1</sup>,**  
(1)University of California San Francisco, San Francisco, CA, (2)UC Berkeley, Berkeley, CA

**Background:** Over the last decade, dozens of genes carrying *de novo* variants have been identified, each contributing large biological effects to autism spectrum disorders (ASD). The remarkable degree of locus and biological heterogeneity so far identified has raised concerns of an impenetrably complex biology and the necessity for a multitude of individualized treatments. Starting from the earliest successful efforts at systematic ASD gene discovery, systems biological analyses have pointed to a more coherent underlying structure of ASD pathology. However, convergent phenotypes and their corresponding biological pathways have not been systematically explored across multiple risk genes.

**Objectives:** Here we studied multiple ASD risk genes in parallel *in vivo* in order to identify points of functional convergence during brain development as well as small molecule modulators of ASD risk gene disruption.

**Methods:** We used the diploid frog *Xenopus tropicalis* to study, *in vivo*, ten genes with the strongest statistical evidence for association with ASD by CRISPR-Cas9 mutagenesis. We used systematic small molecule screening in *Xenopus* to identify compounds intersecting the biology of these genes. Finally, we used *Xenopus* and human models of brain development to dissect and validate the underlying molecular mechanisms.

**Results:** All ten high-confidence ASD genes are expressed in the *Xenopus* developing telencephalon at timepoints mapping to human mid-prenatal development and loss of function mutations lead to an increase in the ratio of excitatory neural progenitor cells to maturing excitatory neurons in the dorsal forebrain. Systematic small molecule screening identified that estrogen, via Sonic hedgehog signaling, rescued this convergent phenotype in *Xenopus* and human models of brain development.

**Conclusions:** This work supports previous *in silico* systems-biological findings implicating cortical excitatory neurons in ASD vulnerability, and extends them by demonstrating that ten of the most strongly associated ASD genes converge on neurogenesis of these cell types--despite apparent diverse cellular functions. It also suggests estrogen as a resilience factor that may mitigate a broad range of ASD genetic risks, an intriguing finding given the strong male sex bias in ASD diagnosis.

## POSTER SESSION — MOLECULAR GENETICS

### Poster 430 - Molecular Genetics Posters

**430.001 (Poster)** Integrated Analysis of 28,642 Individuals Recruited Online Identifies New ASD Risk Genes and Highlights the Interplay of De Novo and Inherited Variants

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Background: Autism spectrum disorder (ASD) is highly heritable based on data from large population and twin studies. ASD risk is complex and stems from genetic and non-genetic factors. Studies have identified ~100 ASD genes, yet most risk genes are unknown. SPARK (SPARKForAutism.org), a national research cohort, has recruited tens of thousands of recontactable families affected with ASD, allowing longitudinal phenotypic and genomic characterization.

Objectives: Significantly larger sample sizes are needed to identify all genetic risk factors for ASD.

Methods:

10,242 ASD cases from 9,136 SPARK families were genotyped with 654,027 SNPs (Infinium Global Screening Array v 2.0) and exome sequenced. We identified *de novo* variants (DNVs) from 10,097 SPARK trios (including 7,051 affected individuals and 3,046 unaffected siblings) and meta-analyzed with DNVs from 9,847 published autism trios. To identify new autism risk genes, we applied DeNovoWEST to test the enrichment of *de novo* damaging variants in each gene. We also applied a modified version of TADA that integrates gene level constraint and allows a fraction of risk genes to harbor only deleterious missense variants. To analyze the contribution of inherited variants to ASD risk, we applied a transmission disequilibrium test to rare loss of function (LoF) variants in 9621 autism trios and 193 parent-ASD offspring pairs from SPARK and the Simons Simplex Collection (SSC). CNVs were called from SNP chromosome microarrays and normalized exome read depth using multiple pipelines.

Results: Forty-seven genes were identified as exome-wide significant by DeNovoWEST ( $p < 0.05 / (2 * 19000) = 1.3e-6$ ); most of these genes have been implicated in autism or NDDs. To further prioritize candidate genes, we applied a modified TADA and identified 145 genes that fall below the commonly used threshold of  $FDR < 0.1$ . A comparison of significance values (by DeNovoWEST) to posterior probability of association (PPA) shows that the top 100 PPA-ranked genes by modified TADA all have significant p-values from DeNovoWEST ( $p < 1E-3$ ) and therefore can be considered high-confidence autism candidate risk genes. DNVs in these 100 genes and 359 known NDD genes explain two-thirds of the overall enrichment of this class of variants in individuals with ASD versus controls. We also found significant over-transmission of rare, likely gene-disrupting variants (1.13x,  $p = 1.8e-9$ ) in LoF intolerant genes (ExAC  $pLI \geq 0.5$ ). Variants in the high-confidence ASD risk genes and 359 known NDD genes account for less than 15% of the over-transmission of rare, inherited variants, suggesting that many risk genes harboring inherited LoF variants remain to be identified.

We identified the first gene, *UBR1*, that increases ASD risk only through inherited variants ( $p_{Meta} = 1.36E-06$ ). No transmitting parent of a *UBR1* mutation has an ASD diagnosis, consistent with reduced penetrance. Only one of the 22 SPARK or SSC probands harboring deleterious alleles of *UBR1* has intellectual disability and this individual also harbors a damaging variant in *TSC1*.

Conclusions: Our results highlight the value of sequencing ASD exomes at scale, leading to new insights on inherited risk in ASD. Samples from the ongoing recruitment efforts of SPARK will help address the missing heritability in ASD.

**430.002 (Poster)** The Clinical and Molecular Consequences of Variation in the Chromodomain DNA Helicase Binding Protein (CHD) Gene Family

**M. A. Gillentine<sup>1</sup>, E. E. Eichler<sup>2</sup>, T. Wang<sup>3</sup>, K. Hoekzema<sup>4</sup>, J. Rosenfeld<sup>5</sup>, P. Liu<sup>6</sup>, T. Nowakowski<sup>6</sup>, M. Nordenskjold<sup>7</sup>, J. Gecz<sup>8</sup>, R. K. Earl<sup>9</sup>, F. Kooy<sup>10</sup>, X. Kun<sup>3</sup> and M. I. Valenzuela Palafoll<sup>11</sup>.** (1)Genome Sciences, University of Washington, Seattle, WA, (2)Department of Genome Sciences, University of Washington, Seattle, WA, (3)Center for Medical Genetics, School of Life Sciences, Central South University, Changsha, China, (4)Baylor College of Medicine, Houston, TX, (5)Baylor Genetics, Houston, TX, (6)University of California San Francisco, San Francisco, CA, (7)Karolinska Institutet, Stockholm, Sweden, (8)Adelaide Medical School and the Robinson Research Institute, University of Adelaide, Adelaide, Australia, Adelaide, SA, Australia, (9)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (10)Department of Medical Genetics, University of Antwerp, Edegem, Belgium, (11)Hospital Vall d'Hebron, Barcelona, Spain

Background: Genes underlying neurodevelopmental disorders (NDDs) converge on shared functional networks. We hypothesize that variants in related genes, particularly gene families, result in shared clinical phenotypes and, as such, patients may benefit from shared targeted therapies. Here, we focus on the chromodomain DNA helicase binding protein (*CHD*) gene family, consisting of 10 genes involved in chromatin remodeling which have an enrichment of *de novo* variants among NDDs based on analysis of >152,000 exomes. Several *CHD* members have been strongly implicated in NDDs, including CHARGE syndrome (*CHD7*), autism spectrum disorder (ASD, *CHD8*), and epileptic encephalopathy (*CHD2*).

Objectives: We aim to explore the impact of *CHD* variation at the gene family level in NDDs and determine the phenotypic and molecular consequences of such variation.

Methods: We identified probands with variants in the *CHD* genes through targeted sequencing data from our Autism Spectrum/Intellectual Disability network (n = 16,377), exome data from the SPARK consortium (n = 6,499), clinical sequencing data generated by Baylor Genetics Laboratories (n = 9,536), collaborations through GeneMatcher and international collaborations, as well as the literature. We identified >900 probands with variation in all 10 *CHD*-encoding genes (*CHD1-CHD9* and *CHD1L*). We are correlating these findings with transcriptional signatures generated from single-cell RNA-seq (scRNA-seq) of human fetal cortex samples, as well as patient-derived and Cas9 gene-edited induced pluripotent stem cells. We are using differentiated neuronal cells to assess broad cellular changes, as well as *CHD*-specific functionality.

Results: Using two statistical models, four *CHDs* meet genome-wide significance ( $p < 5 \times 10^{-7}$ ) for loss-of-function and/or missense variants. We expanded the clinical phenotype associated with variation in *CHDs*, including rare *CHD*-related disorders and those without identified syndromes, such as *CHD5* (n = 57) and *CHD9* (n = 74). We found there is a shared phenotypic spectrum of developmental delay/intellectual disability, ASD, and seizures, with varying frequency among different *CHD* genes. Based on the types of variation discovered, we conclude that *de novo* missense variation contributes to the majority of probands in our cohort, suggesting a dominant negative impact for chromatin remodeling complexes. The exceptions are *CHD2*, *CHD7*, and *CHD8*, which are more consistent with haploinsufficiency.

Protein homology analyses distinguish three unique homology groups: 1) *CHD1/CHD2*, 2) *CHD3-5*, and 3) *CHD6-9*. scRNA-seq of fetal cortex samples shows high levels of expression of the *CHD* genes among dividing radial glia, outer and truncated radial glia, and intermediate progenitor cells, with decreased expression generally among inhibitory and MGE newborn neurons, although *CHD3* and *CHD5* share their own unique expression pattern with highly enriched expression in excitatory neurons. Fibroblasts from probands with *CHD1*, *CHD2* and *CHD8* variants reprogrammed successfully and are being utilized for functional work, while other cell lines are being generated using Cas9 gene editing.

Conclusions: We show that *CHDs* broadly have clinical relevance for NDDs, including those not described as syndromic, and share phenotypic similarities, but that the class of mutations differ with respect to groups. Finally, we have begun to determine some of the molecular characteristics and pathomechanisms of variation in this gene family.

#### **430.003 (Poster)** The Genetic Characterization of Probands with Autism Spectrum Disorder and Their Extended Family Members

**J. Zhang<sup>1</sup>**, A. Ghorai<sup>2</sup>, S. C. Taylor<sup>3</sup>, H. C. Dow<sup>2,4</sup>, B. N. Gehringer<sup>2,4</sup>, A. Langer<sup>2,4</sup>, E. Rawof<sup>2,4</sup>, L. S. Perez<sup>2,4</sup>, M. H. Goodman<sup>2,4</sup>, A. A. Pallathra<sup>5</sup>, S. D. Elkhatib Smidt<sup>2,6</sup>, D. J. Rader<sup>2</sup>, L. Almasy<sup>2,7</sup>, E. S. Brodtkin<sup>4</sup> and M. Bucan<sup>2</sup>, (1)Graduate Group in Epidemiology and Biostatistics, University of Pennsylvania, Philadelphia, PA, (2)Department of Genetics, University of Pennsylvania, Philadelphia, PA, (3)Graduate Group in Neuroscience, University of Pennsylvania, Philadelphia, PA, (4)Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, (5)Department of Psychiatry, Catholic University of America, Washington, DC, (6)Division of Neurology and Sleep Center, Children's Hospital of Philadelphia, Philadelphia, PA, (7)Department of Biomedical and Health Informatics, Children's Hospital of Philadelphia, Philadelphia, PA

Background: Autism Spectrum Disorder (ASD) is a group of heterogeneous disorders with heritability estimated at 60% to 90%, suggesting a strong genetic etiology. However, the genetic causes of more than 90% of the ASD cases remain unknown. The genetic etiology of "idiopathic" ASD is complex and polygenic, involving multiple susceptibility genes and genetic variation of varying frequency and inheritance patterns. The Autism Spectrum Program of Excellence (ASPE) at the University of Pennsylvania is focusing on the genetic etiology of ASD by recruiting individuals with ASD without intellectual disability (ID) and their extended family members. ASPE also recruits families with variants in *NRXN1*, a known ASD-risk gene encoding a transsynaptic protein neurexin 1. Through quantitative phenotyping and whole genome sequencing (WGS), ASPE focuses on the genetic etiology of the entire autism spectrum.

Objectives: To characterize the full spectrum (rare, common, inherited and *de novo*) of genetic risk alleles in ASPE families without ID.

Methods: Standard quality control procedures were performed on ASPE WGS data. Genetic variants were annotated using ANNOVAR. Deleterious single nucleotide variants (SNVs) and insertions and deletions (indels) were selected if they were rare (gnomAD allele frequency < 0.1%) protein-truncating variants (nonsense, frameshift, splicing), or rare missense variants with CADD score > 20 or REVEL score > 0.5. Structural variants (SVs) and copy number variation (CNV) were called by Manta and Canvas. ExpansionHunter was used to detect 19 well-known repeat expansions in ASPE families. Inherence pattern of these variants were inferred from the pedigree. A list of 155 ASD risk genes was created by combining published ASD risk gene lists based on the Transmission And *De novo* Association test (TADA).

Results: ASPE is an ongoing study. Currently, 315 individuals (117 probands) in 118 families have been sequenced. The average age of probands is 33 years old and 78 (66.7%) of them are male. Ten families (8.5%) had known *NRXN1* deletion/mutation prior

to recruitment (*NRXN1* family). In 7 *NRXN1* probands/families (70.0%), we identified 19 inherited deleterious SNVs/indels in 19 TADA ASD risk genes. For the rest of the families without known ASD-related genetic variants prior to recruitment (phenotype-first probands/families, n = 108), we identified 57 inherited deleterious SNVs/indels in 39 TADA ASD risk genes in 29 probands/families (26.9%). Among them, 14 probands/families (48.3%) carry inherited deleterious SNVs/indels in multiple TADA ASD risk genes. We are in the process of analyzing the SV, CNV and repeat expansion data.

**Conclusions:** We have identified genetic variants that are likely to contribute to the risk of ASD for 29 out of 108 phenotype-first families (26.9%). Moreover, 70.0% of the *NRXN1* families and 13.0% of the phenotype-first families carry more than one deletion/mutation in different ASD risk genes. These data support the hypothesis that ASD phenotypes are due to multiple genes and their interactions. The integrative analysis of variants of varying frequency, inheritance patterns and type (SNV, indel, SV, CNV, and repeat expansion), and ASD polygenic risk score will help us better understand the genetic basis of ASD.

**430.004 (Poster)** Whole Exome Sequencing Reveals Complex Genetic Architecture of Autism Spectrum Disorder in an Israeli Population

*A. Shil<sup>1,2</sup>, R. Tal<sup>1,2</sup>, H. Abukaf<sup>3</sup>, H. Golan<sup>2,3</sup>, G. Meiri<sup>2,4</sup>, H. Flusser<sup>2,5</sup>, A. Michaelovski<sup>2,4</sup>, I. Dinstein<sup>2,6</sup> and I. Menashe<sup>1,2</sup>, (1)Public Health, Ben Gurion University, Beer Sheva, Israel, (2)National Autism Research Center, Beer Sheva, Israel, (3)Physiology, Ben-Gurion University of the Negev, Beer Sheva, Israel, (4)Preschool Psychiatric Unit, Soroka University Medical Center, Beer Sheva, Israel, (5)Child Development Center, Soroka University Medical Center, Beer Sheva, Israel, (6)Department of Psychology, Ben-Gurion University of the Negev, Beer Sheva, Israel*

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**Background:** Autism Spectrum Disorder (ASD) is a multifactorial neurodevelopmental condition with a significant genetic susceptibility component. Recent whole-exome sequencing (WES) studies have found hundreds of rare ASD susceptibility variants distributed in hundreds of genes suggesting a complex genetic architecture of ASD etiology. The Israeli population is comprised of heterogeneous ethnic groups some of which are characterized with high consanguinity (e.g. Jewish orthodox, Bedouin Arabs), which leads to high prevalence of genetic diseases in these population. Yet, until now no attempt was made to identify ASD susceptible genetic variants in Israel.

**Objectives:** To identify genetic variants associated with ASD in an Israeli population.

**Methods:** DNA samples were collected from children with ASD enrolled at the National Autism Research Center (NARC) of Israel and their parents. WES was performed at the Broad Institute on Illumina HiSeq sequencers using the Illumina Nextera exome capture kit as part of the autism sequencing consortium (ASC). GATK's best practice guidelines were used for variant discovery from the WES data. We defined gene-disrupting variants (GDVs) associated with ASD according to the following criteria: (1) high-quality and rare (allele frequency <5%) SNVs; (2) SNVs with deleterious functional consequences according to Ensembl's VEP criteria (e.g. frameshifts indels, nonsense variations, splice acceptor/donor variants and deleterious missense substitutions according to SIFT and PolyPhen-2 algorithms); (3) SNVs were identified in exons of 224 genes with established association with ASD according to SFARI and ASC databases; and (4) genotype was unique in the child with ASD compared to his/her parents.

**Results:** The exome of 171 children from 159 families were evaluated in this study. Of these, 26 children (15.2%) had one or more GDVs distributed in 25 ASD genes. The majority of these GDVs were missense de-novo variants. To the best of our knowledge, none of the identified GDVs were associated with ASD before. Interestingly, our sample included two affected siblings that carried the same recessively inherited GDV, thus increasing the likelihood for this GDV to cause ASD in this family. Further support in our findings was by the hypergeometric analysis indicating statistically significant concordance between observed and expected phenotypes associated with these GDVs ( $p < 10^{-20}$ ).

**Conclusions:** Our results suggest a unique genetic architecture underlying ASD in the Israeli population.

## POSTER SESSION — MOLECULAR NEUROSCIENCE

### Poster 431 - Molecular Neuroscience Posters

**431.002** (Poster) Circulating Noncoding RNAs As a Signature of Autism Spectrum Disorder Symptomatology  
**S. Salloum-Asfar<sup>1</sup>**, **K. Errafii<sup>1,2</sup>**, **S. F. Elhag<sup>1</sup>**, **N. J. Satheesh<sup>1</sup>** and **S. A. Abdulla<sup>1</sup>**, (1)Qatar Biomedical Research Institute (QBRI), HBKU, Qatar Foundation, Doha, Qatar, (2)College of Health and Life Sciences, Hamad Bin Khalifa University, Qatar Foundation, Education City, Doha, Qatar., Doha, Qatar

**Background:** Autism Spectrum Disorder (ASD) is a multi-faced neurodevelopmental disorder that uncovers itself during the early years of child development. The complexity of ASD makes clinically diagnosing the condition, not an easy feat. Consequently, by identifying biomarkers that associate itself with ASD severity and combining it with clinical diagnosis, one may better factionalize within the spectrum and therefore devise more targeted therapeutic strategies.

**Objectives:** Currently, there are no reliable biomarkers that can be used for precise ASD diagnosis, our objective is to define circulating noncoding RNA profile in plasma of ASD with mild and severe symptomatology.

**Methods:** We have subdivided our cohort (N=45) into two groups, the first of which entails children who express severe ASD symptoms and the second mild ASD symptoms. Using next-generation sequencing, we were able to identify several circulating noncoding RNAs in plasma. Differential expression analysis was performed using the CLC Genomics Workbench version 20.0.4 on miRNAs, piRNAs, snoRNAs, and Y-RNAs between the two groups.

**Results:** This study is the first to show that miRNAs, piRNAs, snoRNAs, and Y-RNAs are stably expressed in plasma in our ASD cohort. We utilized comprehensive evidence-based data sources to introduce, for the first time, several potential circulating ncRNAs biomarkers, isolated from plasma, with the prospect of recognizing cases that manifest severe ASD characteristics from mild ones and hence may be implemented as early diagnostic biomarkers (Figure 1).

**Conclusions:** Our data identifies circulating ncRNAs specific to either our severe or mild group and hence stands as an objective diagnostic biomarker and potential therapeutic target.

**431.003** (Poster) Transcriptome-(Phospho)Proteome Characterization of the Brain of a Constitutional Model of Cytoplasmic-Predominant Pten Expression with Autism-like Phenotypes  
**S. T. Thacker<sup>1</sup>** and **C. Eng<sup>2</sup>**, (1)Genomic Medicine Institute, Lerner Research Institute of Cleveland Clinic, Cleveland, OH, (2)Genomic Medicine, Cleveland Clinic, Cleveland, OH

**Background:** *PTEN*, a well-studied tumor suppressor, has one of the strongest Mendelian associations with autism spectrum disorder (ASD), representing a special case in autism's complex genetic architecture. Animal modeling for constitutional *Pten* mutation creates an opportunity to study how disruption of Pten affects neurobiology, providing insights that may be generalizable or at least inform our understanding of ASD. Although the neural transcriptome has been well characterized in *Pten* models, little has been done concerning the proteome and phosphoproteome. This is a critical gap in knowledge given that these – omic landscapes are more proximal to the actively observed biology than the transcriptome.

**Objectives:** We sought to comprehensively characterize the neural proteome and phosphoproteome of the *Pten*<sup>m3m4/m3m4</sup> mouse, which exhibits cytoplasmic-predominant Pten expression and has known behavioral and neurodevelopmental phenotypes.

**Methods:** Proteomic and phosphoproteomic scans of *Pten*<sup>m3m4/m3m4</sup> (N = 3) and wildtype (N = 3) mouse brain at two-weeks- (P14) and six-weeks-of-age (P40) were performed using liquid chromatography with tandem mass spectrometry technology with prior phosphopeptide enrichment when appropriate. Following quantification of differentially expressed/phosphorylated proteins, we performed various bioinformatics analyses, including gene overlap, gene enrichment, pathway, and network analyses, to identify the similarity across the various datasets, understand the affected biological landscape, and identify important regulatory molecules.

**Results:** We identified numerous differentially expressed/phosphorylated proteins, finding that dysregulation was greater at P40, consistent with the prior neural transcriptome data. We found the affected biological pathways were largely related to PTEN function, neurological processes, or neuroinflammation. Although we found minimal overlap among differentially expressed transcriptome-proteome-phosphoproteome molecules between P14 and P40 brains (never more than 35%), there was congruence amongst the affected pathways. Importantly, network analysis identified Pten and Psd-95 (encoded by *Dlg4*) as predominant regulatory nodes in the proteome and phosphoproteome, respectively. Moreover, we found overlap between our differentially expressed/phosphorylated proteins and known ASD risk genes.

**Conclusions:** Differential expression/phosphorylation revealed by transcriptome-proteome/phosphoproteome analyses of a germline *Pten* mutation model point to ASD risk genes like *Pten* and *Dlg4* as major hubs in the protein networks, highlighting their important regulatory influence. Our observations here suggest Pten and Psd-95, known interactors in biological networks in the brain, are critical to either initiation or maintenance of cellular and perhaps organismal phenotypes related to ASD. Future research should explore rescuing Pten and Psd-95 function in attempts to ameliorate neurological pathologies and behavioral abnormalities.

## POSTER SESSION — NEUROCHEMISTRY

### Poster 433 - Neurochemistry Posters

**433.001** (Poster) Neuronal Damage Associated NAA-Naag Metabolism Imbalance and Socio-Communicative Impairments Correlation in ASD.

*C. D. Jimenez-Espinoza, Physiology, University of La Laguna, Santa Cruz de Tenerife, Spain*

**Background:** Autism Spectrum Disorder (ASD) is a neurodevelopment disorder characterized by socio-communicative impairments as one of the core symptoms. Autistic symptoms may be seen in the first year of life, they vary in severity from mild to severe, and in a few instances, they may improve over time, even without treatment. The neuropeptide N-acetyl-aspartyl-glutamate (NAAG) modulates glutamate release which has been proposed as a key mechanism underlying symptoms of ASD. NAAG provides one of the components of the proton magnetic resonance spectrum ( $^1\text{H-MRS}$ ) in humans. The signal of NAAG, however, largely overlaps with its precursor and degrading product N-acetyl aspartate (NAA) that by itself does not act in glutamatergic neurotransmission. Previously, we described the altered N-Acetyl-aspartyl-glutamate levels found in cingulated cortices by  $^1\text{H-MRS}$  in individuals with ASD that suggested neuronal damage. Taken together, the findings of this study support our hypothesis and a role for NAA-NAAG imbalance and impairments in the Social-communication skills in autism, which lead the next step in our investigation to correlate imbalances neurochemistry linked to cingulated cortices in social and communicational skills in the autism spectrum disorders.

**Objectives:** To study imbalance of NAA-NAAG metabolism in the cingulated cortices correlated with the AQ domains social skills and communication associated with ASD severity using  $^1\text{H-MRS}$ .

**Methods:** We quantified NAAG and NAA separately from the  $^1\text{H-MRS}$  signal in 22 patients with ASD and 44 healthy comparison subjects, matched for age, gender on a 3.0 Tesla MR scanner. Autism quotients (AQ) scores were assessed. Statistic one-way ANOVA and Bonferroni correction was applied. Furthermore, the Pearson correlation hallmarks the goal.

**Results:** The results of the Pearson correlation were represented graphically, where it was observed that there is no correlation between the Socio-communicative skills and the NAA/NAAG ratio in the ACC ( $r = -0.43$ ,  $P = .005$ ) in ASD group (Fig.1). However, when was stratified ASD plus TD groups as AQ1, AQ2, AQ3, and AQ4, there was within groups differences (AQ1, AQ2, AQ3, and AQ4) of NAA/NAAG, was increased significantly ( $P = .05$ ) in AQ3 (Fig. 2). There was no ASD group difference of NAAG, NAA, or NAA/NAAG in the PCC, but a positive linear correlation with communication ( $r = .55$ ,  $P = .049$ ). In addition, in both ACC and PCC, the AQ2, AQ3, and AQ4 groups maintain a different correlations pattern than the AQ1 group, both in social skills and communication. These results make us suggest the relation of the deficit socio-communicational with the enlarged relative grey matter volumes (rGMV) of auditory network in ASD adults; in accordance with that described by (Watanabe & Rees, 2016); who demonstrated the relation of the deficits associated with the severity of autistic socio-communicational core symptom.

**Conclusions:** We conclude that the concentrations of NAAG and NAA act differently in ASD. The opportunity to measure NAAG in patients creates a new and promising approach for intensified research on the glutamatergic systems and on the effects of novel drug candidates.

## PANEL SESSION — NEUROIMAGING

### Panel 219 - Etiologies of Atypical Prenatal Development in Autism Spectrum Disorder and Implications for Early Treatment

**Panel Chair: Yehezkel Ben-Ari, Neurochlore, Marseille, France**

Autism Spectrum Disorders (ASD) are “born” in utero by environmental and genetic pathogenic events. The link between initial pathogenic insults and the clinical manifestations years later is complex as it takes place in a particularly dynamic process with all ionic currents and molecular processes engaged in profound modifications. Indeed, initial pathogenic insults impacts brain development and growth, alters developmental sequences leading to misplaced/misconnected neuronal circuits and miswired connectivity that both perturb the operation of behaviorally relevant oscillations and prevent the interactions needed to develop social interactions in the first postnatal years. These changes are therefore the direct cause of the disorder and a possible target of treatments using agents that selectively block these alterations. A multidisciplinary approach devoted to determine these changes during pregnancy, birth and early post-natal life is therefore mandatory. Physiological, molecular, genetic and immunological features have to be determined as initial insults impact all of these parameters. Therefore, to understand and treat ASD and other neurodevelopmental disorders, a dynamic and distinctive look on development is needed. This panel will bring a fresh and novel developmental view on the origin, impact and treatment of ASD.

**219.001 (Panel) ASD Living Biology: The “When, What and How” of ASD Prenatal Beginnings**  
**E. Courchesne, University of California San Diego, San Diego, CA**

Background: ASD genetic studies identify hundreds of ASD risk (rASD) genes contributing to its high heritability. The conundrum is that the majority of rASD genes are involved in different biological processes, expressed in many non-brain tissues, and some have unclear relevance and connection to neurodevelopment. Because ASD begins in the womb, the “when, what and how” of ASD beginnings remains unclear.

Objectives: Identify the when, what and how of ASD prenatal beginnings; test the hypothesis that ASD is a multistage, progressive disorder of prenatal development; and address a key question of how hundreds of diverse rASD genes dysregulate common gene networks leading to ASD.

Methods: Re-analyses of multiple studies of idiopathic ASD and rASD genes; novel analyses of co-expression in large samples of idiopathic ASD; and novel analyses of 193 SFARI ASD risk genes in the context of regulatory and brain-specific gene networks using multiple datasets.

Results:

First, using GTEx data, we found 193 SFARI rASD genes fall into two major groups: broadly-expressed regulatory genes and brain-specific ones. Analyses find both major groups occur in early Epoch-1 and later Epoch-2 prenatal periods. Thus, broadly-expressed and brain-specific rASD genes operate in combination in each Epoch, a finding at odds with three previous studies. Re-analyzing those studies, we demonstrate broadly-expressed and brain-specific rASD genes do indeed express during both Epoch-1 and Epoch-2. In Epoch-1, one set of regulatory broadly-expressed and brain-specific rASD genes disrupts corticogenesis. In Epoch-2, a different set disrupts late fetal and postnatal synaptogenesis and wiring of cortex.

Second, we show broadly-expressed genes in living ASD toddlers are associated with hypoactive brain responses to language; poor language outcomes; published ASD and language relevant and prenatal genes; and patterns of cortical surface area and cortical thickness. These cortex function- and structure-relevant genes are enriched in prenatal cell types including neural-progenitor cells, immature excitatory cells and microglia.

Third, we developed a novel systems-level approach linking ASD genetics with perturbed gene expression in living ASD toddlers, and demonstrated rASD genes are upstream regulators of PI3K/AKT, RAS/ERK, and WNT/B-catenin signaling pathways in ASD toddlers and converge on these pathways through chromatin remodelers, transcriptional factors, and ubiquitination and protease complexes. These disrupted networks in living ASD toddlers enrich Epoch-1 prenatal-stage, and the degree of dysregulation correlates with ASD social symptom severity.

Lastly, we linked these two rASD gene groups with neurodevelopmental processes by leveraging multiple transcriptomic datasets. Systems-level analyses show ASD genetic architecture is hierarchical with broadly-expressed rASD genes converging upon brain-specific genes and multiple neurodevelopmental processes through regulatory networks and signaling pathways, disrupting multiple prenatal stages from proliferation through synaptogenesis.

Conclusions: Broadly-expressed and brain-specific rASD genes form separate networks, but are connected through intermediate genes and signaling pathways including RAS/ERK, PI3K/AKT, and WNT/B-catenin. We call this unified hierarchical architecture the ASD “SPHeRe” model (Sequential, Prenatal, Hierarchical, and Regulatory). Upstream broadly-expressed genes send disrupting signals through regulatory networks and signaling pathways that in turn disrupt downstream brain-specific genes and core neurodevelopmental processes, which cause ASD. Broadly-expressed rASD genes impact multiple organ development including brain.

**219.002 (Panel)** Harnessing the Power of Advanced Fetal MRI to Understanding the Prenatal Origins of ASD  
**C. Limperopoulos, Radiology, Neurology, Pediatrics, Children’s National Health System, Washington, DC**

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Background: There is a growing body of evidence showing that neuropsychiatric disorders including ASD are increasingly finding their footprints in the womb. Novel quantitative fetal MRI tools are advancing our understanding of the prenatal origins of these prevalent and pervasive disorders.

Objectives: Characterize normal in-vivo human fetal brain growth, cortical folding and biochemistry using quantitative prenatal MRI; Examine the role of prenatal maternal stress and premature birth on disrupted fetal brain development; Investigate the relationship between altered prenatal brain development and early features of ASD.

Methods: We prospectively enrolled healthy and high-risk pregnant women into a longitudinal observational study of fetal brain development using quantitative fetal and postnatal MRI brain studies and standardized neurodevelopmental assessments. Fetal brain MRI: performed at 2 time points between 24-40 weeks' gestation. We also enrolled a cohort of ex-utero very preterm infants (<32 weeks gestational; <1500 grams): MRI between 24-40 weeks postconceptional age. Brain/structures volume: calculated from 3-dimensional reconstructed T2-weighted MRI scans. Cortical folding measurements: local gyrification index, sulcal depth, curvedness. Prenatal maternal stress, anxiety, and depression: Perceived Stress Scale, Spielberger State-Trait Anxiety Inventory, Edinburgh Postnatal Depression Scale. The Bayley of Infant and Toddler Development III, the Infant-Toddler Social and Emotional Assessment and the Modified Checklist for Autism in Toddlers: administered at 18 months. Premature cohort also completed: Communication and Symbolic Behavior Scales (CSBS).

Results:

In-utero cohort: We enrolled 325 pregnant women, for which 147 mother/baby dyads (70 male and 77 female fetuses) with 238 fetal MRI visits have undergone infant neurodevelopment testing to date (mean age of 19.67±4.50 months). Elevated prenatal maternal stress, anxiety, and depression scores were negatively associated with infant cognitive, motor, and social-emotional performance and early autistic features. Fetal cortical grey matter volume was negatively associated with infant internalizing and dysregulation domains; fetal brainstem volume was negatively associated with infant language skills. Regional fetal cortical LGI and sulcal depth were negatively associated with infant social-emotional performance; externalizing, dysregulation, and competence domains, and cortical curvedness in frontal lobe was positively associated with infant internalizing domain.

Ex-utero (preterm) cohort: We enrolled 142 infants (81 males, 51 females): early preterm MRI (mean gestational age of 29.1 weeks), term-equivalent MRI (mean of 39.3 weeks), no evidence of parenchymal brain injury. 95 infants have completed 18-month neurodevelopmental evaluations. 39% of preterm infants tested positive on the CSBS. Lower cerebellar volumes at preterm and term were associated with increased risk for elevated scores on the CSBS, infant social emotional problems, cognitive delays. Cortical gray matter volumes at term were negatively associated with cognitive and language performance, as well as externalizing and domains.

Conclusions: Our data suggest that elevated prenatal maternal psychological distress is associated with impaired regional fetal brain growth and long-term risk for socio-affective behavioral deficits. Similarly, early extrauterine exposure following preterm birth is associated with altered third trimester brain growth and an elevated risk for cognitive impairments and autistic features. Elucidating the exact timing and underlying mechanisms of ASD will require novel, non-invasive approaches to study the emerging structural and functional brain development of the fetus.

**219.003 (Panel)** Maternal Autoantibodies As a Pathway to ASD  
**J. Van de Water, MIND Institute, University of California, Davis, Davis, CA**

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**Background:** The incidence of autism spectrum disorder (ASD) has been rising, however ASD-risk biomarkers remain lacking. We previously identified the presence of maternal autoantibodies to fetal brain proteins specific to ASD, now termed maternal autoantibody-related (MAR) ASD.

**Objectives:** The current study aimed to create and validate a serological assay to identify ASD-specific maternal autoantibody patterns of reactivity against 8 previously identified proteins (CRMP1, CRMP2, GDA, NSE, LDHA, LDHB, STIP1 and YBOX) that are highly expressed in the developing brain and determine the relationship of these reactivity patterns with ASD outcome severity.

**Methods:** We used plasma from mothers of children diagnosed with ASD (n=450) and from typically developing children (TD, n=342) to develop an ELISA test for each of the protein antigens.

**Results:** We determined patterns of reactivity a highly significant association with ASD and discovered several patterns that were ASD-specific (18% in the training set and 10% in the validation set vs 0% TD). The three main patterns associated with MAR ASD are CRMP1 + GDA (ASD%= 4.2 vs TD%=0, OR 31.04,  $p < 0.0001$ ), CRMP1+ CRMP2 (ASD%= 3.6 vs TD%=0, OR 26.08,  $p = 0.0005$ ) and NSE + STIP1 (ASD%= 3.1 vs TD%=0, OR 22.82,  $p = 0.0001$ ). Additionally, we found that maternal autoantibody reactivity to CRMP1 significantly increases the odds of a child having a higher ADOS severity score (OR 2.3; 95% CI: 1.358- 3.987,  $p = 0.0021$ ).

**Conclusions:** We used machine learning sub-group discovery to identify with 100% accuracy MAR ASD-specific patterns as potential biomarkers of risk for a subset of nearly 20% of ASD cases. Further, maternal autoantibodies to the CRMP1 biomarker increases ASD severity suggesting potential differential mechanisms of pathogenicity based on the pattern of autoantibodies present.

**219.004 (Panel) Early Prognosis of ASD through Machine Learning Analysis of Pregnancy and Birth Data**  
**Y. Ben-Ari, Neurochlore, Marseille, France**

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**Background:** Clinical and experimental observations suggest that ASD is generated in the womb. The incidence of ASD is also increased by C-Section delivery, obstetric complications and preterm birth.

**Objectives:** To identify newborns at risk of developing ASD and identify impacting parameters in order to facilitate early behavioral treatment, known to ameliorate ASD deficits and attenuate long-term outcomes.

**Methods:** We compared retrospectively without a priori maternity parameters in babies diagnosed 4-5 years later with ASD (63) and age-matched neurotypical (NT) babies born in the same maternity and similar conditions (189). For each mother and baby at birth, 116 parameters were recorded: 77 numerical (ultrasound measurements, etc.) and 39 categorical (sex, familial medical history, etc.). A supervised machine learning algorithm was trained to classify babies in two groups, ASD and NT, using a model based on the gradient boosting decision tree algorithm. A cross-validation technique was used to ensure the generalizability of the classifier's results on an unseen independent cohort. Parameters with the highest impact on the classifier were extracted. The difference in the distribution of the 116 parameters between NT and ASD groups were investigated by statistical tests. Covariance analysis was used to model fetal brain developmental trajectories and head circumference (HC) obtained from ultrasound acquisitions during the 2nd (T2) and 3rd (T3) trimesters and before birth.

**Results:** Classifier. We trained a classifier on our dataset aiming to minimize false ASD detections while keeping true ASD detection rate as high as possible. The proportion of NT babies correctly classified as NT was of 0.96 (95% CI = [0.95, 0.97]). The proportion of babies with ASD correctly classified in the ASD group was of 0.41 (95% CI = [0.37, 0.45]) but with a positive predictive value of 0.77 (95%CI = [0.72, 0.81]), meaning that 77% of babies classified as ASD were indeed diagnosed later with ASD.

Impactful Parameters: Timing of fetal rotation on head, femur length in T3, sex, mother's white blood cell count in T3, and the type of feeding of newborns have the highest impact on the classifier's decisions.

Significant Parameters. Sex ( $p < 0.001$ ), newborn's temperature difference between birth and day 1 ( $p < 0.001$ ), results of CMV test ( $p < 0.001$ ), fetal heart rate during labor ( $p = 0.001$ ) and IgG level ( $p < 0.001$ ) are significantly different between ASD and NT groups.

**Head circumference (HC) growth.** The HC growth rate is significantly different between NT and ASD during the 2nd trimester ( $p=0.046$ ). A subpopulation of ASD fetuses (38%) had significantly larger HC in T2 ( $p=0.02$ ), T3 ( $p<0.001$ ) and before birth ( $p<0.001$ ) in comparison to NT and other ASD ones.

**Conclusions:** Our results suggest that it might be possible to establish a prognosis at birth of a subpopulation of babies who will develop ASD. Further replications are needed to optimize the analysis and better specify impacting parameters. Results suggest an in utero origin of the reported bigger brains of children and adolescents with ASD (Caly et al. Sci.Rep. in press).

## POSTER SESSION — NEUROIMAGING

### Poster 434 - Neuroimaging Posters

**434.001 (Poster)** A Connectome-Wide Mega-Analysis of Functional Dysconnectivity in Autism Spectrum Disorder  
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**Background:** Autism spectrum disorder (ASD) has been conceptualized as a disorder of brain connectivity. However, neuroimaging research studies have been hampered by small sample sizes and inconsistent findings with regard to whether connectivity is increased or decreased in patients, whether these alterations affect focal systems or reflect a brain-wide dysfunction, and whether these disturbances are age- and/or sex-dependent.

**Objectives:** To use a connectome-wide mega-analytic approach aggregating data from three large autism cohorts to map functional dysconnectivity across the entire brain in ASD patients and to relate these connectivity disturbances to distinct dimensions of clinical symptomatology.

**Methods:** Following preprocessing, denoising, and application of stringent quality control criteria, our final sample consisted of 1824 (1427 male) participants, including 796 individuals diagnosed with ASD and 1028 neurotypical controls aged 5-64 years old with  $IQ>70$ . Functional images were parcellated into 390 brain regions, assigned to 7 canonical brain functional networks and subcortical structures. Functional connectivity (FC) between each pair of nodes (i.e., brain regions) was measured using the Pearson correlation coefficient between regional time courses. Fisher z-transformation and mixture modeling were applied to normalize these values. We used ComBat to harmonize the data for the effect of scanning site. Group differences between ASD and TD were evaluated on a connectome-wide basis using the network-based statistic. Differences in both directions (ASD>TD and vice versa) as well as interactions of diagnosis with age and sex were evaluated at  $p = \{.05, .01 \text{ and } .001\}$  component-forming thresholds. Head motion was controlled for in a multiple linear regression model.

**Results:** Autism patients showed complex, widely distributed alterations of FC that encompassed the entire brain and which reflected both increased and decreased inter-regional coupling. Functional hypoconnectivity predominantly affected sensory and higher-order attentional networks and was strongly associated with both social impairments and restrictive and repetitive behaviors in autism. Functional hyperconnectivity was observed primarily in cortico-subcortical systems and between the default mode network (DMN) and the rest of the brain, and this pattern was strongly associated with social impairments. All subscales of the short sensory profile were strongly associated with both hyperconnectivity and hypoconnectivity. Interactions between diagnosis and age or sex were not significant.

**Conclusions:** Autism is associated with a complex pattern of both hypo and hyperconnectivity that encompasses the entire brain. These widespread connectivity alterations correlate with clinical dimensions related to sensory processing, social impairment and restricted, repetitive behaviors, and do not appear to vary significantly as a function of age and sex.

**434.002 (Poster)** Altered Cerebellar White Matter in Sensory Processing Dysfunction Is Associated with Impaired Multisensory Integration and Attention

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**Background:** Sensory processing dysfunction (SPD) consists of behaviorally-observed differences in response to incoming sensory information. SPD is estimated to affect up to 16% of all children and 40-80% of children with other neurodevelopmental disorders, such as autism spectrum disorder (ASD) or attention deficit hyperactivity disorder (ADHD). While SPD is not recognized as a standalone disorder, the DSM-V includes sensory hyper- and hypo-responsivity as core symptoms of ASD.

**Objectives:** We compare cerebellar white matter (WM) microstructure between children with SPD and typically developing controls (TDC). Furthermore, we examine the relationship between cerebellar WM microstructure and behavioral measures of sensory processing.

**Methods:** Forty-two children (8-12 years) with SPD (29 male) and 39 TDC (31 male) were enrolled through the University of California, San Francisco. SPD designation required a "Definite Difference" label for at least one of the following subtotals of the Sensory Profile (SP): Auditory Processing, Visual Processing, Vestibular Processing, Tactile Processing, Multisensory Processing, Oral Sensory Processing, or Short Sensory Profile total. Participants also completed the Differential Screening Test for Processing (DSTP), a direct measure of auditory discrimination. Whole-brain DTI scans were obtained using a 3-Tesla MRI scanner. Five WM tracts were examined: the left and right cerebral peduncles (CP-L and -R), middle cerebellar peduncle (MCP), and left and right superior cerebellar peduncles (SCP-L and -R). For each tract, the following values were generated using the FMRIB Software Library: fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (RD), and axial diffusivity (AD). Two-tailed *t*-tests ( $\alpha = 0.05$ ) were run to investigate group differences in DTI metrics, and Pearson correlations were used to examine relationships between DTI metrics and behavioral measures.

**Results:** Compared to TDC, the SPD group showed impaired microstructure: low FA, high MD, and high RD in the SCP-R ( $p = 0.0499, 0.004, 0.004$ ), high MD and RD in the MCP ( $p = 0.03, 0.03$ ), and low FA and high RD in the CP-R ( $p = 0.03, 0.03$ ; *Figure 1*). Significant, moderate correlations were found between WM microstructure and DSTP Acoustic, Acoustic-Linguistic, and Total scores in the CP-L and -R (*Table 1*). SP Auditory Processing subtotal significantly correlated with microstructure in all tracts examined. SP Tactile Processing subtotal significantly correlated with microstructure in the CP-L. SP Multisensory Processing subtotal significantly correlated with microstructure in the SCP-L and -R. SP Inattention subtotal significantly correlated with microstructure in the SCP-L, -R and MCP. Overall, correlations were significant for the SPD group but not TDC.

**Conclusions:** Results suggest children with SPD have altered cerebellar WM microstructure relative to TDC. Correlations suggest a dissociation between WM microstructure in the cerebrum versus the cerebellum, where cerebellar tracts are associated with measures of higher-order functions (e.g. attention and multisensory processing) more than with unimodal or direct sensory measures (e.g. SP Tactile or DSTP). The SP Auditory subtotal correlates with microstructure in all tracts, which can potentially be explained by the SP Auditory subtotal including aspects of both auditory processing and attention. These findings may help elucidate the role of the cerebellum in normal and altered sensory processing.

**434.003 (Poster)** Altered Patterns of Brain Dynamics Linked with Body Mass Index in Youth with Autism  
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Background:

Children with autism spectrum disorder (ASD) are more likely to be overweight and obese (OWOB) compared with typically developing (TD) children (Kahathuduwa, West, Blume, et al., 2019). Functional brain differences have also been shown in both ASD (Hull et al., 2018) and OWOB children (Moreno-Lopez et al., 2016). However, only one study has examined brain differences in children with ASD and OWOB concurrently (Kahathuduwa, West, & Mastergeorge, 2019) so little is known regarding the neural mechanisms associated with OWOB in ASD and its associated behavioral impacts.

Objectives:

To identify dynamic brain activation patterns underlying OWOB in children with ASD compared with TD children and characterize their relationships with assessments of behavior.

Methods:

Using a large resting-state fMRI dataset from the Autism Brain Imaging Data Exchange (ABIDE), we investigated co-activation patterns (CAPs) of brain nodes identified by independent component analysis in 129 children and adolescents between 6 and 18 years of age ( $n = 68$  ASD; Mean age = 10.69; Mean BMI = 19.51 kg/m<sup>2</sup>). Inclusion criteria were clinician's DSM-IV-TR or DSM-5 diagnosis of ASD for ASD participants, mean framewise displacement (FD) < 0.5 mm, and body mass index (BMI) for age and sex above the 5th percentile (healthy weight, overweight, and obese). Group independent component analysis (ICA) was used to parcellate the brain (**Figure 1**). Following ICA,  $k$ -means clustering was used to identify the recurring CAPs or brain states (**Figure 1**). Dynamic brain state metrics were calculated, including dwell time (DT), frequency of occurrence, and transitions. Data were analyzed using hierarchical multiple regression models. The first model used BMI and diagnosis to predict each dynamic brain metric for the 5 CAPs. The second model included the interaction term between BMI and diagnosis as a predictor. Covariates included age, sex, mean FD, and Full IQ. Scores from the Behavior Rating Inventory of Executive Function (BRIEF) and Social Communication Questionnaire (SCQ) were used as dimensional predictors to examine how behavior moderates the relationship between BMI and CAP metrics.

#### Results:

A BMI x diagnosis interaction showed that children with ASD had a positive relationship with the frequency of CAP 4 (characterized by co-activation of lateral frontoparietal, temporal, and frontal networks), while TD children had a negative relationship with the frequency of CAP 4 on the basis of BMI. Dimensionally, this pattern was negatively associated with inhibition skills. Children with ASD had shorter CAP 1 (characterized by co-activation of the subcortical, temporal, sensorimotor, and frontal networks) and CAP 4 DTs compared with TD children. CAP 1 DT was negatively associated with cognitive flexibility, inhibition, social functioning, and BMI. Cognitive flexibility additionally moderated the relationship between BMI and brain dynamics in CAP 2 (visual network) (**Figure 2**).

#### Conclusions:

Our findings provide novel evidence of neural mechanisms associated with OWOB in children with ASD, and suggests children with ASD may have different neural mechanisms associated with OWOB compared with TD children. Further, children with ASD may be more vulnerable to the moderating effects of cognitive inflexibility on the relationship between brain flexibility and co-occurring OWOB.

#### 434.004 (Poster) Amygdala Connectivity As a Marker for Social Functioning in Autism Spectrum Disorder

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**Background:** Autism Spectrum Disorder (ASD) is a highly heritable disorder with a complex polygenic architecture<sup>1</sup>. Polygenic scores for ASD (PS-ASD) measure the cumulative effect of common genetic variants nominally associated to ASD, providing the opportunity to investigate neuroimaging markers influenced by genetic predisposition to ASD. Previous neuroimaging studies have linked social symptoms of ASD to structural and functional alterations of the amygdala, a composite subcortical structure with different connectivity pathways subserving different aspects of social functioning<sup>2,3</sup>. However, our understanding of which amygdala pathways may be altered in ASD is still very limited<sup>4</sup>.

**Objectives:** This study aims to investigate alterations in amygdala functional connections as a potential intermediate phenotype for ASD, and more specifically, a biomarker for social functioning.

**Methods:** PS- ASD were computed on 343 ASD cases and 241 typically developed (TD) controls from the EU-AIMS Longitudinal European Autism Project (LEAP<sup>5</sup>). We used resting-state functional magnetic resonance imaging data on a subsample of 380 individuals between 7 and 30 years of age (211 ASD cases) to define parcels of amygdala based on its functional connectivity within three large-scale networks subserving distinct aspects of social functioning<sup>3</sup>. Thus, we obtained three parcels defined by maximal connectivity with lateral orbitofrontal cortex (IOFC: AOF), with ventromedial prefrontal cortex

(vmPFC: APF), or with caudal anterior cingulate cortex (cACC: AAC). We used regression models to test the associations between PS-ASD and parcel volumes, and between parcel volumes and Vineland scores of adaptive functioning in the socialisation domain. We included as covariates: age, sex, intelligence quotient (IQ), diagnostic group, total brain volume, site of data acquisition, levels of comorbid ADHD traits and the first four principal components of genetic ancestry.

**Results:** We found a significant association between volumes of APF ( $b=-0.13$ ,  $t(363)=-4.44$ ,  $p<0.001$ ; Figure 1.A) and AAC ( $b=0.07$ ,  $t(363)=2.50$ ,  $p=0.013$ ; Figure 1.B) and levels of adaptive social functioning. There was no main effect of PS-ASD on parcel volumes, but we found a significant interaction effect between PS-ASD and ADHD traits ( $t(363)=2.32$ ,  $p=0.02$ ) on AAC volume. Higher PS-ASD was linked to larger AAC volume in individuals with high levels of ADHD traits ( $b=0.21$ ,  $p=0.01$ ; Figure 2). Finally, PS-ASD was significantly associated to measures of adaptive social functioning ( $b=-0.02$ ,  $p<0.001$ ), and significance of both PS-ASD and AAC volumes on social scores was retained in the full model.

**Conclusions:** We found that reduced amygdala connectivity with the prefrontal cortex, and increased connectivity with the anterior cingulate cortex were associated with better adaptive social functioning. Furthermore, we found preliminary evidence for a possible role of dorsal amygdala connectivity as mediator between cumulative effects of common genetic variants associated with ASD and adaptive social functioning, at least in individuals with high levels of ADHD traits. Our results support previous findings on alterations of frontal-amygdala connectivity in ASD and the role in generating appropriate adaptive social behaviour<sup>4,6</sup>, and extend these findings to amygdala connections with the anterior cingulate cortex. Further work is needed to investigate how ADHD comorbidity interplays with the cumulative genetic load for ASD to modulate its association with amygdala connectivity.

**434.005 (Poster)** Amygdala-Rostral Anterior Cingulate Cortex Connectivity Changes in Children and Young People with ASD Receiving AB-2004

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**Background:** Functional magnetic resonance imaging (fMRI) studies have provided biological evidence that individuals with autism spectrum disorder (ASD) have altered connectivity, linking aberrant brain region connectivity patterns to behaviors. AB-2004 is an investigational compound in development that binds a certain class of microbial metabolites in the lumen of the gastrointestinal tract, and is expected to result in reduced levels of these and related metabolites in the blood and the brain. Preclinical studies suggest these metabolites of microbial origin may impact oligodendrocyte maturation and myelination capacity, leading to the possibility that AB-2004 treatment may result in improvements in functional connectivity in the brain coinciding with improvements in ASD-related behaviors.

**Objectives:** Measure changes in resting connectivity by fMRI at baseline and after 8 weeks of treatment with AB-2004 in ASD participants with gastrointestinal dysfunction enrolled in the AXL-1224-2004-001 clinical trial.

**Methods:** MRI sessions were designed to collect data for anatomical registration (T1), resting fMRI, myelin maps (T1/T2), and structural connectivity (DTI). Resting state fMRI scans (two 5 -minute sessions with alternating phase encode directions) were performed without any external stimuli to detect functional connectivity between brain regions. Of the ten participants enrolled in this sub-study, reliable baseline and end-of-treatment data were obtained from eight participants. Areas of interest included the amygdala, which is essential for emotions and fear responses, and the rostral anterior cingulate cortex (rACC), involved in emotion assessment, including empathy, impulse control, emotion, and decision making, all of which are affected to varying degrees in people with ASD.

**Results:** Significant reductions were detected in coupling strength between the bilateral amygdala and the rACC when comparing baseline (mean  $r$ -value = 0.45) and end of treatment values (mean  $r$ -value = 0.37; Pearson corrected paired  $t$ -test  $p = 0.048$ ). Six of the eight participants (75%) showed post-treatment decreases in connectivity. There was no apparent impact of age on amygdala-rACC connectivity. Potential relationships between these observed changes in functional connectivity and anxiety were identified. There was a trend toward significance between reduced post-treatment anxiety (assessed by the Pediatric Anxiety Rating Scale (PARS) at baseline relative to end of treatment) and reductions in coupling ( $n=6$ , Pearson  $r = 0.75$ ,  $p = 0.087$ ; 2 subjects without end-of-treatment PARS were excluded).

**Conclusions:** These data provide preliminary evidence that AB-2004 treatment may lead to changes in functional connectivity in brain regions associated with emotional processing in ASD subjects, and serve as an hypothesis-generating dataset to support

further evaluation of MRI as a potential biomarker linking drug activity with changes in behavior. A larger placebo-controlled clinical study is being planned.

**434.006** (Poster) Association of Amygdala Volume and Development with Anxiety in Autism Spectrum Disorder  
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**Background:** Anxiety is commonly experienced by autistic individuals, but is challenging to quantify and disentangle from core autistic symptoms. For example, a recent study estimated 17% of children with autism have clinically significant anxiety related to distinct aspects of autism that would not be captured by traditional anxiety assessments. Within the brain, the amygdala has been associated with both autism and anxiety. However, the relationship between early development of amygdala structure and later observed anxiety within autistic individuals, particularly possible differences between traditional and autism distinct anxieties, is unclear.

**Objectives:** Explore associations in autism between amygdala volume and development across early childhood with measures of comorbid anxiety, including anxiety domains distinct to autism spectrum disorder.

**Methods:** Structural MRI scans were acquired across four timepoints (mean study ages 3.18, 4.28, 5.35, 11.37 years) within a longitudinal sample consisting of 283 ASD (89 females) and 133 TD (60 females) participants, for a total of 953 timepoints. Left and right amygdala volumes were extracted for all participants. At study time 4, anxiety was assessed in 70 ASD (14 females) participants using the Anxiety Disorders Interview Schedule-IV-Parent Interview (ADIS) with the Autism Spectrum Addendum (ADIS-ASA). The ADIS assesses traditional DSM anxiety domains (OCD, separation, social, specific phobia, generalized anxiety disorders) while the ADIS-ASA measures additional forms of anxiety distinctly related to autism (idiosyncratic fears, fear relating to social confusion, special interest fears, fears of change, atypical OCD). Individual measures of traditional and distinct anxiety were computed by taking the highest score among the subdomains comprising the ADIS and ADIS-ASA. Linear mixed effects models were first used to estimate annualized percent change (annual growth) in amygdala volumes from study time 1 to 3. Subsequent linear effects models tested for associations with both traditional DSM and distinct autism related anxieties assessed in mid/late childhood (study time 4) with baseline (study time 1) amygdala volume, concurrent amygdala volume (study time 4), and amygdala annualized percent change (study time 1-3).

**Results:** Statistically significant (FDR corrected  $p < 0.05$ ) associations of left and right amygdala volumes at both study time 1, and study time 4 were found with ADIS-ASA measures of distinct autism related anxieties. Smaller amygdala volumes at both timepoints were associated with increased ADIS-ASA anxiety scores. No such associations were observed with traditional ADIS measures of anxiety. However, right amygdala annualized percent change scores were found to be significantly associated with this measure. Faster amygdala growth was associated with increased traditional ADIS anxiety scores. A trend relationship between right amygdala annualized percent change and ADIS-ASA anxiety scores did not reach statistical significance.

**Conclusions:** Significant associations between anxiety and amygdala volume in autism indicate that early life brain measures may be predictive of anxiety levels in later childhood. Furthermore, associations with autism distinct anxieties but not traditional anxiety measures highlight possible unique neurophenotypes underlying different types of anxiety in autism. Further research is needed to identify how specific anxiety subdomains are reflected in the brain in autism.

**434.007** (Poster) Atypical Cerebellar Activity during Sensory Stimulation in ASD Youth  
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### **Background:**

Sensory overresponsivity (SOR) is a debilitating sensory modulation impairment commonly experienced by individuals with autism spectrum disorder (ASD), characterized by an extreme negative response to sensory stimulation such as loud noises and scratchy fabric (Kientz and Dunn, 1997; Baranek et al., 2006; Klintwall et al., 2011). While SOR is often associated with poor social and adaptive behavior (Ben-Sasson et al., 2009; Schaaf et al., 2010), it has only recently begun receiving attention from ASD researchers and its neural mechanisms continue to be investigated (Green et al., 2015, 2016, 2019).

The cerebellum plays a key role in sensory-motor function, and prior research has shown structural, cellular and functional atypicalities in the ASD cerebellum (Rogers et al., 2013; Khan et al., 2015). Recent studies have found increased cerebellar resting-state functional connectivity with sensory-motor regions and linked atypical cerebellar connectivity to sensory symptoms in ASD (Khan et al., 2015; Oldehinkel et al., 2019). Despite the important role of the cerebellum in sensory-motor processing and cerebellar pathology in ASD, there is currently almost no research on the role of the cerebellum in SOR in ASD.

### Objectives:

To investigate differences in cerebellar activity in ASD compared to typically developing (TD) youth during aversive sensory (auditory and/or tactile) stimulation, and to determine whether these differences are associated with SOR severity.

### Methods:

We collected functional magnetic resonance imaging (fMRI) data to examine cerebellar activation in response to mildly aversive auditory, tactile and joint (auditory + tactile) stimuli in 19 high-functioning ASD (16M) and 19 TD (16M) participants. Participants were age- and IQ-matched (age range 9-17, mean age = 13.66). SOR severity was measured using a composite of parent-reported tactile/auditory subscales from the Short Sensory Profile and Sensory Over-Responsivity Inventory (Dunn, 1999; Schoen et al., 2008). Results were cluster corrected for multiple comparisons at  $p < 0.05$  and thresholded at  $z > 2.3$ .

### Results:

No significant cerebellar activation clusters were identified in the tactile condition in either group. In the auditory condition, the ASD group showed left cerebellar activation including the Left Crus I, Left Crus II, Left VIIb and Left VIIa regions (Figure 1A), but there was no significant within-group TD activation, or diagnostic group differences. In the joint condition (Figure 1B), only the ASD group showed bilateral activation of the cerebellum including bilateral Crus I, Crus II, lobule VIIb and lobule VIIa. Similar to our previous findings in the cerebral cortex (Green et al., 2015), these cerebellar regions showed significantly greater activation in the ASD compared to TD group in the joint condition. Further analyses will examine whether this greater cerebellar activation relates to SOR symptom severity within the ASD group.

### Conclusions:

While the cerebellum was active in the ASD group during auditory stimulation alone, it was hyper-activated in ASD compared to TD only during joint auditory and tactile stimulation. These results implicate abnormal cerebellar function in sensory processing atypicalities in ASD, especially when the brain is tasked with processing stimuli across multiple sensory modalities, as is the case in real-world situations.

**434.008 (Poster)** Atypical Development of Emotional Face Processing Networks in Autism Spectrum Disorder from Childhood through to Adulthood

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Background: Impairments in social functioning are hallmarks of autism spectrum disorder (ASD), and atypical functional connectivity may underlie these difficulties. Patterns of both hyper- and hypo-connectivity have been reported in those with ASD compared to typically developing individuals, and it is hypothesized that these conflicting findings may be reconciled by accounting for developmental changes.

Objectives: Magnetoencephalography (MEG) was used to investigate age-related changes in whole-brain functional connectivity of eight emotion processing regions of interest (ROIs) during happy and angry face processing in children, adolescents and adults (6-39 years) with ASD (N=83) and age- and sex-matched controls (N=107).

Methods: Happy or angry faces and a scrambled pattern (target) were presented simultaneously while MEG was recorded. Participants indicated the location of the target (left or right) as rapidly as possible by a button press. Time-series for each emotion were derived from 90 cortical and subcortical sources of the AAL atlas using the LCMV beamformer. The phase difference derivative was used to assess phase synchronization of ongoing neural oscillations among sources. Main effects of age, group, emotion and their interactions on the connectivity between the 8 ROIs and the rest of the brain were assessed using Network Based Statistics.

Results: In ASD and controls, increased functional connectivity across age was found predominately in networks in the theta band to happy and angry faces (ASD Happy:  $p_{\text{corr}}=0.004$ ; ASD Angry:  $p_{\text{corr}}<0.002$ ; Controls Happy:  $p_{\text{corr}}<0.002$ ; Controls Angry:  $p_{\text{corr}}<0.002$ ).

We also observed, age-related group differences in functional connectivity in a gamma band network across emotions ( $p_{\text{corr}}=0.016$ ), indicating a disordinal age-related trajectory of functional connectivity to emotional faces. In ASD, age was negatively correlated with the network's connectivity strength ( $r=-0.395$ ,  $p=0.0002$ ), but positively correlated in controls ( $r=0.557$ ,  $p<0.0001$ ). The network contained connections involving the bilateral fusiform gyri (FG), amygdalae, right insula and left anterior cingulate (ACC), with several connections between inferior brain regions and orbital frontal cortices.

Lastly, we found emotion-specific age-related differences in connectivity between groups in the beta frequency band ( $p_{\text{corr}}=0.025$ ). In ASD, age was positively correlated with the network's connectivity strength to happy faces ( $r=0.276$ ,  $p=0.012$ ), while to angry faces, age was negatively correlated ( $r=-0.24$ ,  $p=0.029$ ). In contrast, in the control group age was negatively correlated with the network's connectivity strength to happy faces, ( $r=-0.312$ ,  $p=0.001$ ), while no significant correlation was found for angry faces ( $r=0.109$ ,  $p=0.265$ ). The network included connections involving the bilateral ACC, amygdalae, left FG and right insula, with the highest number of connections in the left ACC.

Conclusions: We observed age-related changes in MEG connectivity underpinning emotion processing in ASD and in typical controls, as well as age-related between-group differences across emotions. These findings establish altered frequency-specific developmental trajectories of functional connectivity in ASD, across distributed networks and a broad age range, which may finally explain the heterogeneity in the literature. Emotion-specific differences in functional connectivity with age between groups, suggest that even happy faces remain difficult to process in those with ASD.

#### **434.010** (Poster) Autism Diagnosis Prediction from Inter-Subject Similarity of Video-Evoked fMRI Timeseries

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Background: Naturalistic viewing paradigms, in which participants undergo functional magnetic resonance imaging (fMRI) scanning while watching videos depicting semi-naturalistic stimuli, have emerged as an important methodological advance toward improving ecological validity in human neuroscience. Coupling these paradigms with machine learning approaches may particularly benefit clinical neuroscience, by providing the power to both inform neurobiological differences between clinical and control groups in more naturalistic contexts (Eickhoff et al., 2020), and to pinpoint the specific stimulus properties that evoke the most robust group differences.

Objectives: Here, we present novel analytic approaches for predicting ASD diagnosis using inter-subject similarity of brain responses across epochs of video clip viewing. Eventually, this technique may yield insights into stimulus properties that are linked with the greatest differences in brain functioning between individuals with Autism Spectrum Disorder (ASD) and controls.

Methods: We used an extensively and densely sampled fMRI dataset from 29 adults with ASD and 22 age-, IQ-, and sex-matched controls with 4 ~15 min video-watching scans (813 TR) and resting-state scans; preprocessing is described in Byrge & Kennedy (2018; 2020). Video scan stimuli were movie trailers from various genres. Results presented here include 36-40 participants per scan (13-15 ASD) following data quality -related exclusions and employ censored timeseries for highest quality from 110 regions of interest (ROIs) from a common anatomical parcellation (Harvard-Oxford). We combined various feature selection and modeling approaches into a cross-validated inter-subject-similarity-based predictive modeling framework (c.f. Shen et al., 2017), using mean pairwise inter-subject correlations between a held-out subject and healthy controls as similarity measures (ISCs) and both permuted group assignments and resting state data as null models.

Results: Using brain-wide ISCs across the entire video, we achieved above-chance diagnosis prediction accuracy of 73.7%-80.6% for the 4 video scans. Preliminary analyses using feature selection to model only subsets of timepoints from each scan obtain even higher accuracy. In previous work using this same dataset, (Byrge & Kennedy, 2020) we were unable to predict diagnosis above chance levels using functional connectivity matrices derived from these same scans.

Conclusions: We can predict ASD diagnosis from video- evoked brain responses but not from video- evoked functional connectomes in this dataset. Ongoing work aims to understand whether this dissociation arises due to statistical properties or neurocognitive differences informative about ASD. Next steps will examine whether the most informative video segments and brain regions replicate in an independent dataset, and will characterize stimulus features of those segments, providing important insights into the low-level stimulus properties and/or socio-cognitive processes driving brain response differences in ASD.

**434.011 (Poster)** Brain Structural Correlates of Autistic Traits across the Diagnostic Divide: A Surface Based Morphometry Study

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Background: Autistic traits (AT) lie in a continuum in the general population, and the higher end of this trait distribution is often linked with a clinical diagnosis of ASD (Robinson et al., 2011; Whitehouse et al., 2011). Majority of previous studies examining the brain structure have used voxel based morphometry to assess the regional grey matter volume (GMV) differences in ASD, using a case-control design. However, these regional GMV differences may also be driven by other surface based metrics such as cortical thickness (CT), surface area (SA) and gyrification (Ecker et al., 2013; Libero et al., 2014). Taking this into account, we aimed to investigate the relationship between CT, SA, volume and gyrification and autistic traits across a sample including individuals with and without ASD, using a dimensional approach.

Objectives: To this end, we collected high resolution T1-weighted structural brain images and Autism Spectrum Quotient (AQ). Surface Based Morphometry (SBM) was used to examine the regional differences in the brain structure in relation to AT.

Methods: Ninety-one adults (66 neurotypicals, 25 ASD: 52 males, 39 females, age 18-60 years) were recruited for this study. This study was approved by the school research ethics committee, University of Reading. High resolution whole brain MPRAGE images were acquired using Siemens 3T MRI scanner installed at the Centre for Neurosciences and Neurodynamics. Freesurfer neuroimaging analysis suite was used to perform the SBM. All the structural brain images were preprocessed using the following steps: 1) correction for head motion, 2) bias field correction, 3) skull-stripping, 4) segmentation, 5) registration, 6) spatial normalisation and 7) smoothing (Fischl, 2012). For the statistical analysis, a Different Offset Same Slope (DOSS) model was used to test the relationship between CT, SA, volume, local gyrification index (LGI) and AT, including age and gender as nuisance variables. Precomputed Monte-Carlo Simulation was used to run the multiple comparisons test with a vertex-wise cluster-forming threshold (0.05) and the threshold for statistical significance ( $p=0.05$ , two-tailed).

Results: We found significant positive association between all four metrics including CT, SA, volume, LGI and AT. The significantly associated cluster in CT were observed in the left lingual gyrus, right lateral occipital cortex and right pars triangularis, whereas the significantly associated cluster in SA were observed only in the right lateral occipital cortex. The significant associations with cortical volume were observed in the left lingual gyrus, right lateral occipital cortex and right pars triangularis. A significant cluster for LGI was observed in the right lingual gyrus.

Conclusions: Our study findings were consistent with previous reports (Ecker et al., 2013; Yang et al., 2016) of brain structural differences in individuals with ASD. These findings suggest widespread cortical volume differences (in the pars triangularis, lateral occipital cortex and lingual gyrus) may be significantly driven by CT and SA, including the social brain regions. Such brain structural differences may underlie aberrant cortical cytoarchitecture properties underpinning atypical socio-communication and visual processing behaviour respectively associated with higher AT.

**434.013 (Poster)** Corpus Callosum Structure and Inter-Hemispheric Functional Connectivity in Autism Spectrum Disorder

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Background:

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental disorder characterized by impairments in social communication and repetitive, restricted patterns of behaviors and interests (American Psychological Association, 2013). Using neuroimaging to discover reliable markers of ASD is an avenue of ongoing research that may lead to earlier diagnosis and identify targets for intervention. Smaller corpus callosum (cc) volume (Anderson et al., 2011) and disruptions in functional connectivity (Kana, Libero, Moore, 2011) are some of the consistently reported neural impairments in ASD. However, few studies have examined the relationship between cortical morphology and functional connectivity in ASD.

Objectives:

The objectives of the current study were to characterize volumetric differences in specific segments of the cc in ASD, measure inter-hemispheric (homotopic) functional connectivity, and elucidate the structure-function correspondence by examining the relationship between these two variables.

#### Methods:

Structural MRI and resting state fMRI data from 39 males with ASD ( $16.5 \pm 7.0$  years) and 55 typically-developing (TD) controls ( $16.7 \pm 6.2$  years) matched on age ( $t(92) = .097, p = .92$ ) were obtained from the Autism Brain Imaging Data Exchange (ABIDE I) database. The corpus callosum (cc) was divided into five subdivisions (anterior, mid-anterior, central, mid-posterior, and posterior) using the *FreeSurfer* 6.0 software (Fischl, 2012). Volumes were calculated for each sub-region and were summed together to yield a total cc volume for each subject. Homotopic functional connectivity was calculated between a voxel in one hemisphere and its mirror voxel in the opposite hemisphere using the Resting-State fMRI Data Analysis Toolkit (REST) in MATLAB. Total cc volumes were also correlated with z-scores of interhemispheric correlation values to establish a structure-function relationship.

#### Results:

The ASD group had significantly smaller volumes in the central section ( $M = 486.23\text{cm}^3, SD = 84.50, F(93) = 7.69, p = .007$ ) of the cc. However, a one-tailed t-test revealed no differences in total cc volume between ASD and TD ( $t(93) = .802, p = .373$ ). Further, the ASD group showed stronger interhemispheric connectivity in the superior frontal gyrus (SFG) than the TD group ( $t = 1.988, p = .05$ ). There was no significant correlation between these structural and functional variables in the ASD group ( $r = -.137, p = .413$ ), nor the TD group ( $r = -.027, p = .844$ ).

#### Conclusions:

These findings suggest that individuals with ASD have morphological differences in the cc that may be specific to certain sub-regions. The total cc volume and resting-state interhemispheric functional connectivity may not be directly related, aligning with previous findings (Anderson et al., 2011). Targeted comparisons between specific sub-regions and corresponding homotopic region connectivity may reveal subtle differences in structure-function relationship. Additional research is necessary to determine the effects of these structural differences on ASD symptomatology and behavior.

#### **434.014 (Poster)** Cortical Gyrfication Morphology in ASD and ADHD: Implication for Further Similarities or Disorder-Specific Features?

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Background: Shared etiological pathways are suggested in autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) given high rates of comorbidity, phenotypic overlap and shared genetic susceptibility. Investigation of both neurodevelopmental disorders (NDDs) in the same study using common methodology will enhance our understanding of further shared and possible disorder-specific underlying neurobiological mechanisms that may drive these conditions. Cortical gyrfication morphology, measured through magnetic resonance imaging (MRI), is an understudied brain construct in ASD and ADHD literature. However, considering that the peak of gyrfication expansion occurs in the early developmental years and the timing of onset of ASD and ADHD symptomatology is also in early childhood, investigating this brain construct in these two NDDs may provide insight into important contributing etiopathological factors. Contradictory findings have been found in the few studies that have examined gyrfication morphology in ASD and ADHD, possibly due to small sample sizes among other limitations. To our knowledge, no study has yet investigated gyrfication in ASD and ADHD versus typically developing (TD) children in the same study and there is limited evidence of the relation of this measure to clinical symptoms.

Objectives: 1. To investigate gyrification morphology in a large sample of children and adolescents with ASD and ADHD compared to TDs. 2. To examine potential functional implications of gyrification differences by investigating the relation between this brain construct and ASD and ADHD symptomatology, across diagnostic groups.

Methods: Neuroimaging (T<sub>1</sub>-weighted), cognitive and behavioural data were obtained from Province of Ontario Neurodevelopmental Disorders (POND) network, a multi-site Canadian study. We undertook a whole-brain, vertex-wise approach using FreeSurfer software to measure local Gyrification Index (*I*GI), a surface-based measure of the degree of local gyrification. General linear models (GLMs) were conducted on the command-line stream of FreeSurfer to examine *I*GI differences between groups and investigate the effect of IQ. The QDEC application on FreeSurfer was used to examine brain-behaviour relations. We controlled for the effects of age, sex and surface area in all analyses.

Results: Analyses were performed on 539 (197 ASD; 96 ADHD; 246 TD) children and adolescents 6-17 years of age. We found no significant group differences in *I*GI, but significant age and sex effects across diagnostic groups. Specifically we report a decrease of *I*GI with age and greater *I*GI in girls compared to boys. There were also no diagnosis-by-age interaction effects, suggesting similar developmental trajectories of *I*GI across ASD, ADHD and TDs in the age range of our cohort. Including IQ in the model yielded similar results except for the absence of main effects of sex. Brain-behaviour relations generally showed increased *I*GI in the right medial temporal lobe was associated with higher social communication, hyperactive/impulsive and inattentive problems but lower adaptive functioning.

Conclusions: This investigation of gyrification morphology in ASD and ADHD in the same cohort with common methodology contributes to our understanding of shared and disorder-specific brain mechanisms in these two NDDs, and informs potential contributing etiopathological factors of these two NDDs. Our results support the emerging literature suggesting overlap of neuropathology in ASD and ADHD.

**434.015 (Poster) Cortical Myelination in Toddlers and Preschoolers with Autism Spectrum Disorder**

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Background: Disruptions to brain maturation in the first years of life in ASD are well documented, including early brain overgrowth, primarily driven by surface area overexpansion, and accelerated white matter development (i.e., increased fractional anisotropy). However, knowledge of the specific neurodevelopmental processes contributing to atypical brain maturation is extremely limited. Among such neural maturational processes is intracortical myelination, which is thought to contribute to fine-tuning of brain network connectivity. To our knowledge, this is the first in-vivo study reporting on intracortical myelin content in toddlers and preschoolers with ASD.

Objectives: To examine intracortical myelin content (MC) in young children with ASD as compared to typically developing (TD) peers.

Methods: Participants were young children with ASD (mean age: 44±12 months; range: 23-62 months) and TD children (mean age: 42±15 months; range: 20-65 months) enrolled in a longitudinal study of early brain markers of autism. ASD diagnoses (or clinical best estimates for the youngest participants) were established based on the DSM-5 criteria, supported by the ADOS-2 and ADI-R. Data from 36 participants (20 ASD, 16 TD) for whom both T<sub>1</sub>-weighted (T<sub>1w</sub>) and T<sub>2</sub>-weighted (T<sub>2w</sub>) anatomical MRI scans were successfully acquired during natural sleep were included. Data quality, inspected by two independent raters, was equivalent in both groups. MC was estimated through the ratio of T<sub>1w</sub>/T<sub>2w</sub> signal intensity, using the Human Connectome Project pipelines. The average T<sub>1w</sub>/T<sub>2w</sub> ratio was extracted from 34 regions of interest (ROIs) per hemisphere from the Desikan-Killiany atlas. Analyses were performed on the 12 ROIs with the highest T<sub>1w</sub>/T<sub>2w</sub> ratio (averaged between hemispheres), representing the most myelinated cortices (i.e., visual, sensorimotor, auditory, posterior aspects of cingulate, and limbic cortices). Group differences in MC were examined with two-sample t-tests. General linear models (GLM) were employed, with the T<sub>1w</sub>/T<sub>2w</sub> ratios as outcome variables, and diagnostic group, age, and group-by-age interaction terms as predictors for each ROI. Grey/white contrast to noise ratio (CNR) and sex were included as covariates in all analyses. Corrections for multiple comparisons were conducted using Benjamini-Hochberg False Discovery Rate (FDR; corrected  $p_{FDR} < 0.1$ ).

Results: Direct group comparisons revealed no group differences (ASD vs. TD) in the T<sub>1w</sub>/T<sub>2w</sub> ratio for the 12 ROIs. The GLM analyses revealed significant group-by-age interaction effects in 6 out of the 12 ROIs (i.e., cuneus, lateral occipital, pericalcarine, posterior cingulate, parahippocampal, and precuneus cortices), with T<sub>1w</sub>/T<sub>2w</sub> ratio consistently increasing with age in TD children but not in the ASD group, while controlling for sex and grey/white CNR (Figure 1).

Conclusions: Although no group differences were observed in MC in the selected heavily myelinated areas, a consistent pattern of differential relationships between age and MC was evident in children with ASD vs. their TD peers across multiple ROIs. Specifically, TD children showed age-related increase in MC in visual, posterior cingulate, precuneus and parahippocampal cortices, consistent with prior studies on typical myelin development in this age range. However, there was a general lack of relationship between MC and age in the ASD group, suggesting a disrupted developmental trajectory of intracortical myelination in ASD.

**434.016 (Poster)** Developmental Predictors of the Fusiform Gyrus Cortical Morphology

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Background:

The fusiform gyrus (FG), located in the ventral occipitotemporal cortex has been found to play differential roles in the left and right hemispheres, with visual word learning and word formation being left lateralized and face processing being right lateralized (Davies-Thompson et al., 2016). Previous research has demonstrated that these skills improve with age (Herba & Phillips, 2004; Nelson, 1981). People with autism spectrum disorder (ASD) have shown altered activation and connectivity of the FG reportedly due to delays and deviations during development (Schultz, 2005). However, few studies have investigated the morphometric features (cortical thickness, CT; grey matter volume, GMV) of the FG as they relate to age. CT reflects the size, density and arrangement of cells and has been shown to develop differently in individuals with ASD (Zielinski et al, 2014); GMV also has been shown to have developmental differences in ASD (Foster et al., 2015). In the present study, we focused on how development, as measured by age, and autism symptoms predicted morphometric features of the FG.

Objectives:

The goal of the present study was to examine morphometric features of the FG (CT and GMV) as they relate to age and autism symptomatology.

Methods:

A total of 106 individuals (age range: 8-40 years) participated in this structural MRI study. High resolution T1 weighted images were acquired using a 160 slice 3D MPRAGE volume scan (TR = 200 ms, TE = 3.34 ms, flip angle = 12, FOV = 25.6, 256 × 256 matrix size, 1 mm slice thickness) on a 3T Siemens Allegra scanner. Established *Freesurfer* morphometric data analysis procedures were used to extract the mean GMV and CT from these participants. All participants also completed the Autism Spectrum Quotient (AQ), a measure of autism symptoms. Separate linear regression analyses compared each morphometric measure of the left and right FG with age and AQ scores.

Results:

The linear regression model revealed that age statistically significantly predicted GMV in the left,  $F(1,107) = 8.197$ ,  $p = 0.005$ , adj.  $R^2 = 0.62$ , and right FG,  $F(1,107) = 4.145$ ,  $p = 0.044$ , adj.  $R^2 = 0.28$ . CT significantly predicted only the right FG,  $F(1,105) = 16.511$ ,  $p < 0.005$ , adj.  $R^2 = 0.128$ . AQ score was not a statistically significant predictor of GMV in the left,  $F(1,75) = 0.677$ ,  $p = 0.413$ , adj.  $R^2 = -0.4\%$ , or right FG,  $F(1,75) = 1.233$ ,  $p = 0.270$ , adj.  $R^2 = 0.3\%$  or CT in the left,  $F(1,73) = 0.636$ ,  $p = 0.428$ , adj.  $R^2 = -0.5\%$ , or right FG,  $F(1,74) = 1.183$ ,  $p = 0.280$ , adj.  $R^2 = 0.2\%$ .

Conclusions:

The findings of the current study suggest that morphological features of the FG change as a function of development. This may also provide neurobiological insights into the role of cortical morphology of FG in functions, such as face processing and visual word learning.

**434.017 (Poster)** Examining Volumetric Gradients Based on the Frustum Surface Ratio in the Brain in Autism Spectrum Disorder

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**Background:** Autism Spectrum Disorder (ASD) is a neurodevelopmental condition accompanied by differences in brain morphometry. Neuroanatomical abnormalities in ASD include differences in the development of grey matter volume, which has extensively been studied in the past (Courchesne et al., 2001; Hazlett et al., 2011; Ecker et al., 2017). However, traditional analyses do not assess how grey matter volume is distributed across cortical layers. This is of importance as ASD-related genes have been shown not to be equally expressed across all cortical layers, but may affect either the superficial (Parikshak et al., 2013) or the inner (Willsey et al., 2013) layers differentially, which in turn may impact on cortical lamination and folding.

**Objectives:** We aimed to characterize a novel feature assessing the surface-based distortion of grey matter volume across cortical surfaces based on typically developing (TD) controls, and to utilize this feature to characterize differences in brain morphometry between individuals with ASD relative to TD.

**Methods:** We included 92 adults with ASD and 92 TD, aged 18-52 years. Cortical surface models were extracted from T1-weighted volumetric images using FreeSurfer (<http://surfer.nmr.mgh.harvard.edu/>). Vertex-wise estimates of 'Frustum Surface Ratio' (FSR) were calculated as the ratio of the volume expected based on the pial surface ( $V_E$ ), and the actual (i.e. analytical) volume ( $V_A$ ) (Winkler et al., 2018). We examined the relationship between FSR and other cortical measures to explore its biological plausibility in the subsample of TD. Subsequently, we examined differences between ASD and TD by regression of a GLM at each vertex with (1) group, gender, and site as categorical fixed-effects factors, (2) an age-by-group interaction term, and (3) age and FSIQ as continuous covariates.

**Results:** The spatial distribution of FSR appeared to approximate the normal distribution, capturing information on cortical volume and brain geometry, and followed the outline of primary and secondary gyri and sulci (Figure 1A). Measures of FSR were highly correlated with vertex-wise estimates of mean curvature, sulcal depth, and pial surface area, although none of these features explained more than 76% variability in FSR on their own (Figure 1B). Following correction for multiple comparisons (RFT-based cluster-corrected,  $p=0.05$ ), we observed that the degree of FSR was significantly increased in ASD relative to TD in many cortical clusters, including inferior parietal, superior temporal, and cingulate regions (Figure 2A). We also observed significant age-by-group interactions, indicating that between-group differences in FSR are age-dependent, with differences being most prominent at age 40 and above (Figure 2B).

**Conclusions:** Our findings suggest a more outward-weighted gradient of CV in ASD, which may indicate a larger contribution of supragranular layers to regional differences in CV. Therulesult of a steeper age-related decline of FSR are in line with similar developmental trajectories been reported for cortical volume (Lange et al., 2015), cortical thickness (Zielinski et al., 2014), and gyrification (Kohli et al., 2019) in ASD. The degree of FSR might therefore serve as a novel proxy measure assessing volumetric gradients along the depth of the cortical mantle, and may guide future studies into the genetic underpinnings of ASD.

#### 434.018 (Poster) Extra-Axial Cerebrospinal Fluid Volume Normalizes with Age in Autistic Individuals

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**Background:** Autism spectrum disorder has long been associated with a variety of organizational and developmental abnormalities within the brain. In a series of recent studies, an increase in extra-axial CSF volume has been reported in autistic individuals between the ages of 6 months and 4 years (Shen et al., 2013; Shen et al., 2017; Shen et al., 2018). In each of these studies, the increased extra-axial CSF volume was predictive of the diagnosis and severity of the autism symptoms, irrespective of whether or not the individual came from a simplex or multiplex family.

**Objectives:** In the present study, we explored the trajectory of extra-axial CSF volume throughout the lifespan in both autistic and typically developing (TD) participants. We hypothesized that an elevated extra-axial CSF volume would be found in autistic individuals compared with TD controls, with that difference persisting throughout the lifespan.

**Methods:** We tested the hypothesis with a dataset that implemented an accelerated longitudinal design and included 201 individuals. Each individual had between 1-5 timepoints of data with each timepoint separated by 2-3 years. A total of 456 T1-weighted MRI scans were analyzed. The segmentation of extra-axial CSF from these scans was accomplished via a previously established pipeline (Mostapha et al., 2018; Shen et al., 2018). Using a separate dataset from the Human Connectome Project, the pipeline was found to be highly reliable (ICC = 0.96). A linear mixed-effects model fit was used to determine longitudinal, age-related changes in extra-axial CSF volume as a function of diagnostic group, diagnostic group by age<sup>2</sup>, age, age<sup>2</sup>, and sex in R 4.0.2 using the package nlme.

**Results:** Starting at age three, we estimated an average extra-axial CSF volume of approximately 45 cm<sup>3</sup> for both the autistic and TD groups. Between 3 and 20 years, the volume of extra-axial CSF approximately doubled. After age 20, the extra-axial CSF volumes leveled off through age 42. The trajectories of extra-axial CSF volume between 3 and 42 years were similar for the autistic and TD groups (group x age interaction,  $t(251) = -0.72, p = 0.47$ ). Also, no significant differences between the autistic and control groups were observed after recentering age at 10 ( $t(198) = -0.93, p = 0.36$ ), 20 ( $t(198) = -1.71, p = 0.09$ ), and 30 ( $t(198) = -1.52, p = 0.13$ ) years.

**Conclusions:** In contrast to our hypothesis and previous reports of increased extra-axial CSF volume in autistic individuals between six months and four years, we found no group differences in extra-axial CSF volume between 3 to 42 years. When considered in combination with previous reports, our results suggest that the increased extra-axial CSF volume in young autistic children normalizes later in childhood.

**434.019 (Poster)** Functional Lateralization of Language Processing in Individuals with a History of ASD, Current ASD, and Typical Development

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**Background:** Left-hemisphere (LH) language dominance characterizes 76-96% of the population; degree of asymmetry predicts handedness (Berl, et al., 2014), and relates to individual differences in language. Individuals with autism spectrum disorder (ASD) and language impairment show more atypical hand-dominance (Markou et al., 2017) and lateralization; greater symmetry predicts greater language impairment (Lindell & Hudry, 2013; Herbert et al., 2004). While atypical asymmetry of brain *structure* is prominent in ASD (Postema, et al., 2019), less is known about asymmetries of brain *function*. Studies of individuals with a clear history of ASD, who lose the ASD diagnosis (LAD) and have no symptoms or language impairment in adolescence (Fein et al., 2013), may reveal whether *functional* neural asymmetry becomes more typical after language impairments resolve.

**Objectives:** We assessed ASD-specific differences in functional hemispheric asymmetry using an fMRI-based lateralization index (LI), quantifying how LH versus right-hemisphere (RH) brain regions were differently engaged during a language task. LI scores for Broca's area, which is highly LH-lateralized during language processing, were predicted to differ in ASD. Because few studies have examined functional brain LI in ASD, supplemental analyses explored group differences in 180 cortical regions of interest (ROIs).

**Methods:** We re-examined fMRI data from a sentence comprehension task (Eigsti et al. 2016) for three groups: (1) ASD, with average cognitive abilities [ $n=23$ ; M(SD) age=13.9(3.3) years]; (2) LAD [ $n=16$ ; 13.7(3.6)]; and (3) typically-developing (TD) participants [ $n=19$ ; 13.3(2.8)]. Groups did not differ on age, handedness, gender, or nonverbal IQ. MRI data, collected on a 3T Siemens Allegra, were prepared using fMRIPrep v20.0.6, converted into CIFTI format, and co-registered to the Human Connectome Project (HCP) cortical atlas (Glasser et al. 2016) using Ciftify (Dickie et al. 2019). Task-activated brain regions were identified using GLM; LI was calculated for HCP parcels:  $(\text{Ract}-\text{Lact}) / [\text{abs}(\text{Ract})+\text{abs}(\text{Lact})]$ . One-way ANOVAs with planned comparisons were conducted to assess diagnostic differences in LI for Broca's area and for exploratory analyses of 180 HCP cortical ROIs, uncorrected for multiple comparisons.

**Results:** No main effect of diagnosis for Broca's area LI emerged. Planned  $t$ -tests revealed significantly reduced LH lateralization in Broca's area in ASD compared to TD, with medium effect size ( $t=-1.89^*$ , Cohen's  $d=0.57$ ); LAD/ASD and LAD/TD groups did not differ. Exploratory analyses found significant group differences with medium-to-large effect sizes in 17 cortical ROIs; all demonstrated reduced leftward asymmetry of language-related activations for ASD and LAD compared to TD (Table 1, Figure 1).

**Conclusions:** We probed hemispheric asymmetry in ASD using an fMRI language task. Participants with current ASD showed atypically reduced functional asymmetry in Broca's area, and exploratory analyses suggested atypical activity-related asymmetry in both ASD and LAD for numerous cortical regions. Broadly, these results suggest that there is reduced LH specialization during language processing in individuals with ASD by history, even in the absence of *current* language impairment. Future work will examine correlations between functional asymmetries and behavioral characteristics, and interpret functional differences in the light of structural brain asymmetry.

**434.021 (Poster) Longitudinal Analysis of Amygdala Connected Cortical and Limbic Regions**

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**Background:** The amygdala is widely implicated in the neurobiology of autism spectrum disorder (ASD) and social functioning. Altered trajectories of amygdala growth in childhood are observed in ASD, however little is known about how this occurs within the context of the network of brain regions sharing direct anatomical connection with the amygdala, and what those implications are for ASD.

**Objectives:** To conduct a study of the structural development of the amygdala and of limbic and cortical brain regions with known direct anatomical connections to the amygdala in boys and girls with ASD and with typical development (TD).

**Methods:** Nine-hundred and fifty longitudinal structural MRI were acquired from 282 children with ASD (93 female) and 128 children with TD (61 female) on up to four timepoints (Mean ages: 3.2, 4.3, 5.3, 11.4 years). Images were segmented using MRICloud (Mori et al., 2016), producing volumes for subcortical and cortical regions of interest which were normalized as proportion of total cerebral volume. Thirty-two regions of interest with known anatomical connection to the amygdala (Freese & Amaral 2009; Hennessey et al., 2018) were submitted to mixed effects multivariate distance matrix regression (mMDMR) analysis which assessed global phenotypical differences associated with ASD diagnosis, sex, and age, and the two- and three-way interactions thereof. mMDMR is a multivariate, person-centered statistical method that allowed us to test longitudinal associations between predictor variables (i.e. age, diagnosis, sex) and a distance matrix, where the distance matrix contains pairwise dissimilarities between each individual's amygdala anatomical profile at a point in time. Inspection of effect sizes identified the region(s) that drove the multivariate effects, which were then descriptively plotted using univariate mixed level models. Social Responsiveness Scale and Vineland Adaptive Behavior Scales were acquired.

**Results:** The anatomical profiles of amygdala-connected regions exhibited persistent diagnostic differences (Diagnosis:  $X = 2.1, p = .015$ ) that grew larger over time (Age x Diagnosis:  $X = 1.9, p = .035$ ) (Figure 1A). Overall, robust developmental changes were observed for both ASD and TD ( $X_s \geq 169, p_s < .001$ ). Sex differences between anatomical profiles were observed (Sex:  $X = 2.9, p = .002$ ), which did not differ by diagnosis or change in magnitude over development ( $X_s \leq 1.3, p_s \geq .21$ ). Although the magnitude of diagnostic differences was similar in males and females with ASD, an examination of effect sizes revealed that in boys diagnostic differences were disproportionately due to differences at the middle temporal pole and subgenual anterior cingulate cortex, while in girls, diagnostic differences were primarily due to differences in the fusiform gyrus, entorhinal cortex, and superior temporal gyrus (Figure 1B). Descriptive analyses of these regions revealed unique longitudinal trajectories in males and females with ASD and TD. Analysis then revealed significant associations between amygdala-connected anatomy and the Social Responsiveness Scale and Vineland Adaptive Behavior Scales.

**Conclusions:** The anatomical profile of amygdala connected regions differ in autism, and those differences increase over development in childhood. While the magnitude of differences associated with ASD were similar in males and females across this anatomical profile, different regions were affected by autism in boys and girls.

**434.022 (Poster) Lower Sex Prediction Accuracy in Females with Autism Supports the Extreme Male Brain Theory**

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**Background:** Autism spectrum disorder (ASD) is characterized by a male preponderance with four to five times more males diagnosed than females. Even studies accounting for potential ascertainment bias still report a ratio of around two times more males than females. This makes it very likely that factors related to typical sexual differentiation are involved in the neurobiology of ASD. The extreme male brain theory (EMB) states that one mechanism contributing to such skewed sex ratio is elevated exposure to prenatal testosterone in utero (Lai et al., 2015). Increasingly, studies provide indirect and direct evidence for this, but neuroimaging studies into this question are still scarce. Here we leverage two large-scale datasets with sufficient numbers of females to address whether sex classification accuracy in females with ASD can be informative about the EMB.

**Objectives:** To test the predictions of the EMB theory using machine learning.

**Methods:** We used the Simple Fully Convolutional Network (SFCN) architecture (Peng et al., 2019) to predict biological sex based on linearly registered 3D T1 images, as shown in Fig 1. This model was trained and validated with 14,503 neurotypical (NT) male and female subjects from the UK Biobank (UKB) dataset. Next, we transferred the UKB-trained model to the LEAP dataset by finetuning it with just NT subjects and then testing it in both NT and autistic (ASD) subjects, including males (M) and females (F). The Longitudinal European Autism Project (LEAP) dataset comprised 98 ASD-F, 94 NT-F, 276 ASD-M and 173 NT-M. Two-fold cross validation was used to generate prediction results for all subjects. For the first (second) fold, the model was finetuned with 133 (134) NT subjects, and tested with 134 (133) NT and 187 (187) ASD subjects. To test reproducibility of results, the UKB-trained model was also transferred to the Autism Brain Imaging Data Exchange (ABIDE I+II) datasets by finetuning it with 276 NT-M and 276 NT-F. The model was then tested in NT and ASD subjects (138 NT-F, 138 NT-M, 138 ASD-F, 138 ASD-M).

**Results:** Sex classification accuracy was lower for female ASD subjects than for female NT subjects (ASD-F: 77.55%; NT-F: 86.17%, rank-sum test p-value:  $1.7e-2$ ). This observation supports the extreme male brain hypothesis, which states that females with ASD resemble NT males. The same pattern was also true for both ABIDE datasets (sex classification accuracy for ASD-F: 68.12%; NT-F: 84.78%, rank-sum test p-value:  $1.8e-7$ ), where ASD females were also more likely to be misclassified as males. For males, the sex classification accuracy for ASD and NT subjects was comparable. In the LEAP dataset, sex classification accuracy for: ASD-M, 93.84%; NT-M, 90.17%, whereas in ABIDE dataset, the sex classification accuracy for: ASD-M, 78.99%; NT-M, 83.33%.

**Conclusions:** We found replicable patterns of females with ASD being more likely to be misclassified as males based on their structural brain image. Considering such sex differences in ASD neurobiology can give us a better understanding of sex-related mechanisms contributing to ASD risk.

#### **434.023 (Poster)** Microstructural Neural Correlates of Maximal Grip Strength in Children and Adolescents on the Autism Spectrum

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**Background:** Children with ASD exhibit weaker grip strength compared to typically developing (TD) peers, and this group difference becomes exacerbated in adolescence and adulthood (Abu-Dahab et al., 2013; Travers et al., 2017). This is concerning because grip strength has been associated with concurrent and future daily living skills (Travers et al., 2017). While some have investigated the neural basis of grip in ASD (Unruh et al., 2019; Wang et al., 2019; Travers et al., 2015), it remains unclear how grip strength may map onto neural structures in ASD compared to TD, and whether these grip-brain relationships are similar or different in childhood compared adolescence.

**Objectives:** Examine diagnostic similarities and differences in the microstructural correlates of grip strength in ASD and TD during childhood and adolescence.

Methods: Data were acquired from two cohorts: the first, children (ages 6-10), 56 with ASD and 73 with TD; the second, adolescents (ages 11-17), 31 with ASD and 28 with TD. Maximal grip strength was collected using a hand dynamometer according to Halstead-Reitan Battery guidelines (Heaton et al., 1991). Multi-shell DWI was performed on a 3T scanner with isotropic 1.8mm<sup>3</sup> voxels and 2mm<sup>3</sup> voxels for the childhood and adolescent cohorts, respectively. Neurite orientation and dispersion index (NODDI) values of intracellular volume fraction (ICVF) and orientation dispersion index (ODI) were calculated (Zhang et al., 2012). Using T-SPOON corrected maps (Lee et al., 2009), voxel-based analyses were performed within each cohort predicting NODDI metrics from grip strength, diagnostic status, and their interaction controlling for age, sex, and head motion. False discovery rate ( $p < .05$ ) was used for multiple comparisons with a cluster threshold of  $k > 10$  contiguous voxels.

Results: Figures 1 and 2 depict significant clusters associated with grip strength. In the childhood cohort, one ICVF and 20 ODI (average: 60 voxels) clusters were similarly associated with grip across groups. These clusters included the frontal white matter, superior corona radiata, and cerebral peduncles. 19 ICVF and 6 ODI clusters (average: 126 voxels) demonstrated grip-by-group interactions in areas including the precentral gyrus, thalamic radiation, and cerebellar peduncles. In the adolescent cohort, one ICVF and four ODI clusters (average: 23 voxels) were similarly associated with grip across groups. Clusters included the postcentral gyrus and inferior corticospinal tract. The adolescent cohort showed 14 ICVF and 6 ODI grip-by-group interactions (average: 20 voxels) in areas including the precentral gyrus and internal capsule.

Conclusions: Across childhood and adolescence, there are more diagnosis-specific microstructural correlates of grip than diagnostic-independent correlates. This may suggest altered neural recruitment for motor tasks in ASD, even during childhood when grip is similar to TD. A diagnosis-specific relationship between grip and microstructure in cortical areas, such as the precentral gyrus, an area critical for directing motor actions, is consistent across cohorts. The adolescent cohort appears to show diagnosis-specific relationships between grip and microstructure in subcortical areas such as the brainstem, where the childhood cohort does not. These results may reflect differential motor circuit maturation in the ASD group during adolescence, when grip behavior begins to diverge from TD.

#### 434.024 (Poster) Motion Sensitivity and Visual Gamma Oscillations in Children with ASD

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Background: People with ASD have atypical visual motion sensitivity, e.g. a significant reduction in spatial suppression (SS) compared to neurotypical (NT) controls that may result from disturbed excitatory-inhibitory interactions in the visual cortex. SS is a perceptual phenomenon of impaired motion direction sensitivity to large high-contrast moving stimuli as compared to small ones (~1 degree of visual angle). The SS is thought to reflect enhanced surround inhibition in the primary visual cortex (V1) caused by an excitatory feedback from extrastriate visual areas that is engaged by the large stimuli. We have previously suggested that in NT individuals the top-down potentiation of surround inhibition by intensity of visual input may also explain attenuation of the magnetoencephalographic (MEG) high-frequency gamma response (GR) with increasing motion velocity of large high-contrast gratings. This was supported by the fact that the strength of velocity-related GR attenuation reliably predicted inter-individual differences in the SS both in typical adults and in children.

Objectives: We tested the prediction that an atypically reduced SS in children with ASD is associated with a weak velocity-related GR attenuation and/or with abnormal correlation between these behavioral and neural indexes of surround inhibition in the visual cortex.

Methods: GRs to large high-contrast gratings moving with three velocities (1.2, 3.6 and 6.0 deg/sec) were measured in the visual cortex in 35 NT boys and 36 boys with ASD aged 7-15 years using MEG and individual MRI-derived brain models. Both psychophysical direction duration thresholds for large and small gratings (Threshold<sub>LARGE</sub> and Threshold<sub>SMALL</sub>) and MEG data were available for 33 NT and 23 ASD children. SS was estimated as  $\log_{10}(\text{Threshold}_{\text{LARGE}}) - \log_{10}(\text{Threshold}_{\text{SMALL}})$ .

Results: At the group level, children with ASD did not differ from NT children in regard to GR amplitude or frequency. Both groups demonstrated similar developmental decreases in GR frequency and increases in GR power. Velocity-related suppression of GR was observed in both groups and did not differ between NT and ASD children. In NT children the stronger GR attenuation in V1 correlated with stronger SS ( $R = -0.38$ ,  $p = 0.03$ ) and higher Threshold<sub>LARGE</sub>, as it has been previously described in this sample using sensor-level analysis (Orekhova et al, Neuroimage 2020). In children with ASD the stronger GR attenuation in V1 also correlated with stronger SS ( $R = -0.51$ ,  $p = 0.01$ ), but, unlike that in NT children, this correlation was driven by the correlation with lower Threshold<sub>SMALL</sub>.

Conclusions: Typical GR parameters and velocity-related GR attenuation in children with ASD indicate that excitatory-inhibitory interaction in the visual cortex is not commonly disturbed in this population. Qualitatively different correlations between GR attenuation and motion direction detection thresholds in NT and ASD groups suggest that reduced spatial suppression in children with ASD may depend, at least in part, on a weaker surround inhibition within the V1. This feature mainly worsens their perception of small moving stimuli and may not be attributable to atypical top-down modulation of V1 circuitry.

**434.025 (Poster)** Multivariate Analysis of Atypical Patterns of fMRI Connectivity Modulation in ASD

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Background:

Autism spectrum disorder is a complex neurodevelopmental condition. There appears to exist pronounced behavioural, cognitive, and neural heterogeneities across individuals diagnosed with autism. These heterogeneities can complicate traditional case-control studies – for instance in situations where an autism behavioural phenotype is related to an atypical, but strongly individualized brain phenotype. The heterogeneity in autism has made understanding underlying mechanisms and the complex interrelation between neurobiology and cognitive profiles in autism challenging. A more fine-grained characterization of the neural processes specifically in action under cognitive loads might however advance our understanding of this disorder. Therefore, in this study, we explore the added value of novel, innovative tools with the aim to improve the interpretability of task-based functional magnetic resonance imaging (fMRI) and parse heterogeneity in autism.

Objectives:

To identify patterns of neural (a)typicality in the way individuals with autism engage with cognitive demands at the individual level.

Methods:

All analyses were based on different subsamples from the EU-AIMS/AIMS2TRIALS multisite Longitudinal European Autism Project (LEAP) with participants between 6 and 30 years of age. This study includes data drawn from five different fMRI task paradigms. We employ a novel task-potency approach which combines the unique aspects of both resting-state fMRI and task-fMRI. This allows us to disentangle the relative contribution of task-induced functional connectivity from that of the individuals' baseline connectivity architecture in a multiple task setting. Second, we use a method called normative modeling which maps atypicality of features on an individual basis with respect to the distribution of those features in a group of typically developing controls. It is well suited to parse sample heterogeneity at the individual level. Third, we apply robust out-of-sample canonical correlation analysis to relate high dimensional brain data to behavioural data in a way without making prior assumptions on the most relevant features.

Results:

We found greater levels of global functional connectivity atypicality for autism in each fMRI task paradigm (all  $p < 0.001$ ). The 10% brain regions that on average are most atypical for each separate task are shown in the attached figure. The particular spatial patterns of this atypicality furthermore show similarity across tasks - more so in autism than controls ( $p = 0.002$ ). We found significant and robust brain-behavior modes of covariation between functional connectivity atypicality spatial patterns and autism-related behavioral features for each of the tasks.

Conclusions:

we have applied innovative techniques to aid understanding of autism brain connectivity heterogeneity in a multi-task setting. We found that these techniques reveal a globally atypical strategy in which individuals with autism engage with tasks, and that this carries a level of similarity across tasks that could benefit from further exploration. We furthermore validated the behavioural relevance of these techniques through showing significant relationships between brain and behavioural data. This suggests that normative modelling and task potency can be useful tools in the challenge of understanding the neural foundations of autism.

**434.026 (Poster)** Robust and Interpretable Brain Signatures of Autism and Predictors of Clinical Symptom Severity

**Background:**

Autism spectrum disorder (ASD) is among the most common and pervasive neurodevelopmental disorders, affecting 1 in 54 children. Despite decades of research, the neurobiology of ASD is still poorly understood, as inconsistent findings preclude the identification of robust and interpretable neurobiological markers and predictors of clinical symptoms.

**Objectives:**

Identify robust and interpretable dynamic brain markers that distinguish children with ASD from typically-developing (TD) children and predict clinical symptom severity.

**Methods:**

We leverage multiple brain imaging cohorts (ABIDE: 403 ASD children with mean age 13.9 years, 399 TD children with mean age 14.9 years; Stanford 101 ASD children with mean age 11.7 years, 101 TD children with mean age 10.9 years) and exciting recent advances in explainable artificial intelligence (xAI), to develop a novel multivariate time series deep neural network (tsDNN) that extracts informative brain dynamics features that accurately distinguish between ASD and TD controls, and predict clinical symptom severity.

**Results:**

Our model achieved consistently high classification accuracies in cross-validation analysis of data from the multisite ABIDE cohort. Crucially, our tsDNN model also accurately classified data from an independent Stanford cohort without additional training. xAI analyses revealed that brain features associated with posterior cingulate cortex and medial prefrontal cortex, which anchor the default mode network, and the superior temporal sulcus and fusiform gyrus, which anchor the human voice and face processing and communication systems, most clearly distinguished ASD from neurotypical controls in both cohorts. Furthermore, feature identification procedures yielded a unique predictive fingerprint in each individual and features associated with the posterior cingulate cortex emerged as robust predictors of the severity of social and communication deficits in ASD in both cohorts.

**Conclusions:**

Our findings, replicated across two independent cohorts, advance our understanding of brain mechanisms underlying behavioral impairments in childhood autism, and contribute significantly towards the development of more effective and precise diagnostic and treatment strategies for autism.

**434.027 (Poster) Shared or Distinct? - Neuroanatomical Underpinnings of ASD in Carriers and Non-Carriers of the 22q11.2 Microdeletion**

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**Background:**

There is increasing interest in using human genetic models to better understand the mechanistic underpinnings of autism spectrum disorder (ASD). A crucial step in this process, however, is to demonstrate that the biological underpinnings of ASD in genetic high-risk conditions are similar to those in idiopathic illness. 22q11.2 deletion syndrome (22q11.2DS) is a genetic condition with complex clinical phenotypes that include ASD. Evidence from *in vivo* neuroimaging studies (Antshel et al., 2007; Jalbrzikowski et al., 2017; Gudbrandsen et al., 2019) suggests that 22q11.2DS individuals with ASD symptomatology are neuroanatomically distinct from those without, and may represent a distinct neurobiological subgroup. None of these previous studies, however, included individuals with idiopathic ASD. It therefore remains unknown how closely the neurobiological phenotype of ASD in 22q11.2DS resembles the ASD phenotype in those without the microdeletion.

Objectives:

To establish whether ASD symptomatology in 22q11.2 deletion carriers is underpinned by the same – or distinct – neural systems that mediate these symptoms in non-carriers.

Methods:

We examined vertex-wise estimates of cortical volume, surface area, and cortical thickness across 131 individuals (6-25 years). We included (1) 50 22q11.2 deletion carriers (n=25 ASD, n=25 without ASD), and (2) 81 non-carriers (n=40 ASD, n=41 healthy controls). In accordance with previously published studies (Jalbrzikowski et al., 2017; Gudbrandsen et al., 2019), all individuals with ASD met diagnostic cut-offs in the reciprocal social interaction and communication domain of the ADI-R (Lord et al., 1994), but were allowed to fall below threshold in the repetitive behaviors domain. We employed a multivariate dimensional approach using canonical correlation analysis (CCA). This allowed us to; 1) treat ASD as a continuous clinical construct spanned by multiple symptom domains assessed via the five subscales of the Social Responsiveness Scale (SRS; Bölte & Poustka, 2008; Constantino & Gruber, 2012), and 2) to examine the multivariate association between inter-individual clinical profiles and neuroanatomical variability in 22q11.2 deletion carriers and non-carriers.

Results:

Initially, CCA was performed across all individuals within our sample (see **Fig.1**), where clinical variability across the five subdomains of the SRS could be reduced to two latent trait variables that were (1) highly predictive of group membership (i.e. ASD vs. nonASD), and (2) significantly associated with neuroanatomical variability across multiple morphometric features. However, when comparing the multivariate association between inter-individual clinical profiles and neuroanatomical variability between groups, i.e. 22q11.2 deletion carriers and non-carriers (see **Fig.2**), we identified a high degree of factor similarity in the clinical canonical variate structure, but a low neuroanatomical factor similarity.

Conclusions:

ASD symptomatology is mediated by distinct neuroanatomical substrates in individuals with and without the 22q11.2 microdeletion, even when taking inter-individual variability in SRS subdomains of ASD into account. Brain mechanisms underlying ASD associated with specific genetic etiology may thus diverge from those in idiopathic illness.

**434.028 (Poster)** Social and Repetitive Behaviours in Youth with Autism Spectrum Disorder and the Association with Amygdala Subnuclei Maturation

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Background: The amygdala plays a key role in regulating emotional processes, including emotional recognition and some aspects of fear and anxiety responses. Dysregulated amygdala development has been reported in young children with ASD, while less is known about amygdala maturation in later childhood and adolescence, a sensitive window for social skill development.

Objectives: To determine if amygdala subnuclei follow different developmental growth trajectories in youth with ASD compared to TD youth, and whether specific amygdala subnuclei growth associate with ASD symptoms.

Methods: In this longitudinal magnetic resonance imaging (MRI) study, we assessed macrostructural development of the amygdala subnuclei in older children and adolescents with (n=23) and without ASD (n=15) at 2 timepoints 3 years apart. At the first session, participants were scanned with MRI at a median age of 12 years, with a second scan at a median age of 15 years.

The volumes of seven subnuclei (basolateral, central, medial, cortical, paralaminar, corticoamygdaloid area and anterior amygdaloid area) were extracted using an automatic segmentation algorithm for the two timepoints, to examine growth.

**Results:** In adolescents with ASD only, amygdala subnuclear volumetric changes were assessed in relation to ASD symptomatology. Participants with ASD were diagnosed using the Autism Diagnostic Observation Schedule, General (ADOS-G) and the Autism Diagnostic Interview, revised (ADI-R). Amygdala subnuclei growth was compared between the participant groups and revealed larger BLA nuclei volumes in adolescents with ASD compared to neurotypical participants ( $B=46.8$ ,  $p=0.04$ ). When examining ASD symptomatology in relation to the growth of the amygdala subnuclei, reciprocal social interaction scores on the ADI-R were positively associated with increased growth of the BLA nuclei ( $B=8.3$ ,  $p=0.001$ ). Growth in the medial nucleus predicted the communication ( $B=-46.9$ ,  $p=0.02$ ) and social ( $B=-47.7$ ,  $p<0.001$ ) domains on the ADOS-G. Growth in the right cortical nucleus ( $B=26.14$ ,  $p=0.02$ ) predicted ADOS-G social scores. Central nucleus maturation ( $B=29.9$ ,  $p=0.02$ ) was associated with the repetitive behaviors domain on the ADOS-G. Larger BLA volumes may be due to increased neuronal density, consistent with postmortem studies.

**Conclusions:** These findings reveal an association between amygdala subnuclei volumes and ASD symptoms, which may reflect activity-dependent plasticity. Improved understanding of amygdala subnuclei growth trajectories in youth may aid in identifying key windows for targeted interventions, particularly for social communication in adolescents with ASD who display social impairments.

**434.029 (Poster) Somatosensory-Evoked Potentials Associate with Tactile Sensitivity in Early Childhood Autism**  
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**Background:**

The presence of sensory symptoms has recently been recognized as a core feature of autism spectrum (AS), consistent with estimates suggesting that over 90% of individuals with autism show atypical responses to sensory stimuli that affect every-day functioning. It is during the early years of life that sensory symptoms emerge (<age 3) and may exacerbate the core social communicative and behavioral difficulties observed in autistic individuals. While increasing evidence suggests that altered inhibitory function results in atypical responses to sensory stimuli, little is known about the neural mechanisms underlying sensory differences in early childhood autism (<age 8).

**Objectives:**

Here, we use electroencephalography (EEG) to investigate tactile cortical processing in young children aged 3-6 years with autism compared to typically developing (TD) children, and to determine if properties of somatosensory-evoked potentials (SEPs) are associated with "real-world" parent-reported tactile symptoms.

**Methods:**

Scalp EEG was recorded from 28 children with a diagnosis of autism and 41 age- and sex-matched TD children aged 3-6 years during passive tactile fingertip stimulation. Children received tactile fingertip stimulation at different rates (1050ms and 150ms interstimulus interval (ISI) in blocked presentations) while watching a movie. Latency and amplitude measures for various SEP responses elicited with the 1050ms ISI were derived and the difference between SEP amplitudes elicited by 1050ms and 150ms ISIs was used as a measure of adaptation.

The Wechsler Non-Verbal Scale of Ability (non-verbal IQ) was utilized to assess intellectual functioning, and parents completed a standardized questionnaire to assess sensory symptoms in everyday life (Child Sensory Profile 2, CSP-2).

Properties of SEPs and adaptation were compared between autistic and TD children using ANCOVA models controlling for age and sex. Partial correlations, controlling for age and sex, were used to determine associations with parent-reported tactile symptoms.

#### Results:

As expected, autistic children had a lower non-verbal IQ compared to the TD children ( $p=0.006$ ) and showed significantly more parent-reported tactile symptoms, including both greater hyper- and hypo-sensitivity (all  $p<0.001$ ). There were no differences in the latency and amplitude of early and mid-latency SEP responses (P50, N80, P100), nor adaptation between autistic and TD children. However, the latency of a later SEP response (N140) differed between autistic and TD children, suggesting faster processing speed in children with autism ( $p_{corr}=0.035$ ). Further, correlational analyses showed an association between early SEP responses and behavioral tactile symptoms specific to the autism group (Figure, P50:  $r=0.38$ ,  $p=0.057$ ; N80:  $r=0.53$ ,  $p=0.005$ ; P100:  $r=0.52$ ,  $p=0.007$ ). This observation prompted an exploratory analysis using tactile phenotype as grouping variable rather than autism diagnosis. With this sensory-based regrouping, we observed differences in the late SEP response (N140), but also earlier responses (N80, P100) between the tactile sensitive and tactile typical groups; however, these fell short of corrected significance.

#### Conclusions:

Our findings suggest that altered early somatosensory cortex processing may index tactile symptoms in early childhood autism. Together, these findings advance our understanding of the neurophysiological mechanisms underlying tactile symptoms in early childhood autism and, in the clinical context, may have implications for improving therapies and creating autism-friendly environments.

#### **434.030 (Poster)** Structural Growth Trajectories and Rates of Change of Infant Brain Development in the First Six Months of Life

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#### Background:

The most rapid changes in postnatal brain development occur in an infant's very first months, as brain volume doubles and synaptic density quadruples. Multiple lines of evidence also show that changes during this critical developmental period are highly dynamic. Notably, the first months' of life are also an important period of behavioral development, when many early milestones are met and signs of neurodevelopmental disorders, such as autism, first become identifiable.

#### Objectives:

To assess dynamic growth trajectories of early structural brain development in typically developing infants' first six months of life.

#### Methods:

A Siemens 3T Prisma scanner was used to collect T1 and T2 weighted images from 68 typically developing infants (37 males, gestational age: 38.5 $\pm$ 2.1 weeks). Each infant was scanned at up to three times between birth and 6 months of age, with age at first scan and time between MRI scans pseudo-randomly distributed, resulting in 110 scans total. A 3D T2-weighted SPACE sequence and T1-weighted 3D MPRAGE sequence were employed T2- and T1-weighted anatomical images. A deep learning-based method was applied on combined T1w and T2w images to segment brain images into three tissue types: corticospinal fluid (CSF), gray matter (GM) and white matter (WM)(Wang et al., 2014). Quality of segmented brain images was ensured by carefully performing quality control using qualitative and quantitative measures. Total intracranial volume (ICV, CSF+GM+WM) and total brain volume (TB, GM+WM) were summed based on segmented images. Changes of ICV and TB over time were analyzed by generalized additive mixed effect model (GAMM). Both chronological age and corrected chronological age using infant's gestational age were used in the GAMM analyses. Effects of gestational age and sex effects were also examined.

#### Results:

The deep learning based method reliably identified different tissue types, even in images acquired around the 6<sup>th</sup> month of life which are known to have low image contrast between GM and WM. Consistent with the literature on infants between birth and three months of age (Holland et al., 2014), significant effects of corrected age and sex were observed for both ICV (age:  $p < 2.12 \times 10^{-18}$ , sex:  $p < 2.29 \times 10^{-6}$ ) and TB (age:  $p < 9.22 \times 10^{-29}$ , sex:  $p < 1.05 \times 10^{-6}$ ). Infants' ICV and TB increase rapidly over time and males have overall larger ICV and TB than females. In contrast to Holland et al., the main effect of gestational age and interactions between gestational age and age were not observed for either ICV or TB ( $p > 0.05$ ). Developmental trajectories of the structural brain in the first six months of life is dynamic (i.e., time-varying change rates instead of constant change rates): change rates of ICV and TB at birth were over 3 times higher than at month 6 (0.7%/day vs. 0.18%/day, respectively).

#### Conclusions:

Using a non-uniform longitudinal sampling strategy and a relatively large cohort of typically developing infants, we demonstrated dynamic structural growth trajectories of typically developing infants between birth and 6 months of age. Establishing normative trajectories during this critical period of development may facilitate the detection of deviated growth trajectories associated with neurodevelopmental disorders.

## POSTER SESSION — NEUROPHYSIOLOGY/ELECTROPHYSIOLOGY

### Poster 435 - Neurophysiology/electrophysiology Posters

**435.001** (Poster) Anticipation of Social and Non-Social Rewards in Youth with and without ASD  
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**Background:** While there has been sustained interest in the role of reward processing in autism spectrum disorder (ASD), researchers are just beginning to focus on the anticipation, as opposed to receipt, phase of reward processing in this population (Keifer et al., 2019). However, most social reward paradigms are not naturalistic and thus may not be as salient as their non-social monetary reward counterparts (Matyjek et al., 2020). Thus, we developed a naturalistic novel social interaction paradigm that models the anticipation of social rewards (Jarcho et al., 2013) and adapted it for event-related potential (ERP). Examining ERPs during reward anticipation may be particularly useful in parsing apart different stages of reward processing given its high temporal resolution. This task has never been applied in individuals with ASD and it is essential to utilize naturalistic tasks to model social reward processing in this population to better understand associated anticipatory reward processing deficits.

**Objectives:** This study examined ERP response during the anticipation of social rewards using a novel, naturalistic paradigm and a non-social control task in youth with and without ASD.

**Methods:** Thirteen youth with ADOS-2 confirmed diagnoses of ASD (10 male;  $M_{age}=13.53$ ,  $SD_{age}=1.83$ ) and 10 IQ-matched youth without ASD (5 male;  $M_{age}=13.38$ ,  $SD_{age}=1.56$ ), while undergoing EEG, completed the Virtual School Paradigm (VSP; Figure 1) and a non-social comparison task, the Doors Task. Both task modeled anticipation of social/monetary rewards in three conditions; 100% chance of nice/winning, 100% chance of mean/losing, or 50% chance of nice/mean or winning/losing social feedback/money (Hajcak et al., 2005). In both tasks, the SPN, an ERP that is generated by reward-related brain regions and sensitive to the anticipation of motivationally relevant feedback (Brunia et al., 2011), was extracted while participants waited to receive feedback. Each participant's parent completed the SRS-2 measure of autism symptom severity.

**Results:** The overall deception rate (i.e., belief they were interacting with real peers) did not differ between ASD and Non-ASD groups ( $t(20)=.313$ ,  $p=.76$ ). SRS-2 was associated with SPN response to anticipation of unpredictable peer feedback ( $r=.432$ ,  $p<.05$ ) such that participants with more ASD symptoms demonstrated attenuated (more positive) SPN amplitudes across groups (Figure 2). SPN to the anticipation of feedback from unpredictable peers was correlated with the social- awareness, communication, and motivation (all  $r>.42$ ,  $ps<.05$ ), but not social cognition or restricted/repetitive behavior subscales of the SRS-2. Correlations between the SRS-2 and SPN did not emerge during trials with predictably nice or mean peers nor on unpredictable, predictable win, or predictable loss trials on the Doors Task (all  $p's>.05$ ).

**Conclusions:** More ASD symptoms were related to attenuated SPN amplitudes in anticipation of feedback from unpredictable peers, but not predictable peers nor monetary rewards. These findings diverge from prior work and suggest that during anticipatory reward processing, youth with ASD demonstrate deficits specific to the social domain (Clements et al., 2018). Additionally, given that unpredictable peers tend to be the most motivationally salient, decreased anticipation or 'wanting' of feedback in youth with more ASD symptoms may reflect attenuated engagement with salient social partners.

**435.002** (Poster) EEG Study of Local and Global Perception in Children with Autism and Children with an Increased Likelihood of Synaesthesia

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**Background:** Synaesthesia, a mixing of the senses, is more common in autism. Behavioural findings suggest synaesthesia and autism share perceptual alterations, e.g. favouring local (details) over global visual processing. Here we compared electrophysiological responses to local/global visual input in children with autism, children with an increased likelihood of

synaesthesia, and control children (ages 4–6 years, pre-literate). We hypothesized that even prior to developing synaesthesia, children with an increased likelihood of developing synaesthesia would resemble children with autism in the pattern of Visual Evoked Potentials for local vs global visual input. Grapheme-colour synaesthesia, one of the most common forms, usually develops during/after acquiring literacy.

**Objectives:** To demonstrate that children with autism and potential synaesthetes share characteristics of electrophysiological responses to visual input. To explore the behavioural characteristics of children with an increased likelihood to develop synaesthesia.

**Methods:** We measured EEG during passive viewing of high/low spatial frequency (6.0/0.75 c/deg) gratings at high/low luminance contrast (100%/10%). We hypothesized larger Visual Evoked Potentials in the autism and synaesthesia groups for the high versus low spatial frequency stimuli, especially at high contrast, reflecting higher sensitivity to details and enhanced responses in the parvocellular visual system. We additionally assessed letter reading skills and synaesthesia consistency, and collected questionnaire data (Sensory Profile, Social Responsiveness Scale).

**Results: EEG data:** We found a main effect of contrast on P1 amplitudes ( $p < .001$ ), and main effects of spatial frequency, contrast, and their interaction for N2 amplitudes (all  $p < .001$ ) for control children ( $N = 20$ , 9F/11M, age  $67.2 \pm 3.2$  months). Preliminary data from the synaesthesia ( $N = 9$ , 3F/6M, age  $65.2 \pm 5.9$  months) and autism ( $N = 9$ , 1F/8M, age  $69.6 \pm 3.8$  months) groups revealed numerically larger P1 amplitudes for high versus low spatial frequency stimuli; this effect was reversed for controls, in line with our hypothesis. There were no group differences for the N2 component. **Behavioural data:** Sensory Profile and Social Responsiveness Scale scores were significantly different for children with autism ( $t(30) = 5.8$ ,  $p < .001$ ), with the synaesthesia and control groups scoring similarly ( $t(22) = .61$ ,  $p = .55$ ). There were no group differences in pre-literate letter recognition ( $F(2,36) = .62$ ,  $p = .54$ ). Regarding synaesthesia consistency at follow-up after learning to read, in the synaesthesia group 66% of 6 re-tested individuals scored within the synaesthetic range, versus 13% for controls ( $z = 2.4$ ,  $p = 0.015$ ), and 25% for the autism group (only 4 children re-tested).

**Conclusions:** Preliminary EEG results suggest favouring of detailed stimuli in early visual cortex in autism and synaesthesia groups. Behaviourally, potential synaesthetes do not show autistic traits or altered letter recognition, while as expected, synaesthesia was more prevalent in this group at follow-up after acquiring reading skills.

**435.003 (Poster)** Effects of Age and Cognitive Ability on Maturation of Resting-State Peak Alpha Frequency in Children with Autism

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**Background:** Electroencephalographic (EEG) peak alpha frequency (PAF) represents a marker of neural maturation (Miskovic et al., 2015) that typically increases with age throughout childhood (Chiang et al., 2011). Abnormal maturation of PAF is observed in children with autism spectrum disorder (ASD). PAF does not increase with age in young children (aged 2 to 12 years) with ASD and, in contrast to typical development (TD), is positively associated with cognitive ability in this cohort (Dickinson et al., 2017). These differences appear to depend upon age (Edgar et al., 2019), underscoring the importance of considering both age and cognitive ability from childhood throughout adolescence to further understanding of PAF maturation in ASD.

**Objectives:** The current study aimed to clarify and extend previous findings by assessing the effects of age, cognitive ability, and diagnostic status on PAF in a sample of children and adolescents with and without ASD.

**Methods:** Resting EEG data (with eyes closed) and behavioral measures were collected from 54 children with ASD and 48 TD controls aged 9 to 18 years. At least 30 seconds of artifact free EEG data were available for each participant. PAF was extracted from occipital electrodes. Statistical analyses included t-tests to examine between-group differences in PAF, Pearson correlations to examine bivariate relations, and multiple regression to assess the incremental and joint effects of age, NVIQ, and diagnosis (TD vs. ASD) on PAF.

**Results:** Age was positively associated with PAF in both TD ( $r(46) = .391$ ,  $p = .006$ ) and ASD ( $r(52) = .323$ ,  $p = .017$ ) groups, with no between-group difference in strength of the association. NVIQ was positively associated with PAF ( $r(52) = .204$ ,  $p = .140$ ) in ASD but not TD ( $r(46) = -.008$ ,  $p = .959$ ). A multiple regression model with age, NVIQ, and diagnosis as predictors significantly predicted PAF ( $F(7, 94) = 3.01$ ,  $p < .007$ ,  $R^2 = .183$ ). Examination of the three-way age x NVIQ x diagnosis interaction and lower order effects indicated a marginally-significant three-way interaction effect ( $p = .085$ ). Simple slopes plots (Figure 1) derived from this model illustrate that the relationship between NVIQ and PAF shifts from negative to positive as a function of age in TD children but remains stable and slightly positive in ASD irrespective of age.

**Conclusions:** Findings add to a body of evidence indicating relationships among resting-state neural rhythms and developmental differences in ASD. Whereas previous studies utilizing younger ASD samples indicated the absence of association between age and PAF (Dickinson et al., 2017), current results indicated that age was positively associated with PAF in both ASD and TD groups. Notably, the relationship between NVIQ and PAF shifted from negative to positive in the TD group during middle adolescence (14 years old). By contrast, the ASD group maintained a stable relationship between NVIQ and PAF throughout adolescence, indicating a different trajectory of neural maturation. These findings support previous reports that PAF abnormalities in ASD depend on age (Edgar et al., 2019) and further underscore the importance of examining resting-state neural rhythms in relation to age and cognitive function to interpret neural maturation in ASD.

**435.004 (Poster)** Greater P1 Mean Amplitude in Children with ASD Versus ASD+ADHD during Pattern-Reversal VEP Task  
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**Background:** The visual evoked potential (VEP) is a reliable brain signal obtained in response to controlled flash stimuli. The P1 VEP component characterizes the integrity of early visual attention systems. Alterations in VEP waveforms have been detected among children with genetic variants of ASD (e.g., LeBlanc & Nelson, 2016) and other developmental disorders such as attention-deficit/hyperactivity disorder (ADHD; e.g., Anjana et al., 2010). Thirty to 80% of children with ASD experience clinical symptoms of ADHD (Rommelese et al., 2010). Whether or not VEP waveforms differentiate children with a dual diagnosis of ASD and ADHD (ASD+ADHD) from children with ASD alone is unknown and may offer insight into the biological basis of comorbidity among these developmental disorders.

**Objectives:** The objective of these analyses was to determine whether P1 amplitude differed among school-aged children with ASD and ASD+ADHD.

**Methods:** As part of a larger study, ERP data was derived from 38 children with ASD (35 males,  $M_{age} = 9.13 \pm 1.33$  years), 21 children with ASD+ADHD (17 males,  $M_{age} = 9.28 \pm 1.33$  years), and 26 children without clinical concerns (19 males,  $M_{age} = 8.86 \pm 1.44$  years) during a pattern-reversal VEP task. The VEP stimulus was a white and black checkerboard presented in the center of the screen with each checker subtending a  $0.86 \times 0.86$  degree visual angle. The stimulus pattern was reversed every 500 ms for 100 trials. P1 mean amplitude was extracted from the midline occipital electrode Oz (70 ms after event for 100 ms) and compared between groups using univariate ANOVA. Bivariate correlations between P1 mean amplitude and caregiver-reported behavioral outcomes on the Behavior Rating Inventory of Executive Function (BRIEF) were also explored within each group.

**Results:** There was a significant effect of group for P1 mean amplitude,  $F(2,82) = 3.29, p = 0.042, \eta^2 = 0.074$ . Post-hoc comparisons indicate that this effect was driven by differences in the ASD groups, such that P1 mean amplitude was greater among children with ASD ( $M = 6.12, SD = 0.53$ ) relative to children with ASD+ADHD ( $M = 3.94, SD = 0.71, p = 0.046$ ). P1 mean amplitude was negatively correlated with the BRIEF planning/organization ( $r = -0.50, p = 0.020$ ), monitoring ( $r = -0.57, p = 0.007$ ), and metacognition ( $r = -0.52, p = 0.015$ ) scales in the ASD+ADHD group but not in the ASD or control groups, suggesting that children with lower P1 mean amplitude had more difficulty in these domains.

**Conclusions:** Taken together, the results of the current study suggest that VEP waveforms may differentiate children with ASD alone from those with a comorbid presentation of ASD and ADHD. These results add to a growing body of literature that reinforces the utility of studying neural generators of VEPs as a stratification biomarker of ASD. Moreover, our data suggest that the VEP may also provide meaningful information about neurocognitive factors contributing to the comorbidity ASD and ADHD clinical profile.

**435.005 (Poster)** Lower Autonomic Tonus at Rest in Children with Autism Spectrum Disorder  
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**Background:**

Autism spectrum disorder (ASD) is a neurodevelopmental disorder more and more associated with autonomic nervous system (ANS) dysregulation. Surprisingly, few studies have looked at the state of the ANS at rest, on which the activation state depends. Children with ASD seem to suffer from cardiovascular dysregulation, predominantly involving parasympathetic control, as well as reduced sympathetic electrodermal tonus at rest (Bujkonava et al., 2016). The evaluation of the complex mobilization of the

sympathetic and parasympathetic branches of the ANS needs to be characterized through a set of effectors. However, no studies have yet examined the physiological ANS tonus at rest with multiple simultaneous physiological parameters recordings in ASD children.

#### Objectives:

The aim of this study is to examine parasympathetic (PNS) and sympathetic nervous system (SNS) activity at rest via measures of pupillary oscillations (hippus), electrodermal activity (EDA), cardiac inter beat interval (RR interval) and heart rate variability (HRV) in children with ASD.

#### Methods:

ASD children (n=15, 15 males; age in months: 104±23) were compared to age-matched typically developing (TD) controls (n=15, 6 males; age in months: 106±24). Pupillary hippus, EDA, RR and HRV have been continuously recorded during five minutes in a seated position. We evaluated the following parameters: pupillary hippus frequency (Hz), median pupillary value (mm), positive and negative pupillary amplitude (mm), EDA number of spontaneous peaks, EDA amplitude (μS), EDA area under the curve (AUC), EDA tonus (μS), RR interval (ms), peak frequency (Hz) and absolute power density (ms<sup>2</sup>) in low (LF-HRV: 0.04-0.15 Hz) and high frequency (HF-HRV: 0.15-0.4 Hz) bands of HRV spectral analysis. Participants have been asked to look at a screen during the whole length of the experiment and stay still on the armchair. Conditions of luminosity (10 Lux), hygrometry (27% rh) and temperature (23°C/ 76.4°F) were constant.

#### Results:

As many ASD participants presented difficulties in looking at the screen for a long period, we did not obtain sufficient pupillary data to analyze. We excluded two participants from EDA analysis due to excessive movements. The analysis of EDA parameters did not show any significant difference between ASD and TD children, but we observed a trend of both increased spontaneous EDA activity and reduced EDA tonus in ASD compared to TD children. We found significantly shortened RR intervals (631±82 ms vs. 694±92 ms, p=0.05), reduced absolute power density in HF-HRV (2.68±0.44 ms<sup>2</sup> vs. 3.00±0.39 ms<sup>2</sup>, p=0.04) and reduced peak frequency in LF-HRV (0.08±0.03 ms<sup>2</sup> vs. 0.11±0.02 ms<sup>2</sup>, p=0.009) in ASD compared to TD children. Interestingly, HRV analysis showed a more important inner variability among ASD children suggesting lower vagal control.

#### Conclusions:

We observed that ASD is associated with abnormal parasympathetic and sympathetic mechanisms involved in ANS regulation at rest in childhood. Lower cardiac vagal regulation and faster heartbeat as assessed in our ASD group may indicate a low level of arousal at rest (a low ANS tonus) and an impaired vagal control that could be associated with deficits in behavioral and psychological features of the social engagement system.

**435.006 (Poster)** Measurement of Sympathetically Driven Autonomic Arousal during Eye Contact in Children with and without an Autism Diagnosis

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#### Background:

Autism spectrum disorder (ASD) is a prevalent neurodevelopmental condition, characterized by difficulties in the social domain and repetitive and restricted behaviors. In recent years, there has been an increased interest in identifying the role of aberrant stress regulation and anxiety in ASD and emerging reports have shown a link between aberrant functioning of the autonomic nervous system (ANS), a central component of the physiological stress system, and ASD. Previous studies have demonstrated for example, aberrant sympathetically driven autonomic arousal responses upon the presentation of eye contact with a live interacting model.

#### Objectives:

The current study aimed to further investigate the impact of live dyadic eye contact on autonomic arousal responses in children with ASD.

## Methods:

Recordings of skin conductance responses (SCR) were performed while the children were presented with a live model facing them either with a direct eye gaze or with closed eyes. An assessment was made of both the absolute SCR amplitude, which is the maximum change in skin conductance relative to baseline after the onset of the (eye contact) event, as well as the half-recovery time (50%) of recorded skin conductance responses, defined as the time elapsed between the SCR peak amplitude and the decline back to 50% of the amplitude.

## Results:

Within a preliminary sample of 21 children with ASD (8-12 years) and 8 control children (without a diagnosis of ASD), no group-related differences were revealed in overall amplitude of the SCR arousal response (SCR amplitude) ( $p > 0.05$ ). In terms of SCR half-recovery time, it was shown that only in the control group, not in the ASD group, a condition effect of eye contact was present, indicating faster recovery upon the eyes closed, compared to the direct eye contact condition. No such modulation was evident in the ASD group (condition  $\times$  group:  $F(1,22) = 5.13, p = .03, \eta^2 = .19$ ).

## Conclusions:

Together, these findings indicate that typical condition-related modulations of autonomic arousal upon live eye contact are absent in children with ASD, further highlighting a role of aberrant autonomic nervous system functioning in ASD. Future directions include an investigation of the impact of intranasal administration of oxytocin on these processes, considering the implicated role of oxytocin in balancing ANS function.

### **435.007** (Poster) Measures of Tonic and Phasic Activity of the Locus Coeruleus – Norepinephrine System in Children with Autism Spectrum Disorder

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**Background:** The locus coeruleus-norepinephrine (LC-NE) system plays a critical role in arousal regulation and selective attention. A growing body of research suggests that this system may function differently in individuals with autism spectrum disorder (ASD). For example, indirect psychophysiological measurements of the LC-NE system, including pupil diameter and the event-related potential (ERP) P3 component may be atypical in ASD. Thus, understanding the dynamics of both tonic (resting pupil size) and phasic (pupil dilation and P3) indices may provide meaningful insights about how the LC-NE system may function differently in ASD.

**Objectives:** To examine tonic and phasic LC-NE activities, and to determine the association between these measures in children with ASD.

**Methods:** Participants included 24 children with ASD and 27 age- and nonverbal-IQ matched typically developing (TD) children. The study included two experiments: 1) a baseline eye-tracking task to measure resting, tonic pupil diameter, and 2) a three-stimulus oddball paradigm to measure P3 amplitude and phasic changes in pupil size. For the baseline task, participants were asked to relax, remain still, and look at a black central crosshair, which was displayed on a grey background. For the oddball paradigm, isoluminant stimuli (small circle = standard [76% of trials]; large circle = target [12%]; square = novel [12%]) were presented on a gray background. Participants were instructed to respond via a button press when a large circle was presented. Pupil diameter was monitored using an EyeLink 1000 Plus remote eye-tracking system and EEG was recorded using a 128-channel high-density Geodesic electrode array.

**Results:** For the baseline eye-tracking paradigm, children with ASD showed significantly increased pupil diameter compared to their TD peers ( $p < .05$ ). For the oddball task, phasic changes in pupil dilation to standard stimuli was significantly increased in children with ASD ( $p < .01$ ), whereas pupil dilation to oddball stimuli was decreased ( $p < .05$ ) compared to their TD peers. The mean amplitude of the P3 component (400-600ms) peaked at the posterior region of interest (ROI) but did not differ between ASD and TD groups ( $p = 0.054$ ). However, the re-orienting negativity (RON) found in the frontal ROI (400-600ms) was significantly decreased in children with ASD ( $p < .05$ ). For both groups, the relationship between tonic and phasic indices showed that reduced pupil dilation to oddball stimuli was correlated with increased baseline pupil size ( $r = -.35, p < .05$ ). Analysis among phasic indices found that greater RON amplitude was associated with larger pupil dilation to oddball stimuli ( $r = -.39, p < .01$ ) and smaller pupil dilation to standard stimuli ( $r = .42, p < .01$ ) across the group.

Conclusions: Consistent with prior reports, our results show that children with ASD exhibit increased tonic (pupil) and reduced phasic (P3 and pupil dilation) activation of the LC-NE system. Across both groups, atypically elevated tonic activation of the LC-NE system was associated with reduced phasic responsiveness. These findings expand our understanding of neurophysiological differences present in ASD, and suggest that aberrant LC-NE activation may be associated with atypical arousal and decreased responsivity to behaviorally-relevant information in ASD.

**435.008** (Poster) Obtaining Valid ERP Data: Implementing a Single Session Behavioral Protocol for Valid EEG Data Collection  
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#### Background:

Event-related potentials (ERPs) measure the timing and nature of neural responses and can be used with a range of participants including individuals with autism spectrum disorder (ASD). However, due to the perceived difficulty of acquiring ERP data, research has often excluded preschool-aged children with ASD with lower cognitive functioning and significant comorbid disorders. Previous researchers addressed this issue through multiple desensitization sessions completed before data acquisition, which are not always feasible. We have developed an intensive behavioral support protocol to increase feasibility of successful data collection within a single ERP session. Before the child arrives at the laboratory, a research assistant conducts a semi-structured interview to assess the child's readiness for data collection. After interview completion, we send a bathing cap to practice applying in the bathtub. This may prepare the child for the EEG net, which is soaked in an electrolyte solution before application. When the child enters the lab, a visual schedule and social story is presented to the child by a trained research assistant. Predesignated reinforcers are provided throughout the experiment to promote engagement (e.g., breaks, chocolate). This protocol has led to successful ERP data collection across children with ASD and other neurodevelopmental disorders (NDDs), including fragile X syndrome and Down syndrome.

#### Objectives:

The objective of the current study was to examine clinical characteristics that may have contributed to the success of ERP experiment completion. This work aims to promote representation of lower-functioning children with NDDs in neuroscience research and emphasize the need for continued development of ERP methods that support inclusion of diverse, representative samples.

#### Methods:

Participants with NDDs and typical development were recruited for an ERP experiment on face processing, as part of a larger longitudinal study on the development of ASD. The collection of ERP data was attempted in 125 participants ranging from 35 to 108 months of age ( $M=62.58$  months,  $SD=17.00$ ). Independent samples t-test were calculated to examine clinical measures that may influence data collection, including: 1) T-scores from The Child Behavior Checklist as a measure of anxiety and attention deficit hyperactivity disorder (ADHD); 2) the Clinical Severity Score (CSS) from the Autism Diagnostic Observation Schedule-Second Edition as a measure of ASD impairment; 3) the Sensory Experiences Questionnaire total score as a measure of sensory sensitivity; 4) the Early Learning Composite from the Mullen as a measure of cognitive ability.

#### Results:

ERP data was successfully collected from 69% of the sample demonstrating validity in comparison to other studies utilizing a longer behavioral protocol. As seen in Table 1, participants successfully completing the experiment scored lower on measures of ASD impairment, ADHD symptoms, and sensory sensitivity. Anxiety symptoms and cognitive ability were not associated with successful experiment completion.

#### Conclusions:

The results of the current study demonstrate that clinical characteristics were significantly associated with successful ERP data acquisition. Specifically, greater ADHD symptoms, autism severity, and sensory sensitivity may have inhibited valid data acquisition. Alteration to the current protocol should be considered and implemented in future work to promote broader success in ERP experiment completion.

**435.009** (Poster) Phase-Amplitude Coupling in Autism Spectrum Disorder: Results from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT)

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**Background:** Electrical activity recorded from neuron populations in the brain oscillates at distinct frequencies and can be recorded from the scalp using electroencephalography (EEG). Phase-amplitude coupling (PAC) describes how these neural populations interact by measuring the modulation of high frequency activity amplitude by low frequency activity phase. The topography and phase bias (i.e., phase of the low frequency oscillation at which high frequency activity has the highest amplitude) of PAC can give insight into the feedforward and feedback information flow in resting-state network dynamics. Given the hypotheses that imbalances in excitatory/inhibitory and/or feedforward/feedback activity occur in autism spectrum disorder (ASD), we speculate that coupling characteristics (in terms of PAC strength, phase bias, and spatial location) between high and low frequencies may be a useful brain-based biomarker of ASD.

**Objectives:** We evaluate differences in PAC metrics of resting-state brain dynamics between children with and without ASD.

**Methods:** We draw from data collected by the multi-site Autism Biomarkers Consortium – Clinical Trials (ABC-CT), including high-quality data from 211 ASD and 104 typically-developing (TD) children aged 6-11 years old. We measure PAC from six 10-second EEG segments from each participant. PAC clustering was evaluated within diagnostic groups over all high and low frequency pairs in each of 18 electrodes spanning the surface of the scalp. We identify where significant PAC occurs in terms of frequency pairing and channel location, and we evaluate the low frequency phase in which the high frequency amplitude is most biased. We statistically compare groups in terms of PAC strength, phase bias, and topography.

**Results:** We found increased PAC in ASD, most notably in alpha-gamma coupling in frontal electrodes and beta-gamma coupling in temporal electrodes (Figure 1). Additionally, we found a decrease of phase bias (i.e. maximum gamma amplitude shifted towards the trough of the alpha wave) in frontal channels for participants with ASD. Alpha-gamma PAC strength in the in FP1 and FP2 electrodes was significantly and positively correlated with multiple domains of ASD behaviors as measured by the Social Responsiveness Scale Restricted and Repetitive Behaviors section and the Autism Diagnostic Observation Schedule (ADOS) Social Affect and Total scaled scores (all  $p < 0.05$ ).

**Conclusions:** The findings of increased PAC activity and atypical phase bias in ASD are shown here using a large, well-controlled sample with a thorough comparison of all potential frequency pairs and electrodes where PAC can occur, using clustering techniques to limit spurious findings. Prior studies suggest a mechanistic link between phase bias and circuit-level mechanisms that are likely to be altered in ASD (e.g. balance between bottom-up (feedforward) and top-down (feedback) activity in the cortex); our findings therefore offer opportunities for back-translation into animal models. Overall, these findings hold strong potential to inform brain-based biomarker development.

**435.010** (Poster) Relating ASD Traits and Sensory Overresponsivity to Early Electrophysiological Indices of Auditory Processing in Children with and without ASD.

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**Background:**

DSM-V criteria of autism spectrum disorder (ASD) includes for the first time a focus on sensory differences (e.g., sensory hypersensitivity). While research suggests that sensory hypersensitivity is common in ASD, there is also mounting evidence that perception, the interpretation of sensory stimuli, is often better among those with ASD. We sought to disentangle the complex relationship between sensation and sensory differences in ASD by studying brain signatures that remain as close as possible, temporally, to the sensory input being processed. Here we measure auditory habituation and discrimination in the first 125ms of processing in addition to the more traditional mismatch negativity (MMN), and map these onto sensory features and autistic traits in both autistic and typical populations.

## Objectives:

We sought to identify differences between ASD and TD children in habituation and early and late discrimination and determine how these neurophysiological indices correlate with ASD traits and sensory overresponsivity. We then investigated how early and later neural indices of discrimination are correlated across and between groups.

## Methods:

Thirteen children with ADOS-2 and ADI-R confirmed ASD and 13 TD children matched on chronological age (TD  $M = 12.53$ ; ASD  $M = 12.81$ ) and nonverbal IQ (TD  $M = 109.46$ ; ASD  $M = 110.00$ ) participated in this study. The P1 and MMN were evoked by pure tones of 1000Hz and 1200Hz at 60 dB during a passive oddball task. ERPs were measured as the mean amplitude 50ms around the component's peak latency (P1: 71-121ms; MMN: 126-226ms). Habituation was measured by the difference of the response to standard auditory stimuli over consecutive repetitions, and discrimination by the difference between standard and deviant waveforms. ASD traits were measured by the Autism Quotient and sensory overresponsivity was measured from items on the Sensory Profile.

## Results:

At the early P1, children with ASD had marginally better discrimination ( $T = 1.76, p = 0.09$ ) and less habituation ( $T = 2.76, p = 0.01$ ). Higher ASD traits correlated with marginally better P1 discrimination ( $r = -0.38, p = 0.06$ ), better MMN discrimination ( $r = -0.49, p = 0.01$ ), and less P1 habituation ( $r = -0.38, p = 0.05$ ). Only late MMN discrimination (not early P1 perceptual indices) correlated with more sensory overresponsivity ( $r = -0.49, p = 0.01$ ). This correlation was driven by ASD participants ( $r = -0.67, p = 0.02$ ) and was nonsignificant for TD participants. Early P1 and late MMN discrimination were positively correlated ( $r = 0.64, p < 0.001$ ) especially for TD participants ( $r = 0.82, p = 0.001$ ), and only marginally for ASD participants ( $r = 0.49, p = 0.09$ ).

## Conclusions:

Results suggest that children who have better auditory discrimination at the MMN have more ASD traits and more sensory overresponsivity. Children with ASD also have marginally better early discrimination, with less habituation. While early and late discrimination are highly linked in TD children, they are only marginally correlated in ASD. These data support findings low-level perception operates more independently in autistic cognition than in typical development.

### **435.011** (Poster) Respiratory Sinus Arrhythmia and Sleep Problems Among Children on the Autism Spectrum

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**Background:** A biopsychosocial framework of sleep problems in autism highlights complex interrelations between sleep and bioregulatory systems (Schreck & Richdale, 2020). Little empirical work, however, has explored physiological indices related to sleep among children on the autism spectrum, a group at considerable risk for sleep problems (Díaz-Román et al., 2018). Respiratory sinus arrhythmia (RSA), an index of parasympathetic nervous system activity, has been linked with sleep quality, but not duration, among neurotypical children. Whereas higher baseline RSA (RSAB) is a robust physiological marker of emotion regulation that should support sleep, the effect of RSAB may depend on RSA reactivity (RSAR) to stress (i.e., withdrawal of parasympathetic activity, or RSA withdrawal; El-Sheikh et al., 2013). No studies have explored RSAR nor the interaction between RSAB and RSAR as related to sleep in children on the autism spectrum.

**Objectives:** Among a sample of children on the autism spectrum, the current study explored RSAB, RSAR, and the interaction between RSAB and RSAR in relation to sleep problems and duration.

**Methods:** The sample included sixty-one children (Age  $M=7.95, SD=1.47$ ; 26% female) with community diagnoses of autism spectrum disorder (ASD) confirmed by clinical best estimate procedures involving the ADOS-2. Estimated IQ ranged from 47 to 121 ( $M=80.35; SD=20.36$ ; 39%  $\leq 75$ ). RSA data was collected via a 3-minute baseline and a 3-minute challenge task. Sleep problems and duration were measured using the Children's Sleep Habits Questionnaire, Abbreviated (NICHD SECCYD-Wisconsin, 2017). A neurotypical sample ( $N=23$ ; Age  $M=5.73, SD=1.63$ ; 35% female) was used to contextualize the degree of sleep problems in the children with ASD.

Results: No significant correlations emerged between RSA indices and sleep. Age was significantly negatively related to sleep problems,  $r(60)=-0.32, p<0.05$ , and was controlled in subsequent analyses. RSAB and RSAR interacted in the prediction of sleep problems (Table 1). For children with high RSAR, there was a significant inverse effect of RSAB on sleep problems,  $B=-5.00, p=0.04$ ; for children with low RSAR, the association between RSAB and sleep problems was nonsignificant,  $B=2.67, p=0.15$  (Figure 1). No main effects or interactions of RSA predicted sleep duration. The sample with ASD ( $M=26.98, SD=11.89$ ) had significantly more sleep problems than neurotypical sample ( $M=18.13, SD=8.07$ ),  $t(66)=3.20, p<0.01$ .

Conclusions: This study extended evidence from neurotypical development (El-Sheik et al., 2013) to show that RSAB and RSAR interacted to predict sleep problems (but not duration) in children with ASD. At lower levels of RSA withdrawal in response to stress, baseline RSA may be less consequential for sleep due to the limited range of arousal in response to stress. In contrast, at higher levels of RSA withdrawal in response to stress, moderate arousal that is compatible with sleep may be preserved when RSA is generally higher, whereas hyperarousal that disrupts sleep may ensue when RSA is generally lower. Contrasts with the comparison sample suggest potential resilience against sleep problems for children with ASD who exhibit high RSAB and high RSAR. Future longitudinal research may help to clarify the directionality of these effects across time.

**435.012 (Poster)** rTMS to the Superior Temporal Sulcus Modulates EEG Theta Power in Occipital Cortex in Autism Spectrum Disorder

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Background: Atypicalities in visual processing, specifically in facial processing, are well-documented in individuals with autism spectrum disorder (ASD). Prior work has revealed associations between impairments in facial recognition and evoked power in several electroencephalographic (EEG) spectral bands (Martinez et al., 2019; Rojas & Wilson, 2015). Transcranial magnetic stimulation (TMS) to the dorsolateral prefrontal cortex modulated gamma activity in individuals with ASD in a visual perception paradigm (Casanova, Sokhadze, Casanova, & Li, 2020); Given the relevance of the right posterior superior temporal sulcus (rpSTS) in atypical face and social perception in ASD, the effects of TMS to this region on EEG signatures and visual attention warrant investigation.

Objectives: To evaluate modulatory effects of TMS to the rpSTS on EEG power spectra while viewing social and nonsocial stimuli in adults with and without ASD.

Methods: The preliminary sample included five individuals with ASD (1 female, mean age = 27.96) and nine controls (8 females, mean age = 29.22); data collection is ongoing. Intermittent theta burst stimulation (iTBS) was conducted using the Magstim Super Rapid system with four booster modules (Magstim Ltd, Whitland, Wales). Right pSTS was targeted based on its primary role in social cognition in ASD (Ozonoff & Miller, 1996; Zilbovicius et al., 2006); stimulation site was determined by anatomical estimates based on the 10-20 EEG coordinate system. EEG was recorded using a MicroCel 128-channel sensor net while participants passively viewed faces and houses. Spectral power was averaged across all epochs for each stimulus type. Theta (4-8 Hz), alpha (8-12Hz), beta (12-30Hz), low gamma (30-50Hz), and high gamma (70-90Hz) power were examined across stimulus types in EEG recordings before and after iTBS administration. Power data were logarithmically transformed, examined via repeated measures ANOVA, and corrected for multiple comparisons. Regions of interest included right parietooccipital cortex (P8, site of stimulation) and occipital cortex (O2, OZ, O1).

Results: Main effects emerged in occipital cortex. At OZ, a stimulation by diagnosis interaction in theta power was observed, such that theta power in participants with ASD increased from pre-TMS EEG to post-TMS EEG while remaining stable in controls,  $F(1,12)=14.14, p<.01$ . A similar interaction effect was found at O2, such that theta power increased after TMS administration in individuals with ASD but decreased marginally in controls,  $F(1,12)=6.38, p<.05$ . There were no significant changes in power for any of the spectral bands in the right parietooccipital cortex near TMS stimulation site in either group.

Conclusions: Results suggest that iTBS impacts theta power differently in ASD vs. TD. Continued research is needed to determine if results replicate in a larger sample, and, if so, why TMS impacts theta power differently in these respective groups. Although little is known about the functional significance of theta power in occipital regions, Dawson and colleagues (2012) found that in individuals with ASD receiving early intervention, greater theta power to faces was associated with better social communication. It is therefore possible that increases in theta power due to rTMS may index potential improvements in social communication in individuals with ASD.

**435.013 (Poster)** Sensory Correlates of Electrophysiological Responses to Repeated Auditory Stimuli in Activity-Dependent Neuroprotective Protein Syndrome

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**Background:** ADNP syndrome is an autosomal dominant neurodevelopmental disorder caused by pathogenic variants in the activity dependent neuroprotective protein (ADNP) gene, involved in chromatin remodeling and synaptic function. ADNP syndrome is characterized by mild-to-severe intellectual disability, autism spectrum disorder (ASD), speech and motor delays, and medical comorbidities. Abnormal sensory processing is also prominent. ADNP syndrome is among the most common single gene causes of ASD, and ASD presents in 50-70% of cases.

**Objectives:** This study aimed to characterize neurobiological markers of ADNP by examining electrophysiological responses to repeated auditory stimuli. Additionally, we explored whether neural responsiveness and habituation related to clinical sensory symptoms.

**Methods:** EEG was recorded from children ages 3-17 with ADNP syndrome (n=16) and typically developing (TD) controls (n=16). Participants heard a series of four consecutive 50ms, 1000hz tones. Inter-tone interval was 616ms; inter-trial interval was 4000ms. Amplitudes and latencies of N1, P2, and N2 event-related potentials were extracted and compared between groups. Habituation was defined as the amplitude difference between tone one and two. Sensory symptoms (hyperreactivity, hyporeactivity, seeking behaviors) were assessed using the Sensory Assessment for Neurodevelopmental Disorders (SAND).

**Results:** In response to tone one, the ADNP group showed significantly longer latency than TD controls for P2 ( $M_{ADNP}=306\text{ms}$ ,  $SD_{ADNP}=42.5$ ;  $M_{TD}=265\text{ms}$ ,  $SD_{TD}=21.4$ ;  $p=.002$ ) and N2 ( $M_{ADNP}=440\text{ms}$ ,  $SD_{ADNP}=35.4$ ;  $M_{TD}=387\text{ms}$ ,  $SD_{TD}=39.1$ ;  $p<.001$ ) components, with large effect sizes ( $d=1.21$ ;  $d=1.42$ ; respectively). Compared to the TD group's average tone one P2 amplitude ( $M=4.40\text{mV}$ ,  $SD=2.47$ ) and P2 habituation ( $M=2.37\text{mV}$ ,  $SD=1.78$ ), the ADNP group showed a subset of participants with significantly higher P2 amplitudes (n=5;  $M_{High}=10.50\text{mV}$ ,  $SD_{High}=4.28$ ;  $p=.03$ ) and P2 habituation ( $M_{High}=8.19\text{mV}$ ,  $SD_{High}=4.77$ ;  $p=.05$ ), and a subset of participants with significantly lower P2 amplitudes (n=11;  $M_{Low}=2.25\text{mV}$ ,  $SD_{Low}=1.33$ ;  $p=.007$ ), with a trend toward lower P2 habituation ( $M_{Low}=1.39\text{mV}$ ,  $SD_{Low}=2.31$ ). When comparing SAND scores, ADNP most prominently differed from TD in seeking behaviors ( $p<.001$ ). Within the ADNP group, the attenuated P2 response subset trended toward more seeking behaviors than the enhanced P2 response subset ( $M_{Low}=20.54$ ,  $SD_{Low}=4.37$ ;  $M_{High}=14.60$ ,  $SD_{High}=6.50$ ), with a large effect size ( $d=1.07$ ). Seeking behaviors was also negatively correlated with tone one P2 amplitude ( $r=-.70$ ,  $p=.002$ ) and habituation ( $r=-.63$ ,  $p=.009$ ) across the full ADNP group.

**Conclusions:** Results suggest that electrophysiological responses in ADNP syndrome differ from controls. The ADNP group showed delayed auditory processing, specifically for later neural components, P2 and N2. The ADNP group also showed impaired sensory perception modulation, with subsets of participants showing either attenuated or enhanced P2 amplitudes and habituation compared to TD controls. Further research is necessary in order to determine factors underlying these differences in stimulus response profiles within ADNP syndrome. While the sensory profile of ADNP syndrome is still being explored, seeking behaviors are most notable, and their increased use among those with lower P2 response and habituation indicates that altered auditory processing may relate to sensory seeking behaviors. In fact, these results suggest that sensory seeking may be a compensatory function used by children with low response to external sensory stimuli to make sense of their environments.

**435.014 (Poster)** Stratification of Children with Autism Using the ERP N170 and the Eye Tracking OMI from the Autism Biomarker Consortium for Clinical Trials (ABC-CT).

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**Background:** Multiple candidate electroencephalogram (EEG) and eye tracking (ET) biomarkers have been put forward for use in understanding the development and trajectory of symptoms in individuals with autism spectrum disorder (ASD)(e.g., Ewen et al.,

2019; McPartland et al., 2020). These markers may be useful in clinical trials as stratification markers that identify more homogeneous subgroups (McPartland et al., 2020). We focus on two variables derived from EEG and ET assays used in the Autism Biomarkers Consortium for Clinical Trials (ABC-CT): N170 latency to upright faces (N170L) and the Oculomotor index of gaze to human faces (OMI). Evidence suggests that children with ASD show longer latencies for the N170L compared to typically developing (TD) children, indicating slower processing of faces (Kang et al., 2018). The OMI was developed by the ABC-CT (McPartland et al., 2020) to quantify visual attention to faces across three ET assays. Lower OMI scores reflect diminished attention to human faces.

**Objectives:** The aim of this project is to evaluate the potential of N170L and the OMI as stratification biomarkers.

**Methods:** The ABC-CT is a NIH funded study that evaluated candidate biomarkers in children with ASD (n=280) and TD (n=119) at three timepoints (McPartland et al., 2020; Webb et al., 2019). For OMI and for N170L, thresholds were compared when constructed based on the outlying 10% of the TD control group at baseline and on the outlying 25% of the ASD group at baseline. Because of a clear age-based effect in N170L, we considered thresholds for the variables adjusted for age. ASD and TD participants who fell outside of the threshold at baseline were assessed for clinical correlates and for consistency of stratification variables across timepoints.

**Results:** (1) OMI: Although age is also significantly associated with OMI ( $p < .001$ ), it appears to be less crucial to consider an age-adjustment with OMI. Without an age-adjustment, a cut-off of the lower 10% of the OMI in the TD group, corresponding to participants spending 22% or less time looking at faces, includes approximately 40% of the OMI scores in the ASD group (Figure 1). (2) N170L: Age was significantly associated with N170L ( $p < .001$ ). In contrast to the OMI, a cut-off of the upper 10% of age-adjusted N170L in the TD group includes a much smaller number of ASD participants (22.1% of the age-adjusted N170L in the ASD group). A single value cutoff is less informative for the N170L, as the cutoff will be age-adjusted. Results on within-subjects variability across timepoints and results on clinical correlates of the subgroups defined by the cut-offs will be described in the presentation.

**Conclusions:** OMI shows promise as a stratification biomarker for autism research. Further study is required to evaluate the utility of the N170L as a stratification biomarker. Initial results from this dataset indicate that age-based adjustments will be necessary. Discussion of the impact of age adjustment on creation of biomarkers for use in clinical trials will be included in the presentation.

**435.015 (Poster)** The Relationship between Resting EEG Frontal Theta Power, Eye-Blink-Rates, and Restrictive and Repetitive Behaviors in Children with Autism Spectrum Disorder: Results from the ABC-CT

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**Background:** Poor performance on dopamine-mediated cognitive tasks (e.g., inhibitory control) is associated with lower frontal theta activity, measured by electroencephalography (EEG), and decreased dopamine levels are indexed by reduced eye-blink-rates (EBRs). Hornung et al. (2019) found reduced resting theta power and EBRs in males with ASD, which were further associated with greater ASD symptomology, suggesting the potential influence of atypical dopamine levels on the clinical phenotype. The relationship between dopamine levels, as indexed by theta power and EBR, and restricted and repetitive behaviors (RRBs) in ASD is poorly understood, despite the recognized influence of dopamine-related inhibitory control deficits on RRB severity.

**Objectives:** Compare (1) absolute resting frontal theta power and (2) EBRs in children with ASD and healthy-controls to evaluate (3) whether EEG or EBR-based indices of dopaminergic function explain variance in RRBs.

**Methods:** This study used data from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT). Participants included 280 children with ASD (215 males; age  $M=8.55 \pm 1.65$ ; FSIQ  $M=96.58 \pm 18.11$ ) and 119 typically developing (TD) controls (83 males; age  $M=8.51 \pm 1.61$ ; FSIQ  $M=115.12 \pm 12.55$ ). Participants were administered the ADOS-2, ADI-R, and DAS-2. The SRS-2 was used to examine ASD symptomology, specifically RRBs. EEG recorded absolute resting theta power was extracted from the midline frontal electrode (Fz). EBR was obtained from eye-tracking collected during viewing of paradigms assessing attention and social information: activity monitoring (AM), biological motion (BM), interactive social task (SI), static scenes (SS), and

visual search (VS). Independent samples t-tests were used to compare group means of EBRs, theta power, and SRS-2 scores, and linear regression analyses were performed to examine the relationships between these variables.

**Results:** There were no significant differences in theta power between diagnostic groups. Children with ASD had significantly higher EBRs only during the SI paradigm compared to TD ( $t(197)=4.93, p<.001$ ). No significant relationships were found between theta power or EBRs and RRBs in ASD. There was a significant group-by-sex interaction for predicting theta power ( $F(1,323)=4.69, p=.031$ ), such that males had significantly lower theta power compared to females in ASD; this was not observed in TD children. Furthermore, males with ASD had significantly lower theta power compared to TD males ( $t(174)=-2.53, p=.012$ ); this relationship was not significant in females. There was also a significant EBR-by-sex interaction for predicting RRBs during the SI paradigm in ASD ( $F(1,253)=7.18, p=.008$ ), where lower EBRs were associated with higher RRBs in females with ASD, but not males.

**Conclusions:** Consistent with previous findings, males with ASD had reduced absolute resting frontal theta power. However, this difference was not observed in females, suggesting there are sex-specific differences in frontal theta within ASD. EBRs were elevated in ASD during viewing of a social interaction, which may be indicative of increased dopamine activity during this specific stimulus. However, further research should also examine levels of attention which may impact dopamine. While theta power was not associated with RRBs, EBRs were only predictive of RRB scores in females with ASD, again suggesting the need for further exploration of sex differences in both neural activity and behavior within ASD.

## POSTER SESSION — NEUROPSYCHOLOGY

### Poster 436 - Neuropsychology Posters

**436.002** (Poster) Executive Functioning Skills in Early Childhood: Comparing Children with ASD, ID, and Co-Occurring ASD and ID

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#### Background:

Executive functioning (EF) is broadly defined as higher-order cognitive abilities to facilitate independent and goal-directed behaviors (Lezak et al., 2012). Specific EF skills frequently include working memory, inhibition, cognitive flexibility, planning and organization, and attention. EF skills are important to academic, adaptive, and social success (e.g., Moriguchi, 2014). These skills develop rapidly in early childhood (Blair, 2016) and are linked to early school readiness (Vitiello & Greenfield, 2017).

Approximately 30% of children with autism spectrum disorder (ASD) have an intellectual disability (ID; American Psychiatric Association, 2013). Many children with ASD, ID, and co-occurring ASD/ID experience EF deficits. However, there is minimal research on EF skills in early childhood for these populations. The majority of the existing research is over a decade old and generally indicate early childhood children with ASD exhibit poorer EF skills than children with other developmental delays (Griffith et al., 1999). Research regarding EF skills in children with ID and ASD/ID is limited to individuals who are school-aged and older. Given the importance of EF skills to daily functioning, additional research is needed to understand their development and presentation in early childhood for children with ASD, ID, and ASD/ID.

#### Objectives:

This research evaluated parent-reported EF skills among children in early childhood with ASD, ID, and ASD/ID.

#### Methods:

Participants included 87 children between the ages of 24 and 71 months diagnosed with ASD ( $n=24$ ), ID ( $n=23$ ), or co-occurring ASD/ID ( $n=40$ ) that had completed a comprehensive psychological evaluation at a university developmental clinic. Diagnoses were made by a psychology team that included a licensed psychologist following diagnostic caregiver interview, rating scale administration, performance-based assessments, and behavioral observations. Parent ratings of child EF skills on the Behavior Rating Inventory of Executive Function – Preschool Version (BRIEF-P) were evaluated using mixed analysis of variance (ANOVA) comparing diagnostic groups.

#### Results:

Participants overall exhibited clinically significant deficits in EF. Further, results suggest that early childhood children with ASD, ID, and ASD/ID may have somewhat unique EF skill profiles. Children with ID exhibited the most significant EF impairments and children with ASD displayed the least. Working memory deficits were the most impaired EF skill across all diagnostic groups.

#### Conclusions:

Early childhood children with ASD, ID, and ASD/ID demonstrate EF deficits. Our results tentatively suggest that EF skills in children with ASD, ID, and ASD/ID may present differently in early childhood as compared to school-age. Clinicians should consider assessing EF skills at initial evaluations and re-evaluations as children develop to ensure interventions and educational placements are appropriately designed. Further research is needed to evaluate longitudinal differences between early childhood and school-aged EF skills.

**436.003** (Poster) Neuropsychological Profiles of a Spanish Preterm and Very Low Birth Weight Children Cohort  
*M. Magan Maganto<sup>1</sup>, R. Canal-Bedia<sup>1</sup>, Á. Bejarano<sup>1</sup>, M. V. Martín Cilleros<sup>1</sup>, A. Hernández Fabián<sup>2</sup>, A. Calvarro-Castañeda<sup>1</sup>, J. A. Yon Hernández<sup>1</sup>, E. Díez Villoria<sup>1</sup>, H. Roeyers<sup>3</sup> and M. Posada<sup>4</sup>, (1)University of Salamanca, Salamanca, Spain, (2)Hospital Clínico Universitario de Salamanca, Salamanca, Spain, (3)Department of Experimental-Clinical and Health Psychology, Ghent University, Ghent, Belgium, (4)Institute of Rare Diseases Research, Instituto de Salud Carlos III, Madrid, Spain*

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#### Background:

Children born preterm have a higher risk to develop neurodevelopmental disorders (Twilhaar et al., 2018), such as Autism Spectrum Disorder (ASD), with a prevalence of 7% (Agrawal et al., 2018) compared to <2% in the general population (CDC, 2020).

The study of neurodevelopmental trajectories and neuropsychological profiles of preterm children is essential to understand potential future difficulties they may face. A recent prospective study by Chen et al. (2020) describes early cognitive functioning trajectories in premature children and associates them with the later diagnosis of ASD. Although this contributes to ASD early detection in preterm children, neuropsychological trajectories and the difficulties encountered at different developmental ages are still lacking.

#### Objectives:

The objective was to explore the neuropsychological profiles of Spanish preterm children with very low birth weight (VLBW, <1500gr) in function of gestational age (GA) and growth percentiles (GP). This study focused on ASD symptomatology, cognitive development, executive functions and adaptive behavior.

#### Methods:

A total of 62 children born preterm with LBW participated in this research. Assessment evaluation, at 7-10 years old, consisted of the application of the following standardized tests: ADOS-2 module 3 (Lord et al., 2012) for ASD symptomatology; WISC-V (Wechsler, 2014) for cognitive development; ENFEN (Portellano et al., 2009) and BRIEF-2 (Gioia et al., 2015) for executive functions; and Vineland-3, parent version (Sparrow et al., 2016) for adaptive behavior.

Standardized index scores were compared to the general population with  $p < 0.01$ . The general indexes and sub-indexes of each instrument were also compared to GA and GP to evaluate associations using Kendall's tau-b ( $\tau_b$ ) with  $p < 0.01$ . Visual representations of the profiles were made for each instrument to better conceptualize the domains that were affected. This was done by converting the scores into standardized mean differences and grouping by GA and GP.

#### Results:

Scores in ADOS-2 showed a moderate association between GA and the Restricted and Repetitive Behaviour (RRB) domain ( $\tau_b = 0.34$ ), particularly "Unusual sensory interest in play material/person" ( $\tau_b = -0.31$ ) and "Excessive interest in unusual or highly specific topics/objects" ( $\tau_b = -0.28$ ).

The most affected scores in the WISC-V were Working Memory (median=94) and the Picture Span subtest (mean=8.66). A higher GP was also moderately associated with better Verbal Comprehension scores ( $\tau_b = 0.27$ ).

In the ENFEN, scores on the Phonological Fluency, Colour Making Trail and Planning subtests were lower than in the general population (median=5).

The raw scores of the BRIEF-2 were significantly associated with GP for Global Executive Composite (weak association;  $\tau_b = -0.22$ ), Emotion Regulation Index (moderate;  $\tau_b = -0.28$ ), Emotional Control (moderate;  $\tau_b = -0.28$ ) and Plan/Organize (weak;  $\tau_b = -0.23$ ).

In the Vineland-3, scores of Daily Living Skills (mean=89.18), Socialization (mean=92.94) and Motor Skills (median=92) domains were significantly lower than the general population.

## Conclusions:

The results of this study contribute to the description of neuropsychological profiles that could help to develop and design personalized preventive interventions that focus on the specific difficulties which are found in the preterm population. Particularly, it seems that preterm children are more affected in the RRB domain, which suggests further research on specific trajectories could differentiate between ASD and non-ASD preterm children.

**436.004 (Poster)** Proprioceptive Channel Bias during Postural Control in Young Adults with Autism Spectrum Disorder (ASD).  
**R. J. Knox and M. Dumas, School of Psychology, Queen's University Belfast, Belfast, United Kingdom**

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## Background:

Postural control deficits in Autism Spectrum Disorder (ASD) are well established, yet their aetiology remains unclear. Postural control involves the integration of proprioceptive, visual and vestibular information. In neurotypical (NT) participants, proprioception contributes the most, followed by vestibular sense and vision least. However, when one sense is perturbed, for example when eyes are closed, resulting in vision loss, vision is down-weighted and the remaining senses up-weighted to maintain postural control. Evidence suggests adults with autism might weight these senses differently, relying less on vision and more on proprioception during balance tasks than NT. For instance, impaired postural control in adults with autism has been observed in response to proprioceptive, but not visual, perturbations and they may be less destabilised by visual perturbations than NT (Dumas et al., 2016; Greffou et al., 2012). However, due to a lack of research in this area, it is unclear how NT and ASD adults may differ in their ability to re-weight these senses during the minutes immediately following perturbation.

## Objectives:

The aim of this study was to investigate a bias for using proprioceptive over visual information for postural control in adults with autism. Accordingly, it compared how NT and ASD adults adapt to visual and proprioceptive perturbations.

## Methods:

16 young adults with ASD (age range: 16-40) with IQ>80 and 20 NT age, gender and IQ matched controls participated. Non-postural measures included an IQ test, sensory profile and ADOS-2 (for ASD group only). Postural assessments involved measurement of sway in response to three sensory conditions: visual perturbation (surround sway-referencing), proprioceptive perturbation (platform sway-referencing) and combined visual and proprioceptive perturbation. Participants stood unshod on a balance platform and sway was measured using motion capture. Each trial comprised a practice of the condition, 2 minutes of baseline gathering, 3 minutes of perturbation and a further 2 minutes without perturbation.

## Results:

Postural sway between groups did not differ at baseline. In response to the visual-only perturbation, NT, but not ASD adults, showed an increase in sway from baseline. Conversely, in response to the proprioceptive-only perturbation, ASD, but not NT adults increased their sway from baseline. Both groups showed the greatest increase in sway in response to the combined visual and proprioceptive perturbation, although there was no group difference in response magnitude. During the 3-minute adaptation period following perturbation, the ASD group showed consistently higher sway levels compared to the NT group, regardless of sensory condition.

## Conclusions:

Our results indicate increased reliance on proprioceptive and decreased reliance on visual information for postural control in ASD, as ASD participants were more affected by proprioceptive and less affected by visual perturbation than NT participants. The lack of group difference in sway from baseline to perturbation-onset in the combined condition suggests that these sensory-channel-specific group differences may be offset by one another. Finally, increased postural sway in the ASD group across the adaptation period of all sensory conditions suggested that adults with ASD found it more difficult than NT adults to adapt.

**436.005 (Poster)** Reduced Flexibility in Autism on an Unpredicted Emotional Flexibility Task

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**Background:** Flexibility is the ability to switch from one task or from one perspective to another and is an adaptive skill usually required in unexpected situations. Autistic individuals encounter flexibility difficulties in the daily life, but laboratory tasks often fail to demonstrate them. A weak ecological validity of laboratory tasks, partly due to their predictability, could be responsible of this apparent contradiction.

**Objectives:** The aim of the study was to investigate whether autism is associated with difficulties in flexibility using an ecological valid shifting paradigm inducing unpredictable emotional shifts.

**Methods:** Our online study was completed by 101 autistic adults without intellectual deficiency (47 females) and 145 typically developed controls (85 females). Participants (18 - 45 years old) performed the Emotional Shifting Task, involving unpredictable switches of valence of sequentially presented socioemotional stimuli. They also performed the Task Switching Task (TST), involving predictable switches and letter/number stimuli.

**Results:** Autistic participants had a larger switch cost than control participants (i.e, lower correct response rate and longer response time in the shift but not in the non-shift condition) in the Emotional Shifting Task only ( $p < .001$ ). On the Task Switching Task autistic participants did not differ from control participants in their correct response rate but had longer response time in the shift and in the non-shift condition ( $p < .001$ ).

**Conclusions:** Our findings might suggest a critical role of unpredictability in flexibility difficulties in autism. However, there might be also a critical role of socio-emotional stimuli. Thus, we also discuss our results in the context of socio-emotional avoidance hypothesis and of the locally oriented perception hypothesis.

## Novel Therapeutic Approaches (gene, protein or RNA targeted therapies)

### PANEL DISCUSSION — NOVEL THERAPEUTIC APPROACHES (GENE, PROTEIN OR RNA TARGETED THERAPIES)

#### Panel 206 - Gene-Based Therapies in Development for Rett Syndrome

**Panel Chair:** Randall Carpenter, *Rett Syndrome Research Trust, Trumble, CT*

**Discussant:** Dominique Pichard, *International Rett Syndrome Foundation, Cincinnati, OH*

Rett Syndrome (RTT) is a developmental disorder characterized by loss of spoken language and hand use, and distinctive stereotypic hand movements. Typical RTT is almost exclusively caused by de novo loss of function mutations in the X-linked gene, *MECP2*. Mouse models deficient in *Mecp2* protein have a range of phenotypes that mimic the human syndrome. Mice with induced Rett Syndrome do not have evidence of neuronal death, suggesting that Rett syndrome is a neurodevelopmental condition as opposed to a neurodegenerative condition. Furthermore, genetic reactivation of silenced *Mecp2* in conditional knockout mice produces a robust and enduring reversal of phenotypes. The inherent reversibility of the mouse phenotypes makes restoration of *MECP2* protein an obvious therapeutic strategy for treatment of RTT. This session will provide an update on the molecular pathophysiology of RTT and significant progress with four genetically based therapeutic approaches – gene replacement, DNA editing, RNA editing and RNA transsplicing. The therapeutic presentations will review the scientific foundation for each approach, current status of development as well as advantages and disadvantages compared to the alternative therapeutic approaches.

**206.001 (Panel Discussion)** Scientific Rationale for Restoring *MECP2* Protein As a Treatment for Rett Syndrome  
*M. J. Lyst, University of Edinburgh, Edinburgh, United Kingdom*

Rett syndrome (RTT) is a severe neurological disorder that is associated with intellectual disability and features of autism. RTT predominantly affects females, and arises due to loss-of-function mutations in the X-linked *MECP2* (methyl-CpG binding protein) gene. After decades of research, *MECP2* is now understood to be an abundant nuclear protein which functions predominantly in neurons. There, *MECP2* binds broadly across the genome by associating with DNA sequences containing methylated cytosine. *MECP2* then recruits the NCoR co-repressor complex and brings about subtle transcriptional down-regulation of thousands of genes. Aberrant regulation of gene expression is therefore thought to be an important component of the pathology of RTT. Despite this progress in our understanding of the molecular function of *MECP2*, the knowledge gained has not yet suggested a straightforward path towards the development of a therapy for RTT. Efforts to devise treatments for RTT have therefore focussed on strategies – such as gene therapy - which aim to directly restore expression of the *MECP2* protein, and that do not rely on understanding the molecular mechanism of action of *MECP2*. This work has accelerated greatly over the last decade, motivated by the observation that restoration of *MECP2* expression in adult mice – using conditional alleles of the gene - results in a dramatic reversal of the neurological symptoms associated with *MECP2* deficiency. However, obstacles still remain for the RTT gene therapy field. For example, the toxicity that would result if *MECP2* is expressed at too highly levels – as illustrated by the severity of the symptoms of *MECP2* duplication syndrome – must be avoided, whilst, at the same time, robust expression of *MECP2* in a high proportion of neurons must be achieved. There are many approaches aimed at solving such problems, and success would make RTT the first autism spectrum disorder to be treated by a therapy that is targeted at the underlying pathology.

**206.002 (Panel Discussion)** An Innovative Regulated Gene Replacement Therapy Approach for Rett Syndrome  
*S. Prasad, Taysha Gene Therapies, San Francisco, CA*

#### Background:

Rett syndrome (RTT) is an X-linked neurodevelopmental disorder that can be caused by loss-of-function mutations in the dose-sensitive gene *MECP2*. RTT is characterized by a period of typical development followed by the onset of psychomotor regression, development of repetitive hand stereotypies, loss of verbal abilities, social withdrawal, and gait impairment. As a monogenic disease, development of gene replacement therapy has long been considered for RTT. However, due to random X inactivation, *MECP2* expression varies on a cell-by-cell basis. Thus, a gene replacement therapy approach is needed with flexible therapeutic gene expression within each cell, that addresses the deficiency of *MECP2*, but also, importantly, avoids harmful overexpression of *MECP2*. Our academic collaborators at UTSouthwestern have designed a proprietary method that enables

titration of therapeutic gene expression on a cell-by-cell basis. A regulatory element added to the untranslated region of the therapeutic gene harnesses endogenous microRNAs to titrate expression based on cellular *MECP2* protein levels. This technology is termed miRARE (microRNA-responsive autoregulatory element) (Sinnott 2017, 2020; Gadalla 2017). Taysha's approach leverages the clinically and commercially proven AAV9 vector platform, which has been widely characterized in preclinical and clinical studies, and now also in the commercial setting. Taysha utilizes a scaled manufacturing process in the HEK293 mammalian system across all our programs and the lumbar intrathecal route of administration. Taysha is currently developing a gene replacement therapy (TSHA-102) for RTT, which includes the miRARE technology that enables flexible and regulated gene expression.

#### **Objectives:**

The aim of this presentation is to introduce Taysha's approach to gene therapy development for rare neurological genetic diseases. The specific approach for gene replacement therapy development for RTT (TSHA-102) will also be presented.

#### **Methods:**

Broadly, the AAV9 vector platform has clinical precedent and a well-delineated biodistribution, safety, tolerability, and efficacy profile in the gene therapy field. Also, intrathecal delivery of AAV9-based gene therapies delivered through lumbar intrathecal injection has been shown to result in significant transduction across multiple cells within the CNS in preclinical studies and clinical experience with this route of administration is increasing. TSHA-102 has been tested in both wild-type and RTT knockout mice in order to assess safety and efficacy.

#### **Results:**

TSHA-102 demonstrated a favorable tolerability profile in wild-type mice, specifically exploring overexpression of *MECP2*, and increased survival in knockout mice. We plan to initiate the first-in-human phase 1/2 study for RTT, delivering TSHA-102 intrathecally at escalating doses. Safety and tolerability will be assessed and efficacy assessments spanning RTT symptomatology will be included.

#### **Conclusions:**

Due to the complexity of ensuring that *MECP2* expression occurs within strict physiological parameters, gene replacement therapy development for RTT has yet to enter clinical studies. Preclinical studies with TSHA-102 — a gene replacement therapy utilizing the miRARE regulatory element that allows for flexible expression of the therapeutic gene — demonstrated the potential for benefit of TSHA-102 as a treatment for RTT. Taysha plans for an IND or CTA submission for a first-in-human phase 1/2 study in the second half of 2021 and study initiation by the end of the year.

**206.003** (*Panel Discussion*) Development of RNA Editing As a Therapeutic Approach for Rett Syndrome  
**J. Sinnamoni, M. Jacobson and G. Mandel, Oregon Health & Science University, Portland, OR**

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**Background:** RNA editing is a form of post-transcriptional regulation where specific RNA nucleotides are modified to produce a different sequence than what is encoded in the genome. In mammalian cells, the prominent form of RNA editing is the deamination of adenosine to form inosine by a family of enzymes known as adenosine deaminases acting on RNA (ADARs). Inosine is interpreted by the cellular machinery as guanosine, allowing RNA editing to have a wide range of important regulatory effects including changes in RNA splicing, miRNA biogenesis, and protein function. The potential for using the activity of ADARs to edit specific adenosines in a transcript to correct genetic mutations was first proposed 25 years ago, but only recently have specific approaches been developed for this purpose. We are testing RNA editing as a potential therapy in the context of Rett Syndrome, which is caused by loss-of-function mutations in the gene encoding the X-linked transcription factor, Methyl-CpG binding protein 2 (*MECP2*). Approximately 36% of Rett Syndrome mutations are potentially amenable to correction by RNA editing, and restoration of *MeCP2* expression has been shown by multiple groups to improve or even reverse the progression of Rett-like symptoms in mice.

**Objectives:** Our objective is to harness the RNA editing activity of ADAR enzymes to correct Rett Syndrome G>A mutations using two distinct but complementary approaches. 1) Using specially designed guide RNAs to recruit the endogenous enzymes, which are highly expressed in the nervous system. 2) Delivering engineered guide-directed enzymes containing the ADAR catalytic domain.

**Methods:** We have developed and characterized several mouse models and human neuronal cell lines containing Rett Syndrome patient mutations to test the different editing approaches. Endogenous ADARs can be recruited to edit specific mutations using guide RNAs that can be delivered either as modified anti-sense oligonucleotides or expressed from adeno-associated viruses (AAV). The engineered enzymes are expressed along with the appropriate guide RNAs using AAV and can be delivered either directly into specific brain regions or systemically.

**Results:** Using both *in vitro* and, most recently, *in vivo* models, we have shown that Rett Syndrome patient mutations can be edited efficiently in the brain and that repaired MeCP2 protein localizes to heterochromatin as wild-type. Editing rates as high as 50% can be achieved in multiple neuronal cell-types *in vivo* and the restoration of protein function correlates with the level of RNA repair.

**Conclusions:** RNA editing represents a promising therapeutic avenue for Rett Syndrome and offers distinct advantages over other approaches that rely on delivering MeCP2 at the correct physiological level. Ongoing studies will determine if sufficient levels of RNA editing can be achieved throughout the brain to prevent or reverse Rett-like symptoms in mice.

**206.004 (Panel Discussion) RNA Transsplicing Therapeutic Development for Rett Syndrome**  
**S. R. Cobb, Centre for Discovery Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom**

Rett syndrome (RTT) is a severe neurological disorder resulting from loss-of-function mutations in the X-linked *MECP2* gene. A related but equally severe neurological disorder is *MECP2* duplication syndrome in which affected individuals express one or more extra copies of *MECP2*. The gene product encoded by *MECP2* is a nuclear localized protein that is especially abundant in neurons. Deletion of *MeCP2* in mice, either globally or exclusively in the nervous system, recapitulates the cardinal features of the disorder seen in patients. Conversely, genetic rescue experiments in mice have shown that profound neurological defects caused by lack of MeCP2 can be corrected if MeCP2 is subsequently made available. Spurred on by this work, several groups have gone on to develop gene therapy vectors to show an effect in ameliorating certain RTT-like dysfunction in mice. Whilst encouraging, these studies have also shown that excessive or ectopic expression of vector-derived MeCP2 can be detrimental both in peripheral tissues and in the nervous system. There is thus a barrier to clinical translation in the form of the ability to achieve widespread delivery of vector-derived *MECP2* throughout the brain whilst ensuring MeCP2 is expressed at appropriate levels in the appropriate cells. This is especially challenging given that most patients with RTT are females displaying X-linked mosaicism whereby only a proportion of the cells express the mutant *MECP2* allele and thus require gene restoration.

Trans-splicing therapy represents an attractive strategy to overcome many of these hurdles. The approach works by targeting between the *MECP2* gene and the MeCP2 protein at the level of RNA. Specifically, by hijacking a cell's natural RNA splicing machinery to join a therapeutic RNA trans-splicing molecule to 'healthy' parts of the endogenous gene, entire regions harbouring disease-causing mutations can effectively be 'bypassed'. By enabling the correction of entire chunks of *MECP2* sequence, any given therapeutic trans-splicing molecule would be effective across a significant proportion of the Rett patient population (>95%). This is distinct from other editing approaches which would necessitate developing interventions on a more patient specific basis. Since the RTM can only join the endogenous target that is already expressed at physiological levels, this approach would also restore MeCP2 levels towards normal without the possibility of elevating MeCP2 towards toxic thresholds.

## PANEL DISCUSSION — NOVEL THERAPEUTIC APPROACHES (GENE, PROTEIN OR RNA TARGETED THERAPIES)

### Panel 234 - Advances in Gene-Based Therapies in Neurodevelopmental Disorders

**Panel Chair: Mustafa Sahin, Boston Children's Hospital/Harvard Medical School, Boston, MA**

Due to advances in genetics and genomics, we now realize that autism spectrum disorder (ASD) has a strong genetic basis. There is a list of over 100 validated genes, variants in which are highly associated with autism. Meanwhile, gene based therapies have found their way into the central nervous system. Case in point is spinal muscular atrophy, for which three gene based treatments are now FDA-approved. The combination of these advances have brought us to the doorstep of an era where gene-based therapies for various causes associated with ASD are being developed and tested. This panel is aimed to inform the INSAR community about the opportunities and challenges in developing gene-based therapies for autism-related disorders. We will highlight four talks focusing on introducing genetic expression constructs into the brain and manipulating gene expression using anti-sense oligonucleotides.

**234.001 (Panel Discussion) Gene Therapy for Tuberous Sclerosis in Mouse Models**  
**X. Breakefield, Massachusetts General Hospital, Boston, MA**

We have created stochastic models of TSC1 and TSC2 in mice by injecting a vector encoding Cre recombinase into the brain ventricles of newborn pups which are homozygous for floxed loci of the equivalent mouse genes. This results in loss of function of the encoded proteins, hamartin and tuberlin, respectively in a subset of neural cell types in the brain. Such mice show neuropathologic abnormalities seen in TSC patients, develop hydrocephalus and epilepsy, and typically die at 1-2 months of age. Intravenous injection of adeno-associated virus (AAV) vectors encoding hamartin or a condensed form of tuberlin at three weeks of age extends the lifespan of these mice for over 300 days and normalizes some of the neuropathology. These AAV vectors deliver the gene to cells throughout the body and are able to cross the blood-brain barrier. They have been used clinically with benefit in other hereditary neurologic, metabolic and eye diseases. Studies are underway to evaluate biodistribution and potential toxicity of these “gene replacement” AAV vectors prior to consideration of clinical trials for TSC.

**234.002 (Panel Discussion)** CRISPR Activation to Rescue SCN2A Haploinsufficiency in Autism Spectrum Disorder  
*S. Tamura<sup>1</sup>, P. W. Spratt<sup>2</sup>, A. Nelson<sup>3</sup>, S. J. Sanders<sup>3</sup>, K. J. Bender<sup>4</sup> and N. Ahituv<sup>5</sup>.* (1)Bioengineering and Therapeutic Sciences, UCSF, San Francisco, CA, (2)UCSF, San Francisco, CA, (3)Department of Psychiatry, Weill Institute for Neuroscience, UCSF School of Medicine, San Francisco, CA, (4)Department of Neurology, UCSF, San Francisco, CA, (5)USCF, San Francisco, CA

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**Background,** Loss-of-function (LoF) mutations that cause haploinsufficiency (having only one of two functional gene copies) in *SCN2A* are one of the most frequent causes of autism spectrum disorder (ASD). Individuals with *SCN2A* haploinsufficiency are often comorbid with intellectual disability and developmental delay.

**Objectives,** Here, we set out to use CRISPR activation (CRISPRa) to target the promoter of *SCN2A* and upregulate its expression to overcome *SCN2A* haploinsufficiency in mice and human ESC-differentiated excitatory neurons.

**Methods,** We optimized adeno-associated virus (AAV) CRISPRa conditions to upregulate *SCN2A* both in mice and human cell lines. We then optimized these conditions in mice and carried out electrophysiological phenotyping to analyze the degree of rescue following upregulation.

**Results,** We injected AAV CRISPRa into the medial prefrontal cortex of *Scn2a*<sup>+/−</sup> mice and observed a rescue of the associated heterozygous cellular deficits, including action potential firing speed and synaptic maturation. In human ESC-differentiated excitatory neurons, we are currently growing these cells to maturation and plan to treat with CRISPRa to functionally assess whether we can rescue their electrophysiological properties.

**Conclusions,** In summary, our project provides a potential therapeutic for one of the most significant causes of ASD and can also be adapted to treat other commonly observed haploinsufficient neurodevelopmental disorders.

**234.003 (Panel Discussion)** Targeted Augmentation of Nuclear Gene Output (TANGO) Technology for Protein Upregulation  
*I. Aznarez, Stoke Therapeutics, Bedford, MA*

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**Background:** TANGO is a novel technology which exploits antisense oligonucleotide (ASO)-mediated modulation of pre-mRNA splicing to increase protein expression. TANGO ASOs prevent naturally occurring non-productive events that lead to either transcript degradation by nonsense-mediated mRNA decay (NMD) or nuclear retention. This results in increased productive mRNA and full-length, fully functional protein. Using bioinformatic analyses of RNA sequencing datasets, we identified non-productive events in more than 50% of protein-coding genes, of which approximately 1,246 are disease-associated.

**Objectives:** To provide support for the TANGO concept and the broad applicability of the technology to address genetic diseases amenable to protein upregulation.

**Methods:** We selected targets representing various types of NMD-inducing, non-productive alternatively spliced (AS) events (cassette exons, alternative splice sites, and alternative introns), as well as gene functions and gene sizes. ASOs were designed to target the various events and screened using a combination of *in vitro*, *in vivo*, and efficacy studies in human cells, mice, and non-human primates (NHP).

**Results:** TANGO ASOs designed to target the three types of non-productive AS events led to dose-dependent reductions in non-productive mRNA and dose-dependent increases in both productive mRNA and protein levels *in vitro*. The *in vivo* effectiveness of upregulating protein through TANGO was demonstrated in Dravet Syndrome (DS), a developmental and epileptic encephalopathy caused by haploinsufficiency in which 25% of patients present with autism spectrum disorder (ASD). We employed the *Scn1atm1Kea, F1:129S-Scn1a<sup>+/-</sup> x C57BL/6J* mouse model (DS mouse), which has been shown to recapitulate features of DS including seizures and sudden unexpected death. DS mice were administered a single dose of STK-001, an ASO that targets the *SCN1A* gene, via intracerebroventricular (ICV) injection. We show that STK-001 increases productive *Scn1a*

mRNA and restores Nav1.1 protein from 50% to near normal levels in the brain for up to 14 weeks. The restoration of Nav1.1 resulted in 76% of STK-001-treated mice being seizure-free versus 48% of placebo-treated mice with 80% reduction in the average number of spontaneous seizures in the STK-001 group measured by electroencephalography (EEG). Two dose levels of STK-001 were also evaluated in NHP via a single intrathecal lumbar bolus injection. Twenty-eight days post-injection, Nav1.1 was increased up to 3-fold in the high-dose group in regions of the cerebral cortex which are thought to be involved in disease pathology.

*Conclusions:* STK-001 has potential to provide a gene-specific, disease-modifying treatment to restore Nav1.1 to physiological levels and provide a therapeutic benefit. STK-001 is currently being evaluated in a Phase 1/2a clinical trial in patients with DS. Collectively, these data suggest that TANGO can be employed to upregulate a wide range of gene types, functions, and sizes to treat genetic diseases. As most monogenic causes of ASD are haploinsufficiencies, the TANGO technology is especially suited as a potential therapeutic approach.

**234.004 (Panel Discussion)** From Impossible to Possible: A Personal Journey from Diagnosis through Drug Development for Angelman Syndrome.

*A. Berent, GeneTx Biotherapeutics, New York, NY; Foundation for Angelman Syndrome Therapeutics, New York, NY*

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**Title:** From Impossible to Possible: A personal journey from diagnosis through drug development for Angelman syndrome.

**Speaker:**

Allyson Berent, DVM, DACVIM

New York, NY

Chief Operating Officer: GeneTx Biotherapeutics

Chief Science Officer: Foundation for Angelman Syndrome Therapeutics

Director: Angelman syndrome Biomarker and Outcome Measure Consortium (ABOM)

Director: International Angelman Syndrome Research Council (INSYNC)

Mother of Quincy: 6 year old beautiful little girl that needs more UBE3A

Veterinarian: Director of Interventional Endoscopy

In 2014 everything changed. The life of a successful veterinary specialist designing medical devices and enthralled in clinical research for animals came to a screeching halt. My little girl Quincy, 5.5 months old, was diagnosed with a random, rare, neurogenetic disorder called Angelman syndrome (AS). Through pure passion, scientific understanding, and medical education, I knew a treatment for this disorder was possible, with the understanding there was absolutely no approved therapeutics. After countless conference calls, scientific stalking, and a dream, I started my journey from becoming a fierce advocate, the Chief Science Officer of the largest non-governmental research funding foundation in AS in the world (FAST), to the co-founder and Chief Operating Officer of GeneTx Biotherapeutics, focused on developing an antisense oligonucleotide for the treatment of Angelman syndrome. The foundation funded an academic lab to develop this ASO and deeply understand the unique phenomenon associated with AS (imprinting). This funding resulted in the discovery of a unique genetic region that could be exploited, essentially turning on the gene missing in neurons of those with AS. It was at that time that the foundation decided to advance the development of this potential disease modifying therapeutic, recruit some of the most experienced experts in ASO drug development in the world, and drive the program for a first in human clinical trial. Through determination, supportive expertise, and amazing consultants, GeneTx completed IND enabling studies and launched a clinical trial for FIH in 2020. The vision and dedication of parents and loved ones drove this program, allowing the team to remain singularly focused on a population approximating 1:15,000.

## Other - Multiple Topic Areas

### PANEL DISCUSSION — OTHER - MULTIPLE TOPIC AREAS

#### Panel 220 - Mechanism in Autism Intervention – Identifying Active Ingredients and Developing Innovative Practice

**Panel Chair:** Jonathan Green, *University of Manchester, Manchester, United Kingdom of Great Britain and Northern Ireland*

**Discussant:** Connie Kasari, *University of California, Los Angeles, Los Angeles, CA*

The autism intervention field is characterised by many studies of bespoke interventions with often seemingly overlapping procedures, tested individually on often quite small samples. How can we bring together the positive elements from all this work to progress rigorously validated common interventions that can be used flexibly in different contexts? There are many putative candidates for ‘active ingredients’ of therapy in autism, but demonstrating their validity and specificity requires a mechanistic approach. There have been unfortunately few robust mechanism studies to date in autism intervention science. This symposium will aim to inspire more use of mechanism designs by showing how they can contribute to refining intervention process, contribute to progress by identifying common active elements across apparently different intervention models, and eventually developing effective modular elements for flexible use in different settings. Leaders in clinical science and trial methodology will discuss approaches to intervention for core autism symptoms and co-occurring mental health conditions across the age range; the potential but also challenges for identifying active ingredients and the pros and cons of implementing modular intervention.

**220.001 (Panel Discussion)** Challenges and Solutions for Assessing Treatment-Effect Mechanisms for Modular Interventions  
**R. Emsley**, *Department of Biostatistics & Health Informatics, Kings College, London, United Kingdom*

Background:

Modelling treatment effect mechanisms allows investigators to understand the pathways through which the intervention affects the outcome. Often there is a range of plausible mechanisms to be tested in order to determine which are the true mechanistic components of a modular intervention. Several assumptions are necessary for obtaining valid causal inferences from mediation analysis.

Objectives:

1. To review statistical methods for assessing mechanisms in observational studies and clinical trials
2. To describe the limitations of these methods and show how they can produce biased results if the underlying assumptions do not hold
3. To introduce novel clinical trial designs that allow investigators to test treatment effect mechanisms as an integral part of the study design

Methods:

Mediation analysis uses statistical models to estimate three parameters: the effect of treatment on the mediator; the effect of the mediator on outcome; the effect of the treatment on the outcome in the presence of the mediator. All three of these parameters can be susceptible to bias unless there is no unmeasured confounding of any of the pathways, and no measurement error in the mediator.

Results:

While random allocation of treatment satisfies some of the assumptions (such as no confounding of the randomisation to mediator or outcome pathways, respectively), conclusions drawn are still susceptible to: i) bias in the presence of mediator-outcome confounding; ii) measurement error in the mediator.

Improving clinical trial designs can provide more powerful tests of whether candidate core components represent truly causal mechanisms. Traditional parallel group designs with between-group comparisons are not optimal for disentangling putative and

possible competing treatment-effect mechanisms. Methodological advances such as *dismantling designs* (removing one aspect of the intervention), *randomising multiple components* of an intervention, *multiphase optimization strategy* (MOST) focussing on their promise to test the underlying aetiological mechanisms of an intervention.

Conclusions:

Mediation analysis is a powerful statistical tool to unpick how treatments work and which are the active ingredients. Like all statistical methods, if the necessary assumptions do not hold then the resulting estimates can be biased. Improving the design of studies, especially the use of randomisation to all or parts of a modular intervention, can improve the validity of the assumptions.

**220.002** (*Panel Discussion*) A Mechanistic Approach to Early Social Communication Intervention in Autism – Findings and Possibilities

**J. Green**, *University of Manchester, Manchester, United Kingdom of Great Britain and Northern Ireland*

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**Background** - Paediatric Autism Communication Therapy (PACT) is an approach to early autism intervention derived from ideas in neurotypical developmental science. This theory (eg Tomasello 2003) locates the origin of infant and young child social communication in the quality and extent of their experience of responsive interaction and communication with key adults. Studies have suggested that similar processes may apply also within early autism development (Siller and Sigman 2008, Wan et al 2013), thus providing a natural target for intervention. PACT works with caregivers using video-feedback therapy to achieve a proximal increase in adult synchronous response to child communication. Following developmental theory, it postulates then a chain of effect from this caregiver responsiveness to increased child dyadic social initiation, and then generalisation of these child acquired skills across person and context into adaptive function. This theoretical formulation of intervention process thus lends itself to mechanistic evaluation.

**Objectives** – To test the logic model of the PACT intervention using mechanistic analysis.

**Method** – Mechanism analysis within a parallel group RCT of PACT vs Usual Care (Pickles et al 2016), incorporating novel use of repeated measures to mitigate measurement error in behavioural observations.

**Results** – The analysis supported the intervention logic model by demonstrating that proximal change through intervention on sensitising caregiver synchronous response strongly mediated a significant improvement in dyadic child social communication: and that this change in child communication generalised across context, person and skill strongly to mediate the significant reduction found in researcher-rated autism symptom severity on ADOS. The results replicated a simpler mediation analysis (Aldred et al 2012) from a previous PACT trial. They supported causal inferences from related observational developmental studies.

**Conclusions** – Substantial mechanism analyses require large enough and good enough quality trial design but can be invaluable in identifying active ingredients of therapy and allowing strong causal inferences within developmental theory itself (inferences difficult to make in a non-experimental context). The mechanistic analyses here support the PACT logic model and define what we consider therefore effective components of the intervention, which we have made use of in different contexts:

1. *Across age* - a similar parent-mediated social communication intervention with babies at familial risk from nine months, demonstrated effects on elements of the mediation pathway, but was underpowered to test actual mediation. (This illustrates one of the key issues in mechanism testing – the need for samples large enough to be powered for the test).
2. *Across culture* – the active components of intervention were adapted into a culturally appropriate task-shifted non-specialist health worker intervention in South Asia, and two trials have showed that the first part of the mediation pathway at least shows effectiveness.

*Future opportunities* include the combination of such active components with other validated elements, perhaps derived from different studies, so as to further pursue common treatment progression and refinement in an evidenced fashion for the core autism condition. We can also explore different delivery and dosage options for this active module, so as to maximise treatment efficiency.

**220.003 (Panel Discussion)** Developing a Modular Intervention for School-Aged Children Addressing Autism-Related Challenges and Mental Health Needs

**J. J. Wood**, *Human Development & Psychology, University of California, Los Angeles, Los Angeles, CA*

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**Background:** School-aged children with autism often exhibit substantial heterogeneity in comorbid conditions and clinical needs, posing a challenge to the design of successful intervention protocols. This clinical heterogeneity entails varied expressions of the core syndrome of autism as well as frequent manifestations of mental health challenges experienced by children with typical development, such as anxiety and aggression, and thus may be a good match to modular cognitive behavior therapy (CBT) protocols that can flexibly address individualized clinical needs for each child (cf. Weisz et al., 2012). We have proposed that CBT protocols with a modular format might usefully incorporate evidence-based intervention components capable of addressing the most pressing clinical needs of individual children with autism within the domains of social-communication skills, peer relationships, flexibility, emotion regulation, and self-care skills. Further, the inherent complexity of module selection is a critical feature of this type of intervention package that requires special attention and pilot testing by end users (e.g., community practitioners).

**Objectives:** The primary objective of our research program has been to develop an efficacious modular intervention with the capacity to address the heterogeneous clinical needs of individual school-aged children with autism in a weekly outpatient psychotherapy context.

**Methods:** Through iterative research, we have developed a free, open-access online modular intervention compendium for school-aged children with autism using four strategies/lenses for module selection and integration: (1) a transdiagnostic approach to selecting module content for specific clinical needs, such as aggression, based upon distillation procedures and empirically-supported intervention criteria, which begins with the assumption that focal interventions that work for children with typical development might also help children with autism; (2) modifications to standard evidence-based practices for specific clinical needs that have proven to be more efficacious than the standard-of-practice in head-to-head comparisons of multicomponent intervention packages; (3) studies of the correlates of desired outcomes (e.g., the duration of gradual exposure associated with the greatest reduction of obsessions and compulsions within CBT clinical trials); and (4) conceptual models of the mechanisms of action of CBT with direct implications for module design (e.g., Brewin, 2006). Ultimately, modules addressing some of the core aspects of autism (e.g., friendship; conversation) as well as concurrent mental health needs were developed in a traditional manual format. These modules were then redesigned for implementation by community practitioners through the development of a free online platform with video training elements and an automatized module selection algorithm that relies on session-by-session formative assessment.

**Results:** Several randomized controlled trials of these modular CBT interventions have been conducted (e.g., Wood et al., 2020, 2021), with promising treatment effects on autism-related clinical needs as well as concurrent mental health challenges. The redesigned online version of the intervention has been tested in a recent implementation study, with positive practitioner outcomes found in preliminary analyses.

**Conclusions:** An internet-based modular intervention package that can be updated in response to new empirical findings may be a practical method for both disseminating and continuously updating interventions that are flexible in addressing heterogeneous clinical needs in autism.

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**PANEL DISCUSSION — OTHER - MULTIPLE TOPIC AREAS**

**Panel 226 - New Approaches to Parsing Heterogeneity in Autism and Understanding Cross-Disorder Similarities**

**Panel Chair:** *Eva Loth, Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom*

**Discussant:** *Evdokia Anagnostou, Autism Research Center, Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

The past decade has shown that no single clinical, neurobiological or genetic feature is universal or specific to autism. Instead, considerable heterogeneity within the autism spectrum paired with frequent overlaps between neurodevelopmental conditions have crystallised as key barriers to our ability to map genotype-phenotype links and to develop targeted support and treatments

for particular individuals. Hence, new designs and methodologies beyond traditional case-control comparisons are required to identify markers and mechanisms of subgroups with shared characteristics within and/ or across established diagnostic boundaries. This symposium brings together clinical and preclinical scientists from several international autism consortia to discuss new cohort designs, translatable tests and analytical approaches. Eva Loth will present the design and methods of the AIMS-2-TRIALS/ CANDY Preschool Imaging Study that compares children with autism, ADHD, ID and epilepsy across six dimensions. Minshi Peng will show similarities and differences in gene expression patterns between autism and ID. Adriana di Martino will present work aimed to identify common and distinct functional patterns between autism and ADHD in a deeply phenotyped neuroimaging sample. Azadeh Kushki will present a data-driven, diagnosis-agnostic approach to discover subgroups across autism, ADHD and OCD. Evdokia Anagnostou will synthesise approaches and discuss their strengths and challenges.

**226.001 (Panel Discussion) Designs and Methods to Identifying Neurocognitive Subgroups across Six Dimensions from Preschoolers to Adults**

*E. Loth<sup>1</sup>, A. Goodwin<sup>1</sup>, M. J. Brammer<sup>2</sup>, A. N. de Rothschild<sup>1</sup>, J. Koziel<sup>1</sup>, A. Pilkington<sup>1</sup>, R. Leech<sup>3</sup>, H. Roeyers<sup>4</sup>, T. Falck-Ytter<sup>5</sup>, R. Delorme<sup>6</sup>, E. Demurie<sup>6</sup>, M. A. Krol<sup>7</sup>, P. F. da Costa<sup>8</sup>, B. Oakley<sup>9</sup>, T. Bourgeron<sup>10</sup>, M. Mues<sup>11</sup>, A. Lefebvre<sup>12</sup>, A. Maruani<sup>13</sup>, J. Cooke<sup>8</sup>, T. Charman<sup>14</sup>, G. Pasco<sup>15</sup>, A. Fritz<sup>16</sup>, L. Girke<sup>17</sup>, M. Potter<sup>18</sup>, P. E. Springer<sup>19</sup>, H. J. Odendaal<sup>20</sup>, D. Murphy<sup>1</sup> and J. K. Buitelaar<sup>21</sup>, (1)Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (2)Centre for Neuroimaging, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (3)Imperial College London, London, United Kingdom, (4)Department of Experimental-Clinical and Health Psychology, Ghent University, Ghent, Belgium, (5)Karolinska Institutet & Uppsala University, Uppsala, Sweden, (6)Excellence centre for Autism and Neurodevelopmental disorders, Paris, France, (7)Psychological and Brain Sciences, Boston University, Boston, MA, (8)Centre for Neuroimaging Sciences, King's College London, London, United Kingdom, (9)Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (10)Human Genetics and Cognitive Functions, Institut Pasteur, Paris, France, (11)Experimental, Clinical and Health Psychology, Ghent University, Ghent, Belgium, (12)AP-HP, Robert-Debré Hospital, Child and adolescent Psychiatry unit, Paris, France, (13)hopital robert debre, paris, FRANCE, (14)Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (15)Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (16)Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (17)Karolinska Institutet, Stockholm, Sweden, (18)Stellenbosch University, Cape Town, South Africa, (19)Department of Paediatrics and Child Health, Stellenbosch University, Cape Town, South Africa, (20)Department of Obstetrics and Gynaecology, Stellenbosch University, Cape Town, South Africa, (21)Department of Cognitive Neuroscience, Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands*

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## Background

Clinical and genetic findings converge in highlighting both considerable heterogeneity within autism and substantial overlaps between autism and other neurodevelopmental conditions. These factors hinder our ability to predict individual developmental outcomes and develop targeted therapies. To identify markers that parse heterogeneity within autism, several large-scale research initiatives have been established. However, despite recent transdiagnostic approaches to psychiatry, such as the NIMH Research Domain Criteria, most clinical studies compare a single condition (e.g., autism) to a 'neurotypical' control group. New study designs, reliable transdiagnostic tests suitable for broad age and ability ranges, and analysis methods that capture individual profiles of relative strengths/ difficulties are required to identify subgroups within or across neurodevelopmental conditions.

## Objectives

To create a multi-disciplinary research platform comparing individuals with autism, Intellectual Disability, ADHD, and/ or high rates of environmental risks factors impacting social, emotional and cognitive development; 2) to develop valid and reliable tests that assess six bio-behavioural dimensions and that are comparable across broad age and ability ranges; 3) to develop robust methods to assess individual profiles across multiple measures and identify subgroups within and/ or across established diagnostic categories.

## Methods

First, by partnering AIMS-2-TRIALS with CANDY we set up a series of linked studies from preschoolers to adults with common or comparable 'deep-phenotyping' protocols, including clinical characterisation, functional outcome, neurocognitive development, brain structure, function, and genetic and environmental risk factors. The Preschool Imaging Project compares 500 children with autism, ADHD, ID and epilepsy and typical development longitudinally between the ages of 3 to 6 years; the Multiplex Family Study comprehensively assesses 100 families, and the South African PASS study longitudinally follows 4,500 children with high environmental risk factors for social, emotional or cognitive development. Second, we developed scalable

smartphone/ tablet apps that assess social, emotional, cognitive, reward, sensory and unpredictability processing. We created three versions for preschoolers, school-age children and adolescents/ adults and use Bayesian Optimisation to vary task parameters/ complexity. Third, to establish individual cross-domain profiles and identify data-driven subgroups, we created an analysis pipeline including imputation, normative modelling and the intersection of 2-12 different clustering techniques (e.g., centroid, connectivity based).

## Results

We demonstrate feasibility of this approach (including pediatric MRI sleep-scanning) in 50 preschool children in Europe and 100 children in South Africa. (2) We developed the first touch screen battery comprising established and new tests (social reinforcement learning, social habituation, auditory and tactile discrimination) that span broad age and ability ranges. (3) Our analysis pipeline allows us to create for each individual within and cross-domain profiles, relative to, for example age, sex, and/ or mental age expectations. We show that the ‘clustering intersection method’ not only enables us to determine the optimal number of clusters (subgroups) but determines which participants may be reliably allocated to the same subgroup by different methods, which is essential for subgrouping in a clinical context.

## Conclusion

By combining cross-disorder designs, new scalable tests assessing relevant bio-behavioural dimensions, and robust multi-variate analysis methods we provide tools to better understand both within-disorder heterogeneity and cross-disorder commonalities.

**226.002 (Panel Discussion)** Heterogeneity within Autism Viewed through Its Mutational and Gene Expression Patterns and Those of Developmental Disability

*M. Peng<sup>1</sup>, B. Wamsley<sup>2</sup> and K. Roeder<sup>3</sup>, (1)Carnegie Mellon University, Pittsburgh, PA, (2)University of California, Los Angeles, Los Angeles, CA, (3)Department of Statistics and Data Science, Carnegie Mellon University, Pittsburgh, PA*

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## Background

The genetic architecture of autism spectrum disorder (ASD) is increasing coming into focus through studies of both rare and common variation. Clearly both types of variation affect risk, with common variation apparently playing the prominent role at the level of populations. For developmental disabilities (DD) more broadly, rare *de novo* variation plays the larger role. Still, the nature of the overlap in genetic architecture between ASD and more broadly defined DDs, and its implications for both shared and distinct neurodevelopmental deficits remains poorly characterized.

## Objectives

To understand similarities and differences between cohorts ascertained for ASD and DD more broadly (which includes ASD) through the study of their mutational patterns as well as the expression patterns of the genes implicated for either or both.

## Methods

We study cohorts of subjects ascertained for ASD whose DNA was assessed by whole-exome sequencing (WES) to discover protein coding mutations. Likewise, we obtained data from a large cohort of subjects who were ascertained for DD and whose DNA was also characterized by WES, specifically the Deciphering Developmental Disorders (DDD) study. For each cohort, we evaluate the distribution of protein-truncating and severe missense *de novo* variants in each gene using the Transmitted And De novo Association framework. Comparing the expectation of mutations to the observed count, TADA integrates the information into a summary statistic of association for each gene implicating genes in ASD or DD or both. We also evaluate the expression patterns of these genes in fetal brain cells utilizing two single-cell RNA sequencing datasets, which were jointly analyzed through integration and hierarchical clustering of cells.

## Results

Using the pattern of *de novo* mutations in subjects ascertained for ASD, we implicated 120 genes in risk at an FDR < 0.05 threshold. Likewise, from the DDD cohort, we implicated 428 genes in risk. The intersection of these lists produced 84 genes, consistent with the known comorbidities. Nonetheless, the mutational patterns also showed high heterogeneity between ASD and DDD cohorts, suggesting somewhat distinct etiologies. From single cell enrichment analysis, we found that ASD genes were associated with a subcluster of upper layer excitatory neurons. By contrast, DDD genes were enriched in a subcluster of maturing

excitatory neurons. In addition, the upper layer neurons enriched in ASD best resemble layers 3/4 neurons whereas for DDD they best resemble layers 2/3 neurons.

## Conclusions

Sources of risk for ASD and other DD overlap and this is reflected in shared risk genes identified from the ASD and DDD cohorts. The observation of some distinct mutational patterns, however, argues for important, yet nuanced differences among genes in their impact on core features of ASD. Moreover, the gene expression patterns in cell types suggest DD gene expression is enriched in cells engaged in active transcription, protein translation/modifications, migration and extension of axons, whereas ASD gene expression is enriched in cells engaged in cytoskeleton organization, synaptic signaling and activity dependent programs. Thus, despite both being enriched in superficial cortex, they likely have different effects on cortical development.

### 226.003 (Panel Discussion) A Data-Driven, Diagnosis-Agnostic Approach to Discover Subgroups across Autism, ADHD and OCD

M. M. Vandewouw<sup>1</sup>, E. Anagnostou<sup>2</sup>, J. P. Lerch<sup>3</sup>, M. J. Taylor<sup>4</sup>, J. Crosbie<sup>5</sup> and A. Kushki<sup>6</sup>, (1)Program in Neuroscience & Mental Health, The Hospital for Sick Children, Toronto, ON, Canada, (2)Autism Research Center, Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (3)Wellcome Centre for Integrative Neuroimaging (WIN), University of Oxford, Oxford, ON, United Kingdom, (4)The Hospital for Sick Children, Toronto, ON, Canada, (5)Psychology, The Hospital for Sick Children, Toronto, ON, Canada, (6)Bloorview Research Institute, Toronto, ON, Canada

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**Background:** Autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD), are neurodevelopmental conditions with overlapping etiology, neurobiology, and phenotype, and large within condition heterogeneity. Existing studies examining shared neurobiological characteristics among these conditions often use diagnostic labels to derive group-level statistics for comparisons, an approach that often fails to capture the large within-diagnosis variability and between-group overlap. To address this limitation, data-driven and diagnosis-agnostic approaches have been proposed to characterize the nature of variability across neurodevelopmental conditions. These techniques have been used to discover homogeneous subgroups that transcend diagnostic boundaries, demonstrating that homogeneity in neurobiology does not align closely with existing diagnostic labels. These studies, however, have focused on measures of brain structure, and a gap still remains in diagnostic-agnostic characterization of brain function across ASD, ADHD, and OCD. This is a critical gap given the well-established patterns of hyper- and hypo-connectivity in neurodevelopmental conditions.

**Objectives:** We employed a data-driven clustering approach to identify homogeneous subgroups of typically developing (TD) children and those with labels of ASD, ADHD, or OCD based on measures of resting-state functional magnetic resonance imaging (fMRI) connectivity.

**Methods:** Five minutes of resting-state fMRI data were obtained on 442 ASD (N=195; age=11.7±4.1years), ADHD (N=126; age=11.6±2.8years), OCD (N=42; age=12.5±2.6years), and TD (N=79; age=11.0±4.2years) children from the Province of Ontario Neurodevelopmental Disorders (POND) network. Data were preprocessed using fMRIPrep, and time-series were extracted for 200 bilateral cortical regions belonging to seven canonical resting-state sub-networks and 32 bilateral subcortical regions. Brain connectivity networks for each participant were constructed from pairwise correlations thresholded using orthogonal minimal spanning trees. Graph theory measures were calculated at three levels: individual brain regions (nodal strength, clustering coefficient, and centrality), resting-state networks (density and subnetwork segregation), and the global network (global efficiency and modularity). Graph measures were regressed against age, sex, motion, and resting-state acquisition type, and the z-scored residuals were used in the analysis. Affinity matrices were computed for each measure using a scaled exponential similarity kernel and fused using Similarity Network Fusion. Subgroups of participants were identified from the fused matrix using hierarchical clustering.

**Results:** Preliminary analyses revealed three subgroups (Predominantly-ASD: 14 ADHD, 56 ASD, 8 OCD, 13 TD; Mixed: 29 ADHD, 38 ASD, 14 OCD, 13 TD; Predominantly ADHD/TD: 79 ADHD, 96 ASD, 20 OCD, 52 TD). The predominantly-ASD group had a higher proportion of ASD compared to ADHD participants (pcorr=0.001), while the predominantly ADHD/TD group had higher proportion of ADHD (pcorr=0.047) and TD (pcorr=0.047) compared to ASD participants. The groups were significantly different in Child Behaviour Checklist (CBCL) attentional problems scores (p=0.0099), but not in general adaptive functioning (ABAS), social communication (total SCQ score), or full-scale IQ. Several methodological challenges may have contributed to the clustering results as the groups differed on age (p<0.001), scan type (movie or Inscapes; p=3.0402e-44), and motion (p=2.1713e-12). Global efficiency and strength of subcortical regions contributed most to the clustering results.

**Conclusions:** Preliminary results suggest that homogeneity in resting state connectivity may not align with diagnostic labels, although several methodological challenges remain to be explored.

## 226.004 (Panel Discussion) Transdiagnostic Functional Mapping of Autism and ADHD

P. Segura<sup>1</sup>, A. Di Martino<sup>2</sup>, J. Stroud<sup>1</sup>, S. Bishop<sup>3</sup>, S. H. Kim<sup>4</sup>, C. Lord<sup>5</sup>, F. X. Castellanos<sup>6</sup>, M. P. Milham<sup>2</sup>, J. Filho<sup>2</sup>, A. K. Simhal<sup>1</sup>, J. Cloud<sup>7</sup> and S. Colcombe<sup>7</sup>, (1)Autism Center, Child Mind Institute, New York, NY, (2)Child Mind Institute, New York, NY, (3)University of California San Francisco, San Francisco, CA, (4)Psychiatry, Center for Autism and the Developing Brain, White Plains, NY, (5)University of California, Los Angeles, Los Angeles, CA, (6)Department of Child and Adolescent Psychiatry, NYU Langone Health, New York, NY, (7)Nathan Klein Institute, New York, NY

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### Background.

Clinical and biological heterogeneity remain major challenges for biomarker identification in psychiatry, including autism. An illustration of such challenge is the frequent cooccurrence of symptoms qualitatively similar to those observed in autism spectrum disorder (ASD) in children with attention deficit hyperactivity disorder (ADHD). The extent to which autism traits share common neural correlates across these diagnoses remains largely unclear. Mixed results of common and/or shared atypicality emerged from initial studies, that however have been largely focusing on parent ratings and on diffusion or structural MRI.

### Objective.

To identify shared and distinct effects of autistic traits on intrinsic functional connectivity (iFC) in a well characterized sample of children of either ASD or ADHD

### Methods.

We analyzed data from children aged 9+2 yrs with a primary DSM-5 diagnosis of either ADHD (n=98) or ASD (n=64) based on multisource assessment of two independent evaluators following a diagnostic consensus. Autistic traits were indexed by calibrated severity scores (CSS) of the Autism Diagnostic Observation Schedule-2 (ADOS-2) administered/scored “blindly” to prior history/diagnostic concerns. Using resting state fMRI low motion images an unbiased voxel-wise brain connectome multi-distance-based matrix regression (MDMR) examined regions whose iFC was associated with ADOS-2 CSS and follow up seed-based correlation analysis (SCA) explored their iFC-ADOS-2 CSS patterns. To examine both diagnostic shared and specific iFC patterns analyses were conducted across and between diagnostic groups (i.e., Dx by CSS interaction). Median FD, ADHD symptoms, and age were covariates and Gaussian random field corrected for multiple tests ( $Z > 3.1$ ,  $p < 0.05$ ). Replication of results was assessed in an independent sample including group age-matched children with ASD, ADHD, TDC (n=64, 98, 53, respectively).

### Results.

MDMR across diagnoses revealed two clusters significantly related to inter-individual differences in autistic traits: 1) PCC and precuneus portions of the default network (PCC-DN), 2) middle frontal gyrus aspects of the fronto-parietal network (MFG-FP). SCA revealed a pattern consistent with higher internetwork iFC for children with autistic traits across diagnosis. MDMR

diagnosis by ADOS-2 CSS interactions revealed an ASD-specific negative association between ADOS-CSS S and interhemispheric iFC of MFG-FP. A similar iFC pattern was confirmed in the independent transdiagnostic sample.

### Conclusions.

Results showed both transdiagnostic and diagnostic-specific brain-behavior relations with autistic traits. Specifically, a stronger FP-DN internetwork iFC characterized individuals with elevated ADOS-2 CSS transdiagnostically and differentiated them from ADHD<sup>AS</sup> and TDC. This suggests that atypical network segregation may be a risk factor for autistic traits in neurodevelopmental conditions. At the same time, findings that a negative interhemispheric iFC-AS relation only characterized children with ASD, underscores that additional diagnostic specific pathways specific to ASD exist. Overall, these results suggest that emerging hybrid, dimensional and categorical models of psychopathology also apply to autism and autistic symptoms.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 304 - Behavioral Treatment Trials

**304.001** (Oral) Facing Your Fears in Schools: Implementing CBT for Anxiety in Students with ASD in Urban Schools – Results from a Randomized Trial.

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Background: Youth with ASD are at high risk for developing clinically interfering anxiety that negatively affects friendships, home life, school participation and performance (Adams et al. 2018). Unfortunately, substantial disparities in access to mental health services exist, especially for traditionally underserved students (Zuckerman et al. 2014). The implementation of evidence-based mental health programs to students with ASD in schools is emerging, and the need for a sustainable delivery model is essential. The purpose of the current study is to train interdisciplinary school providers (ISPs) to deliver a school-based CBT program (Facing Your Fears- School Based (FYF-SB; Reaven et al. 2019) to traditionally underserved students with ASD or other social/communication difficulties and anxiety, and examine implementation and treatment outcomes.

Objectives: To examine the effectiveness of a Train-the-Trainer approach to implement FYF-SB in urban schools to students with ASD and anxiety, via a randomized trial, and examine preliminary outcomes.

Methods: Seventy-seven ISPs, from 25 schools (27 school teams) across 3 public school districts were trained to deliver FYF-SB. Thirteen school teams were randomized to FYF-SB, and 14 teams to Usual Care (UC). Trainings were co-led by teams of previously trained ISPs and research personnel (clinical psychologists). CBT Knowledge was measured pre/post training. Eighty-one students (82% male; 31% Latino, 30% non-white; M age=10.71; 7-14 years) participated. Inclusion criteria: Exceeding clinical threshold on the Screen for Childhood Anxiety and Related Disorders (SCARED; Birmaher et al. 1999), T-scores above 60 on the Social Responsiveness Scale-2<sup>nd</sup> Edition (SRS-2; Constantino & Gruber, 2012), and estimated IQ above 70. Fidelity was coded for 60% of sessions. SCARED and acceptability measures were administered post-intervention.

Results: ISPs demonstrated significantly increased CBT Knowledge following training:  $t(60)=-6.29, p<.001$ . An average of 10/12 sessions were completed. Very good treatment fidelity (absence/presence of core components) was obtained across teams;  $M=86%$  (range: 76%-98%). Upon completion of FYF-SB, providers reported that FYF-SB was easy to understand and put into practice (90% agree/strongly agree) and indicated that FYF-SB enhanced their ability to manage their students' anxiety (88% agree/strongly agree). Overall, students reported that they enjoyed FYF-SB (71% the most/very much). Students who received FYF-SB displayed significantly greater reductions in anxiety compared to students who received UC according to SCARED-Parent report for Total Anxiety ( $p=.011$ ) and the following subscales: Panic ( $p=.014$ ), Separation ( $p=.003$ ), and Social Anxiety ( $p=.005$ ). Students who received FYF-SB also reported significantly greater reductions in anxiety compared to students who received UC according to Separation ( $p=.014$ ) and Social anxiety subscales ( $p=.002$ ) on the SCARED.

Conclusions: Results indicated that ISPs demonstrated significant improvements in CBT knowledge following training and can deliver FYF-SB as intended. FYF-SB was seen as acceptable by school providers and students. Significantly greater reductions in anxiety occurred according to parent and student report, for students randomized to FYF-SB. Implementing evidence-based mental health interventions in public schools, via a Train-the-Trainer approach has the potential to increase access to care for traditionally underserved students with ASD and broaden provider capacity via a sustainable delivery model. Future research directions and limitations will be discussed.

**304.002** (Oral) Social Rhythmic Entrainment to Child-Directed Singing in ASD and TD Toddlers

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Background: Caregiver-infant rhythmic social interactions are crucial to social development (Beebe et al., 2016). Typically developing (TD) individuals are sensitive to the timing of social engagement from infancy. In our recent work using child-directed singing, a naturally-occurring, rhythmic, social interactive behavior, both the caregiver and typically developing (TD) infants time-locked their own social-affective cues to key rhythmic moments; infants as young as two months old increased attention to caregivers' eyes at the song beats, and such rhythmically entrained eye-looking further increased in six-month infants. Here we examine whether and how rhythm continues to serve as a mechanism for the scaffolding of social attention into

toddlerhood. Given the critical importance of looking at the eyes of others for understanding social information, we examined whether attention to the eyes of a caregiver is modulated by rhythmic structure in TD toddlers, and in toddlers with autism spectrum disorder (ASD) who have impairments in social timing and coordination (Ozonoff et al., 2010).

**Objectives:** Examine modulations in eye-looking arising from rhythmic entrainment in TD and ASD toddlers.

**Methods:** Seventy-two chronologically age- and sex-matched TD (n=33) and ASD (n=39) toddlers (18-26 months) watched videos of an actress engaging them with child-directed singing while eye-tracking data was collected. Eye-looking was quantified as the amount and timing of toddlers' fixations on actresses' eyes. Rhythmic structure (song beats) were determined using vowel onsets and offsets of the beat-aligned syllables. We measured whether changes in looking to the eyes of actresses were time-locked to the beats using permutation testing of crosscorrelograms compared with chance rates of eye-looking in both ASD and TD samples. Distributions of individual toddlers' eye-looking timing at the beat were analyzed using circular  $\nu$ -tests.

**Results:** Time-locked to the rhythm of the singing, toddlers increased their eye-looking at levels greater than expected by chance ( $p < 0.05$ ; Figure 1a,b). At the beat, TD toddlers exhibited a 13.1% increase in eye-looking above mean levels while ASD toddlers' eye-looking increased 8.3% above mean levels. Phase analyses indicated rhythmically entrained eye-looking across individual toddlers in both TD and ASD groups ( $p < 0.01$ ; Figure 1c,d). There were no significant differences in the overall proportion of time TD ( $\bar{x}=0.26$ ,  $s=0.20$ ) and ASD ( $\bar{x}=0.23$ ,  $s=0.21$ ) toddlers fixated on the actresses' eyes during naturalistic child-directed singing ( $p > 0.05$ ).

**Conclusions:** These findings extend prior demonstrations of rhythmically-entrained eye-looking in TD infants to TD toddlers suggesting that rhythm continues to be an important structuring mechanism for supporting social behavior throughout early childhood. Initial analyses with toddlers with ASD suggest that eye-looking in ASD is also modulated by rhythmic structure during child-directed singing perhaps due to the robust, stereotyped, predictable, and repetitive cueing provided in the song context. Future analyses will examine whether rhythmically-entrained eye-looking is attenuated in toddlers with ASD and potential (differential) drivers of entrained eye-looking in both TD and ASD toddlers.

**304.003 (Oral) Supporting Caregivers Post Participation in Caregiver-Mediated Jasper Intervention: Needs and Assistance during Follow up**

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**Background:** Caregiver-mediated social communication intervention can lead to gains in children's engagement and communication as well as caregivers' use of intervention strategies (e.g., Shire et al., 2015). Although gains over baseline continue, child and caregiver outcomes often dip during follow up. Little is known about if and when caregivers may want support to maintain their treatment gains as their children's needs change in the period after intervention has ended.

**Objectives:** Explore caregivers' experiences following parent-mediated intervention through (a) quantitative data from a novel mobile health questionnaire (MHQ) given weekly for three months following intervention to examine if, when, and how often caregivers endorsed a need for support and (b) qualitative data from focus groups.

**Methods:** Fifteen children with autism age 2.0-8.7 years ( $M=55.8$  months) and their caregivers received 12 weeks of a caregiver-mediated developmental social communication intervention- Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2006) from community interventionists employed by a provincial public health system in Canada. The five interventionists were trained to intervention fidelity by the study team with fidelity checks scoring at or above the required criterion of 80%.

**Measures:** First, the MHQ included 3 questions rated from 1 (typical/no support needs) to 7 (getting worse, high support needs), modeled after Clinical Global Impressions (Guy, 1976). Weekly, caregivers rated the child's social communication, engagement, and their perceived support needs. Second, three focus groups (3-4 families/group) were led by their health region leadership. Open-ended questions addressed families' experience in the follow-up period.

**Results:**

**Children's engagement and communication in follow up:** MHQ scores ranged from 1 to 4 for question 1 and question 2 ( $M=2.16$ ,  $SD=.875$ ;  $M=2.10$ ,  $SD=.854$ ).

Need for support during follow up. Scores ranged from 1 to 5 for question 3 ( $M=2.29$ ,  $SD=.74$ ). Caregivers reported a need for support (MHQ score of 3-7) on average 4 times over 12 weeks. Most families indicated a mild need for support (score of 3), however, 4 families indicated moderate (4) or marked (5) needs for support. More intense support needs emerged mid-way through follow up period. Interventionists responded within 24 hours by email to check-in and provide suggestions to resolve challenges.

Constant comparative analysis of coded focus group data led to five themes including feeling sufficiently supported by weekly check-ins that encouraged accountability and personal reflection on strengths and challenges. However, the families also reported challenges maintaining children's engagement and regulation, replicating the intervention structure, and integrating strategies into more 'naturalistic' daily routines.

Conclusions: Two-thirds of families desired support during follow up. On average, caregivers indicated a need for support 4 times during the follow up period. Caregivers were contacted through email and phone calls by their interventionist which families reported were sufficient to resolve challenges such that no family requested a video conference or home visit. Caregivers suggested readily-accessible electronic resources may support continued learning. Future research to understand child and family predictors of differential support needs may help plan to allocate limited resources.

#### **304.004** (Oral) Parents' Application of Mediated Learning Principles As Predictors of Toddler Preverbal Social Communication Outcomes

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Background: Prior research on parent-mediated intervention (PMI) for toddlers with autism used "naturalistic developmental behavioral intervention" (NDBI) strategies for parent learning. Relationships between child outcomes and parent factors were addressed by three NDBI research teams to explain intervention effects (Brian et al, 2016, 2017; Gulsrud et al., 2016 and Shire, et al., 2016; and Rogers et al., 2019). As yet unexplored is whether promoting active social engagement using a mediated learning approach predicts unprompted social initiations for toddlers with autism.

Objectives:

Two research questions (RQs) were explored.

1. How did parents who received the Joint Attention Mediated Learning (JAML) intervention compare with control group participants in their post-intervention application of three mediated learning principles in unstructured parent-toddler interaction?
2. To what extent were parents' application of these principles associated with toddlers' preverbal social communication outcomes.

Methods: Parent-toddler dyads ( $n = 120$ ; child age  $M = 24.7$ ; 69% Caucasian; 84% male) were randomized to JAML ( $n = 58$ ) and control ( $n = 62$ ) conditions. A partial-interval recording system was applied in observer-blinded independent coding of parent-child interaction videos. The Mediation of Social and Transactional Engagement Measure (MOSTE) measured parents' application of mediated learning principles focusing (FO), giving meaning (GM), and encouraging (EN). The Preverbal Joint Attention Measure (PJAM) assessed toddler's focusing on faces (FF), turn taking (TT), responding to joint attention (RJA), and initiating joint attention (IJA). RQ 1 was investigated through MANOVA to detect mean differences between intervention and control conditions at post assessment. RQ2 was examined through linear multiple regression with post-intervention child outcomes as dependent variables and parents' application of mediated learning principles as predictors.

Results: RQ1: Post-intervention analysis found significant group differences for parent application of mediated learning principles in favor of the intervention group: FO,  $F(1,118) = 21.14$ ,  $p < 0.001$ ; GM,  $F(1,118) = 24.73$ ,  $p < 0.001$ ; and EN,  $F(1,118) = 7.38$ ,  $p = 0.01$ . RQ2: Significant linear relationships were found between outcome and predictor variables. Analyzed together, group differences in parents' use of mediated learning principles explained variances in child outcomes (24% for FF, 12% for TT, 16% for RJA, and 41% for IJA). While holding other variables constant, EN ( $t = 1.95$ ,  $p < 0.05$ ) predicted RJA and GM ( $t = 3.2$ ,  $p < 0.01$ ) and EN ( $t = 1.21$ ,  $p < 0.05$ ) predicted IJA.

Conclusions: JAML was effective for supporting parents of toddlers with autism to apply mediated learning principles in parent-toddler interaction with successful application of principles predicting increases in toddler outcomes. Specific advantages were found for use of "encouraging" and "giving meaning" to facilitate toddlers' joint attention, defined in the PJAM as (a) occurring on the child's own volition for the purpose of social sharing (e.g., showing or responding to non-directive showing) without prompting, modeling, or reinforcement of predetermined behaviors and (b) excluding instrumental communication (i.e.,

requesting/directing or following directions). Because of its integration into everyday parent-child interaction, parent-mediated learning may have potential to extend social competency beyond immediate intervention contexts.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 305 - 'Getting it Right' for Autistic Children, Youth and Adults: Diagnostic, Transition & Mental Health Support Challenges

**305.001** (Oral) When Are Clinicians Sure? Identifying Socio-Demographic Predictors of Diagnostic Certainty to Inform Diagnosis Among Underserved Populations

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#### Background:

Despite the importance of evidence-based diagnostic assessment of autism spectrum disorder (ASD), the diagnosis of ASD has many challenges and inequities. There are socio-demographic disparities in ASD diagnostic practices, including misdiagnosis and delayed identification that disproportionately affect children and families who have historically been excluded from autism research and clinical services. Clinician decision-making is one factor that may contribute to issues with equitable and timely diagnosis. Diagnostic certainty refers to the extent to which a clinician is certain in their diagnosis, or how sure they are that the individual actually meets ASD diagnostic criteria. Better understanding how diagnostic certainty relates to socio-demographic characteristics is an important research priority with the potential to advance understanding of how clinicians perceive and make decisions about autism diagnoses.

#### Objectives:

Our specific aims were to (1) identify how demographic factors, including child sex, race, age, and family income, predict diagnostic certainty, controlling for core diagnostic measures such as autistic traits and cognitive abilities, and (2) determine whether demographic factors moderate the agreement between core diagnostic measures with diagnostic certainty.

#### Methods:

Participants included youth with ASD from the Simons Simplex Collection (N = 1,869) who completed gold-standard diagnostic assessments at university-affiliated autism research centers. Diagnostic certainty was assessed by asking clinicians how certain they were that the child met criteria for an autism diagnosis (ranged from not at all certain (score of 6) to completely certain (score of 15)). Core diagnostic assessment measures included clinician-observed autism traits (comparison score from Autism Diagnostic Observation Schedule (ADOS-2)), parent-reported autism traits (Social Communication Questionnaire), and an overall estimate of cognitive ability (full scale IQ score). Moderated regression analysis was used to examine (1) main effects of demographic factors and the core diagnostic assessment measures, and (2) interactive effects of demographic factors and the core assessment measures on diagnostic certainty.

#### Results:

Demographic factors were significantly associated with diagnostic certainty, even controlling for core assessment measures (ADOS-2 score, SCQ score, full-scale IQ; see Table 1). Lower income and older child age were associated with less clinician certainty. Children identified as White also had lower levels of clinician certainty. Moreover, family income moderated the association between ADOS-2 scores and diagnostic certainty (see Figure 1). The agreement between ADOS-2 scores and diagnostic certainty was significantly weaker for lower income families.

#### Conclusions:

The present results show that diagnostic certainty (the extent to which a clinician feels sure about the autism diagnosis) relates to child race, child age, and family income, even when controlling for core clinical assessment measures (ADOS-2, SCQ, and IQ scores). Moreover, the agreement between ADOS-2 comparison scores and diagnostic certainty was moderated by family income, such that this association, which ideally should be highly concordant (high ADOS-2 scores associated closely with high diagnostic certainty), is weaker for lower income families. These findings show that diagnostic certainty is not synonymous with the level of autism symptoms, and suggests that demographic factors may influence how clinicians perceive autism diagnoses.

Research on diagnostic practices is urgently needed among diverse and historically excluded communities.

**305.002 (Oral) Building Better Bridges: Outcomes of a Community-Partnered School Transition Intervention for Students with Autism**

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**Background:** For any student, new school transitions can pose challenges. For children with autism, who often poorly tolerate uncertainty and have difficulty navigating complex social environments, these challenges are exacerbated. To date, there are no evidence-based interventions to support children with autism, or their parents and teachers, which are designed to facilitate successful school transitions during this sensitive period.

**Objectives:** We tested the recently developed *Building Better Bridges*, an intervention to improve transitions from kindergarten to primary school and from primary to secondary school. The *Building Better Bridges* intervention includes six parent coaching sessions and a resource binder through which parents learn about special education, the transition process, and how to advocate for their child. Goals include: gathering key information from current teachers about their child to pass on to new school teachers; effectively communicating with school teams; knowing educational policy rights relating to school transition, and; engaging their child in activities over the summer in preparation for the transition.

**Methods:** We tested the *Building Better Bridges* intervention in a four-site (Los Angeles, Davis, Philadelphia and Rochester) randomized controlled trial (*Building Better Bridges* vs. resource binder only control group) to examine its effect on school transition-related outcomes for students with autism as well as their parents and teachers. Inclusion criteria were that families were under-resourced, children attended a preschool or public school, were transitioning to a new school in the upcoming academic year, and had an educational classification or medical diagnosis of autism, confirmed by their score on the Social Communication Questionnaire. We recruited 168 children with autism (treatment n=84, control n=87), and their parents and teachers. See Table 1 for participant characteristics. The primary outcome measure was the Transition Evaluation Questionnaire, which measures parents' and teachers' perceived transition success. Secondary outcomes included children's engagement in learning, parents' self-efficacy and worry regarding managing the transition to school, parents' perceptions of, and children's behavior problems. Measures were collected at three time points: study enrollment, second half of the school year (T1), last 6 weeks of pre-transition school year (T2), and first 6 weeks after the new school year (T3). We used 2-way repeated measures ANCOVAs, controlling for site, to examine the interaction effect of treatment status (treatment, control) and time (T1, T2, T3) on the aforementioned outcomes, and examined pairwise comparisons between treatment groups at each timepoint.

**Results:** Compared with the control group, parents and teachers in *Building Better Bridges* rated the transition as more successful. Teachers, but not parents, rated children as more emotionally engaged in class post-transition. Parents rated themselves as having more self-efficacy in managing the school transition. The *Building Better Bridges* intervention did not improve parents' perceptions of school involvement or reduce children's behavior problems post-transition relative to control. Parental worry decreased from T1-T3 for both groups.

**Conclusions:** Results suggest the *Building Better Bridges* intervention improves some of the key transition outcomes, supporting potential dissemination to school systems. Findings warrant replication.

**305.003 (Oral) Why Are Autistic People More Likely to Experience Suicidal Thoughts? Applying the Integrated Motivational-Volitional Model in Autistic Adults.**

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**Background:**

Autistic people are more at risk of suicidal and behaviours and dying by suicide than the general population and other clinical groups. The Integrated Motivational-Volitional Model of Suicidal Behaviour predicts risk factors, in the presence of stressors,

can increase feelings of defeat and entrapment with suicide perceived as the only available escape route. Characteristics associated with ASD, such as camouflaging and intolerance of uncertainty (IU), not currently in the IMV model, could interact with known risk markers to further increase risk of suicidal intent in this group.

#### Objectives:

1. Do defeat and entrapment apply to suicidal ideation for autistic people?
2. Do camouflaging and IU mediate the relationship between defeat, entrapment and suicidal ideation?

#### Methods:

Data were collected online on: depression (PHQ9-ASC), camouflaging (CATQ), intolerance of uncertainty (IUS12), feelings of defeat and entrapment and suicidality (SBQR-ASC).

#### Results:

Preliminary findings are presented based on a sample of 150 autistic participants: (mean age= 31.6; SD= 10.9).

Suicidality was significantly correlated with entrapment ( $r(61) = .728, p < .001$ ) and defeat ( $r(58) = .606, p < .001$ ). Current experiences of depression significantly correlated with suicidality ( $r(94) = .668, p < .001$ ). Analysis of the subscales for the adapted measure of depression indicated that both the original psychosomatic PHQ-9 items and the adapted autism specific items correlated with suicidality ( $r(58) = .623, p < .001$  and  $r(56) = .535, p < .001$  respectively).

Higher IU correlated with higher levels of defeat ( $r(101) = .532, p < .001$ ) and entrapment ( $r(104) = .504, p < .001$ ). Intolerance of uncertainty also correlated with suicidality ( $r(61) = .348, p = .005$ ) and current depression ( $r(95) = .460, p < .001$ ).

Camouflaging was positively correlated with feelings of defeat ( $r(101) = .264, p = .007$ ) and entrapment ( $r(104) = .336, p < .001$ ). Similarly, camouflaging correlated with higher ratings of current depression ( $r(95) = .408, p < .001$ ), particularly the autism trait subscale ( $r(98) = .448, p < .001$ ).

Initial regression analysis indicates, that when controlling for age, current depression scores accounted for 44.1% of the variance in suicidality ( $p < .001$ ). When age and depression are controlled for, entrapment accounts for 15.9% of total variance ( $p < .001$ ); whilst defeat only accounts for 4.5% of total variance ( $p = .037$ ) in suicidality.

#### Conclusions:

This is the first study to explore the IMV model with a sample with autistic adults. Furthermore it is the first study to explore the additional contribution of constructs known to be important to the understanding of experiences of mental health in autistic people. Suicidality, current depression symptoms, camouflaging and IU were all significantly correlated with defeat, entrapment and all other variables, with the exception of camouflaging where no significant correlation with suicidality was found. Our findings provide preliminary support for the importance of the IMV model predictors of suicidality (defeat and entrapment) when applied to autistic people. In addition, we found that the autism related constructs of intolerance of uncertainty and camouflaging are strongly associated with experiences of defeat, entrapment and depression. Intolerance of uncertainty, in particular, is significantly associated with suicidality. Camouflaging, however, is not (contradicting previous studies).

**305.004 (Oral)** “Listen, I’ve Been Thriving” Vs. “This Is the Worst I’ve Ever Felt!”: An Exploratory Study of Autistic Experiences with In-Person and Online Social Interaction during the COVID-19 Pandemic

**R. E. Stanley**, Marquette University, Milwaukee, WI

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Background: Social distancing during the COVID-19 pandemic has significantly affected the social behavior of people across the world. Social relationships play a key role in health (Umberson & Montez, 2011), and social isolation is associated with increased mortality and poorer mental health (Leigh-Hunt et al., 2017). However, it is unclear whether in-person and online interaction produce equivalent effects on mental health, with research showing both positive and negative outcomes associated with increased social media use (Pantic, 2014; Frost & Rickwood, 2017). Even less understood is how this relationship may be affected by autism spectrum disorder (ASD), which is characterized by atypical social behavior. There is a dearth of qualitative

research assessing autistic perspectives on social interaction and mental health. Given the potential health risks to increased isolation during the COVID-19 pandemic, autistic adults' insight on the topic is more salient than ever.

**Objectives:** To qualitatively explore the in-person and online social interaction experiences of autistic young adults during the COVID-19 pandemic, and their perspectives on the subsequent relationship to mental health.

**Methods:** 83 autistic adults from the United States (23 female, 10 male, 49 nonbinary/other, 2 prefer not to respond, M = 25.7) answered a multiple-choice question about reducing in-person contact during the pandemic, and 10 open-ended questions about their in-person and online social interactions and mental health both before and during the pandemic. Survey responses were coded using thematic analysis. Responses were also coded for mental health symptoms as well as change in mental health symptoms over the course of the pandemic.

**Results:** The majority (83%) of participants reported "significantly" reducing their in-person contact during the pandemic, with the remaining (17%) reporting "somewhat" reducing their in-person contact. The majority (55%) of participants described worsening mental health symptoms during the pandemic, including depression, anxiety, and increased symptoms of ASD, as well as loneliness and generalized stress. However, a portion of participants (13%) described their mental health improving in some ways while worsening in others, while another group (15%) described unmitigated improvement (8% no change, 9% did not answer). Themes and sub-themes generated by the thematic analysis are included in Figure 1.

**Conclusions:** In-person social interaction was described as important for mental health and reducing loneliness, but also overwhelming and exhausting. Online interaction was also described as important for mental health and social connection, a lifeline during the pandemic. Perspectives on the shift to online varied greatly, with some preferring this "new normal," describing it as easier and better for their mental health. However, others reported that online interaction was harder, and that it was not a replacement for in-person interaction. Some participants also reported that they were already socializing primarily online prior to the pandemic, either due to preference or isolation. These results highlight the complexity of social interaction across multiple modalities, opening new avenues for understanding autistic social experiences and mental health. Findings will inform future research on social and mental health interventions, and provide insight on how autistic adults can meet their social needs.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 306 - fMRI and EEG Task-Induced Responses in Autism

**306.001 (Oral)** Changes in Amygdala Activity across the PEERS® Intervention: The Role of Fear of Negative Evaluation  
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**Background:** Social skills and anxiety are highly overlapping among autistic youth (Wood & Gadow, 2010), and improvements in both have been identified across a well-validated social skills intervention (Hill et al., 2017; Lordo et al., 2017; McVey et al., 2016; Schohl et al., 2014), the *Program for the Education and Enrichment in Relational Skills (PEERS®)*; Laugeson & Frankel, 2010). Biomarkers may prove critical in establishing the precise mechanisms of action in treatments like *PEERS®* (Stavropoulos, 2017). Evidence points to electrophysiological underpinnings of response to *PEERS®* (Van Hecke et al., 2013), but further study is needed to examine specific brain regions implicated in social functioning via MRI and explore the role of social anxiety.

**Objectives:** To test baseline anxiety as a predictor of change in amygdala activity following *PEERS®*.

**Methods:** 38 autistic youth (19 in each the experimental [EXP] and waitlist control [WL] groups) drawn from a larger randomized clinical trial of *PEERS®*. Data were collected at two timepoints: before and after the intervention for the youth in the EXP group, or after approximately 14 weeks for the WL group. Parent- and self-report questionnaires measuring social skills and anxiety and functional MRI data were collected. A face processing task was chosen based on existing literature (e.g., Herrington et al., 2016). Functional images were acquired across two runs of a 1-back task which included gray-scale visual stimuli of angry

faces, happy faces, neutral faces, houses, and scrambled images. A face-versus-house contrast based on the literature (e.g., Aoki et al., 2015) was used to elicit amygdala activity.

Results: A 2-way Mixed Effects, Group (EXP vs. WL) x Time (pretest vs. posttest) ANOVA was conducted to examine changes in amygdala activity using FSL's FEAT (Woolrich et al., 2001). There were no significant within- or between-group effects or interaction effects. Multiple regression was used to examine anxiety symptoms as predictors of change in amygdala activity from pretest to posttest in the EXP group. Higher social anxiety symptoms (*Social Anxiety Scale for Adolescents, Fear of Negative Evaluation*) predicted greater decrease in amygdala activity across the intervention ( $\beta = 0.49, p = 0.040, R^2 = 0.24$ ).

Conclusions: Social anxiety, specifically fear of negative evaluation, predicted change in amygdala activity from pretest to posttest; that is, higher social anxiety at pretest was associated with a larger decline in amygdala activity across intervention. This finding aligns with work demonstrating a link between greater fear of negative evaluation and longer gaze duration to emotional faces in autistic adolescents (White et al., 2015), and points to the potential importance of fear of negative evaluation when testing the neural underpinnings of response to social skills intervention among autistic youth. Clinical implications highlight the importance of identifying social anxiety symptoms among autistic youth participating in social skills intervention, as these youth may be the ripest for the greatest benefits from such an intervention.

### **306.002 (Oral) Neural Mechanisms of Emotion Regulation in Children with ASD As Treatment Targets for Anxiety**

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Background: Anxiety is a common and impairing problem in children with autism spectrum disorder (ASD) but the neural mechanisms of anxiety in ASD are not well understood. This study examined associations of anxiety with the BOLD signal change during performance of a neurocognitive task of emotion regulation in a sample of children with ASD and co-occurring anxiety disorder who were seeking treatment with cognitive behavior therapy (CBT).

Objectives: To examine neural mechanisms of emotion regulation in children with autism and co-occurring anxiety disorders.

Methods: The sample included 45 children with ASD [mean age (SD) = 12.2 (1.7), 70 percent male] and 27 typically developing controls unaffected by psychiatric disorders [mean age (SD) = 12.0 (1.7), 60 percent male]. Subjects were characterized with ADOS, ADI-R, and DAS-II and co-occurring disorders were assessed by the Anxiety Disorders Interview Schedule conducted by an expert clinician. Parents complete the Multidimensional Anxiety Scale for Children (MASC). Children completed fMRI task of emotion regulation that required to either passively viewing negative affective images or down-regulate their emotional response to the images.

Results: Whole-brain fMRI analysis of group (ASD vs TD) by task (view vs regulate) interactions revealed reduced activation in children with ASD, relative to TD, during the down-regulation condition of the task in four regions: left superior temporal gyrus, right inferior parietal lobule, right precentral gyrus, left superior parietal lobule. Next, whole-brain fMRI analysis in children with ASD (n=45) was used to test the interaction effect of the total MASC score with the BOLD signal change during decrease vs look-negative conditions of the emotion regulation task. There were significant negative correlations of anxiety with the change of the BOLD signal in three regions: left medial frontal gyrus (k=195, x,y,z=-14,-19,54); right superior frontal gyrus (k=124, x,y,z=11,11,31) and right inferior parietal lobule (k=42, x,y,z=31,-41,36).

Conclusions: Patterns of neural activation during emotion regulation differed between the two groups in: 1) temporal and parietal regions, including the superior temporal gyrus (STG), inferior parietal lobule (IPL) which have been implicated in self-referential processes such as perspective-taking and 2) the ventrolateral prefrontal cortex (vlPFC), implicated in the cognitive control of emotions, with abnormal vlPFC patterns during cognitive reappraisal associated with anxiety. Clinical implications of understanding neural mechanisms to enhance the effectiveness of CBT for anxiety symptoms in ASD are discussed.

### **306.003 (Oral) Early Quantitative and Later Qualitative Neural Differences during Face Processing in Autistic Individuals from Childhood to Adulthood**

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#### Background:

Social communication difficulties in autism are related to adaptive functioning during daily life (Tillman et al., 2019). Rapid and efficient face processing provides crucial information during communication and may be an endophenotype for autism. The underlying neural mechanisms however remain unclear. One theory suggests that differences between autistic and neurotypical individuals arise from quantitative differences in the activation of similar neural pathways, whereas another theory suggests there are qualitative differences in the involvement of different neural pathways. These patterns of neural differences may further vary with development. Temporally sensitive electroencephalography (EEG) research focuses on limited time windows and channels and is unable to disentangle quantitative and qualitative differences, whereas spatially sensitive fMRI evidence is mixed. Multi-channel data-driven approaches that are more temporally and spatially sensitive may provide further answers.

#### Objectives:

In this study, we investigated whether differences in face processing between autistic and neurotypical individuals are better explained by quantitative or qualitative neural processing using a multi-channel analysis approach to event-related EEG responses in 6 to 31-year-olds.

#### Methods:

Participants with and without autism were recruited into child (6-11 years), adolescent (12-17 years), and adult (18-31 years) groups in the EU-AIMS Longitudinal European Autism Project (Loth et al., 2017). Participants passively viewed upright and inverted faces while their 59-channel EEG was measured. 182 (64 females) neurotypical and 222 (55 females) autistic participants with clean EEG data were included in multi-channel EEG analyses.

We used topographic analyses of variance (TANOVA) to test for qualitative differences in topography and analysis of the global field power (GFP) to test for quantitative differences in strength of particular profiles across the whole trial between orientations (upright, inverted faces) and diagnostic groups (autism, neurotypical). Next, we extracted distinct spatiotemporal microstates across orientations and diagnostic groups. Microstates are stable spatial configurations of brain activations that change rapidly to new configurations during the trial.

#### Results:

Upright and inverted faces produced characteristic profiles of topography and strength in the neurotypical groups. These profiles showed subtle differences between the diagnostic groups in adolescents, but not in children or adults (Figure 1).

Analyses of distinct spatiotemporal microstates revealed that compared to the neurotypical group the autistic group showed 1) quantitative differences during early perceptual processing in childhood (orientation\*group interaction for GFP in microstate 4,  $p = .033$ ), 2) early face processing in adolescence (interaction for GFP in microstate 2,  $p = .0009$ ) and adulthood (interaction for GFP in microstate 2,  $p = .001$ ), and 3) qualitative differences during late stage processing across all age groups (microstate 2 and 5 in children, microstate 3 and 4 in adolescents, and microstate 4 and 5 in adults, see Figure 2).

#### Conclusions:

We observed both quantitative and qualitative neural processing differences during face processing between autistic and neurotypical children, adolescents, and adults. These findings may reflect early sensory difficulties and later compensatory processes in autism triggered during adolescence and demonstrate the importance of integrated spatiotemporal analytic approaches in comparing brain processes in neurodevelopmental disorders.

### **306.004 (Oral) Action Monitoring Deficits in Toddlers and Preschoolers with Autism Spectrum Disorder**

#### Background:

Behavioral studies have shown that individuals with autism spectrum disorder (ASD) have problems coordinating their own motor actions (meta-analysis: Fournier et al., 2010). There is also evidence that delays and atypical patterns of development emerge early in the onset of ASD (Iverson et al., 2019). Although we know from previous studies that most individuals with ASD experience motor deficits, the mechanisms underlying these deficits are still unclear. The present study explored two EEG markers during the execution of motor actions to shed light on the neural processes involved in performing actions in toddlers and preschoolers with and without ASD.

#### Objectives:

1. To investigate whether young children with ASD compared to typically-developed (TD) children show altered EEG activation during action execution.
2. To explore if the neural activation is related to a child's fine motor and motor imitation abilities.

#### Methods:

##### *Participants*

The sample that was included in the analysis consisted of two groups of toddlers and preschoolers (ages 21 – 59 months; mean age = 41.1): 30 children that met criteria for ASD on the Autism Diagnostic Observation Schedule (ADOS-2) and 29 TD children.

##### *Behavioral measures*

- Mullen Scales of Early Learning (MSEL; Mullen, 1995) to assess fine motor abilities.
- Elicited imitation battery (based on Rogers et al., 2003) to estimate imitation abilities.

##### *EEG measures*

During the EEG task, children grasped a small toy (e.g., fish) and placed it in a container (e.g., fishbowl). They performed a minimum of 15 trials. EEG data were recorded during this action execution task to measure frontal theta activity, as an index for action monitoring, and central alpha (a.k.a. mu) activity, as an index for motor activity.

#### Results:

The frontal theta activation in the group with ASD ( $M=-.82$ ,  $SD=1.30$ ) was significantly reduced compared to the control group ( $M=.05$ ,  $SD=.82$ ),  $F(1,55)=4.47$ ,  $p=.04$ ,  $\eta p^2=.08$ , even if we control for age and number of clean trials. There was no significant group difference in central alpha/mu activation, C3:  $F(1,55)=.03$ ,  $p=.86$ ,  $\eta p^2=.001$ ; C4:  $F(1,55)=.55$ ,  $p=.46$ ,  $\eta p^2=.01$ . Both groups showed a centrally localized power reduction (see Figure 1). Interestingly, we found significant positive correlations between the frontal theta activation and performance on fine motor,  $r(54)=.34$ ,  $p=.01$ , and imitation tasks,  $r(58)=.41$ ,  $p=.001$ . These correlations appear to be the strongest in the ASD group (see Figure 2). There were no significant correlations between central alpha/mu activation and the behavioral measures: fine motor:  $r(54)=.02$ ,  $p=.92$ ; imitation:  $r(58)=.11$ ,  $p=.42$ .

#### Conclusions:

The group with ASD showed reduced frontal theta activation, which could be an indication of motor control and monitoring deficits. However, the two groups did not differ in mu suppression, so there was equivalent activation of the motor system. There was a positive relation between frontal theta activation and measures of fine motor and imitation abilities. This link might suggest that deficits in action monitoring are involved in compromised motor abilities, such as problems in fine motor movements and imitation. The present study contributes to a better understanding of the neural underpinning of the motor deficits seen in

individuals with ASD.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 307 - Functional and Anatomical Neuroimaging Markers of Autism I

**307.001** (Oral) An Integrated Analysis of Autism Associated Inter-Individual Variations of Gray and White Matter Morphology  
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Background: Autism Spectrum Disorder (henceforth autism) is a complex condition associated with alterations in the gray matter (GM) and white matter (WM) morphometry. Although lots of studies have explored the atypical characterizations particularly in GM volume or WM microstructure of autism, the commonality of most of these studies is their reliance on unimodal analyses. These neglect the possibility that different modalities may reflect common pathological pathways. Studies that highlight the underlying shared variance between modalities in autism remain scarce.

Objectives: To better learn a comprehensive integrated pattern of GM and WM morphometry covariation in autism, we applied a multimodal integrative approach to fuse GM volume and WM diffusion measures in a large deeply phenotyped autism dataset – the EU-AIMS LEAP. Subsequently, we aimed to unravel the associations in autism between multi-modal brain substrates and clinical phenotypes in a general univariate and a multivariate way.

Methods: We studied 183 individuals with autism and 157 typically developing individuals, aged between 6 and 30 years in the LEAP dataset. Linked Independent Component Analysis (LICA) was utilized to simultaneously factorize all subjects' voxel-based morphometry (VBM), fractional anisotropy (FA), mean diffusivity (MD), anisotropy mode (MO), axial diffusivity (L1) and radial diffusivity (RA) into 80 independent components (ICs) of spatial variations. A Generalized Linear Model (GLM) was used to examine case-control differences and univariate brain-behavior associations while regressing out the effects of age, gender, IQ and scan site. Next, Canonical Correlation Analysis (CCA) was performed to respectively explore the aggregated effects between all multi-modal ICs of GM-WM covariations and subscales of ADI and ADOS, and Social Responsiveness Scale (SRS), Repetitive Behavior Scale-Revised (RBS) and Short Sensory Profile (SSP) in autism. The statistical significance of each pair of canonical variates was determined by permutation testing (10,000 times).

Results: We found one IC with a significant group effect in the GLM analyses ( $b=0.189$ ,  $p=5.030 \times 10^{-4}$ ; FDR corrected,  $p=0.040$ ). This component was primarily associated with decreased density of bilateral insula, frontal area, postcentral, angular, cingulate and inferior temporal gyrus, and increased density of caudate and supra-/intra-calcarine cortex in autism; and co-occurred with altered WM diffusion features in superior longitudinal fasciculus, superior, posterior corona radiator (Figure 1). The CCA results showed one significant correlation ( $r=0.618$ , permutation  $p=0.006$ ) between components that involved variation of thalamus, superior and inferior longitudinal fasciculus that mostly located in temporal lobe, and the symptoms of communication and social interaction in autism group (Figure 2). Note that the IC with significant group effect was one of the three ICs that contributed most to the correlation.

Conclusions: Our findings replicate our previous GM density covariations results (Mei et al., 2020), and extend the former results by demonstrating that frontal, parietal, inferior temporal area, basal ganglia, limbic system, and thalamus cooperating with their related WM fasciculi are implicated in autism. Therefore, the convergence of our findings suggests that co-occurring modality patterns of GM and WM morphometry in our study are found collaborating and connecting in the brain underlying mechanisms of autism.

### **307.002 (Oral) Testing Candidate Cerebellar Presymptomatic Biomarkers for Autism Spectrum Disorder**

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**Background:** Autism spectrum disorder (ASD) is a neurodevelopmental disorder diagnosed on the basis of social impairment and restricted, repetitive behaviors (RRBs). Converging results from animal and adult human neuroimaging studies have generated great interest in the cerebellum's role in the pathophysiology of ASD. Specifically, recent theoretical commentaries have posited that cerebellar-mediated error signaling impairments may account for the emergence of ASD-associated behaviors during the second year of life. Together, this work identifies infant cerebellar connectivity as a promising presymptomatic neural biomarker of ASD. However, supportive evidence from pre-specified, longitudinal tests of cerebellar function in human infants is lacking.

**Objectives:** This project aimed to interrogate infant cerebellar functional connectivity (fcMRI) as a presymptomatic neural biomarker of ASD, in a rigorous manner using univariate, multivariate, and enrichment approaches.

**Methods:** We analyzed data from the Infant Brain Imaging Study (IBIS), a prospective study of infants at high and low familial risk for ASD. Imaging processing methods are similar to Eggebrecht et al. (2017). To be included in analyses, we stipulated that participants ( $n = 94$ , 68 male) provide at least 6.25 minutes of motion-scrubbed fcMRI data. Brain-behavior associations were analyzed for 6-month cerebellar functional connections in relation to 12 and 24-month ASD-associated behavior (measures of joint attention, RRBs, and motor coordination; assessed via parent-report and clinical observation) and 24-month ASD diagnostic outcome (positive/negative; assessed via clinical best estimate). Univariate (generalized linear modeling) hypothesis testing, multivariate (support vector machine with nested, leave-one-out cross-validation) predictive classification, and enrichment-based brain-wide screening were used to evaluate potential cerebellar contributions to ASD. Our hypothesis-driven tests focused on cerebellar-frontoparietal (FPN: implicated in error signaling) and cerebellar-default mode (DMN: implicated in prior studies of ASD) connections.

**Results:** Univariate tests of cerebellar-FPN and cerebellar-DMN connections failed to implicate the cerebellum in ASD-associated behaviors in a convincing manner (only .02% of tested cerebellar-cortical connections survived multiple comparisons correction), despite > 80% power to detect medium-sized effects. Multivariate predictive tests with cerebellar-FPN and cerebellar-DMN connections similarly failed to achieve above-chance classification accuracy for 24-month ASD outcomes, despite utilizing procedures that achieved > 80% positive predictive value in prior brain-wide work (Emerson et al., 2017). Whole-brain enrichment approaches identified three 6-month network pairs that were strongly associated with RRBs at 12 or 24 months (**Figure 1**). However, cerebellar regions of interest were implicated at chance within these networks (**Figure 2**).

**Conclusions:** The present study interrogated infant cerebellar connectivity as a presymptomatic neural biomarker of ASD using multiple analytic approaches. Contrary to hypotheses, we failed to observe strong associations between 6-month cerebellar fcMRI and 12-24-month ASD-associated behaviors and outcomes, casting doubt on cerebellar theories of ASD etiology and arguing that cerebellar effects, if present, are likely small. Instead, we identified brain-behavior associations between multiple 6-month network pairs and later RRBs, indicating network-level correlates for emerging ASD behaviors that warrant future testing in independent samples. The frequency of cerebellar contributions within these networks was at chance, suggesting that the cerebellum may support the development of RRBs in the broad context of other (non-cerebellar) functional connections.

### **307.003 (Oral) Dopaminergic Functioning in Autism Spectrum Disorder: An [18F]-Fdopa PET/CT Study**

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**Background:** Dopaminergic signaling has long been hypothesized to contribute to autism spectrum disorder (ASD) traits, such as difficulties in social interaction and communication and stereotyped behaviors. However, few studies examined dopamine functioning *in vivo* in ASD.

**Objectives:** To examine whether (1) individuals with ASD show an increase in striatal presynaptic dopamine synthesis capacity relative to controls, and whether (2) striatal presynaptic dopamine synthesis capacity is associated with self-reported autistic traits.

**Methods:** We recruited unmedicated, non-psychotic adults with ASD ( $n = 44$ ) and matched controls ( $n = 22$ ), aged 18 to 30 years old and with an average-to-high intelligence. All adults with ASD had previously received this diagnosis from a registered mental health clinician, and the first author confirmed this diagnosis using the Autism Diagnostic Observation Schedule-2 (ADOS-2) module 4. After a CT-scan, which was acquired for attenuation-correction purposes, participants underwent a 90-minute dynamic [ $^{18}\text{F}$ ]-FDOPA PET-scan. The influx constant  $k_{in}^{cor}$ , indicative of presynaptic dopamine synthesis capacity, was calculated using reference Patlak graphical analysis. A co-registered, structural T1-weighted MRI-scan, acquired prior to the PET/CT-scan, was used to identify the cerebellar reference region and striatal regions of interest. Both a region-of-interest analysis and a voxel-based analysis was conducted. The Autism Spectrum Quotient (AQ) was used to assess autistic traits.

**Results:** We found no statistically significant differences in striatal dopamine synthesis capacity between ASD and controls ( $F_{1,60} = 0.026$ ,  $p = 0.87$ ). This was confirmed with voxel-based analysis, which showed similar whole-brain distribution of [ $^{18}\text{F}$ ]-FDOPA uptake in ASD and controls. Participants with ASD had significantly higher AQ total scores ( $t_{64} = 8.74$ ,  $p < 0.001$ ), as well as social interaction ( $t_{64} = 8.34$ ,  $p < 0.001$ ) and attention to detail ( $t_{64} = 5.55$ ,  $p < 0.001$ ) subscale scores. However, in both samples, striatal dopamine synthesis capacity was neither significantly related to AQ total scores, nor to AQ social interaction or attention to detail subscale scores (all family-wise error corrected  $p$ -values n.s.). Results were similar before and after adjusting for age, sex, smoking-status, and PET/CT-scanner-type.

**Conclusions:** In contrast to previous hypotheses about the role of dopamine in ASD, the results of this large-sample PET/CT-study show that striatal dopamine synthesis capacity is not increased in ASD and not associated with self-reported autistic traits. Further research is necessary to examine whether the findings generalize to a broader ASD population and to examine other aspects of dopamine signalling in ASD.

### 307.004 (Oral) Increased Glutamate + Glutamine Correlates with Autism Severity and Tactile Sensitivity in Children with Autism Spectrum Disorders

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**Background:** While autism spectrum disorders (ASD) are characterized by difficulties with social and communicative function, sensory abnormalities are common and are increasingly recognized. One of the prevailing theories of sensory abnormalities in ASD is that of altered excitation-inhibition (E-I) balance. This theory suggests that an increase in excitation and/or a decrease in inhibition results in a hyper-excitable and hence 'noisier' system, which in turn results in less efficient encoding and discrimination of sensory information. Despite early suggestions of altered E-I balance in ASD, the literature has produced mixed findings, perhaps owing to the heterogeneity of methods used to quantify and operationalize E-I. Whether and how E-I is associated with sensory processing and autism-related symptom severity also remains unclear.

**Objectives:** In the current study, edited magnetic resonance spectroscopy (MRS) was used to determine and compare levels of glutamate + glutamine (Glx) and  $\gamma$ -aminobutyric acid (GABA) as indirect markers of E-I in a large sample of children with ASD. We also assessed the relationship between these markers of E-I with tactile sensitivity and autism symptom severity.

**Methods:** Ninety-three children with ASD (5 females;  $M_{Age} = 10.19$ ,  $SD_{Age} = 1.57$ ) and ninety-eight typically-developing controls (TDC) (23 females;  $M_{Age} = 9.73$ ,  $SD_{Age} = 1.17$ ) participated in this study. Structural imaging and MRS (i.e., Glx and GABA levels) data were acquired on a Philips 3T Achieva MRI scanner using spectral-edited MRS (TE = 80 ms; 320 averages) from the

primary sensorimotor cortex (SM1) and thalamus (Figure 1a) (~27 ml voxels). Tactile perceptual thresholds (e.g., detection, discrimination and order judgement thresholds) were determined with psychophysics and symptom severity was assessed with the Autism-Diagnostic Observation (ADOS) and ADOS-2.

Results: While we did not observe reduced SM1 GABA levels in children with ASD ( $z = 0.089, p = 0.929$ ) as previously reported, after controlling for age and sex, we found significantly increased levels of Glx ( $z = 2.95, p < 0.003$ ) in children with ASD (see Figure 1b and 1c). Interestingly, higher Glx levels in SM1 predicted lower (i.e., better) sequential frequency discrimination (SQFD) thresholds ( $r = -0.39, p = 0.003$ ) and lower symptom severity scores on all total scales of the ADOS (Communication:  $r = -0.27, p = 0.015$ ; Social Interaction:  $r = -0.23, p = 0.039$ ; Restricted and Repetitive Behaviors:  $r = -0.31, p = 0.004$ ) in children with ASD (see Figure 2).

Conclusions: The finding of higher SM1 Glx levels and its association with lower SQFD thresholds in ASD provides some support for the altered E-I balance theory of sensory abnormalities in ASD. Interestingly, while Glx was increased in ASD relative to TDCs, higher levels of Glx was associated with lower ASD-associated symptom severity. It is important to note that although Glx might reflect glutamatergic function (and 'excitation'), the Glx MRS signal captures both glutamate and glutamine, and cannot distinguish between synaptic, vesicular, or other pools. Thus, how Glx functionally contributes to altered sensory processing and reduced symptom severity in ASD requires further investigation.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 312 - Measure Development

**312.001** (Oral) Computational Behavioral Phenotyping of Autism Spectrum Disorder Using Scalable Computer Vision Tools  
**J. M. Di Martino<sup>1</sup>, Z. Chang<sup>1</sup>, S. Perochon<sup>1</sup>, P. R. Krishnappa Babu<sup>1</sup>, R. E. Aiello<sup>2</sup>, K. L. Carpenter<sup>2</sup>, S. N. Compton<sup>3</sup>, N. O. Davis<sup>4</sup>, S. Espinosa<sup>1</sup>, J. Flowers<sup>5</sup>, A. Harris<sup>5</sup>, J. Howard<sup>5</sup>, S. H. Kollins<sup>4</sup>, E. M. Perrin<sup>6</sup>, M. Spanos<sup>5</sup>, G. Sapiro<sup>1</sup> and G. Dawson<sup>2</sup>,**  
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#### Background:

Observational behavior analysis of children, which is critical for the evaluation, monitoring, and discovery of biomarkers related to Autism Spectrum Disorder (ASD), is performed in-person by trained clinicians. With the rapid development of computer vision and machine learning technology, scalable and objective methods make automatic analysis of human behavior possible.

#### Objectives:

Develop and deploy in pediatric clinics scalable computational behavioral phenotyping tools for screening ASD using a combination of strategically-designed stimuli and computer vision and machine learning tools.

#### Methods:

We developed and deployed in pediatric clinics a scalable tool for computational behavioral phenotyping. The child's face is recorded using the front-facing camera of a mobile device while short movies are presented, these are designed to elicit specific social, emotional, and motor responses (Figure 1). Computer vision algorithms are used to detect and track the child's face position, facial landmarks, gaze, and attention. In addition, interactive games are used to analyze the child's sensory-motor skills.

#### Results:

17-37 months old toddlers were recruited at four Primary Care clinics by study staff or the family's primary physician (ASD: N=40, Typical Developing (TD): N=936). The percentages of usable data was high, 95% and 87% for the iPhone and 95% and 93% for the iPad, for the TD and ASD groups, respectively. Figure 2 summarizes a subset of the main results. First, (a-c), we show that children in the ASD group tend to orient less when their name is called, and if they do orient, they tend to present a higher latency. We show these two features can be combined to improve the assessment precision and specificity. Figure 2 (b-d)

shows the recognition results when gaze data is used, and more interestingly, combined across multiple stimuli. First we illustrate the ROC curves for data collected from individual stimuli and their combination. The bottom illustration (d) shows the space of gaze features, and how tree classifiers partition it, red is associated with a higher risk of ASD and blue with a lower risk.

Conclusions:

We developed and deployed in pediatric clinics a mobile application that displays visual and interactive stimuli designed to elicit behaviors relevant to ASD. Using computer vision techniques, we can automatically track a child's head, facial expressions, and gaze, which are used and combined to infer critical behavioral patterns.

**312.002 (Oral)** Initial Psychometrics of an Early Childhood Social Motivation Questionnaire and Differentiation of Children with ASD

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Background: Early disruptions in social motivation, the predisposition for preferential social orienting; seeking, wanting, and liking social contact; and maintaining social engagement (Chevallier et al., TICS, 2012), are hypothesized to constrain social learning and to contribute to atypical development preceding ASD. Studying social motivation's role in the ontogeny of ASD has been hindered by the lack of measurement tools; here we evaluate a novel social motivation questionnaire for early childhood.

Objectives: To evaluate psychometrics of a parent-report Social Motivation Questionnaire (SMQ) designed for infants through preschoolers and test whether it differentiates children with and without ASD.

Methods: SMQ items provided balanced representation of elements of social motivation described above. Items were informed by the developmental literature, consultation with child development experts, and parent feedback. SMQ versions for specific age groups contained a common set of 51 items adapted for developmental stage, specifically infant (6-17 months), toddler (18 months-3 years), and preschooler (4-6 years). The SMQ was deployed online in two samples: 1) a Qualtrics-recruited sample of typically-developing children ages 6 months-5 years (n=509) and 2) a community-based sample of children ages 18 months-6 years with and without ASD (n=107, n=28 with ASD). Internal consistency was calculated using Cronbach's alpha. Pearson's correlations tested for temporal stability in participants with repeat SMQ ratings after 4 months (n=273), as well as convergent validity with available age-appropriate versions of the Social Responsiveness Scale (SRS), a quantitative ASD trait measure. Exploratory factor analysis (EFA) using principal axis factoring and an oblimin rotation was applied in the larger Qualtrics sample. T-tests compared scores in children with and without ASD.

Results: SMQ scores collected via Qualtrics demonstrated continuous, unimodal distributions (Figure 1A-C), excellent internal consistency for each age group ( $\alpha > 0.93$ ), and evidence of temporal stability,  $r = 0.68$  ( $p < .001$ ). SMQ scores inversely correlated with ASD traits indexed by the SRS,  $r = -0.60$  ( $p < .001$ ), indicating 36% shared variance ( $r^2$ ). Two factors were identified: an overarching social motivation factor (F1) accounting for 28% variance that encompassed all aspects of social motivation and a social withdrawal factor (F2) accounting for 8% variance. These factors showed strong internal consistency ( $\alpha_{F1} = 0.95$ ;  $\alpha_{F2} = 0.87$ ), item loadings between 0.73-0.32, and modest intra-correlation ( $r = 0.23$ ,  $p < .001$ ). In the community sample, children with versus without ASD had lower SMQ scores (Figure 1D;  $t(39) = 9.50$ ,  $p < .001$ ), with a large effect size (Cohen's  $d = 2.4$ ); similar differences were also observed for SMQ factors (F1: Cohen's  $d = 1.9$ ; F2: Cohen's  $d = 2.0$ ).

Conclusions: Strong initial psychometrics were observed for the early childhood SMQ. Measurable cross-age stability during early development suggests trait-like properties of social motivation, while EFA was consistent with a unified social motivation construct in which opposing withdrawal-related behaviors comprised a separable dimension rather than the distal end of a single continuum. The SMQ differentiates young children with and without ASD and correlates with ASD traits but also demonstrates unique variance, consistent with a behavioral dimension having potential transdiagnostic relevance. Future directions include testing this scale prospectively in at-risk populations to assess whether the SMQ can enhance early identification or clinical subtyping to guide intervention.

**312.003 (Oral)** Development and Standardization of the Brief Observation of Symptoms of Autism (BOSA) in Response to COVID-19

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**Background:** The COVID-19 pandemic has presented new challenges to accessing care for individuals with autism, prompting researchers and practitioners to seek innovative approaches that are feasible through telehealth or in-person visits with necessary safety protocols. The Brief Observation of Symptoms of Autism (BOSA) was adapted from the Brief Observation of Social Communication Change (BOSCC) to provide a social context with standardized toys and activities. These can be presented in-person without PPE by a parent, caregiver, or therapist within a 12-14-minute observation. Clinicians familiar with the ADOS-2 can observe the BOSA live, through telehealth, or on recorded video and complete many ADOS-2 codes, which can then be mapped onto DSM-5 criteria to aid in making a diagnosis.

**Objectives:** To examine psychometric properties and determine optimal use as supported by empirical evidence and data-driven scoring procedures for each BOSA version: for minimally verbal children (MV), those with phrase speech and younger fluent (PSYF), fluent 6-10 year old's (F1), and fluent children 11 through adults (F2). Differences between scoring modules (ADOS Toddler, 1-4), examiners (caregiver, therapist) and settings (clinic, home) will also be explored.

**Methods:** ADOS-2 scores were first dichotomized based on existing data to create a "recode rule" for each item. Preliminary analyses were conducted on a sample of 152 participants (84 ASD, 68 non-ASD) who completed BOSCCs as part of previous studies at UCLA and Weill Cornell and included item level distributions and interrater and test-retest reliability. Final analyses will also include factor analysis, correspondence with the ADOS-2, age and IQ effects, recommended cutoff scores., and reliability using interclass correlation coefficients (ICCs).

**Results:** Dichotomized codes were determined by balancing sensitivity and specificity, with specificity  $\geq .65$  as the cut-point for a code of 1 to represent symptom presence. Preliminary results suggest strong interrater reliability and test-retest reliability (percent agreement=85.2% and 94.1%, respectively). Most ADOS-2 items could be reliably scored in this context, though items related to deficits in relationships (e.g., insight into emotions and social situations, responsibility) were coded an "8" in over 50% of the cases. Opportunity to observe the use of joint attention (>80% "8" for MV), gestures (>20% "8" for F1), and presence of restricted and repetitive behaviors (RRBs) was also limited.

**Conclusions:** While the BOSA provides a standardized context to observe behaviors consistent with autism, symptom presence in certain subdomains (e.g., deficits in relationships, RRBs) is not as readily observable in this context and needs to be gathered through supplemental parent report and developmental history. When used in combination with other measures (e.g., the ADI-R), the BOSA provides a social context that allows a clinician to gain clinical information to reliably code many ADOS-2 items that can be mapped onto diagnostic criteria. Widespread interest in and use of the BOSA has already begun due to the urgent need to provide critical services through the pandemic. Even after COVID-19, there is likely to be continued interest in flexible approaches to screening and diagnosis that could potentially improve timely access to appropriate care for families in need of services.

**312.004 (Oral)** Structural Validation of the Autism-Spectrum Quotient Short Form (AQ-Short) in Children with an Autism Spectrum Disorder: A Comparison between China and the Netherlands

**F. Liu<sup>1</sup>, A. M. Scheeren<sup>2</sup>, R. A. Hoekstra<sup>3</sup>, R. Grove<sup>4</sup>, C. Wang<sup>5</sup> and S. Begeer<sup>2</sup>, (1)Horstenberg, Vrije University Amsterdam, Amsterdam, Netherlands, (2)Vrije Universiteit, Amsterdam, Netherlands, (3)Department of Psychology, King's College London, London, United Kingdom, (4)University of Technology Sydney, Sydney, NSW, Australia, (5)NanKai University, TianJin, China**

**Background:** While Autism spectrum disorders (ASD) are recognized and diagnosed globally, there may be subtle differences in autistic traits across cultures. With a population of almost 1.4 billion, and an increasing prevalence of ASD, China represents the largest growing population of autistic individuals in Eastern countries. So far there have been no systematic comparisons of children's autistic traits from Chinese and Western samples using standardized tools and procedures. Autism Spectrum Quotient-Short (AQ-S) has been proven to be a reliable brief questionnaire in successfully capturing the core dimensions of autistic traits in adults but has not been studied on child version. Before any meaningful cross-country comparisons in severity of autistic traits can be made, it is important to investigate whether the tool used is conceptually equivalent across cultures.

**Objectives:** To examine the factor structure of the Chinese and Dutch version of the AQ-S in children with ASD and compare autistic traits in children with ASD in China and the Netherlands.

**Methods:** We analysed parent-reported AQ-S in children with ASD from China (327 children with autism diagnosis, 277 boys and 50 girls) and the Netherlands (694 children with autism diagnosis, 539 boys and 155 girls). The mean age of Chinese children was 8.57 years (SD= 2.97, range=3.5-16.92 years) and the mean age of Dutch children was 11.81 years (SD= 2.54, range= 6-16.12 years). Confirmatory and exploratory factor analyses were performed for the whole sample, as well as for Chinese and Dutch children separately.

Results: Initial confirmatory factor analysis testing the two-factor hierarchical model previously identified in the AQ-S in adult samples did not fit our data of parent ratings of the AQ-S well. Subsequent exploratory factor analyses indicated most support for a three-factor model in the Chinese sample, with factors reflecting “numbers and patterns”, “social skills”, and “mind-reading”; and a five-factor model for the Dutch sample, with factors reflecting “imagination”, “numbers and patterns”, “attention switching”, “social skills”, and “mind-reading”. Differences were observed in the items loading on the factors common to both countries. For example, item 15 “S/he finds it hard to make new friends” loaded on factor mind-reading in China, but on factor Social skills in the Netherlands. The numbers and patterns factor showed a negative association with the social skills factor in Chinese ASD children; this inverse correlation was not observed in the Dutch data.

Conclusions: Our results indicate differences in the underlying factor structure of parent-reported autistic traits in Eastern and Western populations of autistic children. This lack of conceptual equivalence may be due to subtle differences in the expression, recognition, interpretation and reporting of autistic traits across cultures.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 313 - Trajectories in Autism - Impacts and Prediction

**313.001** (Oral) Predictors of Regression and Its Impact on Subsequent Communication Development in Children with Autism  
A. Pickles<sup>1</sup>, N. J. Wright<sup>2</sup>, R. Bedford<sup>3</sup>, M. Steiman<sup>4</sup>, E. Duku<sup>5</sup>, P. Mirenda<sup>6</sup>, T. Bennett<sup>7</sup>, S. Georgiades<sup>8</sup>, I. M. Smith<sup>9</sup>, C. M. Kerns<sup>6</sup>, W. J. Ungar<sup>10</sup>, T. Vaillancourt<sup>11</sup>, C. Waddell<sup>12</sup>, A. Zaidman-Zait<sup>13</sup>, L. Zwaigenbaum<sup>14</sup>, P. Szatmari<sup>15</sup> and M. Elsabbagh<sup>16</sup>, (1)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, (2)Biostatistics & Health Informatics, Kings College London, London, United Kingdom, (3)Kings College London, London, United Kingdom, (4)Azrieli Center for Autism Research, Montreal Neurological Institute-Hospital, Montreal, QC, Canada, (5)Offord Centre for Child Studies, McMaster University, Hamilton, ON, Canada, (6)University of British Columbia, Vancouver, BC, Canada, (7)Offord Centre for Child Studies, McMaster University, Hamilton, ON, CANADA, (8)McMaster Autism Research Team, McMaster University, Hamilton, ON, Canada, (9)Dalhousie University / IWK Health Centre, Halifax, NS, CANADA, (10)The Hospital for Sick Children Research Institute, Toronto, ON, Canada, (11)University of Ottawa, Ottawa, ON, Canada, (12)Simon Fraser University, Vancouver, BC, Canada, (13)Tel-Aviv University, Tel-Aviv, Israel, (14)University of Alberta, Edmonton, AB, Canada, (15)The Hospital for Sick Children, Toronto, ON, Canada, (16)Neurology and Neurosurgery, McGill University, Montreal, QC, Canada

**Background:** Regression, broadly defined as the loss of acquired skills in early childhood, is a key clinical feature of autism. Despite its importance clinically, we know little about factors underlying regression in autism or about the prognosis of children who exhibit regression compared to those who do not. These knowledge gaps are in part due to a lack of consensus on how regression is operationally defined (relative to other domains), the retrospective nature of caregiver report of regression (often years after onset), and the lack of prospective longitudinal data on related developmental outcomes.

**Objectives:** To identify rates and potential predictors of regression and its impact on subsequent development in a prospective longitudinal sample of children with ASD from diagnosis until age 10 years.

**Methods:** We analyzed data from *Pathways in ASD*, a prospective longitudinal study of 421 Canadian children enrolled around the time of an autism diagnosis between ages 2 and 5 years. Rates of regression were identified based on parent report on the ADI-R. Profiles of those with and without regression were compared around the time of diagnosis. Potential differences in various domains of development were evaluated using the VABS-II, including expressive and receptive communication. Trajectories from the time of diagnosis to 10 years of age were compared for those with and without regression.

**Results:** ADI-R data was available for 408 children, of whom 90 (22%) were classified as having regression in the communication domain. Demographic and other health factors did not differ in the two groups, including caregiver education ( $p=.377$ ), family income ( $p=.824$ ), child sex ( $p=.180$ ), reported seizures ( $p=.459$ ), and age of enrollment ( $p=.991$ ). Children with regression walked somewhat earlier (hazard ratio (HR) 1.50,  $p=.001$ ) and attained first words sooner (HR=2.38,  $p<.001$ ) than those without regression. However, both groups attained phrase speech at comparable ages ( $n=318$ ; HR=1.02,  $p=.863$ ). Around the time of diagnosis Those with regression exhibited comparatively greater delays in expressive and receptive communication (ES = -0.36;  $p=.002$ ; ES=-.38,  $p=.002$ ), but not in fine or gross motor skills (ES=-.05,  $p=.676$ ; ES=.13,  $p=.268$ ). Overall, those with regression continued to exhibit expressive communication impairment (95% CI 2.37 to 7.15,  $p<.001$ ) but not receptive communication delay compared to the remainder of the sample. Trajectories of development in communication skills were highly heterogeneous to age 10 years; children with or without regression were equally likely to achieve functional language by this age.

**Conclusions:** Findings from the *Pathways in ASD* cohort analysis replicated those reported in Pickles et al. (2009) showing that parent reporting of regression is more likely if children have already exhibited some clear language milestones such as single words, whereas regression is not associated with the eventual age of attaining phrase speech. While subsequent communication trajectories of those with regression were more impaired than those without, this pattern only persists for expressive not receptive communication development.

**313.002 (Oral)** Comparison of Trajectories of Emotional and Behavioural Problems from Age 2-10 Years in an Autistic and a Typically Developing Cohort

**N. J. Wright<sup>1</sup>, V. Courchesne<sup>2,3</sup>, R. Bedford<sup>4</sup>, A. Pickles<sup>5</sup>, T. Bennett<sup>6</sup>, E. Duku<sup>7</sup>, S. Georgiades<sup>8</sup>, C. M. Kerns<sup>9</sup>, P. Mirenda<sup>9</sup>, I. M. Smith<sup>10</sup>, J. Scourah<sup>11</sup>, P. Szatmari<sup>12</sup>, W. J. Ungar<sup>13</sup>, T. Vaillancourt<sup>14</sup>, A. Zaidman-Zait<sup>15</sup>, L. Zwaigenbaum<sup>16</sup> and M. Elsabbagh<sup>17</sup>,** (1)Biostatistics & Health Informatics, Kings College London, London, United Kingdom, (2)Department of Neurology and Neurosurgery, McGill University, Montréal, QC, Canada, (3)Autism Research Group, CIUSSS du Nord-de-l'Île-de-Montréal, Montréal, QC, Canada, (4)Kings College London, London, United Kingdom, (5)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, (6)Offord Centre for Child Studies, McMaster University, Hamilton, ON, CANADA, (7)Offord Centre for Child Studies, McMaster University, Hamilton, ON, Canada, (8)McMaster Autism Research Team, McMaster University, Hamilton, ON, Canada, (9)University of British Columbia, Vancouver, BC, Canada, (10)Dalhousie University / IWK Health Centre, Halifax, NS, CANADA, (11)McGill University, Montreal, QC, Canada, (12)The Hospital for Sick Children, Toronto, ON, Canada, (13)The Hospital for Sick Children Research Institute, Toronto, ON, Canada, (14)University of Ottawa, Ottawa, ON, Canada, (15)Tel-Aviv University, Tel-Aviv, Israel, (16)University of Alberta, Edmonton, AB, Canada, (17)Neurology and Neurosurgery, McGill University, Montreal, QC, Canada

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**Background:** Autistic youth experience elevated rates of mental health problems. Cross-sectional studies using clinical cut offs report prevalence rates ranging from 30% in autistic pre-schoolers (Hartley et al., 2008) to 70-75% in older autistic children (Chandler et al., 2016; Simonoff et al., 2008). Few studies have compared rates of mental health problems in autism with neurotypical age-matched children, nor examined the longitudinal course of mental health problems over childhood.

**Objectives:** To compare the evolution of three common mental health domains (aggressive behaviors, Anxiety/Depression and Attention Problems) from aged 2-10 years in a sample of autistic children and a sample of neurotypical children, from two independent cohorts: Pathways to Better Outcomes and the Wirral Child Health and Development Study (WCHADS).

**Methods:** The Pathways study enrolled children with ASD (n=421) who were assessed eight times from around the time of diagnosis (age 2-4 years) to age 10.5 years. The neurotypical sample in the WCHADS(n=1233) were assessed five times from age 2.5 to 9.5 years. Mental health problems were assessed using the parent report Child Behaviour Checklist (Achenbach & Rescorla, 2001) preschool (age 2-5 years) and school-age (age 6+ years) aggression, attention problems and anxiety-depression syndrome scales. Growth curve models were fitted with a scaling factor to accommodate the change from the preschool to school age questionnaires. Models assume attrition based on observed scores (i.e. missing at random; MAR).

**Results:** The autistic children had significantly higher scores on the three mental health domains at every time point, and there were significant cohort differences at the intercepts (all  $p < .001$ ). Inspection of Figure 1 suggests the pathway of development in neurotypical and autistic cohorts are not as strikingly different as the intercept. Model fitting nonetheless shows significant differences in log, linear and quadratic growth (all  $p < .05$ ). Differences in slope are due to steeper decline across all domains in autistic children in early childhood, with the model-based estimates suggesting that in late childhood the autistic children continue to show decline in mental health symptoms whereas the neurotypical children began to level out. The WCHADS data on neurotypical children was used to generate percentiles to compare the two cohorts, and the autistic children began around or above the 80<sup>th</sup> percentile on WCHADS scores for aggression and anxiety-depression, and 85<sup>th</sup> percentile for attention problems.

**Conclusions:** Autistic children showed substantially elevated rates of all three mental health domains compared to the neurotypical children at every age, but particularly in early childhood. Both autistic and neurotypical children showed a decrease in all three domains over childhood, with the model-based estimates accounting for attrition suggesting that children with autism showed a steeper decline in early childhood and a continuing decline in late childhood when scores in neurotypical children were levelling out.

**313.003 (Oral)** Distinct IQ Trajectories in Youth with ASD: A Latent Class Growth Analysis

**A. C. Cho<sup>1</sup>, A. M. Iosif<sup>1</sup>, N. Dalloul<sup>1</sup>, D. G. Amaral<sup>1</sup>, C. W. Nordahl<sup>1</sup>, E. Ferrer<sup>2</sup> and M. Solomon<sup>1</sup>,** (1)Human Development & Psychology, University of California, Los Angeles, Los Angeles, CA, (2)Public Health Sciences, University of California Davis, Davis, CA, (3)Psychiatry and Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA, (4)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (5)UC Davis, Davis, CA

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**Background:** Researchers have highlighted heterogeneity in autism spectrum disorder (ASD) as a serious barrier to scientific progress (e.g., Georgiades, Szatmari, & Boyle, 2013). Variation in intellectual ability is particularly important, as it represents a primary aspect of heterogeneity within the ASD phenotype and is a strong predictor of outcomes in ASD individuals (Gillespie-Lynch et al., 2012; Munson et al., 2008). While intelligence quotient (IQ) typically improves through early childhood in ASD (Flanagan et al., 2015), our previous research using the Autism Phenome Project (APP) cohort identified four distinct IQ trajectories in a longitudinal sample of ASD youth from early (ages 2-3.5 years) to middle (ages 5-8) childhood (Solomon et al., 2018). Subgroup membership predicted unique starting points and changes in adaptive communication, externalizing symptoms, and ASD symptom severity. These findings provide initial evidence of different developmentally homogeneous ASD phenotypes; however, we do not know whether these subgroups persist into adolescence and if they are significant predictors of more distal outcomes.

**Objectives:** The present study follows up on the APP cohort to determine whether these IQ trajectories extend into early adolescence (ages 9-13).

**Methods:** IQ scores were computed using the Mullen Scales of Early Learning (Mullen, 1995) and the Differential Ability Scales-II (Elliot, 2007). Latent class growth analysis was used to identify distinct IQ trajectories in a sample of ASD youth with at least one timepoint of data (Timepoint 1:  $n=373$ ; ages 1.7-5.0; Timepoint 2:  $n=154$ ; ages 4.3-9.4; Timepoint 3:  $n=116$ ; ages 9.0-13.6), with neurotypical peers serving as a reference group (Timepoint 1:  $n=162$ ; ages 2.0-4.5; Timepoint 2:  $n=86$ ; ages 4.2-9.9; Timepoint 3:  $n=72$ ; ages 9.9-13.7). Linear and quadratic age-based models were tested for the ASD group.

**Results:** A quadratic model with three classes best fit the data. The reference TD group model presented a normative mean IQ with mild increases that gradually tapered off into early adolescence. In contrast, ASD subgroup 1 ( $n=146$  [39%]; labeled “Changers”) began with notably low IQ followed by large increases that more sharply diminished as individuals entered early adolescence. The trajectory for subgroup 2 ( $n=168$  [45%]; “High Challenges”) also began with a low IQ but presented a decline over time. Subgroup 3 ( $n=59$  [16%]; “Lesser Challenges”) presented a trajectory that was comparable to the reference group (i.e., relatively normative IQ with gradual increase during childhood).

**Conclusions:** Largely replicating our original study, there were three distinct IQ trajectories in the current sample’s ASD group which extended into preadolescence. Unlike the reference group, which exhibited an IQ developmental trajectory consistent with the literature, ASD subgroups 1 and 2 showed distinct trajectories of rapid IQ increase that leveled off and low and declining IQ over time, respectively. Subgroup 3 resembled the normative group and may represent an “optimal outcome” phenotype that has been consistently replicated in the extant literature (Fein et al., 2013). Future analyses will investigate this content by examining whether subgroup membership predicts adaptive communication (Vineland Adaptive Behavior Scales; Sparrow et al., 2005) and internalizing and externalizing behavior (Child Behavior Checklist; Achenbach & Rescorla, 2000, 2001).

### 313.004 (Oral) Influence of Siblings on Adaptive Behavior Trajectories in Autism Spectrum Disorder

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**Background:** It is widely believed that siblings play an important role in shaping the developmental trajectories of individuals with autism spectrum disorder (ASD). The presence of siblings has been associated with better social communication skills, less severe non-verbal communication deficits, and improved theory of mind abilities among individuals with ASD. However, little is known about the impact of siblings on the growth of overall adaptive skills over time, even though adaptive behavior competencies are among the strongest predictors of positive outcomes in individuals with ASD.

**Objectives:** The current study aims to examine the influence of sibling constellation factors, including the presence of a sibling, position in the birth order, gender of the closest-age sibling, and gender match of the sibling dyad, on the adaptive behavior trajectories of individuals with ASD and those with a history of non-spectrum developmental disorders from 9 to 26 years of age.

**Methods:** Participants included 208 individuals with ASD or non-spectrum developmental disorders selected from an ongoing longitudinal study following participants from childhood through adulthood. The Vineland Adaptive Behavior Scales (VABS) was administered to participants at six timepoints between ages 9-26, and change in VABS age equivalents was examined using multilevel models while controlling for demographic and individual descriptive factors.

**Results:** Participants with siblings presented with higher VABS age equivalents from ages 9-26 and experienced significantly steeper growth trajectories ( $B=.49$ ) compared to participants with no siblings ( $B=.39$ ;  $p=.005$ ). Among participants with one or more siblings, multilevel models revealed significantly steeper adaptive skill growth trajectories among participants with a male ( $B=.54$ ) compared to a female ( $B=.44$ ) closest-age sibling ( $p=.001$ ), and among participants with a gender-matched ( $B=.52$ ) compared to a non-gender-matched ( $B=.46$ ) closest-age sibling ( $p=.023$ ). No significant differences were noted based on birth

order position between youngest ( $B=.51$ ), middle ( $B=.44$ ), and oldest children ( $B=.47$ ;  $p=.078$ ). Within these sibling constellation factors, models also revealed a significant interaction with race; while patterns were similar across Black and White participants, the effects were magnified among Black participants.

Conclusions: Findings support the importance of siblings on adaptive skill development among individuals with ASD. While the existing limited literature consisting primarily of cross-sectional and/or small sample studies has revealed that siblings have been positively associated with stronger skill profiles across each of the three domains (socialization, communication, and daily living skills) that comprise adaptive behavior, this study is the first to underscore the significant influence of siblings and specific sibling constellation factors on adaptive functioning broadly as well as change in adaptive functioning over time in ASD. Future studies are needed to replicate the present findings, explore the specific qualities of siblings that may be driving the improvement, and assess the importance of the sibling relationship closeness on adaptive skill growth over time.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 319 - Functional and Anatomical Neuroimaging Markers of Autism II

**319.001** (Oral) Cortico-Cerebellar Functional Connectivity in 9-Month-Old Infants at High and Low Familial Risk for Autism Predicts Later Socio-Communicative Developmental Trajectories

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Background: While the cerebellum is traditionally known for its role in sensorimotor control, specific subregions including the right Crus I (RCrusI) also support language and social cognition (Van Overwalle et al., 2020). Indeed, emerging research has also revealed an association between cerebellar atypicalities and impaired social communication in autism (D’Mello and Stoodley, 2015; Jack et al., 2017). However, it remains virtually unknown how early cerebellar development in infancy relates to later socio-communicative trajectories.

Objectives: To characterize functional connectivity within cortico-cerebellar networks implicated in social/language functions in early infancy and examine its relationship to later impairments in socio-communicative development.

Methods: An initial sample of infants at high ( $n=82$ ) and low ( $n=37$ ) familial risk for ASD was stratified into distinct cohorts by employing K-means longitudinal clustering on receptive language T-scores from the Mullen Scales of Early Learning (at 6, 9, 12, 18 & 36 months). This yielded a three-cluster solution: a Declining, Inclining, High-Inclining cohort exhibiting divergent socio-communicative trajectories (Figure 1a). To validate our clustering method, we compared these cohorts on other measures of language development (MCDI), joint attention skills (ESCS), and autism symptomatology (AOSI, ADOS-T, ADOS). A subset of 66 infants provided usable 8-min resting-state fMRI scans at 9 months (Declining:  $n=18$ ; Inclining:  $n=25$ ; High-Inclining:  $n=23$ ). Seed-based connectivity analyses using RCrusI were run within each cohort. Parameter estimates of connectivity were extracted from clusters showing significant RCrusI connectivity within four anatomically-based regions of interest (ROIs). ROIs were selected based on prior findings showing coactivation of these regions with RCrusI during social and language tasks (D’Mello et al., 2017; Lesage et al. 2017; Van Overwalle et al., 2015). These connectivity indices were then used in between-group comparisons.

Results: Validation analyses revealed that the three cohorts clustered by receptive language scores exhibited significantly divergent trajectories in the number of words comprehended and produced (from 9 to 18 months; Figure 1b-c), as well as significant differences on responses to joint attention (at 12 and 18 months; Figure 1d-e), and autism symptomatology (at 12, 18, and 36 months; Figure 1f-g-h). Importantly, at 9 months of age, infants in these three cohorts showed striking differences in cortico-cerebellar circuits implicated in social/language functions. Specifically, for all ROIs examined -frontal cortex, supplementary motor area, basal ganglia, and thalamus- the Declining cohort exhibited significantly weaker RCrusI connectivity compared to both the Inclining and High-Inclining cohorts (Figure 2). No significant differences between the Inclining and High-Inclining cohorts were observed.

Conclusions: To our knowledge, this is the first study in infants to examine functional connectivity of cortico-cerebellar networks implicated in language and social cognition and to relate early cortico-cerebellar connectivity to later social communication development. Our findings demonstrate that early cortico-cerebellar connectivity within these circuits is already atypical in 9-month-old infants who exhibit declining socio-communicative trajectories in the second and third year of life. Given the

cerebellum's role in prediction, these findings suggest that the establishment of early connectivity within "social" cortico-cerebellar circuits may help scaffold infants' ability to learn from social feedback which tends to be highly probabilistic in nature.

**319.002 (Oral)** Resting Frontostriatal and Frontoparietal Functional Connectivity and Inhibitory Control Ability in Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorder (ASD) show impairments in inhibitory control, or the ability to inhibit dominant behavioral responses, that are related to increased severity of core clinical symptoms. In typical development, inhibitory control is supported by prefrontal cortical (PFC) and striatal network suppression of PFC-parietal motor networks. Atypical activation of PFC and striatum have been observed in individuals with ASD during inhibitory control, but the degree to which brain functional network connectivity is disrupted and associated with behavioral outcomes in ASD is not well understood. Resting-state functional magnetic resonance imaging (fMRI) offers a highly scalable method of quantifying communication within and across networks. The examination of functional connectivity within frontostriatal and frontoparietal networks in relation to inhibitory control behaviors may provide insight into functional differences in neural circuitry involved in inhibitory control impairments in ASD.

Objectives: To characterize relationships between inhibitory control behavior and resting state functional brain connectivity in ASD.

Methods: Twenty-five individuals with ASD (aged 10-33 years) and 19 age-, sex-, and nonverbal IQ-matched typically developing (TD) controls completed an antisaccade task of inhibitory control prior to a resting-state fMRI scan. During the antisaccade task, peripheral stimuli (i.e., white circles) appeared pseudorandomly at  $\pm 12$  or  $24$  degrees from center, and participants were tasked with inhibiting saccades toward the stimuli and making volitional saccades in the opposite direction. Antisaccade accuracy (i.e., whether the first saccade was correctly directed away from the stimulus), latencies of incorrect saccades toward stimuli (i.e., prosaccades), and latencies of correct antisaccades were examined. Normalized correlation coefficients of fMRI activity at rest between selected regions were derived to examine functional connectivity within frontostriatal (dorsolateral PFC [dlPFC], ventrolateral PFC [vlPFC], caudate, and putamen), and frontoparietal (dlPFC, angular gyrus, and supramarginal gyrus) networks. Relationships between functional connectivity outcomes and antisaccade performance were analyzed separately for each group.

Results: Individuals with ASD showed reduced antisaccade accuracy but no differences in pro- or anti-saccade latencies relative to controls. Connection strength did not differ between groups for any frontostriatal or frontoparietal network examined. Several brain-behavior associations were observed in control participants: increased accuracy during the antisaccade task was related to decreased functional connectivity between dlPFC and angular gyrus, faster prosaccade latencies were associated with increased connectivity between right vlPFC and putamen, and increased prosaccade and antisaccade latencies each were correlated with increased connectivity between dlPFC and posterior supramarginal gyrus. However, neither frontostriatal nor frontoparietal connectivity were associated with antisaccade performance in the ASD group.

Conclusions: Results indicate that frontoparietal networks that control behavioral responses and frontostriatal connections utilized for top-down inhibition of behaviors in TD individuals are not related to inhibitory control behavioral outcomes in individuals with ASD. These findings are consistent with previously identified connectivity disruptions in ASD and suggest that differences in the organization of network functioning is associated with inhibitory control impairments in this population. Our results have broad implications for understanding the neurophysiology of executive dysfunction and core clinical symptomatology in ASD.

**319.003 (Oral)** Do Shapes Have Feelings? Examining Social Attribution in Children with Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder Using fMRI

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**Background:** Theory of Mind (ToM) is the ability to think about mental states and understand that others can have a different mental state from one's own, and strongly influences the quality of one's social interactions. ToM deficits are more common in children with neurodevelopmental disorders (NDDs), such as autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) compared to typically developing (TD) children, which contributes to their life-long social and cognitive difficulties. The social attribution task (SAT), consisting of videos of geometrical shapes designed to move in patterns that depict positive social (e.g., helping) or negative social interactions (e.g., fighting), prompts the recruitment of a network of brain regions, compared to random movement, that are reliably active during ToM processing.

**Objectives:** This study is the first to examine the neural correlates of ToM using the SAT during fMRI in a large cohort of ASD, ADHD and TD children and adolescents.

**Methods:** fMRI data were acquired during the SAT (3 runs of 8 pseudorandomized blocks of positive and negative social interactions and random movement) in 76 ASD, 74 ADHD, and 50 TD children (4-19yrs). After scanning, participants were asked to describe what happened in each video; descriptions were scored on the type of social attributions and attribution errors made in each scenario. fMRI data were preprocessed, and within-run time-series analysis was performed using task conditions (social help, social threat, random) as explanatory variables to examine pairwise contrasts (social versus random, social help versus threat). Contrasts were averaged over runs within each subject, and pairwise t-tests were used to investigate group differences, covarying for age and sex ( $Z > 2.3$ ;  $p < 0.05$ , cluster-corrected).

**Results:** TD children made fewer errors when describing the videos compared to the children with NDDs, and were also able to make more social attributions to the social videos compared to the ASD participants; the ASD and ADHD children did not differ in either ToM performance measure. Contrasting the social and random conditions, fMRI data showed differences in neural activation between TD children and children with NDDs in social brain areas, including the right middle temporal gyrus and bilateral anterior cingulate gyri; no differences between the NDDs were observed. Compared to children with NDDs, TD children demonstrated greater recruitment of the right supramarginal, superior temporal gyri and supplementary motor area, in the social help than social threat condition. Additionally, we found that TD children activated bilateral orbitofrontal regions more to social threat than social help animations, while children with ADHD showed no activation difference between these conditions. The only observed between-NDD difference was enhanced activity in the right fusiform gyrus in the ASD children to social help versus threat animations. Distinct brain-behaviour correlations were also seen.

**Conclusions:** Both the NDD and TD participants recruited classic ToM regions during the SAT, supporting the usefulness of this complex task to examine social cognition. However, atypical and distinct activation of social brain areas was found in the children with ASD and ADHD, which could index the neural underpinnings of their ToM behavioural deficits.

### **319.004 (Oral) Genetic and Environmental Influences on Brain Structure in Twins with Autism**

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**Background:** Brain development is altered in children with autism spectrum disorder (ASD); however, the type and degree of these alterations are heterogeneous across individuals. This extreme neurobiological heterogeneity may be due to the variable effects of genetic and environmental influences on brain development.

**Objectives:** The primary objective of this investigation is to synthesize our findings across multimodal neuroimaging approaches to provide a comprehensive analysis of differences in genetic and environmental influences on brain structure in twins with and without ASD.

**Methods:** Same-sex monozygotic (MZ) and dizygotic (DZ) twin pairs in which at least one twin was diagnosed with ASD or both were neurotypical controls (aged 6-15 years) were recruited to participate. T1 (n=164), diffusion-weighted (n=168), and <sup>1</sup>H proton spectroscopy (n=106) MRI data were collected and processed with FreeSurfer, FSL Diffusion Toolbox, and LCMoDel, respectively, in order to examine brain structure based on grey matter morphometry (cortical thickness-CT; surface area-SA; volume-VOL; curvature-CURV), white matter microstructure (fractional anisotropy-FA; mean diffusivity-MD), and neurochemical markers of neuronal integrity (N-acetylaspartate-NAA). Intra-class correlations (ICC) were computed within twin

pairs and ACE modeling for broad sense heritability ( $a^2$ =additive genetics) and environmental influences ( $c^2$ =shared family environment,  $e^2$ =unique environment) was examined to provide estimates for the proportions of variation associated with genetic versus environmental factors.

Results: Brain structure was predominantly genetically-mediated in control twins, with variation in cerebral and cerebellar grey matter (CT, SA, VOL), white matter (FA, MD), and neurochemical levels (NAA) primarily associated with genetic factors, i.e., higher ICCs in MZ versus DZ twin pairs and larger  $a^2$  versus  $c^2/e^2$  estimates. The only measures that were predominantly environmentally-mediated in control twins were CURV and some region-specific CT and MD that may be associated with adaptive plasticity. Similarly, genetic factors also accounted for the majority of variation in brain structure in twins with ASD, potentially to a larger extent for deep brain structures like subcortical VOL and commissural FA, yet there were also significantly greater environmental influences in twins ASD, especially in the frontal lobe and cerebellum. For instance, variation in global and regional CT as well as cerebellar (VOL and FA) and cerebral white matter (FA in projection and association fibers) were primarily associated with environmental factors in twins with ASD. Additionally, twin pair differences in brain structure were also related with twin pair differences in ASD diagnosis and core symptom presentation and severity.

Conclusions: As previously reported, brain structure appears to be primarily genetically-mediated during typical development, with some regional and measure-specific environmental influences that most likely represent changes from adaptive plasticity. However, children and adolescents with ASD exhibit a markedly different and more pervasive pattern of environmental influences on brain structure. Brain-behavior relationships suggest that genetic susceptibility for ASD may primarily contribute to a diagnosis of the disorder whereas environmental exposures may more directly influence some of the extreme heterogeneity in symptom presentation and severity across individuals. These results are promising because they suggest that treatments targeting the early environment could potentially alter brain development to provide some clinical benefits in the core symptom domains.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 320 - Sex Differences in Autistic Behavior Phenotypes

**320.001** (Oral) Investigating Early Sex Differences in Language in Infants at Increased Familial Risk of Autism Spectrum Disorders

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Background:

Autism spectrum disorder (ASD) is highly heritable, with 4:1 prevalence in males versus females, suggesting that sex-differential phenotypes that track with familial risk could inform ASD's neurodevelopmental underpinnings. Language represents a candidate sex-differential marker of heritable ASD risk given: 1) a previously reported female advantage in early language acquisition, 2) evidence for language being an ASD endophenotype, 3) comorbidity of language delay and ASD, and 4) shared neural correlates with ASD.

Objectives:

1. To quantify infant sex differences in receptive and expressive language measures in a population at high and low familial risk of ASD.
2. To examine whether early language trajectories differ by sex as a function of familial ASD risk and diagnostic outcome.

Methods:

We evaluated sex differences in language in participants from the Infant Brain Imaging Study (IBIS) at ages 6, 12, and 24 months. Participants received a 24-month clinical best estimate diagnosis and were stratified by familial ASD liability into three risk-diagnostic groups: HR+ (ASD and a sibling with ASD), HR- (no ASD and a sibling with ASD), and LR- (no ASD and no first-degree family history). Receptive and expressive language scores were obtained from the Mullen Scales of Early Learning (MSEL), a direct assessment, and the Vineland Adaptive Behavior Scales (VABS), a parent-report measure. Sex differences were indexed by Cohen's *d*, with positive effect sizes reflecting lower male scores, aligning with greater ASD-related features in males. We used repeated measures ANOVA to examine risk-based sex differences in 6- to 24-month language development.

#### Results:

When comparing males and females in each group, significant sex differences were observed at 6 months such that HR+ males had lower VABS expressive language scores ( $p=0.004$ ,  $d=0.75$ ) (Table 1). At 12 months, HR+ males exhibited lower VABS expressive ( $p=0.01$ ,  $d=0.71$ ) and receptive ( $p=0.003$ ,  $d=0.81$ ) language scores, with trend-level differences on MSEL expressive ( $p=0.065$ ,  $d=0.50$ ) and receptive ( $p=0.1$ ,  $d=0.43$ ) language. At 24 months, small sex differences were observed in the HR- group only, with males exhibiting significantly lower scores in MSEL and VABS expressive language and lower trend-level differences on MSEL and VABS receptive language. Significant interaction effects of age by group (LR-, HR-, HR+) indicated decreased scores in the HR+ group for both males and females on all measures compared to HR- and LR- groups (Figure 1). Relative declines in language emerged earlier for HR+ males than females, whose group-level scores began to diverge from the LR- and HR- groups between 6 and 12 months. HR+ females did not exhibit a language decline until the period between 12 and 24 months.

#### Conclusions:

We observed that male sex, a known ASD risk factor, was associated with 6- to 12-month differences in language, an ASD endophenotype. These were detected by direct assessment and parent-report, with the latter showing larger differences. This observation supports the role of developmentally sensitive, sex-moderated factors in the emergence of ASD. Language declines during infancy may arise sooner for males versus females at elevated familial ASD risk, highlighting the importance of tracking infant language for early identification and intervention.

#### **320.002 (Oral) Sex Differences in Looking Trends in Autistic Individuals: A Report from the EU-AIMS LEAP Cohort Using Dynamic Videos**

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**Background:** Previous research reports that increased attention towards social stimuli (i.e., Social Attention, SA) in autistic females may modulate exposure to social contingencies, thereby reducing social interaction difficulties and symptom severity. Therefore, heightened SA could relate to specific manifestations of Autism in females, in relation to symptom intensity and socio-cognitive skills.

**Objectives:** This research aims to investigate the second-by-second changes of SA in autistic compared to neurotypical individuals and their relation to symptomatology and sex, as measured by eye-tracking during a dynamic video rich in social information.

**Methods:** 388 autistic (M:F ratio=2.68; mean age=16.7, SD=5.8; mean IQ=96.8, SD=19.9) and 271 neurotypical participants (M:F ratio=1.9; mean age=17.2, SD=5.9; mean IQ=103.8, SD=18.9) took part in the study. Participants' eye-movements were recorded via eye-tracking while watching medium close-up shots of 1-2 people talking to the camera. Each gaze sample was scored 0/1 if it fell within the area of the face, and averaged every 0.5-second since the onset of an individual face, within a 3-seconds time-window. The obtained Proportional Looking Time (PLT) was used in 3 separate Growth-Curve Mixed Models,

with 2nd order polynomials as predictors to capture PLT second-by-second change, and each including the neurotypical, autistic and female participants separately. We report the unstandardised effect sizes ( $\beta$ ) of sex/diagnosis on average and second-by-second change of PLT. Further, we extracted individual  $\beta$  from the models, and tested the partial correlations with autism symptom intensity (SRS-2), and, exploratively, neural event-related responses during a face processing task, measured by the Global Field Power (GFP) of brain microstates, representing quasi-stable topographies switching across time.

Results: Average PLT was higher in females than males, both in neurotypical (Model 1;  $\beta=0.06$ ,  $SE=0.01$ ,  $p\text{-value}<0.01$ ) and autistic group (Model 2;  $\beta=0.04$ ,  $SE=0.02$ ,  $p\text{-value}=0.02$ ; Fig. 1A). The second-by-second change of PLT configured a parabolic shape, with final net increase, that was sharper in autistic females than autistic males ( $\beta=-0.05$ ,  $SE=0.02$ ,  $p\text{-value}=0.002$ ). Average PLT was lower in autistic females compared to neurotypical females (Model 3;  $\beta=-0.09$ ,  $SE=0.02$ ,  $p\text{-value}<0.01$ ; Fig. 1B). Despite no significant association with symptom intensity, we found a negative correlation with GFP of the early microstate, in autistic (N=46; Intercept:  $\rho=-0.30$ ,  $p\text{-value}=0.04$ ; Slope:  $-0.35$ ,  $p\text{-value}=0.02$ ) and neurotypical females (N=47; Intercept:  $\rho=-0.33$ ,  $p\text{-value}=0.03$ ; Slope:  $-0.31$ ,  $p\text{-value}=0.03$ ; Fig. 1C), but not in males.

Conclusions: This task was able to elicit robust sex differences; autistic females showed lower SA compared to neurotypical females, possibly suggesting concurring adaptation/compensation. Further, higher interest in faces associated with smaller GFP in females only, suggesting that the process at work may influence face-processing abilities.

**320.003 (Oral) Differential Impact of Autism on Eating Problems in Females and Males – a Co-Twin Control Study**  
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Background:

Eating problems are common in autism, and include selective eating, sensory issues related to food and inflexible routines around mealtimes. While recent research suggests that gender might play a role in the association between autism and eating problems, few studies have investigated potential gender differences in the impact of autism on different aspects of eating problems. Furthermore, there is a paucity of research exploring the genetic and environmental influence on the link between autism and eating problems.

Objectives:

We aimed to **a)** investigate the relation between autism and both total and specific aspects of eating problems; **b)** explore potential gender differences in these associations; and **c)** examine the influence of genetic and shared environmental factors on the association between autism and eating problems, using a co-twin control design.

Methods:

A sample of twins (N = 192) aged between 15 and 33 years, including 28 individuals diagnosed with autism, participated in the Roots of Autism and ADHD Twin Study in Sweden (RATSS). Participants self-reported eating problems on the SWEedish Eating Assessment for Autism spectrum disorders (SWEAA), including for instance selective eating, sensory sensitivity concerning food, and symptoms of eating disorders, and participated in neurodevelopmental assessments conducted by experienced clinicians. Parent-reported autistic traits on the Social Responsiveness Scale-2 (SRS-2) were also collected. Linear regression models within the Generalized Estimating Equations (GEE) framework were conducted, which account for the clustering in the sample (i.e. the twin-pairs). Autistic traits were used as the exposure and eating problems as the outcome. Regression models included the interaction term autistic traits by gender and were adjusted for age, IQ, and ADHD. Significant associations were followed-up using autism diagnosis as exposure to ensure the clinical relevance of the findings. Lastly, within-pair analyses were conducted using conditional linear regression within GEE, which control for factors shared within twin-pairs, including ~50% of genes among dizygotic (DZ) pairs and 100% of genes among monozygotic (MZ) pairs.

Results:

Autistic traits, as well as autism diagnosis, were associated with an increase in total eating problems, and both were associated with more self-reported problems in several aspects of eating problems, including selective eating and sensory sensitivity

regarding food. A significant interaction effect between autistic traits and gender showed that autistic traits were associated with increased total eating problems particularly among females (see Figure 1). In addition, both traits and autism diagnosis predicted more self-reported problems with eating in social situations for females but not males. In the within-pair analyses, the association between autistic traits and total eating problems remained within DZ-pairs but not MZ-pairs, suggesting a common genetic influence on both variables.

#### Conclusions:

Autistic traits predict increased eating problems, and the association might be influenced by genetic factors common to both variables. Furthermore, autistic traits appear to predict eating problems particularly among females. Potentially, issues around eating might increase the risk of social isolation for autistic females. The often-overlooked area of eating problems could be a relevant target for intervention among autistic adolescents and adults.

#### 320.004 (Oral) Friend Matters: Autistic Girls Talk More about Friends during Diagnostic Interviews

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**Background:** Individuals with autism spectrum condition (ASC) are characterized by social communication challenges. Girls are diagnosed with ASC less often than boys<sup>1</sup> even when their symptoms are equally severe<sup>2</sup>. This may be due, in part, to insufficient understanding of the way ASC manifests in girls. Research suggests that autistic girls and boys present distinct symptom profiles in a variety of domains, including language<sup>3,4</sup>. Closely analyzing boys' and girls' language use during semi-structured clinical assessments could shed light on potential sex differences in the behavioral presentation of autistic individuals, revealing clinically meaningful variations in social phenotype that could ultimately inform the development of personalized supports.

**Objectives:** Compare the frequency of social word production in verbally fluent girls and boys with ASC during the conversation and reporting section of the ADOS-2 Module 3, and measure associations with clinical phenotype. Social words are words that make reference to other people (e.g., him/her, girlfriend, dad).

**Methods:** School-aged girls and boys with ASC (N=101, 25 females) were administered the ADOS-2. Participants were matched on age, IQ, and parent/clinician ratings of autism symptom severity (Table). Recordings of the conversation and reporting section of the ADOS-2 were orthographically transcribed<sup>5</sup> and processed using Linguistic Inquiry and Word Count (LIWC) software<sup>6</sup>. Word frequency was normalized per 1000 words to account for varying word production across participants. The effect of sex on participant word use was modeled using generalized linear regressions with a Poisson distribution, after controlling for age and clinician speech. Tukey-corrected comparisons of estimated marginal means assessed the directionality of effects.

**Results:** There was a significant main effect of sex on social word production (estimate: -.13,  $z=-6.11$ ,  $p<.007$ ), such that boys used fewer social words than girls (Fig.A). To clarify the kinds of social words being used, additional categories of "friend" and "family" words were analyzed. There was a significant effect of sex on "friend" words, with boys using fewer friend words than girls (estimate: -.20,  $z=-2.37$ ,  $p=.02$ ). There was no effect of sex on family words (estimate: -.14,  $z=-1.82$ ,  $p=.07$ ), suggesting that sex differences in social word production may be driven by girls talking more about friends. To assess relationships with clinical phenotype, we modeled ADOS-2 social affect (SA) scores as a function of social word production. After accounting for age, sex, and clinician speech, social word production significantly predicted ADOS-2 SA scores (estimate: -.01,  $z=-3.19$ ,  $p=.001$ ), indicating that participants who used fewer social words were rated as more socially impaired by clinicians (Fig.B).

**Conclusions:** Autistic girls used significantly more social words than boys during a diagnostic assessment – despite being matched on age, IQ, and autism symptom severity. Sex differences in linguistic markers of social phenotype in autism are especially important in light of the late or missed diagnoses that disproportionately affect autistic girls. Specifically, heightened talk about social topics could complicate ASC referral and diagnosis when observers expect a male-typical pattern of reduced social attention, which autistic girls do not always exhibit.

## ORAL SESSION — OTHER - MULTIPLE TOPIC AREAS

### Oral 327 - Understanding Behavioral and Biological Heterogeneity in Autism

**327.001** (Oral) Clinically-Relevant ASD Subgroups Based on Neural and Behavioral Characteristics Revealed through Similarity Network Fusion

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#### Background:

ASD is heterogeneous in risk genes, behaviors, neural features and clinical outcomes. Understanding clinically-relevant subgroups of ASD toddlers could help discover etiological pathways and lead to more tailored treatments. A common subgrouping approach is unimodality stratification into experimenter-defined subgroups<sup>1-3</sup>. A novel unbiased, data-driven approach is similarity network fusion (SNF)<sup>4</sup> and clustering that integrates multiple kinds of measures (e.g., fMRI, clinical) from each individual to identify clusters of patients whose measures are maximally similar to each other and maximally different from patients in other clusters. In this approach, the similarity in patterns drives subgroup clusters independent of diagnosis revealing bio-behavioral dimensionality.

#### Objectives:

Identify homogeneous neurofunctional and clinical subgroups within a large sample of ASD and control toddlers and determine how they differ with respect to attention to social stimuli and trajectories of language and social development.

#### Methods:

We collected fMRI responses to a female speaker reading nursery rhymes<sup>2,5,6</sup> from 112 ASD and 64 Controls aged 13–46 months during natural sleep. Toddlers were clinically tested<sup>7-9</sup> at longitudinal clinic visits; eye-tracking tested each toddler's attentional preference for social images<sup>10</sup>. fMRI preprocessing used AFNI<sup>11</sup> and included motion correction, normalization to Talairach space, and smoothing. Statistical analyses used SPM8, controlling for age, gender and head motion. Percent signal changes (Speech vs. Rest) were calculated for frontal and temporal language regions using Neurosynth ROIs<sup>12</sup>. SNF constructed similarity networks for fMRI and clinical data and Louvian<sup>12</sup> clustering identified fused neural-clinical subgroups. These neural-clinical subgroups were tested for differences in social attention during eye tracking and gains/losses in social and language abilities across early development.

#### Results:

Network fusion and clustering found 6 neural-clinical subgroups, 4 with 100% ASD toddlers and 2 with ~90% TD and other control toddlers. One large subgroup with 100% ASD toddlers showed moderate brain activation to language and good cognitive scores (i.e., ASD good) while another large subgroup with ~88% ASD toddlers stands at opposite ends of the neural-social-language spectrum with hypoactivation and low cognitive scores (i.e., ASD poor). The ASD good subgroup had significantly greater eye tracking-based attention towards social stimuli than the ASD poor subgroup. They also showed substantial gains in language between initial clinical detection and later clinical outcome, while ASD poor subgroup had substantial declines.

#### Conclusions:

Using SNF/clustering methods, 6 neural-clinical subgroups were identified, and collectively suggest that biological and behavioral heterogeneity within ASD, TD and other control toddlers is dimensional. This data-driven approach replicated the finding of two different neurofunctional ASD subgroups—one with good language activation and the other with hypoactivation—that we previously identified using an experimenter-defined language stratification approach<sup>12</sup>. Consistent with the theory that infant attention to social stimuli drives language learning<sup>13</sup>, the ASD good subgroup with greater eye-tracking attention to social stimuli and greater language activation than the other subgroup, had greater gains in social and language across time, while the other subgroup had losses across time. Findings provide novel evidence of neural-clinical ASD subgroups that clarifies understanding of ASD heterogeneity and opens new avenues for discovery of early-age diagnostic and prognostic

biomarkers.

**327.002 (Oral)** Predictors of Adaptive Functioning in a Heterogenous Autism Spectrum Disorder Cohort: A Conditional Random Forest Analysis

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**Background:** Higher cognitive ability predicts better functional outcomes for individuals with Autism Spectrum Disorder (ASD), yet many individuals exhibit a discrepancy between cognitive ability and adaptive functioning. Identifying clinical and demographic predictors of this discrepancy in community-representative samples would improve measurement of response to treatment across the heterogeneous range seen in ASD.

**Objectives:** This study implemented a conditional random forest (CRF) machine learning algorithm to identify clinical and demographic predictors of adaptive functioning in a heterogeneous cohort of individuals affected by ASD.

**Methods:** Participants included N=469 individuals aged 2 to 60 years old from the Rhode Island Consortium for Autism Research (RI-CART) patient registry. Participants varied with respect to presence or absence of a community diagnosis of ASD prior to study enrollment. For this analysis, inclusion criteria were individuals with an available IQ score and at least one diagnostic indicator of ASD: an elevated score in the Autism or ASD range on the Autism Diagnostic Observation Schedule, 2<sup>nd</sup> Edition (ADOS-2) and/or a prior community ASD diagnosis. This allowed for two levels of diagnostic certainty: ASD-confirmed (N=246: Elevated ADOS-2 score *and* community diagnosis) or ASD-inclusive (N=223: Community diagnosis *without* elevated ADOS-2 or elevated ADOS-2 *without* community diagnosis).

The primary outcome was the discrepancy between IQ (standard scores on Peabody Picture Vocabulary Test or the Kaufman Brief Intelligence Test) and adaptive functioning (AF; standard composite scores on the Vineland Adaptive Behavioral Scales), IQ-AF. Participants were stratified by IQ level (IQ < 85; 85-114;  $\geq$ 115). CRF analysis allowed us to simultaneously model many interrelated predictors and complex interactions among variables. Predictors included IQ strata, autism symptoms (Social Responsiveness Scale, 2<sup>nd</sup> Edition; SRS-2), diagnostic certainty, number of psychiatric and medical conditions, demographic variables (maternal age, ethnicity, family income), and age of enrollment. Permuted variable importance identified the most prominent predictors that were then used to plot a representative conditional inference tree to probe complex interactions among predictors.

**Results:** IQ strata, autism symptoms, age of enrollment, minority status, and co-occurring medical conditions were among the top predictors of IQ-AF (See Fig. 1a). Partial dependence plots (Fig. 1b) show that the IQ-AF was highest and positive (i.e., IQ>AF) for individuals with IQ $\geq$ 115, and smaller and generally negative for individuals with IQ<85. IQ-AF was positively associated with age of enrollment and social communication deficits on the SRS-2. The representative tree in Fig. 1c illustrates interactions among predictors. For IQ $\geq$ 115, social communication deficits and older age predicted greatest IQ-AF. For IQ<85, the highest discrepancy was found for individuals aged 9-15 years with social communication scores >75 and restricted and repetitive behavior scores <87 on the SRS-2. For 85 $\leq$ IQ<115, social communication deficits, older age, and having >2 medical comorbidities predicted high IQ-AF.

**Conclusions:** Findings highlight the clinical utility of considering IQ-AF discrepancy when assessing functional outcomes and underscore how core symptom domains of ASD, particularly social communication deficits, and minority status differentially impact adaptive functioning outcomes across the range of IQ and age. Results also highlight the importance of considering co-occurring medical conditions when assessing functional outcomes in ASD.

**327.003 (Oral)** Clinical and Biochemical Predictors of Severity and Response to Applied Behavioral Analysis in Children with Autism Spectrum Disorder: An Outpatient Registry-Based Prospective Study

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**Background:** Applied behavior analysis (ABA) is the standard of care behavioral therapy for children with Autism Spectrum Disorder (ASD). However, literature determining clinical and biochemical predictors of severity and response to ABA among children with ASD is scarce.

**Objectives:** To determine clinical and biochemical predictors of severity and favorable/unfavorable response to ABA in children with ASD aged 2-18 years

**Methods:** Children with ASD (DSM V criteria) between age 2-18 years, who were provided ABA with the help of caregivers, along with various medications as and when indicated, were enrolled in the study and prospectively followed at 1-3 monthly intervals between January 2017 and November 2020. They were reevaluated for symptom severity and behavioral co-morbidities by performing Childhood Autism Rating Scale (CARS), Autism Behavior Checklist (ABC), and Childhood Behavior Check List (CBCL) and compared with the baseline values. Various predictors of response to ABA were identified by univariate and multivariate logistic regression analysis. In children with epilepsy or suspicion of ESES (n=122), sleep EEG was performed. Screening for Fragile X syndrome, Rett syndrome, chromosomal microarray, and next-generation sequencing was performed for children with complex autism/ significant clinical suspicion. Six oxidative biomarkers were analyzed in a subgroup (n=100) and compared with healthy controls (n=50).

**Results:** A total of 1148 children with ASD (911 boys, median age of presentation 4.2 years, IQR 3-6 years, CARS 36.78±4.92, ABC 84.01±16.92) were enrolled. Out of these, 688 (60%) children had significant behavioral co-morbidities (irritability, hyperactivity, disruptive/self-injurious behavior were most common), 122(11%) had epilepsy (31% had epileptiform abnormality-either focal/multifocal discharges or ESES), and 675(59%) had development quotient <50. Forty-four children had complex autism, with clinical suspicion of the underlying neurogenetic syndrome, and definite etiology was detected in 14 (31%) of them. Predominant antipsychotics administered were risperidone, followed by aripiprazole. Predominant anti-seizure medications used were valproate, followed by levetiracetam. At least one year follow up was completed in 965(84%) children, with a median duration of follow up being 1.5 years, and post-ABA institution, CARS was 32.88±2.72 (p<0.001, as compared to baseline reflecting the effectiveness of ABA).

Children with age of ABA institution <4 years had a better response to ABA than older children (p=0.03). No difference was identified between both sexes. Children with a longer duration of ABA had a better reduction in symptom severity (p=0.04). In contrast, those with DQ<50, behavioral co-morbidities, and epilepsy had a relatively less favorable response (p=0.01, 0.02, and 0.04, respectively). The baseline CARS score was also higher in these three subgroups, suggesting more severe illness (p=0.03, 0.03, and 0.04, respectively). Only serum homocysteine and dityrosine level were higher in ASD cases than controls (p=0.01 and 0.001, respectively).

**Conclusions:** Younger age at institution of ABA, higher SES of parents, absence of co-morbidities like epilepsy or hyperactivity, and longer duration of ABA are essential predictors for a favorable response to ABA in children with ASD.

**327.004 (Oral) Depi: A Platform Designed to Enable Precision Medicine in Neurodevelopmental Disorders**  
**L. Perez-Cano<sup>1</sup>, E. Guney<sup>1</sup>, F. Sirci<sup>1</sup>, D. Charvin<sup>2</sup> and L. Durham<sup>2</sup>, (1)Discovery and Data Science (DDS) unit, STALICLA SL, Barcelona, Spain, (2)STALICLA SA, Geneva, Switzerland**

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**Background:**

Today, patients diagnosed with Autism Spectrum Disorder (ASD) account for 1-1.5% of the world population and the condition remains a high unmet medical need. The repeated failures of investigational drug clinical trials conducted in the general ASD population has highlighted the urgent need to shift from a “one-size-fits-all” approach towards drug development programs that start with dissecting the molecular and genetic heterogeneity that manifest in patients with ASD. While many areas of medicine have achieved major therapeutic strides by biologically parsing specific subgroups of patients, this effort has remained limited in Autism.

**Objectives:**

In order to fill this gap, STALICLA has developed DEPI, a first-in-class integrative systems biology and multi-omics platform for precision medicine discovery in the neurodevelopmental disorders (NDD) space. The main goals of the platform are: i) to identify and characterize more homogeneous and clinically actionable subgroups of patients within highly heterogenous

populations with NDDs, including ASD; and ii) to discover and develop precision medicine candidates that can efficiently target the identified subpopulations.

#### Methods:

DEPI leverages proprietary NDD-tailored knowledge bases and the access to genetic and clinical data from large-scale NDD cohorts, to identify non-behavioral biomarkers characterizing NDD patients (a.k.a. endophenotyping). These endophenotypes are then used as features to cluster patients using machine learning, allowing the identification of more homogeneous subgroups of patients eligible for precision medicine. On the other hand, DEPI uses network endopharmacology to identify fast-track drug candidates that can efficiently target these clinically actionable NDD subgroups.

#### Results:

In just over 3 years, DEPI has already proven successful in expediting and de-risking drug development for a first subgroup of patients with ASD and identifying four additional subgroups eligible for precision medicine trials. The first group, ASD phenotype 1 (ASD-Phen1), is characterized by non-behavioral clinical signs and symptoms and is estimated to represent approximately 25% of the ASD population. DEPI also allows systematic multi-omics data-driven screening of thousands of preclinical and phase II/III compounds to delineate their effect on biological pathways of each subgroup-specific pathophysiological mechanisms. The platform has enabled the identification of a therapeutic option that could compensate for the proposed molecular perturbations in ASD-Phen1, STP1, which has entered clinical trial in Q4 2020. DEPI has also enabled the identification of subgroup of patients with a high probability of responding to third-party drug candidates.

#### Conclusions:

DEPI has been designed to make a shift in the field, providing the tools to match the right NDD patients with the right drug treatments.

## POSTER SESSION — PEDIATRICS

### Poster 437 - Pediatrics Posters

**437.001** (Poster) A Mobile Game Platform for Improving Social Communication in Children with Autism: A Semi-Randomized Clinical Trial

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Background: Autism Spectrum Disorder (ASD) is among the most pressing public health challenges in the U.S. and around the world. Many children with ASD are unable to receive timely in-person diagnosis and therapy, particularly during the COVID-19 pandemic. Mobile interventions can fill the gap by allowing all families with access to a smartphone to receive treatment.

Objectives: To evaluate the therapeutic potential of *GuessWhat*, a mobile game designed to improve social communication in children with ASD using any Android- or iOS-based smartphone.

Methods: We conducted a semi-randomized controlled trial where treatment participants received the *GuessWhat* intervention and control participants received treatment as usual. Families of children ages 3-12 years with parent-reported formal ASD diagnosis were recruited remotely and participated in the intervention from home. Participants were asked to play *GuessWhat* for three 90-second game sessions per day, three days per week, for four weeks. Families who had not started playing the game within one week of baseline data collection were asked to refrain from playing it and were assigned into the control cohort. To balance the number of participants in each arm of the study, control participants who had completed the same clinical measures over a similar timeframe as part of a randomized controlled trial previously reported by our lab were also included in the analysis. Two parent-reported socialization outcome measures, Social Responsiveness Scale – 2 (SRS-2) and Vineland Adaptive Behavioral Scales – II (VABS-II), were assessed between treatment and control groups using two-tailed paired sample T-tests. The measures were completed digitally immediately prior to and up to one month after the intervention.

Results: 168 children (85% male, mean age 7.75 years) were enrolled; 100 assigned to treatment, 68 to control. The 61 treatment completers showed significant improvements in SRS-2 Total (3.59,  $p < 0.001$ ) and VABS-II Socialization Standard (6.29,  $p = 0.01$ ) scores whereas the 41 control completers showed no change (1.34,  $p = 0.22$ , and -0.62,  $p = 0.64$ , respectively). The improvements were sustained among all treatment participants following a mixed-effects linear-regression model. Children who played during all four weeks ( $N = 11$ ) or over 28 game sessions ( $N = 17$ ) demonstrated even higher improvements.

Conclusions: Participants who received the mobile game improved significantly on SRS-2 and VABS-II scales, while participants who received treatment as usual showed no changes. The results suggest that *GuessWhat* can engage children with autism in therapeutic gameplay from the comfort of their homes. The intervention presents a feasible approach to improving the efficacy and accessibility of pediatric behavioral therapies.

**437.002** (Poster) Evaluation of the Relationship of Sleep Disturbances to Severity and Common Behaviors in Autism Spectrum Disorder

*S. Miner, Case Western Reserve University, Cleveland, OH*

Background: First described in 1940, autism spectrum disorder (ASD) remains one of the most puzzling disorders of childhood. The underlying neurological disruptions as well as the heterogeneity of its symptoms are poorly understood. ASD is associated with an increased incidence of comorbid inflammatory disorders, psychological disorders, and sleep disturbances. Recent studies have indicated that these comorbidities and associated symptoms, historically attributed to the ASD diagnosis, may in fact be contributing to the behavioral symptoms of the disorder.

Disturbed sleep in children can have many detrimental health consequences including decreased cognition, decreased focus, performance problems, and changes in mood and behavior. These symptoms are common in ASD. Disturbed sleep patterns, such as increased sleep latency (time falling asleep), nighttime waking and early arousal, have been identified in up to 80% of children with ASD. Recent evidence suggests children with ASD experience an increased sensitivity to disturbed sleep that may ultimately increase the severity of the disorder.

**Objectives:** This study explored how disturbed sleep influences the severity of behavioral symptoms common to ASD. Children ages 6-12 with ASD were invited to participate through University Hospitals Autism Center and Connecting for Kids. Actigraphy and an accompanying sleep diary captured disturbed sleep patterns in this population. Participants wore a GT3X actigraphy monitor for 7 nights to collect data on patterns of increased sleep latency, nighttime or early morning waking, and sleep efficiency. Parents completed a sleep diary for their child during actigraphy collection, as well as a medical history and the Autism Spectrum Rating Scale (ASRS) questionnaire.

**Methods:** A descriptive analysis was used to report the characteristics of nighttime sleep and sleep efficiency as well as sleep disturbances of sleep latency, wake after sleep onset, and early morning wake in participants with ASD. Pearson's  $r$  determined the relationships between the number of sleep disturbances experienced by a child with ASD and the severity of specific ASD behavioral scores and ASD diagnostic severity (determined by the ASRS).

**Results:** Of the 24 participants in this study almost 92% had one or more sleep disturbances. A positive correlation was present between the number of sleep disturbances and the severity of delays in social and communication symptoms ( $r = .59, p < .01$ ). No other correlated variables met statistical significance, however, a moderate effect size was found between the number of sleep disturbances and unusual behaviors in ASD ( $r = -.38, p = .07$ ), suggesting a possible, unanticipated, inverse relationship.

**Conclusions:** Exploring the relationship of disturbed sleep to behavior and symptom severity in children with ASD can provide an understanding of how poor sleep influences ASD symptoms. This study identified distinct differences in symptom severity between and within individual participants. This knowledge will be useful to guide efforts to provide patient specific interventions, mitigate ASD symptoms, and improve the likelihood of success of therapeutic and behavioral interventions in this population.

**437.003 (Poster) Examining Health Indicators Among Children with and without Autism Spectrum Disorder**  
**K. L. Staples<sup>1</sup>, E. A. Pitchford<sup>2</sup> and L. R. Ketcheson<sup>3</sup>, (1)School of Health Promotion and Kinesiology, Texas Woman's University, Denton, TX, (2)Department of Kinesiology, Iowa State, Ames, IA, (3)Department of Kinesiology, Health and Sport Studies, Wayne State University, Detroit, MI**

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**Background:** Children with ASD experience disproportionately higher rates of obesity compared to neurotypical children of the same age. Although there are multiple factors that contribute to obesity, the emphasis of public health initiatives has largely been focused on participation in moderate to vigorous intensity physical activity (MVPA). However, previous interventions have had little to no long-term impact on obesity or MVPA among children with ASD. To develop interventions that will promote positive trajectories of health for children with ASD, we must also consider additional health indicators that may collectively have a greater impact on promoting positive trajectories of health for children with ASD.

**Objectives:** The purpose of this study was to develop a more comprehensive understanding of differences in health indicators for children with and without ASD across early and middle childhood.

**Methods:** This study included 48 children with ASD (37 boys) and 49 neurotypical controls (37 boys) between the ages of 3 and 9 years. To examine age-related differences among health indicators, children were divided into two age groups: 3 to 5 and 6 to 9 years of age. Health indicators included body composition, MVPA, motor skill competence, physical fitness, and quality of life (QOL). Measurements included body mass index (BMI) percentiles, GT3X+ accelerometers, the Test of Gross Motor Development – 3<sup>rd</sup> edition, 4 items from the Brockport Physical Fitness Test, and the Pediatric Quality of Life Inventory.

**Results:** Based on BMI percentiles, 48% of children with ASD were classified as overweight or obese compared to 6% of neurotypical children. MVPA was not significantly different between children with and without ASD for either age group. However, 3 to 5 year old children with ASD had significantly poorer musculoskeletal fitness and QOL ( $p < .001, r_g^2 > .61$ ) compared to same aged children with neurotypical development. By 6 to 9 years of age, children with ASD had significantly poorer FMS competency, cardiorespiratory and musculoskeletal fitness, and QOL ( $p < .001, r_g^2 > .53$ ).

**Conclusions:** The findings of this study demonstrate that across early and middle childhood, children with ASD experience poorer health across a variety of indicators. For children with ASD, significantly lower levels of QOL will have a cumulative impact on other areas of health and development. These findings underscore the need for longitudinal and intervention research to understand the competencies children with ASD need to acquire early in development to be active and improve health outcomes. Given the differences in health indicators that emerge with increasing age, early childhood is a critical time for intervention to promote positive trajectories of health and quality of life during sensitive periods of development.

**437.004 (Poster) How Has the COVID-19 Pandemic Affected School Aged Children with Autism: A Parental Report**

**Background:** In the spring of 2020, school closures were widespread across the USA in an effort to control the spread of COVID-19. These shutdowns impacted millions of school aged children, and have had significant psychosocial implications. Children with autism are a vulnerable population with unique educational and social needs. Prolonged school closures due to the ongoing pandemic are likely to have had a unique disruptive effect on the social and emotional functioning of children with autism and their families compared to their neurotypical peers.

**Objectives:** The objectives of the current study was to compare experiences of the COVID-19 Pandemic on children with autism compared to neurotypical peers. Given social differences and preferences for consistency in children with autism, we predicted that children with autism would experience more stress related to disruptions in daily routines, and less stress related to social isolation. In comparison, we expected neurotypical peers to report more stress associated with social isolation. We also explored unique stressors present in children with autism, such as difficulty in meeting therapeutic and academic goals during the shutdown.

**Methods:** A sample of 311 parents of school aged children, ages of 4-15 years old, participated in an online survey via REDCap. The majority of the respondents (62%) were from the Northeast region of the United States and 65% were parents of children with autism and 35% were parents of neurotypical children. The children were 69% male, and 74.6% were non-Hispanic white. Parental perspectives were collected using the Covid-19 Adolescent Symptom and Psychological Experience Questionnaire (CASPE), as well as an exploratory measure meant to identify stressors specific to children with autism, the Parental Stress Survey (PSS).

**Results:** Parents of children with autism reported more overall disruptions for their child on average compared to the parents of neurotypical peers ( $t=4.38$ ,  $df=286$ ,  $p = 0.000$ ). The top three stressors reported by parents of children with autism were not attending school, schedule disruption, and having to stay at home. In comparison, the top three stressors reported by parents of neurotypical children were not seeing friends, not attending school, and having to stay home. In terms of unique stressors present in the autism children, parents of children with autism reported that they spent more time assisting their child with academic work compared to parents of neurotypical children ( $t=3.81$ ,  $df=286$ ,  $p = 0.000$ ). Parents of children with autism expressed concerns regarding reductions in meeting therapeutic, social and academic goals during the shut down.

**Conclusions:** The effects of the COVID-19 pandemic and prolonged school closures have disrupted the lives of all children, but these circumstances have presented unique challenges to children with autism. These results indicate children with autism are a vulnerable group for negative changes due to the pandemic. These findings represent the need for specific clinical and educational intervention to mitigate the effects of the COVID-19 pandemic in children with autism in the years ahead.

**437.005 (Poster) Identification of Sex Differences across Comorbidities in 59K Autism Spectrum Disorder Patients**  
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**Background:** Autism spectrum disorder (ASD) is 3-4 times less prevalent in females than in males. Although sex dimorphism is a consistent and recognized feature of ASD, additional clinical correlates could help to identify potential ASD subgroups; this could shed light on some of the complexities of ASD that remain poorly described and help informing parents. Autism in females can present with phenotypic categories that are distinct from those considered characteristic of the disorders, being the sex an important specifier that could help in defining ASD subgroups and identifying mechanisms for disease, and such phenotypic categorization could help clinicians in guidance and specialist referrals appropriate for the specific anticipated comorbidities. Researchers have long recognized a discrepancy in the ratio ASD presentation in males and females. Yet, these sex differences and their related comorbidities have been incompletely characterized, hindering more accurate diagnosis.

**Objectives:** The purpose of this study is to identify phenotypic categories that occur uniquely in females with ASD, those significantly distinct from males with ASD and females without ASD.

**Methods:** In this work, using large-scale real-world data we characterize developmental and age-specific differences in related comorbidities, developmental, age-specific differences in females with ASD compared to males with the same diagnosis, as well as neurotypical girls. We performed a systematic comorbidity analysis on 1,860 groups of comorbidities exploring the all spectrum of known disease in 59,140 individuals (11,440 females) with ASD, in four age groups. We explored ASD sex

differences in real-world datasets, across all potential comorbidities by comparing 1) females with ASD versus males with ASD and 2) females with ASD versus females without ASD. We used electronic health record (EHR) data from a pediatric hospital to replicate the analysis.

**Results:** Through this analysis, we identified 27 different comorbidities that appeared significantly more frequently in females with ASD. Consistent with prior findings, we identified neurological (e.g., epilepsy, OR>1.8, ages 3-18), congenital (e.g., chromosomal anomalies, OR>2, ages 3-18), and mental disorders (e.g., intellectual disability, OR>1.7, in children aged 6-18). In addition, we found evidence of ten novel phenotypic categories, including endocrine-metabolic (e.g., failure to thrive, OR=2.5, in children aged 0-2), digestive disorders (GERD, OR=1.7 in children aged 6-11 and constipation OR>1.6 in children aged 3-11) and sense organs (strabismus, OR>1.8 in children aged 3-18), that mark a differential, gender-related indicator for children with ASD.

**Conclusions:** This study uniquely contributes to the growing body of research regarding sex-based comorbidity analysis in an ASD population. Our findings provide insights into female-enriched ASD comorbidities that might be important in diagnosis, as well as the identification of distinct comorbidity patterns influencing anticipatory treatment or referrals.

**437.006 (Poster)** Increase in Referrals of Children with Suspected Autism Spectrum Disorder (ASD) from Child Health Surveillance to Specialized Services, in Uruguay, Based on Changes in Health Policies  
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Background: ASD have increased their prevalence worldwide in recent years, detection and a precocious diagnosis are essential to initiate treatment as early as possible. Child health surveillance carried out by pediatricians, in primary health care, represents an important step in detection. Timely referral to specialists for diagnostic confirmation and initiation of early interventions is crucial. Recently [Montiel-Nava et. al 2020] in a survey study, estimated age of first first parents concerns in Uruguay was found at 21 months, and age of ASD diagnosis at 49. In our country, policy efforts have been made to shorten this time gap. In 2005, an integrated national health system (NHIS) was created. This system allows a greater coverage of medical care for the general population. Since 2008, the universal and mandatory use of the child control booklet is implemented. This booklet includes developmental alerts aimed at caregivers. Moreover, a National guide for development monitoring was designed and begun implementation in 2010. This guide is used in child health surveillance visits in pediatric consultation in primary health care for the evaluation of every child under 5 years of age. Furthermore, training programs for the correct implementation of the guideline were carried out for medical personnel. The ASD specialized outpatient clinic, created in 2005 in the pediatric hospital of national reference (CHPR) receives patients from the first level of care from across the country. Our interest is to analyze the characteristics of the referrals and their trends since its creation.

Objectives: To examine and compare the characteristics of patients referred from pediatric visits in children and adolescents who are referred to the ASD outpatient clinic at CHPR, and their trends during the 2005-2018 period.

Methods: Observational, descriptive study from anonymized patient records. Patients visiting for the first time, referred from pediatric consultation in the first level of care, during the period January 2005-July 2018 were analyzed. Data were analyzed using SPSS. The study is approved by the research ethics committee.

Results: In the period 2005-July2018, 331 patients who consulted had referral data. 12% corresponded to patients referred by pediatricians, occupying the 3rd place after psychiatrists and neuropediatricians. It is reported that in 59% of cases it was the family who detected the first symptoms. A statistically significant 8 fold increase ( $p < 0.05$ ) is observed in patient referrals by pediatricians in the 2015-June2018 period (Graph1). In other variables studied (Table1), no statistically significant differences were observed, maintaining temporal stability in the studied years.

Conclusions: The significant increase of referrals from pediatricians may be related with the impact of healthcare strategies. Despite this, the increase is not associated with a lower age of referral, age of identifying first symptoms or age of ASD diagnosis. A limitation is that the ASD outpatient clinic is not part of the primary healthcare system, so the impact of strategies for earlier detection and diagnosis could be shown with less sensitivity or need more time to be detected. We consider that it is important to keep monitoring in order to observe the impact of implemented strategies.

**437.007 (Poster)** Is Meeting the 24-Hour Movement Guidelines Associated with Weight Status and Quality of Life in Children with and without Autism Spectrum Disorder?

**Background:** Children with autism spectrum disorder (ASD) experience higher rates of overweight and obesity and lower quality of life (QOL) than children without ASD. The 24h movement guidelines for children include recommendations for physical activity (60 minutes of moderate to vigorous intensity PA and more than 2 hours of structured and unstructured light intensity PA), sleep (9 to 11h), and sedentary behavior (< 2h of recreational screen time). Examining the 3 recommendations collectively across 24 hours, allows us to move beyond 60 minutes of MVPA to understanding how behaviors throughout the whole day influence the health and well-being of children with ASD.

**Objectives:** The purpose of this study was to determine whether 6 to 9-year-old children with and without ASD were meeting the individual and collective recommendations outlined in the 24h movement guidelines and examine how meeting the 24h movement guidelines influenced their body composition and QOL.

**Methods:** This study included 25 children with ASD (21 boys) and 23 children without ASD (19 boys) between the ages of 6 and 10 years. Physical activity was objectively measured using GT3X accelerometers worn on the hip for 7 days. Screen time, sleep, and QOL were determined by parent report. The Pediatric Quality of Life inventory was used to estimate health-related QOL and included summary scores for physical and psychosocial QOL. The recommendations were examined for week and weekend days. Body fat percentage was estimated using bioelectrical impedance analysis. Independent sample *t*-tests were used to examine how meeting the 24h guidelines influenced body fat and QOL.

**Results:** Children with ASD had significantly higher body fat percentages and lower QOL ( $p < .001$ ). Looking at the individual recommendations, children with ASD engaged in less physical activity, had fewer hours of sleep, and had significantly more screen time than children without ASD. During the week, 16% of children with ASD and 52% of children without ASD met the 24h movement guidelines. Overall, children with ASD met fewer recommendations on the weekend. Children who met the 24h movement guidelines had significantly lower body fat percentage ( $p = .001$ ,  $d = 0.93$ ) and higher estimates of physical ( $p = .038$ ,  $d = 0.61$ ) and psychosocial QOL ( $p = .023$ ,  $d = 0.75$ ).

**Conclusions:** Children with and without ASD who met the 24h movement guidelines were more likely to have a healthier body composition and higher estimates of QOL. By examining the recommendations collectively and across the whole day, we begin to understand which behaviors require targeted intervention. The results of our study demonstrate that to improve the health of children with ASD, we need to understand movement behaviors throughout the whole day and the whole week.

**437.008 (Poster) Mental Health Screening in Pediatric Primary Care for Children with Autism**

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**Background:** Co-occurring mental health problems among children with autism spectrum disorder (ASD) are highly prevalent and require lifespan, transdisciplinary and community participatory care approaches (e.g., Gotham et al., 2020). Pediatric primary care is a principal point of contact for children's healthcare and can be instrumental in first identifying and responding to mental health concerns (e.g., Van Cleave et al., 2018). Yet, limited research has examined mental health screening rates or prevalence for children with ASD in primary care.

**Objectives:** This study reports on mental health screening and patterns in pediatric primary care as part of a larger program of implementation research piloting Access to Tailored Autism INtegrated Care (ATTAIN), an integrated pediatric care model promoting timely identification of mental health needs and care linkage for children with autism (Stadnick et al., 2019).

**Methods:** Data were extracted from the pilot study testing ATTAIN feasibility in six primary care clinics within two healthcare organizations. The two organizations were: Organization 1: a linked health system serving families with private insurance and Medicaid; Organization 2: a large integrated health care system. Demographics and screening data from the Pediatric Symptom Checklist-17 (PSC-19; Jellinek et al., 1999), a brief mental health screener for children ages 4-16 years, were collected during the

four-month pilot, partially during the COVID-19 pandemic. The PSC-17 screening occurred during annual well-child visit appointments.

**Results:** A total of 166 children with ASD were eligible during the pilot period across both organizations (n=81 in Organization 1; n=85 in Organization 2). Eligible children were an average of 9.08 years ( $SD=3.46$ ) of age, 58% Latinx (n=47) and 84% male (n=68) in Organization 1 and an average of 8.00 years ( $SD=3.94$ ), 47% Latinx (n=40) and 81% male (n=69) in Organization 2. Screening rates were similar with 53% (n=43) of eligible children screened in Organization 1 and 55% (n=47) of eligible children screened in Organization 2. In Organization 1, 47% (n=20) screened positive, as evidenced by an elevated PSC-17 Total Score, while 36% (n=17) screened positive in Organization 2. For both organizations, children who had positive screens had clinically elevated scores on the Externalizing and Attention subscales but not on the Internalizing subscale.

**Conclusions:** In this feasibility pilot of ATTAIN, slightly over 50% of eligible patients with ASD were screened using the PSC-17. This screening rate was lower than expected due to changes in practice responsive to the COVID-19 pandemic but also suggests opportunities to refine implementation strategies to boost screening. Positive screening rates differed between organizations (47% versus 36%) but were generally high, reinforcing the co-occurring nature of mental health needs in children with ASD. Those who had positive screens also scored above the clinical cutoffs for both Externalizing and Attention subscales, confirming typical trends in co-occurring challenging behavior presentations in school-age children with ASD (Brookman-Frazee et al., 2017). Next steps are to conduct additional analyses to understand demographic and clinical patterns in screening rates and outcomes and to enhance strategies to improve screening in primary care in order to better provide more relevant and personalized treatments.

**437.009 (Poster)** Prevalence of Broad Autism Phenotype in Parents of Children with Autism Spectrum Disorder Using Autism Spectrum Quotient (AQ) in an Indian Sample Its Impact on Adaptive Behaviours, Behavioural Issues and Severity Children with ASD

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**Background:** This study aimed to find prevalence of BAP in parents of children with ASD in a diverse Indian sample and to determine if presence of BAP in parents affected child severity

**Objectives:** The primary objective of the study was to find **prevalance of BAP** and association of BAP in parents with severity of ASD. Secondary objectives were to find association of BAP in Parents with Behavioral problems and Adaptive behaviors in children with ASD

**Methods:** 95 children, ages of 2-12 years, newly diagnosed with ASD and their 95 mothers and fathers each, were enrolled from 1<sup>st</sup> April, 2019 to 15<sup>th</sup> February, 2020. Children were administered Childhood Autism Rating Scale-2 (CARS-2), Child Behaviour Checklist (CBCL), Vineland II Adaptive Behaviour Scale (VABS-II) for severity of ASD, behavioral problems and adaptive behavior and respectively. Autism spectrum Quotient (AQ) was administrated to all parents. AQ was translated to Hindi and piloted, before commencement of the study. Few questions were adapted to suit cultural requirements.

**Results:** Prevalence of BAP (AQ scores  $\geq 23$ ) was 50% in mothers, and 47% in fathers. Mean maternal AQ was 22.4 and mean paternal AQ was 21.8.

Mean child age was  $65.02 \pm 30.71$  months with the male: female ratio of 2.8:1. 65.3% of the children had severe autism, while 32.6% had mild to moderate autism. The mean CARS-2 score was  $38.87 \pm 5.39$ .

Significant positive correlation was found between CBCL externalizing T- score and communication subdomain of AQ score in both parents. Significant negative correlation was found between VABS-II motor domain standard score with both parents' total AQ score. Regression analysis revealed father AQ communication subdomain score as a significant predictor of VABS motor skill subdomain ( $\beta = -0.276$ ,  $p = 0.034$ ). No association was found between severity of ASD in children and BAP in parents.

**Conclusions:** Most global studies show lower BAP prevalence and lower total mean AQ scores in both mothers and fathers as compared to present study. No significant difference was seen between mothers and fathers in any of the AQ subdomain, in contrast to western population. The higher all-over prevalence of BAP and higher AQ scores may be explained by? higher genetic loading needed for ASD symptoms to manifest. In view of more child centred rearing practices & traditions (especially in joint families) or the cohort consisted of more severe children with more BAP manifestations in the parents.

Children with the best motor functioning are shown to have to lowest cognitive impairment and ASD severity, as per studies analysing Artificial Neural Networks. Impaired parenting skills such as poor encouragement of child's play can thus impact severity in children.

Correlation between communication subdomain of AQ of both parents and more severe child externalizing behaviour can either be attributed to behavioural problems being marker of genetic risk; or to the lack of effective two way communication in such triads.

Defective parent-child interactions may affect parent mediated interventions, which are a norm in ASD management especially in developing country like India. Parents with BAP may require additional support for the successful delivery of parent-mediated interventions.

**437.010 (Poster)** The Association between Parent Concern about Child Weight and Parental Use of Restrictive Feeding Practices in Typically Developing Children and Children with Autism Spectrum Disorder.

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Background: Parents concerned about child overweight may use restrictive feeding practices, which may contribute to the development of unhealthy eating behaviors in children (e.g., emotional eating and overconsumption of restricted foods). Parents of children with autism spectrum disorder (ASD) must often balance feeding challenges (e.g., food selectivity) and behavioral concerns in addition to concerns about health, such as child overweight. The relationship between concern about child overweight and use of restrictive feeding practices may therefore be different between parents of typically developing (TD) children and children with ASD.

Objectives: To compare the association between parent concern about child overweight and use of restrictive feeding practices between TD children and children with ASD.

Methods: We examined a diverse convenience sample of children (3-8 yo) and their parents from the Children's Mealtime Study, which recruited TD children and children with intellectual disabilities (ID). Children with ID with scores  $\geq 65$  on the on the Autism Rating Scale were classified as having probable ASD. Included in this analysis are 59 TD children and 34 children with ASD. Parents completed the Comprehensive Feeding Practices Questionnaire which included two domains capturing restrictive feeding practices: restriction of less healthy foods/sweets and restriction to decrease/maintain the child's weight. Parents reported their level of concern about their child "becoming overweight" and "being overweight," separately on a 5-point Likert scale. The two items were combined and dichotomized to represent "any concern" about child overweight where "any concern" ranged from "a little" to "very" concerned. Linear regression models adjusted for child weight status (0 "no overweight/obesity" 1 "overweight/obesity") were used to examine the association between parent concern about child overweight and restrictive feeding practices. Interaction terms were used to examine group differences.

Results: Nearly 70% of parents of children with ASD reported being concerned about their child's current or future weight status compared to 31% of parents of TD children ( $p < 0.001$ ). Among children with ASD, having any concern about child overweight was not associated with restrictive feeding practices ( $p > 0.05$ ). Conversely, among TD children, parents with any concern about child overweight were more likely to restrict child food intake to maintain or decrease child weight ( $\beta = 0.52$ ;  $p = 0.015$ ) and to restrict child intake of less healthy foods and sweets ( $\beta = 0.80$ ;  $p = 0.007$ ) compared to parents with no concern. Group interaction terms (TD vs. ASD) were not statistically significant ( $p > 0.05$ ).

Conclusions:

Significant associations between parental concern about child overweight and restrictive feeding practices were observed among parents of TD children but not among parents of children with ASD. Compared to TD children, associations among parents of children with ASD were weaker and may not have reached statistical significance due to the small sample size and young age of the sample (i.e., parental concern about overweight in younger children may be less influential). Future studies are needed to confirm these results. Understanding the drivers of parental feeding practices is important for developing recommendations and interventions that align with the needs and concerns of parents of children with ASD.

**437.011 (Poster)** The Complex Relationship between Greenspace and Wellbeing in Children with Autism, Children with Special Healthcare Needs (CSHCN), and Typical Children

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**Background:** There is a sizeable body of research on the impact of natural environments for typically developing children and those with ADHD. However, only two studies have examined whether natural environments impact metrics of wellbeing in children with autism spectrum disorder (ASD): One study found greenspace predicted lower conduct problems in children with ASD and another found greenspace associated with increased anxiety in children with ASD. Both studies were limited by their use of binary outcome variables.

**Objectives:** This study investigated the effects of zip-code level greenspace and greyspace (i.e., constructed non-natural surfaces) on a metric of wellbeing from the 2012 National Survey of Children's Health (NSCH).

**Methods:** The 2012 NSCH is a large cross-sectional public health survey of U.S. children birth to 17 years old. It includes a 5-item metric of wellbeing and caregivers reported on whether their child has an ASD. Greenspace and greyspace metrics were derived from the National Land Cover Database (NLCD). Data from the 2012 NSCH and the NLCD were merged at the zip-code level and data were analyzed with survey weighted and stratified regression models using R's survey package. Co-variables included children with special healthcare needs (CSHCN) status; whether they had anxiety, conduct problems, depression, or learning disabilities; sex, age, race/ethnicity, socio-economic status, maternal education, insurance status, and metropolitan size.

**Results:** The study sample includes 65,593 typically developing children, 1,393 children with autism, and 14,947 non-autistic CSHCN age 6 and older. Multi-variate models with just greenspace and greyspace showed that greenspace had a negative ( $p < 0.001$ ) and greyspace a null ( $p = 0.18$ ) relationship with child wellbeing. Follow-up analyses revealed complex greenspace X conduct problems X diagnostic interaction effects. For typically developing children, trend lines and 95% confidence intervals were non-overlapping; children without conduct problems had higher wellbeing scores than those with conduct problems, displaying little change in relationship to greenspace; typical children with conduct problems displayed a negative relationship indicating that as greenspace increases wellbeing decreases. For children with ASD, trend lines and 95% confidence intervals were non-overlapping; children with ASD and no conduct problems had higher wellbeing scores than those with conduct problems, and displayed a negative relationship indicating that as greenspace increases wellbeing decreases; children with ASD and conduct problems displayed a negative relationship indicating that as greenspace increases wellbeing decreases. For CSHCN, trend lines and 95% confidence intervals were non-overlapping; CSHCN and no conduct problems had higher wellbeing scores than those with conduct problems, and displayed a positive relationship indicating that as greenspace increases wellbeing increases; CSHCN and conduct problems also displayed a positive relationship indicating that as greenspace increases wellbeing decreases.

**Conclusions:** In typical populations, the literature largely supports that natural environments positively impact wellbeing; however, these data suggest that the relationships may be more complex depending on the diagnostic traits of the population studied. A major limitation of this analysis is that greenspace was measured at the zip-code level; local measures are needed to draw firm conclusions.

**437.012 (Poster)** The Effects of Distraction on the Self-Regulation of Preschoolers with Autism Spectrum Disorder

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**Background:** Effortful control is the ability to self-regulate to achieve current and future objectives (Rueda, Posner, & Rothbart, 2005). The presence of distraction can assist with attention and impulsivity control in typically developing (TD) children but this relation between distraction and self-regulation has received less research attention among preschool-age children with autism spectrum disorder (ASD) (Mischel & Ebbsen, 1970). The error related negativity (ERN) is thought to be a neural index of error-monitoring, conflict detection, reinforcement learning, error-related distress, and the motivational significance of errors (Canen & Brooker, 2017).

**Objectives:** This study aimed to determine whether there are significant differences in the self-regulation of preschool-age children with (ASD) as compared to TD preschool-age children using effortful control and delay tasks. Electroencephalography (EEG) tasks were additionally conducted to determine whether there is a correlation between the error-related negativity (ERN) waveform and behavioral measures of effortful control.

**Methods:** Preschoolers ranging from four to six-years-old ( $N = 20$ ) with and without ASD participated in this study ( $n = 14$  participants with ASD). The Delay of Gratification (Mischel & Ebbsen, 1970) and Rabbit-Turtle (Kochanska, Murray, & Harlan, 2000) tasks were used to evaluate self-regulation. This study compared the original tasks to an adapted condition with additional toys for distraction.

EEG was recorded during the Attention Network Test (ANT) for 12 of the above participants ( $n = 9$  participants with ASD). The ERN component was examined over Fz consistent with the prior reports (Brooker, Buss, & Dennis, 2011; Canen & Brooker, 2017).

**Results:** Data collection is ongoing. ASD and TD groups did not differ in completion of Delay of Gratification overall,  $F(1, 18) = 0.07, p = .79$ , or by distraction condition,  $F(1, 18) = 0.34, p = .57$ . Across groups, attention behaviors differed by distraction condition,  $F(1, 18) = 23.39, p < .001$ . The difference in Rabbit-Turtle reaction time was larger for the non-ASD group,  $F(1, 21) = 4.69, p = .042$ , and both groups had less slowing for the Turtle condition when distractors were present,  $F(1, 21) = 5.93, p = .024$ . Preliminary analysis of the ERN data indicates a trend effect of diagnostic group by condition (ERN/CRN) interaction, such that TD children had more negative ERN relative to CRN than the ASD group,  $F(1, 12) = 4.14, p = .065$ . Finally, children in both groups who were able to slow more for the Turtle condition of Rabbit-Turtle had longer delay times for the Delay of Gratification task,  $r(15) = .65, p = .009$ , and had less attention to the temptation,  $r(15) = .61, p = .017$ , without distractors present.

**Conclusions:** These preliminary results indicate that distraction impacts the self-regulation of preschoolers and can differ between ASD and TD groups, shown by both the individual tasks and the correlation between behavioral tasks. Additionally, the preliminary ERN data demonstrate a trend that the ERN is present in the TD group and is not in the ASD group. In future the analyses will account for IQ using the Mullen nonverbal developmental quotient and will investigate the relationship between ERN and the behavioral tasks.

**437.013 (Poster)** The Impact of COVID on Families' Wellbeing with Children with ASD

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Background: The COVID-19 pandemic has disproportionately affected Black, Indigenous, and People of Color (BIPOC) and low-income families. It has disrupted the lives of young children in ways that could have lasting effects on long term outcomes. Potential mechanisms include financial hardship, caregiver stress, and exacerbation of behavioral symptoms. Children with Autism Spectrum Disorder (ASD) may be particularly vulnerable.

Objectives:

To explore the effects of the COVID-19 pandemic on BIPOC and low-income families with children with ASD.

Methods:

We sampled across our research team's previous studies that recruited low-income, racially and ethnically diverse families of young children with psychosocial and developmental risk, including ASD. We administered the Epidemic-Pandemic Impacts Inventory (EPII) to families via phone. The EPII 92-item tool assesses the effects of financial hardship and changes in family dynamics. We examined descriptive statistics and results from chi-square tests comparing the reported financial hardship, family conflict and child behavioral symptoms among families of children with and without ASD.

Results:

To date, the study has enrolled 76 families; 54.0% identified as Black/African-American, 31.1% as Hispanic, 16.2% as white, 8.1% as mixed-race, 5.4% as Asian, and 2.7% as American Indian/Alaska Native. The majority (71.6 %) received public health insurance; 47.3% of families were unemployed. Twenty-one percent of families had a child with ASD, ascertained by evaluation that included administration of the ADOS.

A large proportion of families reported financial hardship, defined as experiencing difficulty accessing sufficient food and paying important bills (49%); 61.8% reported being laid off from work and/or reduced work hours during the pandemic. There were no differences among ASD and non-ASD families.

Reports of increased child behavioral and sleep difficulties were common. However, families of children with ASD were disproportionately affected; 87% of ASD families vs 58% of non-ASD families reported an increase in child behavior and sleep difficulties ( $p = 0.030$ ). Families of children with ASD also experienced an increase in physical conflict among the children in the home compared to non-ASD families (31% vs 11%,  $p=0.056$ ). Overall, there was a marked increase in family conflict but these changes did not affect families of children with ASD differentially. 34.2% of respondents reported increased verbal and physical argument or conflicts with adults at home and 44.7 % reported more conflict with their children or more harshly disciplining children. There were some positive changes associated with the pandemic: 92.0% of families reported spending more quality time with their children.

#### Conclusions:

Overall, this sample of low-income, largely BIPOC families of young children reported profound effects of the COVID pandemic on their financial wellbeing, conflict in the home, and child behavior. Families of children with ASD experienced a disproportionate increase in child behavioral problems and physical conflict between children compared to non-ASD families. The cumulative effects of increased material hardship and family conflict may result in levels of toxic stress, which have lasting impacts. Study data collection is ongoing and will assess family impacts longitudinally during the pandemic and recovery post pandemic.

#### **437.014** (Poster) The Impact of COVID-19 on the Autism Service Delivery System in Alberta

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#### Background:

For children with autism, the COVID-19 pandemic has resulted in significant changes to daily life. These changes have variably resulted in anxiety and other challenges (e.g., depression, sleep disruption) with unknown long-term impact. While social, psychological and economic implications are anticipated, coping may be affected in varying ways, including some children having great difficulty adapting and others experiencing less struggle. Mental health issues, parental anxiety, economic instability, lack of access to services, and financial strain encompass factors that may exacerbate personal and family strain. Further study is needed to understand the impact of COVID-19 on children with autism and their families, and service providers.

#### Objectives:

As part of a larger study, this qualitative sub-study explored the lived experiences of children with autism and their families during the COVID-19 pandemic, along with that of service providers who provide child and family support.

**Methods:** Three focus groups were convened during the pandemic with service providers in Edmonton, Canada. Sixteen service providers in areas of professional or para-professional service (e.g., occupational therapy, psychology, education) participated in focus groups, using Zoom technology. Focus group questions focused on how the pandemic impacted children/youth/families as well as service providers and their practice.

#### Results:

Analysis revealed differential impacts of the pandemic on children and families as well as service providers. Service providers reported pivoting from *in-person* to *online* to *in-person* in some instances (e.g., home visits) and a hybrid of *online and in person* services. Service providers reported requisites of continual sanitization and PPE often in families' homes (e.g., wearing masks, repeatedly wiping down equipment), periodic social distancing, and some requiring quarantine. These shifts resulted in a range of responses from children and families, with some being able to readily adapt to changes such as social distancing, and some positive parent reports of appreciation for more time to engage with their child. On the other hand, these shifts were reported as devastating in varying degrees for many, with some families having negligible resources when they viewed these resources as most needed. Of further concern, social determinants of health barriers were described to heighten family stress such as multiple children with autism in a family, and complex social needs. Shifts in service delivery were viewed to offer new ways to connect with families (e.g., online), with increased access to families' natural surroundings (e.g., home environment), yet simultaneously imposed struggles such as, in some cases, less access to or engagement with some children and families. For some families, online service delivery increased their sense of engagement while for others, it was viewed as less effective than in person alternatives. For service providers themselves, the shifting service delivery environment reportedly resulted in personal/professional stress. They reported exhaustion from revised practice approaches (e.g., social distancing in homes and

classrooms). Service providers also reported fatigue due to working longer hours, having heavier workloads, and often struggling with finding a life/work balance.

Conclusions:

Findings reveal challenges and means by which autism service delivery can better provide care to families in a pandemic.

**437.015** (Poster) Understanding Behavioral Inflexibility and Anxiety in ASD during the COVID-19 Pandemic

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**Background:** The COVID-19 Global Health Pandemic has presented unique challenges to individuals with Autism Spectrum Disorder (ASD) and their families. Behavioral inflexibility (BI), a prominent feature of ASD, is commonly associated with anxiety and requires families with ASD individuals to undertake extensive planning in order to ensure that daily life runs smoothly (Sethi et al., 2019). Due to the pandemic's unprecedented nature, families faced the inability to make necessary preparations, causing upended daily routines. Understanding both BI and anxiety during the COVID-19 pandemic is important to understand well-being for those on the spectrum during this time.

**Objectives:** Our study aims to (1) Characterize BI in ASD during/following the COVID19 pandemic and compare to prior BI data and to (2) Examine how parents of ASD adolescents describe their child's BI in response to the pandemic.

**Methods:** This convergent-parallel mixed-methods research study (Creswell & Piano Clark, V., 2017) was completed in two phases. During *Phase One*, parents of ASD children (N=46) who originally participated in Project BIDD completed the Behavioral Inflexibility Scale (BIS) (Lecavalier et al., 2020), the Parent Rated Anxiety Scale for ASD (PRAS-ASD) (Seahill et al., 2018), and the Parenting Stress Index (PSI) (Abidin, n.d.). In *Phase Two*, a subset of parents of ASD adolescents (N=11) participated in one of four virtual WebEx focus groups to help increase our understanding of ASD adolescent BI. To examine the association between relevant variables, linear regression and Pearson's correlations were used. Qualitative data was transcribed verbatim and analyzed using thematic analysis. Quantitative (based on n=46) and qualitative findings (based on n=11) were merged by using qualitative and quantitative data simultaneously to explain findings. Key results are presented below.

**Results:** Three organizing themes were identified: relative stability of BI during COVID-19, anxiety and BI during the COVID-19 pandemic, and the multiple new roles of caregivers. Caregivers reported negligible decreases in their child's BI during the pandemic in surveys (Change in BIS Sum  $M = -0.38$ ,  $sd=23.38$ ,  $t = -0.80$ ,  $p = 0.43$ ). In focus groups, caregivers discussed how their child's inflexibilities were magnified during the start of the pandemic, but returned to baseline as parents found new routines and adaptations. Child BI was moderately correlated with child anxiety ( $r = 0.65$ ,  $p < .001$ ). During focus groups, caregivers shared stories of children's anxieties increasing when preferred restaurants and activities were no longer available. Interestingly, BI was not related to caregiver stress ( $r = 0.26$ ,  $p = 0.09$ ). During focus groups, caregivers reported high stress levels, (PSI  $M = 90.56$ ), which may be explained by the fact that participants reported taking on new and multiple roles to help their child during this time. Additional themes and findings from the mixed-methods analysis will be presented.

**Conclusions:** BI remains a prominent concern for ASD individuals and their families during the COVID-19 pandemic. Though BI levels remained relatively stable during COVID-19, parents experienced high levels of stress likely due, in part, to the multiple roles now required of them. Implication of these findings for research and clinicians will be discussed.

## Postmortem Studies

### POSTER SESSION — POSTMORTEM STUDIES

#### Poster 438 - Postmortem studies Posters

**438.001** (Poster) Prefrontal and Primary Somatosensory Cortex in Fragile X Patients Is Characterized By Decreased Number of Parvalbumin-Expressing Interneurons

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#### Background:

Fragile X syndrome (FXS) is a genetic neurodevelopmental disorder that is characterized by the deficiency or absence of the fragile X mental retardation 1 protein (FMRP). FXS is the most common single gene disorder that accounts for up to 6% of all Autism Spectrum Disorder (ASD) cases. Many behavioral deficits that characterize FXS, such as cognitive impairment and sensory hypersensitivity, closely overlap with those seen in ASD. It is therefore reasonable to suggest that the underlying brain circuitry in these two populations may undergo similar cellular and molecular cortical modifications during and after neurodevelopment.

Recent findings in ASD postmortem brains from our laboratory show a 50% loss of one of the three major types of cortical GABAergic interneurons in the prefrontal cortex (PFC), the Parvalbumin (PV)+ interneuron. However, there have not been any large-scale human studies that have investigated changes in the 3 cortical GABAergic expressing interneuron populations in FXS postmortem brains.

#### Objectives:

Investigate cortical areas with potential role in the FXS phenotype. These include dorsolateral PFC (Brodmann Area (BA) 46), primary somatosensory cortex (BA3), temporal cortex (BA22), anterior cingulate cortex (BA24), primary visual cortex (BA17) and primary motor cortex (BA4). Our objectives are to: 1) evaluate changes in the PV+ cortical interneuron population across cortical regions and 2) determine if these changes are similar to those previously seen in ASD.

Methods: We will perform triple immunostaining for three interneuron subtypes (CR+, CB+ and PV+) in postmortem human cortical tissue. The total number of cases to be included in this study are 9 Fragile X and 9 control cases. Immunopositive CR+, CB+ or PV+ cells from each selected BA will be quantified from a 3-mm wide bin that is parallel to the pial surface and extends through the entire length of cortical gray matter, using the 40x objective on a light microscope. We will compare total cell numbers and cell ratios using ANOVA.

Results: We have so far quantified the total number of a set of Fragile X (n= 6-7) and control cases (n= 5). At the time of this writing, quantification in BA46, BA3, and BA22 have been performed by blind researchers, while quantification in BA24, BA4 and BA17 are ongoing. Preliminary results indicate a decrease of 38% ( $\pm 6.4$ ) of PV+ cells in BA46 and 30% ( $\pm 5.6$ ) in BA3. However, the total number of CB+ and CR+ cells did not differ in neither of these two cortical regions. Interestingly, there was no notable changes in any of the three interneuron populations within BA22.

Conclusions: Our findings in FXS brains demonstrate that the magnitude of reduced PV+ interneurons in BA46 and BA3 is very similar to that seen in human ASD brains. Furthermore, we show that the decreases in PV+ interneurons are consistent across multiple Brodmann Areas, thereby implicating potential cortical wide deficits in the PV+ population. Collectively, these findings provide us a better understanding of notable interneuron population changes that occur in FXS brains.

## Rare Genetic Disorders

### POSTER SESSION — RARE GENETIC DISORDERS

#### Poster 439 - Rare genetic disorders Posters

**439.001** (Poster) 18p Deletion Syndrome with Co-Occurring Autism Spectrum Disorder and Average Verbal Comprehension Abilities: A Case Study

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Background: 18p deletion syndrome is a well-established rare chromosomal syndrome affecting approximately 1 in 50,000 live births worldwide. The genetic disorder involves deletion of a part or the entire short arm of chromosome 18 first described by Jean de Grouchy and colleagues in 1963. To date, the vast majority of empirical studies and case reports focus on medical complications rather than developmental and neuropsychological functioning. This case report details the unique characteristics of a 10 year old female patient with confirmed 18p deletion syndrome via chromosomal microarray and co-occurring autism spectrum disorder (ASD) requiring substantial support with mild intellectual disability. The patient demonstrated average verbal comprehension abilities, significant deficits in adaptive behavior and nonverbal cognitive functioning, mild language impairment within the context of ASD/co-occurring mild intellectual disability. Previous case reports have found far more severely impacted verbal abilities in individuals with 18p deletion syndrome with or without co-occurring ASD.

Objectives: To contribute to the growing body of literature on the heterogeneity of 18p deletion syndrome and co-occurring disorders (e.g., autism spectrum disorder and attention-deficit/hyperactivity disorder).

Methods: Parent consent and patient assent were obtained. Patient completed a comprehensive psychological evaluation consisting of the ABAS-3, ADHD-5, ADOS-2, BASC-2, BRIEF-2, CPT-3, WIAT-III, and WISC-V. A psychometrician who was blinded to the referral concerns and prior diagnoses administered cognitive and achievement measures. The psychometrician achieved 95% or greater interrater reliability on each measure prior to administration. Other measures were administered and interpreted by a licensed psychologist with significant experience assessing for autism spectrum disorder. Prior chromosomal microarray analysis (4x180K G3 CGH+SNP) was completed by a physician board certified in clinical genetics confirming presence of 18p deletion.

Results: Patient met DSM-5 diagnostic criteria for autism spectrum disorder requiring substantial support with accompanying intellectual disability (mild severity) and language impairment. Additionally, DSM-5 criteria for provisional other specified attention-deficit/hyperactivity disorder with elevated symptoms of inattention without impulsive/hyperactive symptoms was met. The results of the WISC-V found significant deficits in visual spatial, fluid reasoning, working memory, and processing speed performance but average verbal comprehension abilities in contrast to other case reports on 18p deletion syndrome. Knowledge of word definitions was not identified as a restricted interest in the patient.

Conclusions: The results of the present case study correlate with extant results of previous findings related to 18p deletion syndrome related to co-occurring mild intellectual disability. The present case study also found far stronger verbal comprehension abilities versus other areas of intellectual functioning in a 10 year old female patient with co-occurring autism spectrum disorder which other case reports have not found. The present case study contributes to the literature on autism spectrum disorder and co-occurring rare genetic disorders for which there is a paucity of information while informing treatment recommendations.

**439.002** (Poster) Absence of 40-Hz Auditory Steady State Response (ASSR) in 15-Years Old Girl with Microduplication in 22q13.33

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#### Background:

Abnormalities in the SHANK3 gene located in 22q13.33 are highly associated with autism spectrum disorder (ASD). A few cases with microduplication of the SHANK3 gene reported in the literature include intellectual disabilities, mild dysmorphic features, ASD, delayed speech and language development, as well as attention deficit and hyperactivity disorder.

SHANK3 encodes scaffold protein involved in postsynaptic receptor density in glutamatergic synapses, including those in the parvalbumin(PV)+ inhibitory neurons – the key players in generation of sensory gamma oscillations, such as 40-Hz auditory steady-state response (ASSR).

### **Objectives:**

Our goal was to examine if ASSR is atypical in patients with microduplication affected SHANK3 gene.

### **Methods:**

Here we describe a clinical and neurophysiological phenotype of a 15-years old girl (SH01) with microduplication of 16389 bp in 22q13.33, affecting the SHANK3 gene revealed with high resolution molecular karyotyping (SNP Array).

Clinical assessment was conducted by experienced clinicians. In addition, most subjects' parents (n = 9), including SH01's, filled Russian translation of Social Responsiveness Scale (SRS). All TDs' SRS were less than 59 T-score.

Age-matched group of typically-developing children (TD) (N=11, 5 females, age=14.9±1.5(12.6-18.0)) was used as a comparison sample.

All participants took part in the EEG experiment (Neurotravel 32-channels system). During the study they watched silent videos while stimuli were presented via earphones. Auditory stimuli were 40Hz-click trains presented binaurally for 500 ms with inter-trial intervals varied between 500 and 800 ms (N=150 trains). Data were segmented into 1000 ms epochs (-200-800 ms). To calculate ASSR, EEG signal was filtered at 35-45 Hz, while to obtain auditory event-related potential (ERP) at 1-30 Hz. Then, trials with amplitude within 3 STD of the mean were averaged. To better characterize ASSR we used the envelope of filtered signal (Hilbert transform). Baseline correction for the -200 0 ms were applied.

The study was approved by the institutional ethical committee and all participants and their guardians provided informed consent.

### **Results:**

SH01 was diagnosed with mild mental retardation and learning disabilities (F70.88). She has problems with reading and writing, and pronouncing long and complex words, as well as smaller vocabulary than TD peers. Her face is elongated and auricles are protruding, resembling the phenotype of previously described patients with 22q13.33 microduplication. SH01's SRS equals 63 T-scores, which referred to mild autistic symptoms, while neither psychiatric assessment nor the Autism Diagnostic Interview-Revised (ADI-R) suggest ASD. No seizures or MRI abnormalities were reported.

SH01's ASSR did not exceed the baseline values for the whole period of stimuli presentation with the mean value of -0.015 mkV. It was significantly smaller than in TD peers ( $p < 0.05$ ), whose values were above 0.053 mkV for all children with mean equals 0.232 (SD=0.107) mkV. At the same time the amplitudes of SH01's ERP components were unremarkable.

### **Conclusions:**

Absence of 40-Hz ASSR in patient with microduplication, affected SHANK3 gene, indicates deficient temporal resolution of the auditory system, that might underlie language problems, and represent neurophysiological biomarker of SHANK3 abnormalities.

#### **439.003 (Poster) Autism Symptom Severity and Self-Injurious Behavior Among Individuals with ASD-Associated Disruptive Mutations**

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#### **Background:**

Previous research examining associations between autism symptom severity and self-injurious behavior (SIB) is limited and inconclusive, with variable results across studies and samples (Gulsrud et al., 2018; Richman et al., 2013; Steinfeldt-Kristensen et al., 2020). Identification of SIB correlates in monogenetic syndromes may clarify mechanisms of SIB in ASD (Minshawi et al.,

2015). Individuals with disruptive mutations to ASD-associated genes exhibit variable autism symptom severity and may or may not meet full diagnostic criteria for ASD (Beighley et al., 2020; Guo et al., 2018); this heterogeneity allows for examination of associations between ASD severity and other phenotypic characteristics in the context of genetic risk.

#### Objectives:

To determine whether autism symptom severity is associated with SIB status and severity among individuals with ASD-associated disruptive mutations.

#### Methods:

Participants were 124 individuals (mean age = eight years, 48.4% female) with a likely pathogenic mutation to one of eight high-confidence ASD-associated genes. 66.9% of participants met DSM-5 criteria for ASD. Participants completed assessments including the Autism Diagnostic Interview—Revised (ADI-R; Lord et al., 1994), Autism Diagnostic Observation Schedule, Second Edition (ADOS-2, Lord et al., 2013); Repetitive Behavior Scale—Revised (RBS-R; Bodfish et al., 2000), Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012), and a cognitive assessment. A dichotomous current SIB variable was created from the ADI-R per Dempsey and colleagues (2016), while the self-injury subscale of the RBS-R was used as a measure of SIB severity. ADOS-2 calibrated severity scores (CSS) for Social Affect (SA) and Restricted and Repetitive Behaviors (RRB; Hus et al., 2014; Hus & Lord, 2014) and SRS-2 subscales were used as measures of autism symptom severity. Logistic regression was used to determine whether autism symptom severity predicted SIB status after controlling for age and full scale IQ (FSIQ), while linear regression was used to determine whether autism symptom severity predicted SIB severity after controlling for age and FSIQ. A Bonferroni corrected significance level of  $\alpha = .01$  was used for SRS-2 subscale analyses.

#### Results:

ADOS-2 SA CSS, ADOS-2 RRB CSS, and ASD diagnosis were not associated with SIB prevalence or severity. SRS-2 social communication impairment was modestly associated with SIB status ( $\beta = 0.10, p = .006, OR = 1.11$ ) and SIB severity ( $\beta = 0.42, p < .001, \Delta R^2 = .17$ ) after controlling for age and FSIQ. RRB severity as measured by the SRS-2 was also modestly associated with SIB status ( $\beta = 0.07, p = .005, OR = 1.08$ ) and SIB severity ( $\beta = 0.31, p = .004, \Delta R^2 = .09$ ) after controlling for age and FSIQ.

#### Conclusions:

Caregiver-reported social communication challenges and RRBs were modestly associated with SIB status and severity among individuals with ASD-associated disruptive mutations, while clinician-observed symptoms and ASD diagnosis were not associated with SIB. Associations between autism symptom severity and SIB may be present but minor or related to measurement factors (caregiver report vs. clinician judgment; Richman et al., 2013), which could account for discrepant results across studies. Future research should examine factors that may better account for SIB in ASD-associated genetic disorders.

#### **439.004 (Poster)** Autonomic Nervous System Function Early in Development Predicts Later ASD and Anxiety Symptoms in Both Fragile X Syndrome and Typical Development

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Background: Autonomic nervous system (ANS) dysfunction is thought to underpin a variety of psychiatric problems, including ASD and anxiety. For example, studies utilizing cardiac indices of ANS function have documented that poorer parasympathetic nervous system regulation (e.g., lower respiratory sinus arrhythmia [RSA]) is associated with both anxiety and ASD, though the relationship between elevated general arousal (e.g., shorter interbeat interval [IBI]) and anxiety or ASD is less clear. It also remains poorly understood how the maturation of ANS function across early development influences the development of anxiety and ASD symptoms later in childhood. Fragile X syndrome (FXS) is a genetic disorder highly associated with ASD and anxiety symptoms. Previous studies have reported shorter IBI and lower RSA in FXS. However, almost nothing is understood about the developmental maturation of ANS function in infants with FXS or the cascading developmental repercussions of early ANS dysfunction on later anxiety and ASD symptoms.

Objectives: To (a) determine whether children with FXS exhibit atypical ANS maturation across infancy and early childhood; and (b) investigate whether ANS maturation early in life predicts ASD or anxiety symptoms in childhood.

Methods: Participants included 73 males with FXS and 79 age-matched typically developing (TD) males. Baseline heart activity (IBI, RSA) was recorded via electrocardiogram (ECG) at multiple assessments between 3 and 83 months of age, resulting in 372 observations (FXS  $n=175$ ; TD  $n=197$ ). ASD and anxiety symptoms were assessed at one timepoint at or after 24 months in a subgroup of participants (FXS  $n=28$ ; TD  $n=29$ ). ASD symptoms were quantified by the Autism Diagnostic Observation Schedule (ADOS-2) calibrated severity score. Anxiety symptoms were measured by the Spence Preschool Anxiety Scale (PAS) total t-score.

Results: Linear mixed models revealed a significant group\*age interaction for both IBI,  $F(1,116)=9.25, p=.003$ , and RSA,  $F(1,109)=12.01, p=.001$ , with the FXS males exhibiting smaller increases across age in both indices. Post-hoc analyses indicated groups differed significantly on IBI by 29 months,  $t(139)=-2.12, p=.036$ , and on RSA by 24 months,  $t(150)=-2.10, p=.037$ . Subject-specific slopes and intercepts were extracted for IBI and RSA and included in multivariate general linear models as predictors of later ASD and anxiety symptoms along with group and IQ. IBI intercept and slope significantly predicted later anxiety symptoms,  $F_s \geq 4.91, p_s \leq .005$ , but not ASD symptoms. RSA intercept predicted later ASD symptoms,  $F(1,48)=5.30, p=.026$ , but not anxiety symptoms. RSA slope did not predict later ASD or anxiety symptoms,  $F(2,47)=1.46, p=.242$ .

Conclusions: Findings indicate that developmental maturation in ANS function, as indexed by IBI and RSA, is slower in males with FXS than TD males across early development. Shorter IBI (i.e., faster heart rate), which indicates elevated physiological arousal, predicted higher anxiety symptoms in both groups, whereas lower RSA, which indicates poorer parasympathetic regulation, predicted higher ASD symptoms in both groups. These findings are in line with converging evidence of lower baseline RSA in children with ASD and anxiety. These results also suggest that different facets of ANS dysfunction early in life may confer risk for different psychiatric symptoms later in childhood.

**439.005 (Poster)** Characteristics of Individuals with Parent-Reported Diagnosis of Autism Spectrum Disorder within Pitt Hopkins Syndrome

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Background: Pitt Hopkins Syndrome (PTHS) is an extremely rare genetic disorder which has historically been closely associated with autism spectrum disorder (ASD). While individuals with PTHS have been observed to exhibit symptoms that closely mirror ASD (de Winter et al., 2016; van Balkom et al., 2012; de Pontual et al., 2009; Sweatt, 2013), there have been few studies which have specifically examined ASD-like symptomatology in this population. This issue is further complicated by the severe nature of cognitive impairments typically described in PTHS (Sweatt, 2013; Van Balkom, Vuijk, Franssens, Hoek & Heenekam, 2012). A recent study indicated that only 33% of parents reported that their child with PTHS had a diagnosis of ASD (Guest et al., in press), despite this close association.

Objectives: To examine differences between individuals with PTHS whom have a parent-reported ASD diagnosis versus those who do not.

Methods: Participants included primary caregivers of individuals with PTHS ( $M_{age}=8$  years,  $SD=4.91$ ) who participated in a comprehensive demographic interview ( $n=33$ ) and completed standardized measures ( $n=24$ ) including the Modified Checklist for Autism in Toddlers-Revised (MCHAT-R), Communication and Symbolic Behavior Scales-Infant Toddler Checklist (CSBS-ITC), Repetitive Behavior Questionnaire (RBQ), Short Sensory Profile-Second Edition (SSP-2), Parental Stress Index-Fourth Edition (PSI-4), and Vineland Adaptive Behavior Scales, Second Edition (Vineland-II). Two groups of individuals with PTHS were created, those whose caregiver reported an additional diagnosis of ASD ( $n=11$ ; ASD group) and those who did not ( $n=22$ , non-ASD group).

Results: Independent samples t-tests and Pearson chi-square tests were used to compare characteristics between ASD and non-ASD groups within this PTHS sample. No significant differences were found on demographic variables (e.g., age, age of diagnosis of PTHS), number of communication types, vocabulary size, loss of language or motor skills, tantrums, sensory preoccupations, unusual listening responses, aggression, food selectivity, Vineland composite scores, CSBS and MCHAT total raw scores, PSI scores, RBS domain scores, and RBQ domain scores ( $p's > .05$ ). The ASD group had significantly greater total diagnoses endorsed, higher scores on the DBC Disruptive/Antisocial domain, and higher scores on the DBC Social Relating Score ( $p's < .02$ ).

Conclusions: Individuals with PTHS whose parents reported an additional diagnosis of ASD in addition to PTHS did not differ on many domains commonly associated with ASD. Specifically, groups did not differ on restricted repetitive behaviors via RBS and RBQ, red flags for ASD via CSBS and MCHAT-R, adaptive skills via Vineland-II, parental stress via PSI-4, and other parent reported characteristics such as communication, sensory sensitivities/preoccupations, and regression of skills. The ASD group did

have higher numbers of total diagnoses, which may suggest that they have more severe presentations, resulting in a diagnosis of ASD. However, results suggest that more nuanced and gold-standard measures must be used to fully differentiate ASD in this complex population.

**439.006** (Poster) Characterizing the Family Experience of Children with *CHD8* Using an Innovative Online Platform  
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Background:

Disruptive mutations to *CHD8* are strongly associated with autism spectrum disorder (ASD; Bernier et al., 2014). Due to the rarity of *CHD8* mutations, affected families are dispersed internationally. We used an online app, Groopit, as a secure data collection tool to engage families of children with *CHD8* mutations. This project utilizes a participatory approach, operating from the framework that incorporating stakeholders as collaborators helps to ensure that research yields meaningful benefits to the community being studied (Fletcher-Watson et al., 2019).

While there is no known research regarding *CHD8* caregiver experiences, extensive research has demonstrated that parents of children with developmental disabilities (DD) are at heightened risk for psychological stress (Ashford et al., 2019). Assessing the benefits associated with caring for children with DD can also inform the caregiver experience (Hastings, 2016).

Objectives:

To partner with caregivers of children with *CHD8* mutations to characterize parenting experiences using an innovative online platform.

Methods:

Participants were nine parents of children (ages 2-11 years;  $M = 6.9$ ;  $SD = 3.5$ ) with disruptive *CHD8* mutations recruited from a Facebook family group. Parents identified top research priorities via Groopit, including caregiver stress and resilience. Participants provided background information and completed measures of parental stress related to rare genetic disorders (Genetic Syndromes Stressors Scale [GSSS]; Griffith et al., 2011) and caregiver resilience (Positive Gain Scale [PGS]; Pit-ten Cate, 2003).

Results:

Consistent with a *CHD8* phenotype (Beighley et al., 2020), the majority of children (85.7%) were previously diagnosed with ASD and/or global developmental delay/intellectual disability. Most parents (80%) reported that their primary motivation for participating in research via Groopit was for “us [parents] and the world to learn more about the *CHD8* mutation.”

Participants identified multiple sources of stress associated with their child’s rare genetic disorder. Common sources of high stress included: not having access to professionals with knowledge of their child’s condition (66.7%), an educational placement that doesn’t meet their child’s needs (66.7%), and worrying about their child’s future given a lack of adult specialist services (77.8%). Parents, on average, reported a high level of positive gain associated with having a child with a rare genetic disorder. All parents reported that raising their child helped put life into perspective and helped them learn new skills.

Conclusions:

Consistent with past research on parents of children with DD, parents of children with *CHD8* mutations identified parenting stress associated with their child’s genetic disorder. They identified their child’s current care and future receipt of services (e.g., services available in adulthood) as primary sources of stress; this may reflect limited professional understanding of rare ASD-associated genetic disorders and a lack of research on adult outcomes in these disorders. A better understanding of parenting experiences can inform future research priorities (e.g., adult outcomes) and practical resources to help with stress management and respond to parents’ specific concerns (e.g., *CHD8*-specific information packets for providers). Despite these sources of stress, all parents identified positive parenting experiences, highlighting the importance of considering positive gain in future research on caregiver experience in rare ASD-associated mutations.

**439.007** (Poster) Child and Maternal Predictors of Dysfunctional Parent-Child Interactions in Families of Boys with Fragile X Syndrome

**Background:** Fragile X syndrome (FXS) is a genetic disorder characterized by executive deficits including poor inhibitory control (IC), the ability to suppress a dominant response. Additionally, approximately 61% of children with FXS meet DSM-5 criteria for autism spectrum disorder (ASD). Mothers of children with FXS, who carry the *FMR1* premutation, are at heightened risk for depression and parenting stress. Child ASD symptoms and executive deficits have been associated with maternal distress and negative parent-child interactions in other neurodevelopmental disorders, but these relationships have not been studied in FXS.

**Objectives:** This study examined whether boys with FXS exhibit elevated IC deficits, and mothers of boys with FXS report higher depression symptoms or more severe parent-child dysfunctional interactions (PCDI), relative to typically developing boys and their mothers. Within FXS mother-child dyads, we explored whether child IC and maternal depression interact to predict PCDI, controlling for child ASD symptoms.

**Methods:** Participants included 71 males with FXS ( $M(SD)$  age = 44.03(15.09) months) and 52 chronological age-matched male controls ( $M(SD)$  age = 42.79(14.29) months) and their mothers. IC was measured via the Early Childhood Behavior Questionnaire (18-36 months) or the Children's Behavior Questionnaire (>36 months). Maternal depression and PCDI were assessed via the Beck Depression Inventory-2 and Parenting Stress Index-4, respectively. ASD symptoms were assessed via the Childhood Autism Rating Scale-2. Between-group differences were analyzed using independent-samples *t*-tests. Within the FXS group, a hierarchical multiple linear regression predicting PCDI from child and maternal characteristics was run.

**Results:** Boys with FXS exhibited greater IC deficits, ( $t(121)=6.09, p<.001$ ) and ASD symptoms ( $t(88.72)=12.62, p<.001$ ). Mothers of boys with FXS reported higher depression symptoms ( $t(103.99)=4.44, p<.001$ ), and greater PCDI ( $t(120.89)=8.28, p<.001$ ). Results of a hierarchical multiple linear regression predicting PCDI revealed a significant main effect of maternal depression ( $t(67)=2.68, p=.009, b=0.83$ ), and a marginally significant main effect of IC ( $t(67)=-1.72, p=.090, b=-1.82$ ). A child IC\*maternal depression interaction was also indicated ( $t(67)=-1.95, p=.055, b=-0.18$ ), with FXS families with lower child IC and higher maternal depression demonstrating more severe PCDI. Controlling for ASD symptoms did not significantly improve the model fit, and ASD symptoms did not significantly predict PCDI ( $t(66)=1.44, p=.156$ ).

**Conclusions:** Consistent with previous research, our results indicate that boys with FXS demonstrate impaired IC, mothers of boys with FXS exhibit higher depression symptoms, and FXS mother-child dyads evidence greater PCDI, compared to control families. Further, child IC and maternal depression interact to predict PCDI in FXS families, suggesting maternal and child characteristics influence each other and impact interaction quality. Whereas high child IC and low maternal depression may be protective, mothers of boys with FXS with IC deficits and with high depression symptoms may be particularly vulnerable to dysfunctional interactions, which may exacerbate psychological symptoms. Of note, ASD symptoms did not account for additional variance in PCDI beyond child IC and maternal depression. Together these findings suggest that interventions that target child IC and maternal depression may improve interactions in families of children with FXS, irrespective of child ASD status.

**439.008 (Poster)** Developing Angelman Syndrome-Specific Clinician-Reported and Caregiver-Reported Measures to Support Holistic, Patient-Centered Drug Development

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Background:

Valid and reliable measures reporting key symptoms and functional impairments of Angelman syndrome (AS) are required to support the development of patient-centered therapies. Yet, no disease-specific measures have been published to date which meet these criteria.

Objectives:

The main objective was to develop disease-specific measures for use in clinical trials which incorporate the most important symptoms and functional impairments for the treatment of AS. Specifically, to develop clinician-reported measures capturing AS symptom severity and change, and caregiver-reported measures capturing the impact of AS and change.

## Methods:

Best practice guidance for measure development was followed throughout with input from expert clinicians, patient advocates, and caregivers at multiple points during content generation and refinement. Initial measurement concepts were identified from a patient-centered conceptual model of the symptoms and impacts of AS, derived from interviews with caregivers and clinicians. Feedback from clinical and measurement experts was then sought to iteratively refine items and ensure wording was age-appropriate and captured AS-specific symptoms, as well as associated impacts and functional abilities. Importantly, items were phrased differently between the clinician-reported and caregiver-reported measures to maximize relevance and suitability.

Two rounds of cognitive debriefing (CD) interviews were performed; all participants were based in the United States. Five experienced, practicing AS clinicians debriefed the clinician-reported measures; 5 patient advocates along with 15 caregivers debriefed the caregiver-reported measures. To ensure relevance to the spectrum of AS severities and functional abilities, caregivers of children with AS were recruited for all genotypes and a broad age range (1-12 years). These CD interviews were conducted to explore concept relevance and comprehension.

Results: The Symptoms of Angelman Syndrome Clinician Global Impression (SAS-CGI) measure and the Caregiver-reported Angelman Syndrome Scale (CASS) were developed to capture global assessments for: seizures; sleep problems; maladaptive behaviors; expressive communication difficulties; fine motor skills impairment; gross motor skills impairment; cognitive impairment; and impairment in activities of daily living. In addition, a global item was included for assessing overall AS symptoms. In addition to assigning a rating for severity, impact, or change, a free text field is included in the SAS-CGI for clinicians to describe the clinical features. The CD interviews confirmed the measures covered the key concepts of AS for clinicians and caregivers. Second round interviews with clinicians and patient advocates demonstrated that the measures' instructions, items, response options, and recall period were all largely clear and appropriate. Adjustments to the wording of instructions and items were made based on interview feedback.

## Conclusions:

The SAS-CGI and CASS were designed to capture the most important concepts of AS. Robust development in collaboration with AS caregivers, advocates, and clinicians has resulted in content-valid measures. These measures have been incorporated into interventional and non-interventional studies for AS, which will allow the evaluation of their psychometric properties and determine whether further measure refinements are needed.

### **439.009 (Poster)** Developmental, Social and Emotional Characteristics of Girls and Young Women with DDX3X-Linked Intellectual Disability

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Background: Pathogenic variants in the *DDX3X* gene are a relatively common cause of intellectual disability (ID) in females, accounting for an estimated 1-3% of cases. Emerging characterization of *DDX3X*-linked ID based on collated clinical information points towards considerable variability in the range and scope of neurodevelopmental features associated with *DDX3X* variants. Previous studies have suggested potentially elevated rates of autism spectrum characteristics in individuals with *DDX3X*-linked ID. However, few studies to date have carried out post-diagnostic, standardized assessments to delineate the range and specificity of the developmental, social and emotional phenotype associated with *DDX3X*-linked ID.

Objectives: This study's objectives were two-fold. First, we set out to describe systematically the developmental, social and emotional features of a group of females with *DDX3X*-linked ID (n = 20). Second, we aimed to isolate potentially discriminating phenotypes, by comparing the characteristics of females with *DDX3X*-linked ID to those of females with pathogenic variants in other ID-associated genes (ID-comparison group; n = 22).

Methods: We collected systematic phenotyping data for individuals with ID, ascertained from clinical genetics services across the UK. Adaptive ability, autism spectrum characteristics and emotional-behavioural features were assessed via standardised questionnaires and interviews administered to parents, and researcher observations. We first described the characteristics of the *DDX3X* group, then drew comparisons between the *DDX3X* and ID-comparison groups using non-parametric statistical analyses.

Results: The *DDX3X* group demonstrated a range of abilities and difficulties across all of the domains we assessed. The majority of females with *DDX3X*-linked ID experienced significant autism-relevant social challenges. On average, adaptive abilities, autism-spectrum characteristics and overall emotional-behavioural difficulties were comparable across the *DDX3X* and ID-

comparison groups. However, the DDX3X group showed higher levels of anxiety ( $U = 138.50, p = .043, \eta^2 = .097$ ), and engaged more frequently in self-injurious behaviour ( $\chi^2 = 4.38, p = .036, \eta^2 = .10$ ), compared to the ID-comparison group. Parents of individuals with DDX3X-linked ID often reported that self-injurious behaviour is a response to anxiety or distress.

**Conclusions:** In this study, we highlight the heterogeneity of developmental, social and emotional characteristics in DDX3X-linked ID, as well as features that might differentiate this disorder from other causes of ID. Overall autism likelihood does not seem to differ from other causes of ID, but specific social and emotional characteristics may be associated with DDX3X-linked ID. In particular, females in this group may be more vulnerable to suffering from anxiety and engaging in self-injurious behaviour compared to those with other causes of ID. Future studies should investigate the development, onset and presentation of anxiety and self-injurious behaviours, and the mechanisms underlying phenotypic variability in this disorder.

**439.010 (Poster)** EEG Resting State Spectral Differences between SCN2A, Idiopathic ASD, and Typically Developing Controls  
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**Background:** The *SCN2A* gene modulates voltage-gated ion channels<sup>1</sup> with recent investigations finding that mutations may cause neurodevelopmental disorders (NDDs)<sup>2</sup>. Diverging phenotypes indicate that disruptions that generate a loss of *SCN2A* function exhibit ASD/ID, whereas disruptions that generate a gain of *SCN2A* function exhibit infantile epileptic encephalopathy (IEE)<sup>3,4</sup>. Given the diverse phenotypes found in individuals with ASD and high-risk mutations, resting state EEG may serve as a unique tool to identify targeted treatments for NDDs. Previous work in NDDs utilizes resting state electroencephalography (EEG) as a potential biomarker for certain clinical populations; for example individuals diagnosed with idiopathic seizures exhibit higher power in delta, theta, and alpha bands<sup>5</sup>. Moreover, exploration of such neural mechanisms of *SCN2A* have yet to be thoroughly investigated, thus warranting exploration into EEG resting state power.

**Objectives:** We explored differences in EEG band power for individuals with a *SCN2A* genetic mutation with IEE (+IEE) versus without IEE (-IEE) as a behavioral marker of loss versus gain of *SCN2A* function.

**Methods:** Data from 90 children (Table 1) were included in analyses. First, *SCN2A* gene groups were categorized by presence or absence of IEE characterized by seizures present before 1 year of age<sup>4</sup>. Second, we included comparison groups of children with ASD with no known genetic mutation (idiopathic) with either low nonverbal cognition (NVIQ<70; ASDLow, or average nonverbal cognition (NVIQ 85-115; ASDAve), as well as typically developing children (TD).

During a resting state EEG, children watched screensaver-like videos that were presented for two and a half minutes. Medial electrodes in the frontal, central, posterior, occipital regions were included. Group differences in EEG frequency bands were compared using repeated-measures linear mixed effects models with Bonferroni-correction.

**Results:**

Results revealed significant group by frequency interactions for absolute power across all frequency bands (Figure 1). For delta ( $F(4, 639)=29.179, p<.0001$ ) and theta ( $F(4, 639)=52.57, p<.0001$ ) bands, -IEE individuals exhibited higher power than all other groups, while +IEE exhibited higher power than ASDAve, ASDLow, and TD. For alpha, +IEE individuals exhibited higher power than ASDAve, ASDLow, and TD groups ( $F(4, 639)=3.973, p<0.01$ ). For beta, -IEE individuals exhibited higher power than the ASDAve group, while +IEE individuals exhibited higher power than ASDAve and TD groups ( $F(4, 639)=5.53, p<0.001$ ).

**Conclusions:**

This is the first resting state EEG study of this size examining spectral profiles of individuals with a *SCN2A* gene mutation. Results demonstrated differences in EEG spectral profiles for *SCN2A* groups when compared to idiopathic ASD and TD individuals. Within *SCN2A*, participants without IEE have higher power for delta and theta frequencies than those with IEE. Elevated power in delta, theta, and alpha bands for individuals with *SCN2A* mirrors prior work characterizing spectral profiles in adults with idiopathic generalized epilepsy<sup>6</sup>. Future studies should focus on aggregating more individuals with *SCN2A* with diverse phenotypes<sup>4</sup>.

**439.011 (Poster)** Features of Autism and Social Disability in 3q29 Deletion Syndrome

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**Background:** 3q29 deletion syndrome (3q29Del) is a rare genetic disorder caused by a 1.6 MB typically de novo deletion. 3q29Del is associated with a ~20-fold increased risk for autism spectrum disorder (ASD), in both males and females (Sanchez Russo et al., 2020). Prior research suggests that 3q29Del individuals without ASD also exhibit marked features of social disability (Pollak et al., 2019). This prior research further reports that the profile of ASD in 3q29Del is distinct from non-syndromic ASD (nsASD). These prior data rely on self-report measures, which can introduce limitations. Here, we seek to understand phenotypes of ASD and social disability in 3q29Del using data from direct evaluation by trained clinicians.

**Objectives:** To investigate features of ASD-related social disability in 3q29Del using gold-standard clinical assessment tools.

**Methods:** 31 individuals with 3q29Del (mean age 14.5, range 4-39) were assessed for ASD symptoms with the Autism Diagnostic Observation Schedule-2 (ADOS-2) and the Autism Diagnostic Interview, Revised (ADI-R). Clinician best-estimate diagnosis of ASD was made after comprehensive assessment. 51 individuals with nsASD (mean age 9.04, range 4-16) were also administered the ADOS-2. Since ADOS-2 scores from these samples span modules 2-4, social affect (SA) and restricted and repetitive behaviors (RRB) scores were converted. On modules 2 and 3, SA and RRB raw scores were converted to calibrated severity scores (CSS) (Hus et al., 2014). On module 4, SA and RRB raw scores were calculated and then converted to CSS (Hus & Lord, 2014). We compared SA-CSS and RRB-CSS between 3q29Del with ASD (3q29Del-ASD), 3q29Del without ASD (3q29Del-noASD), and nsASD. We also performed item-level analyses between these groups for 19 items that are consistent across modules 2-4. We tested for between-group differences in SA and RRB symptom severity and between-group differences at the ADOS-2 item level.

**Results:** 38.5% of 3q29Del study subjects qualify for an ASD diagnosis. 3q29Del-ASD and nsASD show similar RRB severity ( $p=.73$ ), but 3q29Del-ASD show significantly more severe SA symptoms than nsASD ( $p<.01$ ). 3q29Del-noASD exhibit low-to-moderate severity on SA symptoms (mean SA-CSS 3.84) and RRB symptoms (mean RRB-CSS 4.79). Item level analyses reveal that 3q29Del-noASD and 3q29Del-ASD score similarly on the Conversation item, as well as all items related to stereotyped behaviors and restricted interests (all  $p>.05$ ). Item level analyses further reveal that 3q29Del-noASD and nsASD score similarly on various items pertaining to language and communication (items 1, 5 and 6), the Amount of Social Overtures item, and all items related to stereotyped behaviors and restricted interests (all  $p>.05$ ) (Figure 1).

**Conclusions:** We find that 3q29Del-ASD and 3q29Del-noASD both exhibit autism spectrum-related symptoms, replicating previous findings. 3q29Del-noASD converges with 3q29Del-ASD and nsASD on symptoms related to repetitive behaviors in particular. These data suggest that 3q29Del-noASD have ASD-related social disability and may benefit from therapy to reduce vulnerability and strengthen social skills. Future directions will compare symptom profiles between groups to determine the extent to which ASD symptoms in 3q29Del overlap or diverge with those observed in nsASD. These findings have important implications for the clinical treatment of social disability in 3q29Del.

#### **439.012 (Poster) Gene Functional Networks and Autism Spectrum Characteristics in Young People with Intellectual Disability: A Dimensional Phenotyping Study**

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**Background:** The relationships between specific genetic aetiology and phenotype in neurodevelopmental disorders are complex and hotly contested. The potential for dual diagnosis of intellectual disability (ID) and autism spectrum disorder (ASD) recognises that autism characteristics vary within the ID population and are not an inevitable consequence of low cognitive ability and adaptive impairments. Understanding autism within the ID population is important, because autism predicts the complexity of educational, occupational and social support needs, and influences the well-being of family carers. One factor which can influence behavioural phenotypes, including autism, is the aetiology of each individual's ID. Genes associated with intellectual disability (ID) can be grouped into networks according to known molecular and cellular functions of genetic variants.

**Objectives:** In this study, we explored whether individuals with ID show differences in autism spectrum characteristics (ASC), depending on the functional network membership of their rare, pathogenic *de novo* genetic variants. We set out to establish (1) whether the distribution of autism characteristics within a sample of young people with ID was categorical, unidimensional or

multidimensional, (2) whether gene functional network group membership influenced likelihood of ASC, and (3) whether the predictors of ASC were the same or different between functional network groups, reflecting shared or distinct underlying mechanisms.

Methods: Children and young people with ID of known genetic origin were allocated to two broad functional network groups: synaptic physiology (n=29) or chromatin regulation (n=23). We applied principle components analysis to the Social Responsiveness Scale to map the structure of ASC in this population, then used Akaike Information Criterion (AIC) to test the best fitting models for predicting ASC components, including demographic factors (age, gender), non-ASC behavioural factors (global adaptive function, anxiety, hyperactivity, inattention) and gene functional networks.

Results: When mapping the structure of ASC, we identified three components – Inflexibility, Social Understanding and Social Motivation. We found that, when other factors are accounted for, the chromatin regulation group showed higher levels of Inflexibility. We also observed contrasting predictors of ASC within each network group. Within the chromatin regulation group, Social Understanding was associated with inattention, and Social Motivation was predicted by hyperactivity. Within the synaptic group, Social Understanding was associated with hyperactivity, and Social Motivation was linked to anxiety.

Conclusions: In this exploratory study, the genetic cause of an individual's ID (classified by functional network) did not predict overall likelihood of autistic features, but did influence dimensional autism characteristics and co-occurrences. These results indicate that genetic diagnosis is clinically relevant to understanding the social abilities and difficulties of individuals with ID, but only if genetic diagnosis is considered in the context of a multi-faceted assessment, encompassing dimensions within and beyond the autism spectrum. It is not yet known whether valuable outcomes such as social inclusion and mental health could be improved if these underlying mechanisms were to be considered targets for intervention. Future research should seek to replicate and extend these findings, and investigate the molecular, neural, cognitive and interpersonal mechanisms contributing to the development of social function for individuals with ID.

**439.013 (Poster)** How Do Parenting Stress and Child Autism Symptoms Relate to Caregiver Self-Efficacy during the COVID-19 Pandemic?

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Background: Caregivers of children with neurodevelopmental disorders experience increased stress and challenges related to parenting. Specifically, caregivers who have a child diagnosed with autism report high levels of parenting stress compared to other neurodevelopmental disorders (Craig et al., 2016). These stressors may be further amplified in families of children with autism symptoms and a co-occurring neurogenetic syndrome (NGS) due to increased cognitive impairment, co-occurring medical features, and sensorimotor impairments common to some of these conditions. Caregiver self-efficacy is important in the mental health and wellbeing of parents. However, it is unclear which caregivers might be struggling with self-efficacy during COVID-19, limiting understanding of how to intervene. The present study aims to address this gap by examining predictors of caregiver self-efficacy in a cohort of parents surveyed both prior to and during the COVID-19 pandemic.

Objectives: Our goal is to explore whether caregivers' current levels of self-efficacy during COVID-19 were related to pre-pandemic levels of parenting stress and child autism features.

Methods: Participants were caregivers of children with neurogenetic syndromes (n=35) enrolled in a longitudinal early phenotype study (PEPS) who provided data both before and after the COVID-19 pandemic began. At the time of their post-pandemic assessment, children were ages 1 to 6 years (mean=4) diagnosed with Angelman (n=9), Down (n=2), Fragile X (n=3), Prader Willi (n=8), and Williams (n=13) syndromes. As part of PEPS, families contributed measures of parenting stress (Parenting Stress Index, PSI; Abidin, 1995) and child autism behaviors (Child Behavior Checklist, CBCL; Achenbach, 2001). After the pandemic, we measured parenting self-efficacy using the Parenting Sense of Competence Scale (PSOC; Ohan et al, 2000). We hypothesized that parents with lower self-efficacy post-pandemic would be those with greater parenting stress and child autism symptoms pre-pandemic.

Results: We used multiple regression analyses to predict caregivers' current sense of competency from pre-pandemic parenting stress and challenging behaviors; we ran correlations to ensure that age was not a covariate. The multiple regression model with both predictors was significant with  $R^2=.179$ ,  $F(2, 32)=3.498$ ,  $p<.05$ . Overall parenting stress was a significant predictor of parenting self-efficacy ( $\beta = -.46$ ,  $p = .017$ ), but child behaviors related to autism were not ( $\beta = .09$ ,  $p = .626$ ). We also ran exploratory effects with overall challenging behaviors (CBCL Total) to probe for impact of general challenging behaviors, which were also not predictive of self-efficacy.

**Conclusions:** These results suggest caregivers who entered the COVID-19 pandemic with higher parenting stress may be at greater risk for poorer-self efficacy. These findings highlight the importance of implementing parenting support services and interventions in NGS caregivers, especially in periods of elevated stress such as COVID-19. Our results also suggest that parenting interventions should be targeted to caregivers' level of need rather than child symptomatology alone, as self-efficacy was not related to child symptomatology. **Background:** Caregivers of children with neurodevelopmental disorders experience increased stress and challenges related to parenting. Specifically, caregivers who have a child diagnosed with autism report high levels of parenting stress compared to other neurodevelopmental disorders (Craig et al., 2016). These stressors may be further amplified in families of children with autism symptoms and a co-occurring neurogenetic syndrome (NGS) due to increased cognitive impairment, co-occurring medical features, and sensorimotor impairments common to some of these conditions. Caregiver self-efficacy is important in the mental health and wellbeing of parents. However, it is unclear which caregivers might be struggling with self-efficacy during COVID-19, limiting understanding of how to intervene. The present study aims to address this gap by examining predictors of caregiver self-efficacy in a cohort of parents surveyed both prior to and during the COVID-19 pandemic.

**Objectives:** Our goal is to explore whether caregivers' current levels of self-efficacy during COVID-19 were related to pre-pandemic levels of parenting stress and child autism features.

**Methods:** Participants were caregivers of children with neurogenetic syndromes (n=35) enrolled in a longitudinal early phenotype survey study (PEPS) who provided data both before and after the COVID-19 pandemic began. At the time of their post-pandemic assessment, children were ages 1 to 6 years (mean=4) diagnosed with Angelman (n=9), Down (n=2), Fragile X (n=3), Prader Willi (n=8), and Williams (n=13) syndromes. As part of PEPS, families contributed measures of parenting stress (Parenting Stress Index, PSI; Abidin, 1995) and child autism behaviors (Child Behavior Checklist, CBCL; Achenbach, 2001). After the pandemic, we measured parenting self-efficacy using the Parenting Sense of Competence Scale (PSOC; Ohan et al, 2000). We hypothesized that parents with lower self-efficacy post-pandemic would be those with greater parenting stress and child autism symptoms pre-pandemic.

**Results:** We used multiple regression analyses to predict caregivers' current sense of competency from pre-pandemic parenting stress and challenging behaviors; we ran correlations to ensure that age was not a covariate. The multiple regression model with both predictors was significant with  $R^2=.179$ ,  $F(2, 32)=3.498$ ,  $p<.05$ . Overall parenting stress was a significant predictor of parenting self-efficacy ( $\beta =-.46$ ,  $p=.017$ ), but child behaviors related to autism were not ( $\beta =.09$ ,  $p=.626$ ). We also ran exploratory effects with overall challenging behaviors (CBCL Total) to probe for impact of general challenging behaviors, which were also not predictive of self-efficacy.

**Conclusions:** These results suggest caregivers who entered the COVID-19 pandemic with higher parenting stress may be at greater risk for poorer-self efficacy. These findings highlight the importance of implementing parenting support services and interventions in NGS caregivers, especially in periods of elevated stress such as COVID-19. Our results also suggest that parenting interventions should be targeted to caregivers' level of need rather than child's symptomatology alone, as self-efficacy was not related to child symptomatology.

#### **439.014 (Poster) Joint Attention in Children with Adnp Syndrome**

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**Background:** ADNP syndrome is a rare neurodevelopmental disorder that is highly associated with autism spectrum disorder (ASD) and intellectual disability. While autism traits including deficits in social interaction can be observed clinically, objective tools such as eye-tracking can provide more refined insight into deficits in processing and response to social stimuli. Previous eye-tracking studies have been used to quantify clinically observed deficits in joint attention, or orienting one's attention to an object in response to another person's eye-gazing, in children with ASD. However, such studies have yet to explore whether joint attention to visual stimuli is impacted in children with ADNP syndrome.

**Objectives:** To examine the association between experimental metrics of joint attention with clinician-rated measures of social symptoms of ASD broadly and joint attention skills more specifically.

**Methods:** Eye-tracking data was collected during a visual joint attention task from four children with ADNP syndrome (2 female; ages 7-10; additional data from n=5 participants expected by April, 2021). The task consisted of 16 pseudo-randomized trials in which a woman seated at the center of the video frame directs her attention at one of two objects on screen (lower right, lower left). Experimental variables of interest include: a) proportion of trials where the first saccade is to the target b) average saccade latency for the target object, and c) average proportion of time spent looking at the target (versus distractor) object. We calculated the correlation between these experimental variables and the following items on the ADOS-2 Module 1: ADOS Social Affect (SA) Domain and Response to Joint Attention (RJA).

**Results:** Despite the small sample size, a number of trends were observed between the experimental variables and the clinical data. Moderate relationships were observed between the proportion of correct looks to the target and SA ( $r = -.698$ ) and RJA ( $r = -.595$ ). There was a significant correlation observed between saccade latency and SA ( $r = .961, p = .039$ ) (Fig. 1), while RJA was trending ( $r = .874$ ). Lastly, there is a moderate association between target dwell time and SA ( $r = -.852$ ) (Fig. 2) and RJA ( $r = -.784$ ).

**Conclusions:** Our early findings identify promising trends for associations between eye-tracking metrics of joint attention and clinical observations of social functioning and response to joint attention. These associations suggest this paradigm may offer a valid, objective assessment of joint attention in children with ADNP syndrome. Overall, children with greater impairments in social affect and joint attention followed the on-screen model's gaze to target less often and more slowly, as well as spent less overall time looking at the gazed-at target versus the ignored distractor. Children that had higher social affect responses to joint attention scores tended to saccade to the target item before the distractor item less frequently. This preliminary investigation provides early evidence of joint attention deficits in ADNP syndrome that mirror those seen in ASD and associate with clinical symptoms. We are continuing to collect data to verify these findings, as well as incorporate data from typically developing and idiopathic ASD controls.

#### **439.015 (Poster) Reduced Sensitivity to Eye Contact in Williams Syndrome**

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**Background:** Williams syndrome (WS) is a rare genetic disorder associated with high social motivation and interest in faces as well as an intellectual disability and challenges in complex social cognition. Research on Williams syndrome can contribute to our understanding of the developmental pathways leading from genes to social attention and motivation. Attention to others' eyes is crucial for adaptive social understanding. Consequently, eyes trigger quick and automatic gaze shifts in typically developing individuals. It is not known whether this process is atypical in WS.

**Objectives:** To examine visual attention to others' eyes in Williams syndrome.

**Methods:** Individuals with WS (n = 35; mean age 23.5 years) were compared to controls (n = 167) in stratified age groups (7 month: n = 37, 8-12 years: n = 44, 13-17 years: n = 36, adults: n = 50). Participants were cued to look at either the eyes or the mouth of human faces. The latency and likelihood of a first gaze shift from or to the eyes was measured with eye tracking. The study was pre-registered. Data were analyzed using both standard frequentist and Bayesian statistics.

**Results:** Individuals with WS were both less likely, and slower to orient to the eyes than typically-developing controls in all age groups from eight years of age, but did not differ from 7-month-old infants (see fig.1). These effects were supported by both frequentist and Bayesian statistics, with medium to large effect sizes, and Bayes factors indicating very strong evidence. In contrast to typically developing participants, individuals with Williams syndrome did not show a bias to orient to the eyes rather than to the mouth. Individuals with Williams syndrome had reduced peak saccadic velocity compared to controls, suggesting that hypo-arousal may be an underlying cause of the observed pattern of atypical social attention. No group differences were found in the speed or likelihood of orienting away from the eyes, once they were fixated.

**Conclusions:** Despite the hyper-social behavioral phenotype, WS is associated with reduced attention to others' eyes. This could contribute to the difficulties with complex social cognition observed in this group.

**439.016** (Poster) Symptoms of Autism Spectrum Disorder and Behavioral Phenotype in Children with CLN2 Disease  
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Background: CLN2 disease is a rare, fatal, autosomal recessive, neurodegenerative lysosomal storage disease caused by a deficiency in the enzyme TPP1. Symptoms of CLN2 disease emerge early, usually by 3 years of age, and progress rapidly including seizure onset and the loss of motor, language, and vision functioning. Children with CLN2 disease present with behavioral disturbances and language delay, which are also characteristic symptoms of Autism Spectrum Disorder. However, no research has specifically examined ASD symptomology in children with CLN2 disease.

Objectives: The present study aims to examine symptoms of ASD and behavior in children with CLN2 disease with and without a clinical diagnosis of ASD.

Methods: Data was collected as part of an ongoing, longitudinal, clinical study. Participants included in the current study included 27 children between the ages of 2-18 years with a diagnosis of CLN2 disease. This sample was characterized to include children with CLN2 disease that received a clinical diagnosis of ASD (N = 7; 25%) and children without a diagnosis of ASD (N = 21; 75%). Symptoms of ASD and behavioral functioning were assessed using raw and T-scores from scales on the CBCL in children 2-5 and 6-18 years of age. Item-level analysis of symptoms of ASD on the CBCL were also analyzed on ASD specific domains.

Results: Descriptive data in children 6-18 years of age with CLN2 disease (N = 11) indicate the highest T-scores on the attention problems (M = 62.7, SD = 5.3), social problems (M = 62.6; SD = 5.3), and somatic complaints (M = 60.2; SD = 6.2) scales of the CBCL. Descriptive data in children 2-5 years of age with CLN2 disease (N = 16) indicate the highest T-scores on the attention problems (M = 66.8, SD = 8.6), withdrawn (M = 65.2, SD = 8.9), and the DSM 5 autism spectrum problems (M = 64.1, SD = 8.5) scales of the CBCL. There were statistically significant group differences in children ages 2-5 years with CLN2 disease across DSM-5 oriented scales assessing autism spectrum ( $t(14) = -2.2, p < .05$ ), ADHD ( $t(14) = -4.1, p < .005$ ), and oppositional defiant ( $t(14) = -2.7, p < .05$ ) problems and children with ASD were reported to demonstrate more problems in comparison to children with CLN2 disease without ASD.

Conclusions: This preliminary investigation suggests that children with CLN2 disease may be at increased risk for behavioral problems including attention problems, social difficulties, and aggression. Additionally, children with CLN2 disease may be at higher risk for ASD with 25% of the current sample reporting a co-occurring diagnosis of ASD. Increased behavioral difficulties were reported by parents in children with CLN2 disease and ASD. It is critical to gain a better understanding of how behavioral symptoms present and change over time in children with CLN2 disease in order to better inform diagnostic decisions and treatment efforts. Behavioral intervention may help improve skill acquisition and maintenance, as well as enhance the quality of life for children and their families

**439.017** (Poster) The Impact of Stress, Alcohol Consumption, Social Media Use, and Exercise on Sleep in Caregivers of Children with NGS during COVID-19

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Background: Caregiver well-being is essential in supporting the development of children with neurogenetic syndromes (NGS). Sleep is critical for well-being and health, and NGS caregivers frequently report compromised sleep. Social and physical constraints of COVID-19 have likely further disrupted caregiver sleep, directly due to stress and indirectly due to coping behaviors caregivers may engage in to combat stress. Caregivers may be managing stress using coping mechanisms sometimes reported to negatively impact sleep, like social media and alcohol use. Caregivers may have less time or access to health behaviors that reduce stress and improve sleep, like exercise. However, the impacts of COVID-19 on NGS caregiver sleep, stress, and health behaviors is unclear, limiting understanding of how to intervene and best support caregiver health and well-being.

Objectives: We used an experience sampling approach to examine how stress, alcohol consumption, social media use, and exercise impact sleep in NGS caregivers during COVID-19. We hypothesized that daily stress and health behaviors would relate to caregivers' nightly sleep duration and quality.

Methods: Participants included 50 caregivers of children ages 1 to 7 (M = 4.61) and diagnosed with Angelman (n = 13), Down (n = 9), fragile X (n = 4), Prader Willi (n = 9), and Williams (n = 15) syndromes; 14% were also diagnosed with autism. Using ExpiWell, caregivers completed four surveys per day across four seven-day periods across seven weeks. We focus on five

variables: (1) self-reported stress at the morning assessment, (2) previous night sleep duration and quality, previous day (3) alcohol use and daily (4) exercise and (5) social media use.

Results: Table 1 details descriptive statistics. Analyses include 5975 observations across 50 caregivers. Data completion ranged from 69-74% per variable. Preliminary Spearman correlations indicated that increased stress was correlated with reduced sleep quality ( $r = -.33$ ,  $p < .0001$ ) and duration ( $r = -.18$ ,  $p < .0001$ ). Wilcoxon signed rank tests indicated that sleep quality did not vary whether caregivers exercised ( $Z = -.66$ ,  $p = .507$ ,  $r = .02$ ), however those who exercised slept significantly longer ( $Z = 2.39$ ,  $p = .017$ ,  $r = .08$ ). When caregivers drank alcohol, they reported significantly better sleep quality ( $Z = 2.63$ ,  $p = .009$ ,  $r = .08$ ) and duration ( $Z = 4.32$ ,  $p < .0001$ ,  $r = .14$ ) than those who did not drink at all. There was no association between social media use and sleep quality ( $r = .01$ ,  $p = .770$ ) or duration ( $r = .01$ ,  $p = .728$ ). Final analyses will use mixed effects models to how patterns cluster within and across caregivers over time.

Conclusions: Our results suggest that caregivers' momentary ratings of stress during COVID-19 significantly relate to previous night sleep quality, and sleep was generally better when caregivers exercised. Alcohol consumption was generally low in our sample but did relate to higher sleep quality, whereas social media use did not predict sleep. These results begin to clarify the active ingredients that may be targeted in interventions to reduce caregiver stress during COVID-19 and beyond.

**439.018 (Poster)** Visual Engagement and Attention Differences in Children with FOXP1 Syndrome Parallel Those in Autism Spectrum Disorder

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**Background:** FOXP1 syndrome is a rare genetic neurodevelopmental disorder characterized by intellectual disability and speech and attention deficits. Moreover, *FOXP1* is a risk gene for autism spectrum disorder (ASD), which is associated with poor socialization and abnormal eye-contact and reciprocal gaze. Previous eye-tracking studies in idiopathic ASD (iASD) suggest that visual attention deficits are more attributed to global delays in reorienting of attention than to particular deficits in socialization. No studies have tested whether attentional deficits in FOXP1 syndrome follow this same paradigm.

**Objectives:** We investigated whether children with FOXP1 syndrome a) show similar patterns of visual attention engagement and disengagement to those we previously observed in iASD and b) are impacted by the social versus non-social nature of visual stimuli.

**Methods:** Eye-tracking data were collected from age- and sex-matched groups of individuals with FOXP1 syndrome ( $n=8$ ) and typically-developing (TD) controls ( $n=17$ ), ages 3-17. The FOXP1 cohort received consensus ASD diagnoses based on gold-standard diagnostic assessments (ADOS-2, ADI-R), DSM-5 criteria, and clinical impressions of licensed psychologists and psychiatrists. During the eye-tracking task, a central stimulus was presented for 1s, followed by presentation of a peripheral stimulus on the left or right. The central stimulus either remained on screen ("overlap") or disappeared 250ms before the peripheral stimulus appeared ("gap"). Central and peripheral stimuli were either social (20 child faces) or non-social (20 objects, e.g., ball, globe) and were presented in grayscale. We measured saccade latency to the peripheral stimulus and calculated gap effect (difference between average "overlap" and "gap" saccade latencies) for each participant overall and for each social/non-social condition. Reduced gap effect reflects deficits in engagement of visual attention.

**Results:** A Mann-Whitney U-test revealed a lower gap effect in FOXP1 relative to TD participants, with results approaching significance ( $p=0.091$ ) and of large effect size (Cohen's  $d=0.86$ ). Average saccade latency in the gap condition was higher in FOXP1 compared to TD ( $p=0.027$ ), whereas saccade latencies in the overlap condition did not differ ( $p=0.38$ ). There was no group-by-condition interaction for gap effect ( $p=0.56$ ), suggesting attention engagement was not differentially affected by the social or non-social nature of stimuli. Interestingly, a Mann-Whitney U-test revealed that there was no difference in gap effect between FOXP1 participants with ( $n=3$ ) and without ( $n=5$ ) consensus ASD diagnoses ( $p=0.39$ ).

**Conclusions:** We found a trend toward reduced gap effect in FOXP1 individuals compared to TD individuals, driven by slower latencies in the gap condition. Mirroring our previous findings in iASD, these results suggest that deficits in attention in FOXP1 may be driven by delays in the anticipation or reorientation of attention. As in iASD, there were no differences in engagement

with social versus non-social stimuli among FOXP1 individuals, demonstrating that deficits in visual attention in FOXP1 are independent of stimulus type. These findings lend support to the notion that attentional deficits in FOXP1 may be similar to those in iASD, despite only ~25% of FOXP1 individuals receiving formal ASD diagnoses. This work provides important insight into shared mechanisms of attentional differences across idiopathic and genetic forms of ASD.

# Sensory Physiology

## POSTER SESSION — SENSORY PHYSIOLOGY

### Poster 440 - Sensory physiology Posters

**440.001** (Poster) Altered Visual Evoked Potentials to Illusory Contour Integration Among Children on the Autism Spectrum  
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#### Background:

Individuals on the autism spectrum often exhibit atypicality in their sensory perception, but the neural underpinnings of these perceptual differences remain incompletely understood. One proposed mechanism is an imbalance in the integration of sensory inputs with prior experiences, leading to an increased propensity to focus on local object features over global context.

#### Objectives:

We explored this theory using electroencephalography (EEG) during passive perception of visual stimuli that formed illusory contours in autistic children and neurotypical controls. Specifically, we tested the hypotheses that autistic individuals would have attenuated or delayed visual evoked potential responses to illusory contour stimuli and that these differences in contour-integration mechanisms would correlate with perceptual reasoning ability.

#### Methods:

EEG was continuously acquired in 18 autistic (ASD) and 28 neurotypical (NT) children (age 6-17 years) while they viewed a random series of Kanizsa figure stimuli, each consisting of four equidistant 'Pac-Man' inducers that were either oriented at random rotational angles (non-contour configuration) or aligned such that contour integration would form a square (illusory contour configuration). Of note, the paradigm included both central and eccentric stimulus presentations to the left or right of fixation; data considered here are from central stimulus presentations only. Concurrently with Kanizsa figure stimulus presentation, participants engaged in an unrelated task identifying red-green color change in a centrally-located fixation dot to ensure foveation, which was further verified with eye tracking. Illusory contour integration is typically marked by a negative deflection in the visual evoked potential occurring between 90 and 200ms post-stimulus onset, termed the illusory contour effect. This difference in visual evoked potentials to illusory contour vs. non-contour stimuli was compared between autistic and neurotypical children. All participants also underwent a phenotyping battery consisting of the Weschler Abbreviated Scale of Intelligence-2<sup>nd</sup> Edition, Peabody Picture Vocabulary Test-4<sup>th</sup> Edition, and Social Responsiveness Scale-2<sup>nd</sup> Edition. ASD participants were additionally assessed with the Autism Diagnostic Observation Schedule-2<sup>nd</sup> Edition.

#### Results:

Autistic children had a reduced amplitude illusory contour effect most pronounced over the right posterior occipital region (electrode PO4 in the 10-20 convention) as compared to neurotypical children ( $\text{mean}_{\text{ASD}} = -1.551 \pm 3.048 \mu\text{V}$ ,  $\text{mean}_{\text{NT}} = -4.374 \pm 2.923 \mu\text{V}$ ,  $t(44) = 3.144$ ,  $p = 0.003$ ). There was no significant difference in the latency of the illusory contour effect between groups ( $\text{mean}_{\text{ASD}} = 152 \pm 43 \text{ms}$ ,  $\text{mean}_{\text{NT}} = 161 \pm 32 \text{ms}$ ,  $t(44) = -0.802$ ,  $p = 0.427$ ). No significant correlation between the amplitude of the difference wave and an individual's perceptual reasoning index has emerged in the data collected to date ( $r(34) = -0.180$ ,  $p = 0.294$ ).

#### Conclusions:

Autistic children demonstrate attenuated neural responses to illusory contour stimuli as compared to neurotypical controls, suggesting possible reduced deployment of predictive feedback mechanisms in visual processing of global stimulus features. It remains unclear the relationship of these differences in neurophysiologic mechanisms to specific behavioral phenotypes.

**440.002** (Poster) Attention Mediates Brain-Behavior Relationship of Sensory Processing in Autism Spectrum Disorders

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**Background:** Attention is a fundamental ability that impacts everyday sensory and social behaviors in ASD. Research on the neural basis of attention and sensory processing in autism spectrum disorder (ASD) is increasing. However, there is limited translational research bridging neuroscience and daily participation issues.

**Objectives:** This study used structural equation modeling to examine the relationship between brain measures of sensory processing and behavioral measures of attention, sensory processing, and social responsiveness in young adults with ASD and neurotypical peers.

**Methods:** Participants included 24 young adults with ASD (M age=23.3 years, SD=3.8) and 24 age-matched neurotypical adults. To assess neural sensory processing, electroencephalography (EEG) data were recorded while participants heard random presentations of 4 auditory stimuli (50 ms in duration) at two frequencies (1 and 3 kHz) and two intensities (50 and 70 dB). Participants completed two attention conditions; the passive condition involved only listening to the stimuli, followed by the active condition, wherein participants were instructed to press a button only to the 1 kHz 50 dB tone. For each condition, participants heard 80 trials of each tone in a pseudo-random order with a two-second inter-stimulus interval. Participants completed the self-report forms, the Adolescent/Adult Sensory Profile (AASP), and Social Responsiveness Scale 2 (SRS-2) and were administered the Test of Everyday Attention (TEA), a performance-based attention measure.

**Analysis:** Latent variable mediation analysis was used to examine the hypothesis that attention (TEA total score) mediates the relationship between brain measures of sensory processing (EEG) and behavioral measures of sensory processing (low registration quadrant score), which in turn predict social responsiveness (SRS-2 total score). EEG measures (N1 latency) derived from high-frequency tones of passive and active conditions were combined to obtain a latent variable describing brain measures of sensory processing. Analysis included participants from both groups.

**Results:** The ASD group had significantly delayed N1 latencies during both attention conditions than neurotypical peers. The latent EEG measure significantly predicted attention scores,  $\beta = -.49, p = .03$ , and attention abilities significantly predicted behavioral sensory processing,  $\beta = -.55, p < .0005$ . These results support the mediational hypothesis. The direct effect of EEG measure predicting sensory processing,  $\beta = -.04$ , was not significant but the indirect coefficient was significant,  $\beta = .16, p = .047$ . Lastly, sensory processing significantly predicted social responsiveness,  $\beta = .83, p < .0005$ . This model yielded excellent fit statistics,  $\chi^2(13) = 13.47, p = .41, RMSEA = .03, 90\% CI [.00, .15], p = .53; CFI = .99; SRMR = .06$ .

**Conclusions:** In young adults with and without ASD, attention abilities mediated the relationship between brain measures of sensory processing and behavioral sensory processing, specifically low registration. Thus, attention abilities can facilitate brain mechanisms to better process sensory stimuli to perform everyday sensory processing activities and social skills. Data suggest that statistical modeling can be beneficial in interpreting the nature of brain-behavior relationships in ASD. The results indicate that therapy emphasizing attention skills in ASD can potentially modify sensory and social participation in young adults with ASD.

#### **440.003 (Poster) Atypical Tactile Psychophysics in a Clinical Neurodevelopmental Disorder Cohort**

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**Background:**

Touch plays an important role in human development, both in perception and development of social function. There is ample evidence to suggest that tactile processing is impaired in those with ASD and that it may contribute to the autism phenotype. Recent work using physiological measures, has shown that differences in low-level tactile function are associated with the clinical manifestation of ASD, including social deficits. Psychophysical approaches allow for differentiation of neural-mediated functions (e.g. detection, discrimination). However, it remains unclear to what extent these alterations in tactile perception are specific to ASD or associated with clinical sensory phenotype (e.g. over-responsivity).

**Objectives:**

To investigate whether children with neurodevelopmental disorders (NDD), including ASD, show atypical tactile perception and compare data relative to previously published cohorts. We will also investigate whether those with tactile sensory over-responsivity (TAC SOR) show worse tactile thresholds than those without. In the future we will investigate whether tactile perception differs between NDDs.

#### Methods:

23 children with NDD, 8-12 years old (6 with ASD, 18 with ADHD, 12 with anxiety; 16 male) were included. For reference, we used published data from 100 ASD and 200 TD children. Vibrotactile detection, discrimination, and order judgement were assessed using a Cortical Metrics stimulator (see Fig. 1), to better understand physiological differences. Children were included in the TAC SOR cohort if they scored >2 standard deviations on the Short Sensory Profile Tactile Sensitivity section (parent report measure) and/or >5 on the Sensory Processing 3 Dimensions (SP3D) TAC SOR section (OT-administered direct assessment). Student's T-tests were used to compare groups within this study and between this study and prior data. Spearman correlations were run between the SP3D TAC SOR score and psychophysical measures.

#### Results:

For the NDD cohort, mean static detection threshold was  $10.49 \pm 4.4 \mu\text{m}$ ; mean dynamic detection threshold (indicative of sensory gating) was  $6.38 \pm 2.71 \mu\text{m}$ ; the difference between static and dynamic detection (indicative of feed-forward inhibition) was not significant ( $p > 0.05$ ). Mean amplitude discrimination threshold (indexing lateral inhibition) was  $61.82 \pm 40.4 \mu\text{m}$ ; mean temporal order judgement threshold was  $69.65 \pm 60.80 \text{ ms}$ . These thresholds are significantly higher than previously published TD data ( $p < 0.05$ ) but consistent with previous ASD data (See Fig 1). We found a significant difference in amplitude discrimination between those with and without TAC SOR ( $p = 0.048$ ). Individual differences in amplitude discrimination also correlated with SP3D TAC SOR total score ( $r_s = -0.48, p = 0.03$ ).

#### Conclusions:

In an NDD cohort, we found significant differences in tactile physiology consistent with prior work, suggesting that low-level sensory abnormalities in tactile threshold are robust. We found that amplitude discrimination differed and correlated with TAC SOR score. We previously showed that amplitude discrimination was associated with autism severity. Large variation could reflect the heterogeneity and differentiation of NDDs compared to ASD-only. While larger samples are needed, our results suggest that impaired discrimination could impact SOR. Worse ability to distinguish stimuli at the physiological level may lead to inconsistencies in tactile encoding, contributing to SOR.

#### 440.004 (Poster) Closing the Species Gap: How to Study Sensory Processing Differences Relevant for Autism Spectrum Disorder in Both Rodents and Humans

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**Background:** The study of sensory phenotypes has great potential for increasing research translation between species, a necessity to decipher the neural mechanisms that contribute to higher-order differences in Autism Spectrum Disorder (ASD). Over the past decade, despite separate advances in our understanding of the structural and functional differences within the brain of individuals with and without ASD and in rodent models for ASD, researchers have been unable to directly translate the findings in murine species to humans, mostly due to incompatibility in experimental methodologies used to screen for ASD phenotypes. Focusing on sensory phenotypes offers an avenue to close the species gap because sensory pathways are highly conserved across species and are affected by the same genetic and environmental risk-factors as other diagnostic domains of ASD.

**Objectives:** To design and implement a framework to study sensory processing similarly in both rodents and humans.

**Methods:** First, electrophysiological and behavioural techniques that have been used to study and assess sensory phenotypes consistently across species were reviewed. Next, we identified those paradigms that could provide accessible, translatable, valid, and reliable metrics across species. We designed a framework focused on assessing auditory processing through the collection of evoked-potentials, acoustic startle paradigms, and psychophysical detection/discrimination paradigms. Lastly, to implement this framework, new behaviours were created in order to collect data on auditory processing in a coordinated and systematic fashion across species.

**Results:** We were able to collect the same metrics in both humans and rodents that can provide information about auditory processing in ASD. By simplifying task design by stripping stimuli down to their basic characteristics (e.g., for acoustic stimuli modulating intensity *or* temporal structure *or* frequency) and using as few instructions as possible in tasks of detection or discrimination, i.e. using implicit or very simple behaviours, we were able to remove potentially confounding cognitive variables such as motivation, distractibility, or the understanding of instruction. Importantly, these metrics scale similarly in humans and rodents and therefore results can be translated with a higher degree of confidence.

**Conclusions:** Using this framework across a variety of sensory domains (e.g. vision, olfaction, touch) will reduce the heterogeneity among protocols between and within human and animal research. Through careful protocol design and collaboration, sensory processing phenotypes can be harnessed to bridge the gap that exists between pre-clinical animal studies and human assessment and testing. Only then can we determine the mechanisms contributing to ASD, untangle gene/environment interactions, or assess intervention (e.g. drug) efficacy.

**440.005 (Poster) EEG Indices of Sensory Gating Are Associated with Atypical Perceptual Modulation and Interoception**  
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Background:

Sensory habituation is the process of filtering out repeated sensory stimuli in the environment to prioritize attentional resources towards the most relevant sensory information (Grunwald, 2003), such as blocking out background noises to listen to a conversational partner. Compared to typically developing (TD) comparison groups, individuals with ASD exhibit reduced habituation to repeated auditory stimuli presentation (Williams et al., in press). It is possible that atypical sensory habituation is a basic mechanism that contributes to ASD symptoms relevant to atypical perception of external stimuli (e.g., sights, sounds) and internal stimuli (i.e., interoceptive senses). However, the clinical relevance of auditory sensory habituation is not well understood.

Objectives:

- To examine electroencephalography (EEG) indices of sensory habituation in relation to autistic traits.
- To evaluate relationships among EEG indices of sensory habituation and clinical measures of perceptual modulation and interoceptive awareness.

Methods:

Preliminary data has been collected in 19 typically developing adults (18-40 years old) with no history of psychiatric diagnosis. Data collection is ongoing and will include adults with ASD matched on age and sex. Sensory habituation was assessed using a validated P50 Sensory Gating EEG task (Wan et al., 2007) that administered two auditory clicks spaced 500ms apart. The auditory P50 event-related potential (ERP) was examined over central regions of the posterior scalp electrode sites, a brain area thought to be responsible for pre-attentive processes. Sensory habituation was calculated as: "P50 Gating Ratio=Click 2 amplitude/Click 1 amplitude," with the assumption that higher P50 Gating Ratios (reduced difference between Click 1 and Click 2 amplitude) represents reduced sensory habituation. P50 Gating Ratios were correlated with questionnaires including the Broader Autism Phenotype Questionnaire (BAPQ; Hurley et al., 2007), the Perceptual Modulation subscale of the Sensory Gating Inventory (SGI; Hetrick et al., 2012) which includes items such as "At times I have feelings of being flooded by sounds," and the Interoceptive Sensory Questionnaire (ISQ; Fiene et al., 2018), which includes items such as, "I am confused about my bodily sensations."

Results:

There was a marginal relationship between P50 gating ratios and the BAPQ, but the relationship was nonsignificant ( $r=.294$ ,  $p=.118$ , one-tailed). P50 gating ratios were significantly correlated with the Perceptual Modulation subscale of the SGI ( $r = 0.42$ ,  $p = .035$ , one-tailed) (Figure 2a) and with the ISQ ( $r = 0.40$ ,  $p = .049$ , one-tailed) (Figure 2b).

Conclusions:

The pattern of findings suggests reduced sensory habituation as measured by neural response to auditory stimuli is associated with real-world difficulties modulating and accurately perceiving external and internal stimuli. The findings establish the clinical relevance of an EEG index of sensory processing by linking variability in P50 gating ratios with clinical symptoms related to atypical interoception and sensory sensitivities that are common in ASD.

**440.006** (Poster) Interoceptive Awareness and Its Relationship to Social and Sensory Processing in Youth with Autism Spectrum Disorder

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**Background:** Interoception, or the ability to accurately perceive one's internal physiological cues, is often measured both through interoceptive accuracy (which is dependent on behavioral performance, such as on a heartbeat-tracking task), and interoceptive awareness (IA), which is a metacognitive understanding of how accurate one is on such a behavioral interoception task (Garfinkel et al., 2015). Individuals with Autism Spectrum Disorders (ASD) have been found to have atypical interoception (for review, see DuBois et al., 2016). Interoception is also associated with ASD symptoms, including atypical sensory processing (Schauder et al., 2016) and social awareness, as greater IA may allow one to identify and describe their own emotions better, resulting in increased empathy for others' emotions (Mul et al., 2018).

**Objectives:** To examine the association between interoceptive accuracy, interoceptive awareness (IA), and both social and sensory symptoms in youth with ASD compared to typically-developing (TD) peers.

**Methods:** Participants were 41 (9F) ASD and 36 TD (11F) youth, aged 8-17 years. Participants completed three trials of a heartbeat tracking task where they were asked to silently count their heart beats for a period of time (25/35/45 seconds intervals), without using their hands to feel their pulse, while an examiner recorded their true heart rate (HR). After estimating their HR for each interval, participants also rated how confident they were in their count on a scale of 1-10. Accuracy scores were calculated for each participant and then accuracy and confidence ratings within each interval were correlated within participants, to create a measure of IA (Garfinkel et al. 2015). Parents reported on social awareness and sensory over-responsivity (SOR) using parent-report on the Social Responsiveness Scale (SRS-2; Constantino, 2005) and Sensory Over-Responsivity Inventory (Schoen, Miller, & Green, 2008). Anxiety was measured using parent-report on The Screen for Child Anxiety Related Disorders (SCARED, Birmaher, 1999), and was covaried in the SOR analyses to examine the unique effect of sensory processing over and above anxiety.

**Results:** Independent-samples t-tests showed no significant diagnostic group differences in accuracy, confidence, or IA. Neither accuracy nor IA were independently associated with social awareness; however, a hierarchical regression showed that the interaction between accuracy and IA significantly predicted social awareness over and above the main effect of either one ( $R^2$ change=0.08,  $p=.038$ ). Additionally, within the ASD group, accuracy was significantly associated with SOR, after controlling for anxiety ( $R^2$ change=.07,  $p=.049$ ), indicating that youth with higher SOR had lower accuracy.

**Conclusions:** Despite no significant diagnostic group differences on either heartbeat tracking accuracy or interoceptive awareness, both interoception measures were associated with ASD symptomatology. Notably, both accuracy and IA interacted to predict social awareness, suggesting that *both* the ability to process one's own internal cues *and* awareness of one's own interoceptive abilities are important to social awareness. Moreover, within ASD, accuracy was significantly associated with SOR suggesting that reduced awareness of internal cues may play a role in increased responsivity to sensory stimulation. Results will be discussed in terms of implications for interventions.

**440.007** (Poster) The Physiological Mechanisms of Habituation and Generalization to Mildly Aversive Sensory Stimulation in Youth with Autism and Anxiety Disorders

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**Background:**

Sensory over-responsivity (SOR), an extreme aversive response to sensory stimulation, is common in both Autism Spectrum Disorders (ASD) and Anxiety Disorders (ANX; Tavassoli et al., 2013; Conelea et al., 2014). While SOR and anxiety symptoms are highly correlated (Green et al., 2010), their unique contributions to physiological arousal during sensory stimulation are not well understood. Here, we examined the unique effects of SOR and anxiety symptoms on physiological habituation and generalization of responses to sensory stimulation, both of which are essential to intervention approaches such as exposure therapy.

#### Objectives:

To investigate how SOR and anxiety symptoms uniquely predict physiological responses during exposure to two similar but distinct sets of mildly aversive sensory stimuli, across ASD and ANX youth.

#### Methods:

Participants were 28 ASD, 21 ANX, and 21 typically-developing (TD) youth matched on sex, IQ, and age (8-18 years). Parents reported on their child's SOR severity (composite of tactile/auditory subscales from Short Sensory Profile and Sensory Over-Responsivity Inventory; Dunn, 1999; Schoen et al., 2008), and anxiety symptoms (Screen for Child Anxiety and Related Disorders; Birmaher et al., 1995). Participants experienced six 15-sec Exposure blocks of mildly aversive tactile+auditory stimulation (white noise and scratchy material rubbed on the inner wrist) and four 15-sec Generalization blocks of new, but similar, stimuli. Heart rate (HR) was collected during a 2-min baseline period and throughout the sensory stimulation. Repeated-measures ANOVAs were used to test the effect of diagnostic group as well as SOR and anxiety symptoms on HR across the Exposure blocks and across the last Exposure block through the four Generalization blocks (to examine change from the end of Exposure into Generalization).

#### Results:

There were no diagnostic group differences in mean HR during Exposure, but within the ANX and ASD groups, there was a trend-level trial\*SOR interaction ( $F(1,42)=3.30, p=.077$ ) indicating that SOR was associated with faster increases in HR across the Exposure phase. For the subsequent Generalization phase, there was a significant diagnostic group\*trial interaction ( $F(2,63)=4.63, p=.01$ ) showing that, compared to TD, the ASD and ANX groups had reduced change in HR (flatter slope) to the new stimuli. Additionally, when SOR and anxiety symptoms were entered simultaneously in the model, there were significant trial\*SOR ( $F(1,61)=11.81, p<.01$ ) and trial\*anxiety ( $F(1,61)=8.54, p<.01$ ) interactions, indicating that both symptoms were positively associated with the reduced change in HR response.

#### Conclusions:

Results suggest that SOR is associated with initial increases in autonomic arousal to sensory stimulation, over and above anxiety. However, both SOR and anxiety symptoms uniquely predicted a reduced change in HR response to the new set of stimuli, regardless of diagnosis. The reduced rate of change suggests SOR and anxiety may be associated with an atypical orienting response, which could lead to greater arousal and dysregulation (Bradley, 2009), as well as potentially reduced discrimination of novel stimuli. Notably, results suggest that SOR and anxiety symptom severity may be more important than diagnostic status in predicting these atypical responses; further, the fact that both symptoms were uniquely involved calls for an integrated treatment approach targeting both symptoms.

#### **440.008** (Poster) "Neural Noise" in and Habituation of Auditory Responses in Young Autistic and Typically-Developing Children

**P. Dwyer<sup>1</sup>, Z. J. Williams<sup>2</sup>, S. Vukusic<sup>3</sup>, C. D. Saron<sup>3</sup> and S. M. Rivera<sup>1</sup>, (1)Department of Psychology, University of California, Davis, Davis, CA, (2)Medical Scientist Training Program, Vanderbilt University School of Medicine, Nashville, TN, (3)Center for Mind and Brain, UC Davis, Davis, CA**

Background: There are several competing explanations for atypical autistic sensory perception, such as the hypothesis that inter-trial variability (ITV) of sensory responses ("neural noise") is elevated in autism (Haigh, 2018). However, this account struggles to explain reports of enhanced perception in autism (see Mottron et al., 2006). Alternatively, prior studies do suggest diminished habituation of sensory responses in autism (Hudac et al., 2018; Kolesnik et al., 2019; Matsuzaki et al., 2014).

**Objectives:** The present study used 61-channel EEG to quantify and compare ITV and habituation of auditory responses in young autistic and typically-developing children. We expected habituation to be reduced in autism but expected no group differences in ITV.

**Methods:** Usable EEG was recorded from 127 autistic (20 female) and 79 TD (27 female) participants 2-5 years of age. While watching a quiet video, participants heard, via headphones, complex tones randomly varying in intensity (50, 60, 70, or 80 dB SPL). ~1100-1200 trials were collected at an ISI of 1-2s. EEG was sampled at 1000 Hz and average-referenced. An intensive data processing pipeline including Second-Order Blind source Identification (SOBI; Belouchrani et al., 1997) was used to remove signals of putatively non-neural origin. To compare habituation across groups, we computed ordinal slopes of changes in single-trial EEG amplitudes over the experiment for each participant separately by intensity; mean slopes were then averaged over frontocentral channels in time windows associated with the P1 ( $\pm 50$  ms of grand average ERP peak latency for each intensity) and N2 (201-350 ms) components and analyzed using mixed ANOVA (group x hemisphere x intensity). Correlations between habituation and scores from the Sensory Profile Hyperacusis Index (SPHI; Williams et al., 2019) were also explored. To examine ITV, we computed median absolute deviations (MADs) of amplitudes across trials within intensities. We also estimated, within intensities, inter-trial phase coherence (ITPC) in frequencies between 6-40 Hz (2 Hz steps) using Morlet wavelets with 1-3 cycles (linearly increasing, Delorme & Makeig, 2004). Cluster-based permutation *t*-tests (Maris & Oostenveld, 2007) were used to compare MADs and ITPC across groups at all channels between 1-350 ms.

**Results:** Habituation of the P1 response was greater in autism than TD,  $F(1,204) = 4.63, p = .03$ , but habituation of the N2 was greater in TD than autism,  $F(1,204) = 16.43, p < .0001$ . There was no correlation between habituation and SPHI score estimates. MADs did not differ across groups (all  $p \geq .26$ ). However, ITPC was significantly *elevated* in autism in the 50 dB ( $p = .05$ ) and 60 dB ( $p = .03$ ) conditions, suggestive of *decreased* ITV in autism.

**Conclusions:** As predicted, we found greater habituation of the N2 response in TD than autism; however, unexpectedly, habituation of the P1 was greater in autism than TD, raising questions regarding the time course of habituation of neural responses in autism. Furthermore, as expected, our data did not support the theory that ITV is elevated in autism. Surprisingly, high ITPC suggested ITV is *decreased* in autism, although most of our ITV analyses demonstrated no significant group differences.

## Sensory, Motor, and Repetitive Behaviors and Interests

### PANEL DISCUSSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS

#### Panel 207 - Bodies, Faces, and Limbs: Measuring Movement in the Context of Autism

**Panel Chair:** Mary Beth Nebel, *Center for Neurodevelopmental and Imaging Research, Kennedy Krieger Institute, Baltimore, MD*

**Discussant:** Stewart Mostofsky, *Center for Autism and Related Disorder, Kennedy Krieger Institute, Baltimore, MD*

Recent evidence suggests that autism-associated motor deficits may be grossly underestimated; yet, motor traits specific to autism remain elusive. A key factor contributing to these disparate findings is the lack of rigorous methods for assessing subtle differences in the vast array of motor behaviors that emerge during typical and atypical development. Symposium speakers will present tools to improve measurement feasibility and accuracy for early motor behaviors and to test hypotheses regarding the role motor skills play in the development of social behaviors central to autism. Speaker #1 will present quantitative, body sensor-based measures of early infant leg movement that are more sensitive to clinical risk for autism than standard motor batteries. Speaker #2 will discuss efforts to develop robust computer vision-based methods to measure infant facial movement and to quantify infant-caregiver synchrony. Speaker #3 will provide an overview of studies validating a mobile app using computer vision analysis to assess a range of early motor differences in toddlers with and without autism. Speaker #4 will discuss efforts to expand our understanding of the interplay of early motor and social behaviors to African pediatric populations.

**207.001 (Panel Discussion)** Quantitative Characterization of Early Motor Differences in Autism

**R. B. Wilson<sup>1</sup>, B. A. Smith<sup>2</sup>, T. Safari<sup>3</sup>, D. Elashoff<sup>1</sup> and S. Vangala<sup>1</sup>,** (1)UCLA Medical Center, Los Angeles, CA, (2)Children's Hospital Los Angeles, Los Angeles, CA, (3)Semel Institute for Neuroscience and Human Behavior, Los Angeles, CA

**Background:** Motor dysfunction is one of the first signs of atypical development in infants at high familial risk for autism spectrum disorder (ASD). Quantitative measures of motor in early infancy may improve identification of subtle movement differences that underlie motor dysfunction and are potentially specific to ASD. One promising measure is complexity of infant movement. The ability to execute a complex repertoire of spontaneous movements emerges in early infant development and is a key feature of healthy neuromotor maturation. We hypothesize that motion complexity could have a direct mechanistic link to atypical motor behavior in ASD because (1) poor motion complexity could be related to later motor delays and repetitive motor behaviors and, (2) the expression of healthy motion complexity depends on the integrity of cortical connectivity and aberrant cortical connectivity has been reported in neurobiological studies of ASD.

**Objectives:** Develop a quantitative measure of motion complexity from motor activity evaluated in high risk (HR; defined as having an older sibling with ASD) and low risk (LR; no elevated concern for ASD) infants. Evaluate the relationship of motion complexity to autism outcomes.

**Methods:** Full day quantitative measurement of spontaneous leg movements was obtained utilizing the opal wearable sensor at 3, 6, and 9 months of age from 7 HR infants and 12 LR infants. From the data, we constructed the motion complexity measure. A minimally complex movement pattern is one fully described by a singular periodic function (e.g., a sine wave with a specified frequency). In contrast, high complexity indicates that motion is best described by a superposition of waves of varying frequencies. Therefore, we defined our complexity measure in terms of the variability of the frequency components underlying the observed infant movements. ASD symptoms were measured at 24 and 36 months of age with the Autism Diagnostic Observation Schedule (ADOS).

**Results:** The motion complexity score at each visit time point showed a range of results in the 7 HR infants and 12 LR infants: 3 months, HR: (0.373-0.676, M: 0.528, SD: 0.134) and LR: (0.291-0.902, M: 0.578, SD: 0.191); 6 months, HR: (0.395-1.041, M: 0.703, SD: 0.217) and LR: (0.392-0.883, M: 0.657, SD: 0.162); 9 months, HR: (0.325-1.027, M: 0.645, SD: 0.268) and LR: (0.196-0.864, M: 0.582, SD: 0.208). HR infants that went on to develop a diagnosis of ASD (2/6) showed lower motion complexity compared to those that did not at all time points.

**Conclusions:** HR infants with later ASD diagnosis showed lower motion complexity scores compared to those that did not. We did not find that motion complexity scores show a clear pattern of change with age. Both HR and LR infants showed a large

range of motion complexity, likely representing the variability of typical motor development. Further evaluation of our quantitative measure of motion complexity may lead to a promising early motor measure to detect risk for later ASD diagnosis. These data will be expanded to a larger sample size of HR and LR infants and those with outcomes at the time of the INSAR conference.

**207.002** (*Panel Discussion*) Computational Analysis of Interactional Synchrony: A Novel Measure of Autism Risk  
*C. J. Zampella, E. Sariyanidi, L. S. Cubit, M. Drye, M. Fecher, L. K. Steinbeck, L. A. Wang, K. Bartley, B. Tunc, R. T. Schultz and W. Guthrie, Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

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**Background:** Interactional synchrony, or social-motor coordination, is a fundamental, early-emerging developmental process that may provide a novel lens for understanding social and motor differences in ASD. Computational analysis of synchrony offers a scalable, granular, objective new direction for assessing early autism risk, possibly before overt symptoms emerge. However, current computer vision tools, developed nearly exclusively on adult samples, are not appropriate for quantifying infants' social movements. They fail to accurately quantify facial expressions in the context of head pose variation – a particular problem for infants who move around during natural interactions. They also fail to account for facial morphology differences between infants and adults. This abstract focuses on critical first steps for developing robust computational methods to measure synchrony in infants.

**Objectives:** (1) Develop computer vision methods that accurately quantify infant facial movements by accounting for head movement/orientation and morphology differences; (2) Collect pilot interactional synchrony data on 12-month-old infants at high and low familial risk for ASD.

**Methods:** To quantify the effect of head movement on facial expression measurement, we synthesized 1000 neutral face videos with varying head poses. We quantified facial expressions using state-of-the-art computer vision methods claiming to accurately separate facial pose and expression. Given that all face images were neutral, any detected expressions were spurious, allowing us to measure the degree to which head pose caused inaccurate measurement. To address differences in infant facial morphology, we used a public dataset (N=900) to develop a novel method that estimates face shape using simultaneous input from multiple image frames, and compared it to standard methods that process each frame independently. By taking multiple frames into account, it is possible to separate features that remain stable (morphology) from those that change (expressions), thus more accurately reconstructing an individual's unique face shape. Pilot synchrony data were then collected during brief natural interactions between infants and caregivers, using a bidirectional camera to measure movements in both partners.

**Results:** Head movements generated systematic errors in facial expression measurement that were large enough to be visibly apparent and to frequently mislead standard facial analysis systems; even 10-15° head rotations led to a 30% false positive rate, and errors were extreme (~70%) with larger rotations (30-40°). Our novel method for estimating face shape was 26% more accurate than standard methods. Pilot interactional synchrony data were successfully collected on 30 infant-caregiver dyads, with two sessions recorded to measure reliability across repeated assessments.

**Conclusions:** Results confirm that current computer vision programs yield significant inaccuracies in infant facial estimates due to head movement and differences in facial morphology. Our novel methods account for these confounds, allowing for more robust measurement of infant social movements within natural contexts. In light of these computational advances, digital capture of interactional synchrony holds particular promise for identifying early social-motor biomarkers that can be leveraged for screening. Future directions are to develop a screening threshold based on synchrony features that maximizes specificity for predicting ASD, to test relationships between synchrony and traditional clinical assessments, and to identify synchrony-based latent developmental profiles.

**207.003** (*Panel Discussion*) Computational Approaches to the Assessment of Early Motor Behavior in Autism  
*G. Dawson<sup>1</sup>, K. L. Carpenter<sup>1</sup>, Z. Chang<sup>2</sup>, J. M. Di Martino<sup>2</sup>, S. Espinosa<sup>2</sup>, S. Perochon<sup>2</sup>, P. R. Krishnappa Babu<sup>2</sup> and G. Sapiro<sup>2</sup>,*  
*(1)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC,*  
*(2)Department of Electrical and Computer Engineering, Duke University, Durham, NC*

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**Background:** Early detection of autism spectrum disorder (ASD) is an essential first step toward access to intervention which can impact long term outcomes. Although ASD screening questionnaires are useful, they require literacy and have lower performance with caregivers from minority racial/ethnic backgrounds and lower education. Thus, there remains a need for feasible, accurate, and scalable methods for directly observing and quantifying early autism symptoms. We have developed a digital assessment tool for early ASD symptom detection and monitoring that can be delivered on widely-available devices by designing an application (app) consisting of several brief movies shown on an iPhone or iPad while the child's behavior is recorded via the frontal camera embedded in the device, and using computer vision analysis to quantify behavior. This

presentation will discuss how this computational approach can be useful for assessing early motor skills in toddlers with ASD. Numerous studies have documented deficits in motor coordination as an early feature of ASD.

**Objectives:** Describe a computational approach to the assessment of early motor behaviors in two independent samples of toddlers with and without ASD.

**Methods:** Participants in Study 1 were 104 toddlers, 16-31 months, 22 of whom were diagnosed with ASD, and in Study 2 were 910 toddlers, 17-37 months, 37 of whom were diagnosed with ASD. Both studies were conducted in primary care clinics. The app was administered on an iPhone or iPad while toddlers sat on their caregiver's lap and consisted of a series of brief movies designed to elicit a wide range of ASD-relevant behaviors. A novel bubble-popping game was added to the app in Study 2. During app administration, the child's name was called three times. This presentation will focus on computer vision analysis of motor behavior, including latency of the child's head turn in response to name and postural stability while watching the movies. Furthermore, during the bubble popping game, machine learning algorithms were used to assess motor accuracy, prospective motor control, and sensorimotor timing and integration.

**Results:** In both studies, toddlers with ASD oriented to their name significantly less frequently than non-ASD toddlers and mean latency to orient to name was significantly longer. In both studies, toddlers with ASD exhibited significantly more postural sway as evident by more frequent head movements while watching movies. Preliminary analyses of the bubble popping game showed that toddlers with ASD demonstrated lower fine motor control and accuracy than non-ASD toddlers. This was reflected in the median error (the distance between the center of the popped bubble and the child's touch) and accuracy variability (standard deviation of the accuracy when touching the screen) across all touches.

**Conclusions:** Results of these two studies demonstrate the ability of digital phenotyping deployed on widely-available devices to assess differences in motor skills between toddlers with and without ASD, many of which would be difficult to detect without the fine resolution of computer vision analysis. These findings have far-reaching potential for developing scalable autism screening tools that are feasible in natural settings and enable datasets amenable to machine learning.

**207.004 (Panel Discussion) Towards a Scalable Multidimensional Approach to Identifying Early Markers of Autism Among Toddlers in Sub-Saharan Africa**

*E. Bonney<sup>1</sup>, C. Abbo<sup>2</sup>, M. E. Villalobos<sup>3</sup> and J. T. Ellison<sup>4</sup>, (1)Institute of Child Development, University of Minnesota, Minneapolis, MN, (2)Psychiatry, Makerere University, Kampala, Uganda, (3)Pediatrics, University of Utah, Park City, UT, (4)University of Minnesota, Minneapolis, MN*

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## Background

Motor skills afford children opportunities to interact with people and objects, and develop essential social skills. While evidence has demonstrated strong associations between motor and social skills in typically developing children and those with atypical trajectories such as autism and developmental coordination disorder, the majority of research examining the interplay of early motor and social behaviors has focused on western populations. The cultural appropriateness of new tools designed to quantify these behaviors has not been examined in African settings.

## Objectives

To begin to fill these gaps, we pilot tested the implementation of a multidimensional parent-report assessment in an African setting. We investigated associations between early motor, repetitive and reciprocal social behaviors in toddlers attending well-child clinics in urban Uganda. We hypothesized that more advanced motor behavior would be associated with fewer repetitive behaviors as well as more advanced reciprocal social behaviors in the target population.

## Methods

To assess motor skills, repetitive behaviors, and reciprocal social behaviors in our target population, we translated and cross-culturally validated Ugandan versions of the Early Motor Questionnaire, the Repetitive Behavior Scale for Early Childhood, and the Video-Referenced Rating of Reciprocal Social Behavior, respectively. These questionnaires were administered digitally to parents of toddlers (12-30 months of age) by a team of trained study nurses in two Central Ugandan hospitals. In this early look at the data, we summarize the sample ascertained and report correlation coefficients between key variables, while accounting for chronological age.

## Results

Two hundred and forty-six toddlers (121 females) between the ages of 12 and 30 months participated. The majority of parent respondents were biological mothers of the children (91.1%, n=224), and a high proportion were unemployed (72.8%, n=179). We explored associations between gross motor, fine motor, perception-action, reciprocal social behaviour and repetitive motor behaviour whilst controlling for age. As expected, we observed a positive correlation between reciprocal social behaviour and the frequency of repetitive motor behavior ( $r = .48, p < 0.001$ ), suggesting less sophisticated social responsiveness is associated with more repetitive motor behaviour. We also observed that gross motor skills were negatively correlated with reciprocal social behavior, albeit moderately ( $r = -0.14, p = 0.026$ ). Finally, we observed rather anomalous associations between the frequency of repetitive motor behavior and gross motor skills ( $r = 0.168, p = 0.008$ ), fine motor skills ( $r = 0.24, p < 0.001$ ), and perception action skills ( $r = 0.35, p < 0.001$ ).

## Conclusions

We explored associations between autistic traits (reciprocal social behavior and repetitive behavior) and motor development in a reasonably sized group of urban Ugandan toddlers. Toddlers displaying more repetitive behavior displayed less advanced reciprocal social behavior. Counter to our expectation, toddlers with more advanced gross motor, fine motor, and perception-action skills demonstrated a greater frequency of repetitive motor behaviors. This analysis represents a critical first step toward establishing normative data on autistic traits and motor development in urban Ugandan toddlers. Future work will characterize psychometric integrity of the assessments and derive profiles of risk that may augment future screening efforts.

## PANEL SESSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS

### Panel 227 - Conceptualizing Motor Impairments within the Broader Framework of Autism Spectrum Disorder (ASD): Their Value in Early Diagnosis and the Diagnostic Process.

**Panel Chair:** Anjana Bhat, *Department of Physical Therapy, University of Delaware, Newark, DE*

**Discussant:** Rebecca Landa, *Center for Autism and Related Disorders, Kennedy Krieger Institute, Baltimore, MD*

Motor delays are one of the earliest identifiable markers in at-risk infants who eventually develop Autism Spectrum Disorder (ASD, Landa & Garrett-Mayer, 2006) and increase in magnitude across development (Lloyd, Macdonald & Lord, 2013). Motor impairments in children with ASD are closely linked to their social communication impairments as well as comorbidities in communication, cognition, and function (Licari et al., 2019). A better understanding of motor impairments can provide greater insight into the neural substrates underlying motor performance as well as the neuropathology of ASD. However, motor impairments are currently not part of the diagnostic criteria or specifiers for ASD within the DSM-V. This diverse panel of clinician scientists will present data on motor delays and impairments across the entire developmental spectrum from at-risk infants to children to adults affected by ASD. They will make a case for the pervasive nature of motor impairments in individuals affected by ASD; their association with core characteristics of ASD, and their impact on level of impairment and adaptive functioning. We hope to make a case for why and how motor impairments are intimately linked to the neuropathology of ASD and why they should be considered within the defining criteria or specifiers for ASD.

**227.001 (Panel)** Prevalence of Motor Impairment in Children on the Autism Spectrum and Early Motor Prognostic Markers in Infancy

**M. K. Licari<sup>1</sup>, J. Reynolds<sup>2</sup>, G. A. Alvares<sup>1</sup> and A. O. Whitehouse<sup>1</sup>,** (1)Telethon Kids Institute, University of Western Australia, Perth, WA, Australia, (2)Telethon Kids Institute, Nedlands, WA, Australia

#### Background:

Motor impairment is not currently included in the diagnostic criteria or evaluation of autism. This likely reflects motor impairment sitting outside the traditional social-cognitive conceptualisation of autism and the lack of large-scale studies demonstrating its prominence to advocate for change.

#### Objectives:

The objective of this presentation is to present a summary of our research program investigating the prevalence of motor impairment in large scale cohorts, including evaluating the relationship between motor impairment, core autism symptomatology and other prominent clinical features. Findings from our infant studies examining motor impairment and its potential as an early prognostic marker in infants will also be presented.

## Methods:

Prevalence of motor impairment has been evaluated in the Western Australian Autism Register (N = 2084; 2-6 years; 81.2% male, 18.8% female) and the Australian Autism Biobank (N = 514; 2-6 years; 80.0% male, 20% female). Motor impairment was identified based on scores from the motor subscales of the Vineland and then compared to other domains of functioning (i.e., communication, daily living, socialization), the DSM criteria, intellectual level, age, and gender.

Prevalence of motor impairment and its potential as an early prognostic marker has also been investigated in an infant cohort showing early signs of autism (N=96; recruited 9-14 months; 68.7% male, 22.3% female). Infants were evaluated longitudinally at baseline and three follow-up time points using the Mullen Scale of Early Learning up to three years of age. Utilising similar methodology, our research team are currently conducting a longitudinal high-risk birth cohort with movement being assessed from one month of age.

## Results:

Findings from our large-scale cohort studies have revealed that 26-35% of children on the autism spectrum have clinically significant motor impairment, a rate almost as common as intellectual impairment (29-37%). Even though motor impairment was a common clinical feature, it was not regularly reported (<1.5% cases reported). Motor impairment was more prevalent in children with intellectual impairment (40-52%,  $p<0.001$ ), but still common in those without intellectual impairment (20-29%). Motor impairment was a clinical feature that increases in severity with age and more prevalent in children meeting diagnostic criteria for impairments in non-verbal behaviour and presence of restricted and repetitive behaviours ( $p<0.001$ ).

Motor impairment was a clinical feature common in our infant cohort study. Gross motor impairment was more common (66%), but these resolved in two-thirds of infants at follow-up. Fine motor impairment was less common (30%) but more likely to persist. More than half of the infants with persistent fine motor impairment were classified in the moderate-to-high risk of autism.

## Conclusions:

Findings from our research highlight the need for further consideration of motor impairment within the diagnostic process for autism, along with the potential clinical value of including an evaluation of motor skills within early autism surveillance measures.

**227.002 (Panel)** Quantitative Measures of Average and Peak Acceleration Differentiate Infants at High and Low Familial Risk for ASD and Are Related to Developmental Status.

**R. B. Wilson<sup>1</sup>, M. Tsang<sup>2</sup>, B. Smith<sup>1</sup>, T. Safari<sup>1</sup> and D. Elashoff<sup>1</sup>**, (1)UCLA Medical Center, Los Angeles, CA, (2)UCLA David Geffen School of Medicine, Los Angeles, CA, (3)University of Southern California, Los Angeles, CA

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## Background:

Motor development in the first year of life is fundamental in allowing an infant to 1) build environmental experiences that support cognitive skills, 2) develop a repertoire of complex motor behaviors through movement mistakes and achievements (Piaget, 1952). Impairments in motor development have been posited to be the first sign of atypical development in infants at high-risk for ASD (HR infants). Thus, there is interest in describing the nature of these impairments, which ones are predictive of developmental outcomes, and whether they are amenable to intervention. Quantitative measures of infant motor function may answer these questions by identifying subtle and specific motor impairments in early infancy. Lower movement acceleration has been described in infants at risk for developmental delays due to prematurity or white matter injury, and has been associated with poor locomotor, cognitive, and language outcomes. Thus, this movement feature could be a clinically relevant measure in HR infants.

## Objectives:

To utilize quantitative wearable sensors to identify motor differences in HR infants compared to low-risk (LR) infants, and to identify the relationship of motor activity to developmental domains.

## Methods:

Thirteen LR infants and 24 HR infants participated. HR infants had one older sibling with ASD. LR infants had no elevated concern for ASD. Full day quantitative measurement of spontaneous leg movements was obtained utilizing the wearable sensor at 3 and 6 months of age. Three quantitative features of the leg movement data were assessed: number of leg movements per hour awake and average and peak acceleration. Developmental status was measured at 3 & 6 months of age with the Mullen Scales of Early Learning (MSEL) subscales of gross motor (GM), fine motor (FM), and receptive and expressive language (RL, EL respectively).

#### Results:

There was no significant difference in average and peak acceleration at 3 months of age. At 6 months of age, HR infants showed significantly lower average and peak acceleration of leg movement compared to LR infants [both  $p=0.03$ ]. No difference was found in amount of leg movements between HR and LR infants at both ages. At 3 and 6 months, average acceleration showed a positive but not significant correlation with MSEL GM ( $p=0.08$ ), FM ( $p=0.06$ ), and RL ( $p=0.09$ ) and a significant correlation with EL ( $r=0.30, p=0.04$ ). At 3 and 6 months of age, peak acceleration showed a positive significant correlation with MSEL GM ( $r=0.30, p=0.04$ ), FM ( $r=0.31, p=0.03$ ), RL ( $r=0.30, p=0.04$ ), and EL ( $r=0.32, p=0.03$ ).

#### Conclusions:

Average and peak acceleration differentiated HR and LR infants at 6 months but not 3 months of age. These findings suggest variable motor skills by 6 months. Larger average and peak acceleration values were associated with higher GM, FM, RL and EL abilities. These findings support the hypotheses that quantitative measures of movement acceleration could be used for early identification of ASD, and higher acceleration is related to development of motor and language abilities in ASD. Further work is needed to determine whether acceleration could serve as a useful target for intervention or a marker of development.

**227.003 (Panel)** The Nature and Severity of Motor Impairment in a Large Sample of School-Age Children with Autism Spectrum Disorder (ASD): A SFARI-SPARK Dataset Analysis.

*A. Bhat, Department of Physical Therapy, University of Delaware, Newark, DE*

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#### Background:

Eighty-seven percent of a large sample of children with Autism Spectrum Disorder (ASD) from the SFARI-SPARK study are at risk for motor impairment based on their performance on the Developmental Coordination Disorder Questionnaire (DCD-Q) (Bhat, 2020). In spite of the high prevalence for motor impairment in children with ASD, it is not considered among the diagnostic criteria or specifiers within DSM-V. The DSM-V provision of co-diagnosing motor impairment as DCD was only used in 15% of the children in this sample. In short, motor impairments in school-age children with ASD are under-recognized and remain unaddressed through a lack of motor screening, assessment, and intervention.

#### Objectives:

Three different analyses of the SFARI-SPARK dataset in school-age children with ASD were conducted to study the prevalence of risk for motor impairment and to conceptualize how motor impairments fit within the broader framework of ASD.

#### Methods:

The SFARI-SPARK study dataset ( $n=13,887$ ) was analyzed to examine associations between risk for motor impairment using the Developmental Coordination Disorder-Questionnaire (DCD-Q), social communication impairment using the Social Communication Questionnaire (SCQ), repetitive behavior severity using the Repetitive Behaviors Scale – Revised (RBS-R), and parent-reported current level of cognitive, functional, and language impairments (i.e., ASD specifiers). Next, I analyzed the subdomains of DCD-Q to determine whether gross-motor (visuomotor and multi-limb), fine-motor, or general coordination skills (e.g., moves quickly, fatigues easily, etc.) are better associated with ASD diagnostic criteria or specifiers. Third, I analyzed a subset of children with ASD in the SFARI-SPARK cohort ( $n=1477$ ) who completed both, the DCD-Q and the Purdue Pegboard Test (PPT) to relate DCD-Q data with motor performance on the PPT, a standardized test of bimanual dexterity.

#### Results:

Analysis shows that upon including children with ASD with cognitive impairments, 88.2% of the SPARK sample is at risk for motor impairment using the DCD-Q. The relative risk ratio for motor impairment in children with ASD was 22.2 times greater

compared to the risk in the general population (4%, Rivard et al., 2014) and that the risk for motor impairment further increased as a function of social communication (5.7), functional (6.2), cognitive (3.8), and language (1.6) impairments as well as repetitive behavior severity (5.0). Additionally, the magnitude/severity of risk for motor impairment (including fine- and gross-motor) increased as a function of all impairment types and their levels (i.e., social communication, cognition, language, function, and repetitive behaviors) with medium to large effects. The associations between the DCD-Q and PPT data are currently being analyzed and will be reported in the final presentation.

#### Conclusions:

These findings highlight the multisystem nature of ASD, the need to recognize motor impairments as one of the diagnostic criteria or specifiers for ASD, and the need for appropriate motor screening and assessment of children with ASD. ASD interventions must address not only the social communication and cognitive/behavioral challenges of children with ASD but also their motor function and participation (Kaur & Bhat, 2019; Srinivasan et al., 2015).

#### **227.004** (Panel) Age-Associations, Neural Correlates, and Familiarity of Atypical Sensorimotor Behaviors in ASD

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#### Background:

Individuals with ASD frequently demonstrate sensorimotor issues, and these issues may be central to the disorder(s). The nature and severity of sensorimotor issues vary considerably across individuals, however, suggesting that determination of their primacy to ASD requires analysis of multiple different behaviors and their relation to key clinical and demographic characteristics. To better understand the role of sensorimotor behaviors in core pathophysiological processes of ASD, neural mechanisms also must be defined, as well as their heritability.

#### Objectives:

This talk has two objectives: 1) To characterize age and clinical associations of multiple different sensorimotor behaviors in ASD, and; 2) To describe neural correlates and familial mechanisms of sensorimotor issues with the goal of informing understanding of pathophysiology.

#### Methods:

Three sets of studies will be presented. In study 1 (behavioral study), 109 individuals with ASD and 101 age-(range: 5-35 years) and sex- matched typically developing (TD) controls completed tests of precision gripping force and visually guided saccadic eye movements. Grip force variability and saccade accuracy were examined. In study 2 (fMRI study), 41 individuals with ASD and 28 matched controls completed two functional magnetic resonance imaging (fMRI) runs while performing a test of precision gripping force with their right (run 1) and left hands (run 2). In study 3 (family study), 105 unaffected parents of individuals with ASD and their children (41 trios) as well as 78 age-, sex-, and IQ-matched TD controls completed tests of precision gripping force and visually guided saccades.

#### Results:

In our behavioral study, individuals with ASD showed increased gripping force variability and reduced saccade accuracy compared to controls. Differences in gripping force variability were more severe at younger ages for individuals with ASD, whereas reductions in saccade accuracy were more severe at older ages in ASD. Both grip force variability and saccade accuracy were associated with clinically rated social-communication symptom severity. During the fMRI study, individuals with ASD showed greater activation than controls in contralateral motor cortex (M1) during right-hand gripping, but reduced contralateral M1 and ipsilateral cerebellar activation during left-hand gripping. Results from our family study indicated that, similar to individuals with ASD, parents of individuals with ASD show increased gripping force variability and reduced saccade accuracy.

## Conclusions:

We found that individuals with ASD demonstrate both precision manual and oculomotor issues, but these issues show distinct age associations implicating separate neurodevelopmental processes. Imaging results indicate neural correlates for right and left hand gripping are different suggesting different brain alterations for dominant and nondominant hand movements. Our family study demonstrates that sensorimotor issues in ASD also are evident in unaffected parents, and their impairment is related to that of their affected offspring. We consistently find moderate associations between different sensorimotor issues and core ASD symptoms suggesting they are interrelated aspects of neurodevelopmental mechanisms in ASD.

## ORAL SESSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS

### Oral 321 - Developmental Patterns and Subgroups

**321.001** (Oral) Comprehensive Assessment of Visual Perceptual Skills in Autism Spectrum Disorder  
*A. DiCriscio, J. Smith and V. Troiani, Geisinger Autism & Developmental Medicine Institute, Lewisburg, PA*

**Background:** Previous studies have demonstrated a perceptual bias to local vs. global features in individuals with autism spectrum disorder (ASD); however, results across this area of research are mixed and suggest that a local bias may not be present in all individuals with ASD across all contexts. Current methods commonly utilize paradigms that specifically assess local/global processing (i.e. Navon figures, embedded figures) and little is known regarding performance of individuals with ASD on standardized tests of visual perception. Previous studies have found that individual differences in autism-like traits in the general population were associated with improved performance on the Test of Visual Perceptual Skill Figure-Ground (TVPS-FG) subtest, which requires an individual to locate a smaller figure within a larger, more complex figure (See Figure 1A).

**Objectives:** The purpose of this study was to assess variability in visual perceptual skills using all 7 TVPS subtests, a standardized assessment of visual perception, across children with and without ASD.

**Methods:** Children with (n=48) and without (n=39) ASD completed the 7 subtests of the TVPS. Children were evaluated for ASD by clinicians that specialize in ASD assessment; IQ assessments were also included at the time of testing. ASD symptoms were additionally quantified in children via parent-report on the Broader Autism Phenotype Questionnaire (BAP-Q). We assessed performance across subscales of the TVPS, item-level response variability, and the linear relationship of these metrics with quantitative measures of ASD symptoms. Stimuli across the TVPS subtests are presented in a specified order, with each consecutive trial increasing in difficulty relative to the previous stimulus/trial. We computed a response dispersion index (RDI) that quantifies variability by weighting each stimulus according to its difficulty, with stimuli earlier in the test weighted more than those later in the test. An RDI for each subtest is then calculated by summing the weight of items missed for each individual, with lower RDI scores reflecting more efficient/less variable responses.

**Results:** Children with ASD did not demonstrate better overall performance on any of the 7 TVPS subtests compared to children without ASD, including the TVPS-FG subtest (see Figure 1B). However, when examining individual differences in autism traits, we find that higher BAP-Q scores are associated with better performance on the TVPS-FG subtest. Performance on the TVPS-FG improved as autism traits increased ( $p=0.003$ ; See Figure 1C), an effect that was specific to this subtest. Additionally, results of our item-based analysis indicate a significant relationship between RDI scores on the TVPS-FG and BAP-Q scores, with less variable response patterns being associated with increased ASD symptoms.

**Conclusions:** Results reported here emphasize the need for quantitative assessment of autism traits and may explain why findings regarding a local bias in ASD are mixed, as they may be influenced by the trait distribution of a given sample of participants. We show that the TVPS-FG captures important visual perceptual differences that are associated with the presence of autism traits using both overall and item-level performance metrics. Further, this work provides normative TVPS data in the largest ASD cohort to date.

**321.002** (Oral) Measurement of Subcategories of Restricted and Repetitive Behaviors across Age and Intellectual Functioning in a Large ASD Sample

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**Background:** Restricted and repetitive behaviors (RRBs) comprise a diverse set of behaviors from repetitive sensory motor behaviors (RSMB) to ritualized and rigid behaviors, restricted or circumscribed interests, commonly referred to as insistence on sameness (IS). The Repetitive Behavior Scale-Revised (RBS-R) is one of the most commonly used parent/caregiver-reported measures of RRBs in individuals with Autism Spectrum Disorder (ASD). Despite its widespread use in clinical, neurobiological and genetic research, as well as in clinical practice, studies on the measurement structure of the RBS-R have produced inconsistent findings, impeding progress in the conceptualization and measurement of RRBs in ASD.

**Objectives:** Here we present a comprehensive approach to determine the factor structure of the RBS-R in a large pooled ASD sample using Multidimensional Item Response Theory (MIRT). The size of this sample allowed -- for the first time -- age- and IQ-stratified analyses to assess the scale structure across developmental stages and levels of intellectual functioning. We also assessed the implications of the scale structure through clinical trial simulations to inform intervention designs and endpoint selection.

**Methods:** Item-level data on 3,430 clinically-diagnosed individuals with ASD (519 females, 2,911 males) was combined from four data sources. Children with  $IQ \geq 70$  formed the largest group, ( $N=1,860$ ; Mean age=10.9,  $SD=5.7$ ). The average IQ of the total sample was 89 ( $SD=24$ ; IQ range 12-167). The MIRT analysis was split into four parts. First, the dimensionality of the data was established through an exploratory MIRT using the strata with the highest sample size (children with  $IQ \geq 70$ ). Next, a hierarchical cluster analysis was performed to identify the number of substantive components (i.e. latent factors) that were supported by the data. Third, deviations in structure were assessed in smaller groups stratified by age and IQ. For clinical trial simulations, we calculated power vs. sample size curves using model-based delta and SD of change from baseline scores assuming an effect on only one of the constructs identified (normalized effect size=0.3).

**Results:** We identified a 3-factor solution, comprising repetitive sensory motor behaviors (RSMB), insistence on sameness (IS) behaviors, and self-injurious (SI) behaviors. This structure was broadly consistent across different ages, from children compared to adolescents and adults (all  $IQ \geq 70$ ), and across levels of IQ (comparing  $IQ \geq 70$  vs.  $< 70$ ). While factor correlations between RSMB and IS behaviors were similarly high across different age and IQ strata (all  $r$ 's  $< .5$ ), the strength of association between SI and IS/RSMB factors showed more variability, from low to moderate, across IQ/age comparisons. Clinical trial simulations indicated that using all RBS-R items yields higher power to using effect-specific item subsets, particularly for RSMB and SI, but not IS behaviors.

**Conclusions:** Using the largest sample to date, we confirmed a 3-factor solution of the RBS-R that is consistent across age and levels of IQ. The results therefore support meaningful comparisons in the factors identified across different sub-populations (i.e. age and IQ). Our clinical trial simulations instruct the use of RBS-R total scores, rather than subscale-specific scores, as a clinical endpoint to maximize power to detect a treatment effect.

**321.003 (Oral)** Sensory Features and Associations in the Autism and Developmental Disabilities Monitoring Network, 2006–2014

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Background: Sensory features are highly prevalent among autistic children and include over- and under-responsivity to sensations as well as unusual or repetitive sensory interests. Existing literature suggests sensory features may be present in 54–94% of autistic children (Baranek et al., 2006; Jussila et al., 2019; Tomchek & Dunn, 2007), yet most studies use clinical or

convenience samples which may have limited generalizability. Studies also show associations between sensory features and problems in daily activities including sleeping and eating (Mazurek & Petroski, 2015; Mazurek et al., 2013). Studies from larger and more diverse samples are needed to expand our understanding of sensory features among autistic children.

**Objectives:** The objectives of this study are to use a population-based sample of children from the Autism and Developmental Disabilities Monitoring Network (ADDM) to determine the prevalence of sensory-related features among autistic children, examine differences in sensory features by demographic and functional characteristics, and explore relationships between sensory features and abnormalities in eating and sleeping.

**Methods:** We used data from the ADDM Network for study years 2006–2014, including cohorts of 4-year-old (N=2,915) and 8-year-old (N=22,717) autistic children identified at surveillance sites in the United States. The outcome variable of sensory features was captured through expert review of developmental evaluations in clinical and educational records and described as “odd responses to sensory stimuli.” We first calculated the prevalence of sensory features, with 95% confidence interval (CI) for the sample. We applied multi-level logistic regression modeling (accounting for study year and study site) to examine associations of demographic (age, sex, race/ethnicity, maternal education) and functional variables (cognition, adaptive behavior) with the presence/absence of sensory features. Finally, we examined associations of sensory features with the presence/absence of eating/drinking and sleeping problems, accounting for demographic and functional variables.

**Results:** The sample was 82% male and 55% White, non-Hispanic. The majority (74%; CI: 73.5-74.5%) of the children studied had documented presence of sensory features in their record. Full regression models included 8,442 children, due to missing data. Age of the cohort was not associated with sensory features, but male and White, Non-Hispanic children were more likely to have documented sensory features (Table 1). Children of mothers with >12 years of education and children with adaptive behavior standard scores ≤70 were also more likely to have documented sensory features (Table 1). Children with the presence of sensory features were approximately two or more times more likely to have eating/drinking and sleeping problems (Table 2).

**Conclusions:** Our results from a large, population-based sample support existing literature suggesting a high prevalence of sensory features in autistic children, as well as relationships among sensory features and eating/drinking and sleeping problems. However, they also suggest potential disparities in the documentation of sensory features, which may correspond with reduced access to supports for sensory features and related functional and health problems. Although the ADDM data do not capture a standardized sensory measure, these analyses complement and reinforce knowledge about the presence and impacts of sensory features among autistic children and offer avenues for future research.

### **321.004 (Oral) Developmental Trajectories of Sensory Patterns from Infancy to School Age in Children with ASD and Non-ASD Conditions**

**Y. J. Chen<sup>1</sup>, J. Sideris<sup>1</sup>, L. R. Watson<sup>2</sup>, E. Crais<sup>2</sup> and G. T. Baranek<sup>1</sup>,** (1)Chan Division of Occupational Science and Occupational Therapy, University of Southern California, Los Angeles, CA, (2)Department of Allied Health Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC

**Background:** Past research has demonstrated the early emergence of atypical sensory patterns (e.g., hyper/hypo-reactivity) in infants at-risk for ASD, and their potential utility in predicting ASD outcomes. Whereas previous findings highlighted the cross-sectional differences of sensory patterns across age and clinical groups, there is less research on their longitudinal changes from infancy to school age as differentially related to ASD or other clinical outcomes. More systematic investigations are needed to better understand the development of sensory patterns and heterogeneous outcomes in infants at-risk for ASD among a general population.

**Objectives:** This study aimed to identify developmental trajectories of sensory patterns, which include hyper-responsiveness (HYPER), hypo-responsiveness (HYPO), and sensory interests, repetitions and seeking behaviors (SIRS), from 1 to 6 years of age in a community sample, and to determine their associations with diagnostic outcomes and the effects of demographic factors.

**Methods:** This study used a longitudinal design with person-based analytic approaches. A large community sample of infants (N=1,517) was recruited through the state birth registry. Caregivers completed surveys regarding their child’s sensory patterns and other developmental concerns during infancy (6-19 months; Time1), pre-school years (3-4 years; Time2), and school years (6-7 years; Time3). Sensory patterns were measured by items extracted from the First Years Inventory-v3.1 at Time1 and the Sensory Experiences Questionnaire (SEQ)-v2.1 at Time2 and Time3. Children were classified into four clinical groups – ASD; sensory processing disorder (SPD) and/or sensory-related concerns; other non-ASD/SPD diagnosis/concerns (OD); and no diagnosis/concerns (ND) – based on the Developmental Concerns Questionnaire, Social Responsiveness Scale-2 and SEQ collected at Time2 and Time3. Longitudinally comparable scores of HYPER, HYPO and SIRS based on item-response theory

were included as indicators for multivariate latent growth curve modeling (LGCM). Child's sex, race, and parents' education levels were included as predictors of latent growth factors.

Results: Linear LGCM (CFI=.98, TLI=.96, RMSEA=.035) indicated highly variable trajectories of sensory patterns over early childhood in this community sample. HYPER and SIRS decreased while HYPO increased as mean trends. Child's sex and race were respectively significant predictors of the initial levels of HYPO and SIRS. Parents' education levels predicted the slopes of HYPER and HYPO, and initial levels of HYPO and SIRS ( $p$  all < .01, Figure 1). The slopes of HYPO and HYPER were highly associated with autism severity at age 6 ( $r$  = .54 to .55,  $p$  < .0001). The trajectories by clinical group revealed differential patterns across children with ASD and non-ASD conditions (Figure 2). The slope of HYPER seemed to best differentiate ASD from other clinical outcomes.

Conclusions: These results demonstrated the heterogeneous nature of sensory patterns from early infancy to school age, and the differential associations of sensory trajectories to specific clinical outcomes among a community sample. The change in hyperresponsiveness across this period had particular utility for differentiating ASD versus non-ASD groups, which may have implications for early intervention. Parents' education levels (relative to child's sex and race) accounted for more of the variability in sensory trajectories. Intervention strategies specifically addressing infant's sensory behaviors over time, with tailored family approaches, should be considered in future research.

## POSTER SESSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS

### Poster 441 - Sensory, Motor, and Repetitive Behaviors and Interests Posters

**441.001** (Poster) A Comparison of Restricted Interests in Toddlers with Autism, Developmental Delay, and No Delay  
*M. Frisch<sup>1</sup>, K. L. Coulter<sup>1</sup>, R. P. Thomas<sup>1</sup>, M. Barton<sup>1</sup>, D. L. Robins<sup>2</sup> and D. A. Fein<sup>1</sup>, (1)Psychological Sciences, University of Connecticut, Storrs, CT, (2)A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: Restricted interests are a symptom of autism spectrum disorders (ASD) and individuals with ASD may show preferential attention to objects, over the social world (Baron-Cohen & Wheelwright, 1999). Parents of children with ASD more frequently endorse the presence of restricted interests than their developmentally delayed (DD) peers on the Repetitive Behavior Scale- Revised (Joseph et al., 2013). Studies of school-age children and adults indicate that compared to typically developing (TD) peers, the restricted interests of individuals with ASD differ in nature and intensity (Gutermuth Anthony et al., 2013; Turner-Brown et al., 2011). Categorizations of specific interests in ASD exist; however, no empirical work has examined the specific interests that are common in toddler age children with ASD.

Objectives: This analysis aims to understand the specific restricted interests of toddlers with ASD, compared to toddlers with DD, and TD.

Methods: Participants were parents of 294 toddlers age 12-36 months ( $M$  = 19.20) who received a developmental/diagnostic evaluation due to a positive screener or pediatrician concern. Of these, 72 children were diagnosed with ASD; 131 were DD, and 91 were TD. The TASI, a semi-structured interview (Coulter et al.), was used to elicit caregiver report of the child's behavior. Caregivers responded to two questions about their child's restricted interests: "Is there anything that your child seems interested in that seems like all he/she wants to do?" and "Does your child enjoy carrying around or playing with items that differ from most children his/her age?" and described endorsed interests. Categories of restricted interest were developed drawing from previous coding schemes (Baron-Cohen & Wheelwright, 1999; DeLoache et al., 2007; Klin et al., 2007) and examination of the current data set (Table 1). Each interest category was coded as "endorsed" or "not endorsed" for each respondent. Interests that fit in multiple categories were endorsed for both categories. Sensory interests not tied to a specific object were excluded from analysis (e.g., interest in "loud noises" was excluded, an interest in "vacuum cleaner noises" was included).

Results: Overall, the ASD group endorsed significantly greater frequency of restricted interests (79%) compared to the DD (36%) and TD (33%) groups. Across all groups, the highest endorsed category was household objects (e.g., spoons, keys). Chi-square tests revealed more frequent interests in vehicles,  $X^2(2, 294) = 12.76, p = .0017$ , and household objects,  $X^2(2, 294) = 31.22, p < .0001$ , within the ASD group compared to the other groups (Table 2). No other significant differences were found.

Conclusions: Restricted interests are present in children with DD and TD diagnoses but are significantly more common in toddlers diagnosed with ASD. Specifically, toddlers with ASD display greater interest in vehicles and household objects compared to DD and TD peers. However, there is little qualitative difference between the restricted interests of diagnostic groups, suggesting that a singular interest is common in young children and may not indicate risk for ASD. Future research

should explore differences in engagement with objects of interest and the longitudinal persistence of the interest across diagnostic groups.

**441.002** (*Poster*) A Cultural Comparison of the Latent Structure of Autistic Traits and Sensory Sensitivities in Typically Developing Populations

*E. J. Millington and D. R. Simmons, School of Psychology, University of Glasgow, Glasgow, United Kingdom*

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**Background:**

There is considerable heterogeneity in the phenotype of autism within both the clinical and typically developing populations. This heterogeneity is similarly expressed in sensory experiences, with notable variation between modalities. It is known that there are also cultural variations in the presentation of autism. When these variations are confirmed by standard questionnaires, it is unclear if the results are real or represent differing translations and practices.

**Objectives:**

The aim of this exploratory analysis was to investigate the latent structure of autistic traits and sensory sensitivities, especially whether they are better represented as a continuum or separate groups, and if these structures are common between cultures.

**Methods:**

Researchers with published papers using the Autism Spectrum Quotient (AQ) and Glasgow Sensory Questionnaire (GSQ), measures of autistic traits and sensory sensitivities respectively, were asked to share their datasets. When combined with unpublished data from our lab, the final sample contained 2814 participants living in China, Japan, and the UK, as well as other unknown English-speaking countries.

**Results:**

The first analysis used a Gaussian graphical model to estimate the network of connections between the subscales of the two questionnaires. This showed autistic traits and sensory sensitivities forming two connected but distinct clusters of traits. The notable exception to this was the “attention-to-detail” subscale which was only loosely related to both clusters. Country-level analyses suggested that this network structure applied to all countries.

The second analysis used a Factor Mixture Model to explore the latent factors and groups using all items and participants. The best-fitting model found three groups based on ten factors, with each of the groups near-perfectly corresponding to the participants’ resident country. As expected, the strongest factor represented the autistic phenotype with strong, positive loadings on nearly every item, while the second factor loaded onto items from the GSQ. The subsequent factors were more unusual, with two factors loading onto attention-to-detail and a factor with strong loadings on a variety of items which appear to be culturally specific.

**Conclusions:**

This exploratory study suggests that the interactions between different autistic traits and sensory experiences are consistent between the countries studied. The factor and network structures both suggest three significant dimensions: autistic traits, sensory sensitivities, and attention. At the same time, countries formed their own distinguishable distributions on the measures. This means that scores of individual participants in different countries are not directly comparable. This result is also not necessarily evidence of replicable cultural differences, as subsequent analysis finds that the most notable items have slightly different translations. However, it does indicate that previous research comparing simple means on these questionnaires should be treated with some scepticism.

The size of the difference between the countries meant that the Factor Mixture Model was not sensitive enough to pick up smaller groupings which have previously been identified. While global in nature, the participants were also largely recruited from populations adjacent to the researchers’ universities, so the findings may not be universal.

**441.003** (*Poster*) A Network Analysis of Repetitive Thinking in Autistic Adults

**Background:** While repetitive behaviors are widely studied in autism and considered a core feature of the condition, much less work has been conducted to understand repetitive thinking in autistic people. Passive, repetitive negative thinking (rumination) is robustly associated with the onset of depressive disorders in non-autistic individuals, and preliminary work has suggested that increased rumination may contribute to the higher rates of depression seen in the autistic population.

**Objectives:** We used network analysis to examine the correlational structure of repetitive thinking based on a novel survey battery curated from multiple relevant self-report instruments. We aimed to identify particularly influential symptoms and compare network structures between subgroups of autistic individuals.

**Methods:**  $N=762$  autistic adults ( $M_{Age} = 30.90$  years, 54.4% Female, 10.1% non-binary, 79.5% non-Hispanic White) were recruited from the Simons Foundation's SPARK database (Feliciano et al., 2018). These individuals completed an online survey battery including 58 Likert items drawn from forms such as the Analytical Rumination Questionnaire, Perseverative Thinking Questionnaire, and Negative Event Rumination and Reflection Questionnaire. A regularized partial correlation network then was computed using the graphical LASSO to estimate the functional relations among these items. After combining redundant items into single nodes, we examined the community structure of the network using the walktrap algorithm. Node centrality (i.e., how strongly a specific node is connected to the remainder of nodes in the network) was quantified using one-step expected influence. Permutation tests were used to compare network structures between birth-assigned sex and groups based on age of autism diagnosis (before or after age 18).

**Results:** After node reduction, a total of 39 nodes were included in the exploratory network (Table 1). The walktrap algorithm grouped these nodes into four communities (Figure 1), which we interpreted as (1) General Negative Repetitive Thinking (brooding, worry, and perseveration), (2) Perceived Positive Benefit / Positive Repetitive Thoughts, (3) Adaptive Responses/Positive Reframing, and (4) Obsessive-Compulsive Thinking Patterns. The nodes with the highest expected influence included (a) reviewing past events to make sure one did not do anything wrong (*review*), (b) intrusive thoughts (*ies.intr*), and (c) repetitive thinking about negative events (*mnt*). A case-dropping bootstrap procedure indicated that one-step expected influence estimates were highly stable ( $CS = 0.778$ ). Additionally, permutation tests found no significant differences in overall network structure or global strength values between groups based on gender or age of diagnosis ( $ps > 0.420$ ).

**Conclusions:** Repetitive cognition in autistic adults is composed of several symptom clusters, each of which may be uniquely related to psychopathology in this population. Of the cognitive patterns operationalizing this construct, those most influential ("central") to the structure of the network included searching for errors in past events, experiencing thoughts as intrusive, and responding to negative events with repetitive thoughts. Although node centrality does not itself guarantee that a symptom is a meaningful intervention target, future work in this area should determine whether interventions targeting these central repetitive thinking constructs are effective in reducing the burden of depression and other psychopathology in the autistic population.

**441.004 (Poster)** A Prospective Perception-Action Strategy in Children with Autism during Smart-Tablet Gameplay  
**S. C. Lu<sup>1</sup>**, **D. Lee<sup>2</sup>**, **A. Anzulewicz<sup>3</sup>**, **K. Sobota<sup>4</sup>**, **P. Rowe<sup>5</sup>**, **C. Tachtatzis<sup>6</sup>**, **I. Andonovic<sup>6</sup>** and **J. Delafield-Butt<sup>1</sup>**, (1)Laboratory for Innovation in Autism, University of Strathclyde, Glasgow, United Kingdom, (2)University of Edinburgh, Edinburgh, United Kingdom, (3)Faculty of Psychology, University of Warsaw, Warsaw, Poland, (4)Harimata Sp. z.o.o., Kraków, Poland, (5)Department of Biomedical Engineering, University of Strathclyde, Glasgow, United Kingdom, (6)Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow, United Kingdom

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**Background:** Motor differences between children with autism spectrum disorders (ASD) and those with typical development (TD) have been identified in various activities such as pointing (Torres et al., 2013) and placing (Crippa et al., 2014). Kinematic differences have also been observed in goal-oriented swipe kinematics during smart-tablet gameplay (Lu et al., 2019, 2020). General Tau Theory has been used to describe goal-oriented perception-action strategies (Lee, 2009), which proposes an intrinsic action guide generated by the nervous system coupled to the motor command to guide the physical movement. The coupling constant between the two is assumed to be set by the brain to coordinate the kinematic profile of the goal-oriented action. Here, an exploration to surface a potential difference in the tau-coupling during smart-tablet gameplay in children with ASD is presented.

**Objectives:** To test whether or not the perception-action strategy employed by children with and without ASD differ during goal-oriented swipes in smart-tablet gameplay.

**Methods:** Goal-oriented swipe data were extracted from a study of smart-tablet gameplay for young children (Anzulewicz et al., 2016). Only those swipes that proceeded directly from start to finish without overshooting the target were included. A total of 500 swipes were obtained from 32 children with ASD (aged 33-79 months), and 1426 swipes were obtained from 44 children with TD (aged 36-74 months). The percentage of tau-coupling in each swipe, its duration and distance, and the tau-coupling constant were determined utilising the time and x- and y-coordinates data.

**Results:** Children with ASD demonstrated  $97.90 \pm 10.49$  (mean  $\pm$  SD) % while children with TD demonstrated  $98.98 \pm 7.54$  % of tau-coupling movement, indicating a significantly weakening (t-test,  $p = 0.01$ ) and more variable (F-test,  $p < 0.01$ ) tau-coupling pattern in children with ASD. The coupling constant was  $0.40 \pm 0.93$  for the ASD group and  $0.41 \pm 0.15$  for the TD group. Children with ASD demonstrated a significantly wider range of the coupling constant than children with TD (F-test,  $p < 0.01$ ) while the mean values were similar.

**Conclusions:** The findings indicate that, in comparison to children with TD, children with ASD demonstrated significantly less tau-coupling with higher variability during swipes whilst engaging in smart-tablet gameplay. It should be noted that the coupling constant in ASD was significantly more variable, however, the mean value was similar to what was observed in TD. The results of the coupling constant imply that, for the overall movement, children with ASD and TD used similar strategies to perform the goal-oriented swipes while greater fluctuations were observed in ASD. These findings are consistent with previous reports indicating that individuals with ASD have difficulties in controlling goal-oriented movement efficiently with increased subsecond motor variability during the travel of the movement (Torres et al., 2013). Increased acceleration and jerk amplitudes noted in adults with ASD (Cook et al., 2013) suggests sensorimotor and timing are disrupted at the level of the brainstem integration (Delafield-Butt & Trevarthen, 2017). Therefore, disruption to efficient perception-action regulation by tau-coupling might be a critical motor disruption in ASD.

#### **441.005 (Poster) Adaptive Behaviors Predicted By Sensory Profiles in Toddlers at-Risk for Autism**

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**Background:** Atypical sensory responsivity is prevalent and problematic for children with autism and may have cascading developmental effects, particularly concerning deficits in adaptive behavior development (Lane et al., 2010; Liss et al., 2006). Previous work has shown that elevated sensory profiles (i.e. hypo, hyper, and seeking) have been shown to predict later adaptive behavior skills in elementary school aged children with ASD (Williams et al., 2018) What is not yet known is whether these findings generalize to infants and toddlers with ASD.

**Objectives:** The objective of the current study was to determine to what extent sensory profiles predict adaptive behaviors among infants and toddlers at high risk for developing ASD.

**Methods:** Data were collected as part of an ongoing longitudinal study of high-risk infant siblings. Of the high-risk sibling group ( $n=215$ ), 59 toddlers received an ASD diagnosis based on clinical best estimate at 3 years of age (HR-ASD). This study analyzed parent report data on sensory responsivity, collected at 12 months of age (Sensory Experiences Questionnaire; SEQ 2.1) and a semi-structured assessment of adaptive behavior collected at 36 months of age (Vineland Adaptive Behavior Scales; Vineland-II). A series of multiple linear regressions were computed using sensory profiles (hyperresponsivity, hyporesponsivity, and sensory seeking) to predict adaptive behaviors (communication, socialization, daily living skills, and motor skills). Other model variables included sex and an IQ proxy (Mullen Early Learning Composite; MSEL-ELC).

**Results:** We found significant negative main effects of hyperresponsivity, hyporesponsivity, and sensory seeking scores at 12 months of age on socialization at 36 months of age ( $\beta_{hyper} = -9.32, p < .001$ ;  $\beta_{hypo} = -4.38, p = .012$ ;  $\beta_{seeking} = -4.33, p = .003$ ). Autism diagnosis, MSEL-ELC and sex also had significant negative main effects on socialization. We also found significant negative main effects of hyper- and hyporesponsivity on communication ( $\beta_{hyper} = -5.22, p = .021$ ;  $\beta_{hypo} = -4.09, p = .016$ ). We found significant negative main effects of hyperresponsivity and sensory seeking on motor skills in which ASD diagnosis had an additional negative main effect in the sensory seeking model ( $\beta_{hyper} = -5.38, p = .011$ ;  $\beta_{seeking} = -2.85, p = .037$ ). Lastly, sensory seeking had a significant negative main effect on daily living skills ( $\beta_{seeking} = -2.77, p = .038$ ).

**Conclusions:** Results suggest that the predictive relation of sensory profiles with later adaptive function reported in school-age children with ASD extends to familial high-risk infants later diagnosed with ASD. Given that early sensory symptoms influenced

adaptive function in the HR group as a whole suggests that extreme sensory responsivity may have implications for the broader autism phenotype. In particular, sensory hyporesponsivity in late infancy was strongly related to socialization ability at preschool age. These results suggest that early differences in sensory responsivity could have downstream developmental consequences related to social development and communication, though further research is necessary to explore this possibility (Baranek et al., 2018). If a causal link between early sensory responsivity and adaptive behavior development is found, it would have potentially important implications for early intervention.

**441.006** (Poster) Altered Salience Processing during Visual Exploration in Autism Spectrum Disorder

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**Background:** Reduced attention to social stimuli is a well-replicated in Autism Spectrum Disorder (ASD). This altered visual exploration has been explained by reduced social motivation (top-down approach), although neurobiological evidence is conflicting. An alternative explanation suggested cognitive research with altered profiles of salience processing in ASD (bottom-up approach). Salience describes aspects that stand out from the sensory input stream. The activity of the Locus Coeruleus Norepinephrine (LC-NE) System modulates salience processing via neuronal regulation of sensory selectivity and can be measured by pupillary responses. It remains to be explored whether altered salience processing in ASD translates from cognitive research to visual exploration of dynamic scenes, which typically evoke attenuated social attention.

**Objectives:** Quantify salience processing during visual exploration of dynamic scenes in ASD compared to neurotypically-developed controls (NTC).

**Methods:** We presented 9 movie clips and recorded eye tracking in a sample of participants with ASD (n=164) and NTC (n=164) that were matched for age ([m/SD]; ASD: 16.2y/5.6y, NTC: 16.5y/6.0y), IQ (ASD: 102.1/18.1, NTC: 105.2/16.9), and gender distribution ([female/male]; ASD: 42/122, NTC: 53/111). Movie clips were segmented based on camera cuts into 98 dynamic scenes. The first 8 seconds (i.e. median scene duration) of each scene were analysed. We applied validated computational models of visual attention to estimate two salience maps for each scene frame: Low-level salience (colour, contrast, contour) was computed by the spectral residual approach (Hou & Zhang, 2007), motion salience was computed by the Gaussian mixture-based segmentation model (Zivkovic, 2004) (see figure). Pupillary reactivity was applied as measure of sensory selectivity and related to temporal profiles of corresponding gaze salience. We estimated linear mixed models in a per-trial analysis between groups.

**Results:** Pupillary reactivity during gaze behavior increased with higher low-level and motion salience across groups, which indicated that sensory selectivity was sensitive to low-level and motion salience. Interestingly, the temporal profiles of this association significantly differed between groups: In NTC, pupillary response over time was negatively associated with salience. In ASD, pupillary responses over time was – in contrast – positively associated with salience (see figure).

**Conclusions:** This is the first empirical study to quantify salience processing during dynamic social scenes in ASD compared to NTC. We found different temporal profiles of pupillary reactivity to computational models of salience that indicate different salience processing between groups: In NTC, the sensory selectivity to salience decreases over the course of a scene, where in ASD, the sensory selectivity to salience increases over the course of a scene. We conclude that ASD visual exploration of dynamic scenes is associated with increased sensory selectivity to low-level and motion salience. This might impair sensory selectivity to semantic salience (e.g.: objects, people) and underly attenuated social attention.

Our findings will be extended by an area-of-interests analysis in the coming months and thus we will be able to relate low-level and motion salience processing to social attention during visual exploration.

**441.007** (Poster) An Analysis of Gender Differences in Autism Spectrum Disorder Diagnostic Symptom Presentation in a Tertiary Care Clinic

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Background: Females are diagnosed with Autism Spectrum Disorder (ASD) at a relatively low rate, with an estimated female to male ratio of 1:3 (Loomes et al., 2017). A recent meta-analysis contradicted the previously proposed view that females are at reduced risk for developing ASD, instead suggesting that females with ASD are often missed in the diagnostic process (Loomes et al., 2017). This underestimation of ASD among females may be due to gender differences in ASD symptoms and behavioral profiles, as gold-standard diagnostic measures for ASD have been developed using predominantly male samples (Ratto et al., 2018). ASD symptom severity and adaptive skills are two common concerns in the ASD referral and diagnostic process, and research has produced mixed findings regarding gender differences in these areas, including greater Restricted and Repetitive Behaviors (RRBs) in males with ASD (van Wijngaarden et al., 2014; Allely et al., 2019; Kaat et al., 2020). However, the majority of research has focused on individuals with a confirmed diagnosis of ASD, thereby excluding those who may be missed by diagnostic measures that are based on the male ASD phenotype.

Objectives: To assess gender differences in ASD symptoms and adaptive skills in a clinical sample of individuals referred for an ASD diagnosis.

Methods: The participants for this study were from a database composed of children referred and clinically evaluated for an ASD diagnosis at a tertiary care clinic between 2013-2020. ASD symptom severity was evaluated using *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) Comparison scores* as well as domain-level calibrated severity scores in RRBs and Social Affect (Hus, Gotham & Lord, 2014). Adaptive skills were assessed using either the *Vineland-II/3* or *Adaptive Behavior Assessment System, Second/Third Edition (ABAS-II/3)*. Factorial ANOVAs were conducted to examine the interaction and main effects of gender and ASD diagnosis on ASD symptom severity and adaptive skill mean group differences.

Results: Participants included 456 total individuals (78.9% male;  $M_{\text{age}} = 5.17$  years,  $SD = 3.18$ ), with 47.7% of the sample diagnosed with ASD; non-ASD diagnoses included Language Disorder, ADHD, Global Developmental Delay, and others. Although the factorial ANOVA indicated significant main effects of ASD diagnosis on adaptive skills and ASD symptoms across domains, the only main effect of gender was in the RRB domain ( $F(1, 260) = 5.13, p = .024$ ), such that males referred for an ASD evaluation ( $M = 5.61, SD = 3.16$ ) exhibited significantly more RRBs than females referred for an ASD evaluation ( $M = 4.71, SD = 3.35$ ).

Conclusions: In a clinical sample of individuals referred for an ASD evaluation, males exhibited significantly more RRBs than females. This aligns with recent research on gender differences in RRBs (Kaat et al., 2020), expanding upon those findings to include those who may be mis- or under-diagnosed by current diagnostic procedures. These findings suggest that the female presentation of ASD is quantifiably different than the male presentation. As a result, clinicians should consider these differences when contemplating an ASD diagnosis.

**441.008 (Poster)** Associations between ASD-Related Traits, Restricted and Repetitive Behaviors, and Sensory Reactivity in Children with and without ASD

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Background:

Hypo- and hyper-reactivity to sensory input is a sub-criterion of restricted and repetitive behaviors (RRB) for ASD diagnosis. Hypo-reactivity patterns have been found to distinguish children with ASD from their typically-developing (TD) peers (Ben-Sasson et al., 2009), and sensory reactivity is correlated with RRB (e.g., Gabriels et al., 2008), particularly hyper-reactivity (e.g., Boyd et al., 2010). Recent research suggests that these types of associations might also be found in children and young adults without ASD (Schulz & Stevenson, 2019).

Objectives:

The current study expands on recent work to further examine the relationships between ASD-related traits, RRB, and sensory reactivity in children with and without ASD.

Methods:

The current sample included 13 children ( $M_{\text{age}} = 6.63$  years,  $SD = 2.14$ ; range: 3.83-10.91; TD:  $n = 11$ ; ASD:  $n = 2$ ). As part of a larger study, parents filled out 1) the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012), to assess ASD-related traits, 2) the Repetitive Behavior Scale-Revised (RBS-R; Bodfish et al., 1999), to measure RRB frequency and intensity, 3) the Short Sensory Profile, Second Edition (SSP-2; Dunn, 2014), to assess overall sensory reactivity, and 4) the

Sensory Experiences Questionnaire (SEQ; Baranek et al., 2006), to assess hypo- and hyper-reactivity patterns. Correlational analyses first examined associations in the full sample, then participants were divided into groups low and high on ASD-related traits based on SRS-2 cutoff scores (low traits: T-score  $\leq 59$ ,  $n = 8$ ; high traits: T-score  $> 59$ ,  $n = 5$ ), and groups were then compared on RRB and sensory reactivity.

#### Results:

Positive correlations were found between SSP-2 and SRS-2 scores ( $r(11) = .76$ ,  $p = .003$ ; Figure 1) and between SSP-2 and RBS-R ( $r(11) = .76$ ,  $p = .003$ ). RBS-R was also positively correlated with both SEQ hypo- and hyper-reactivity subscales ( $ps < .042$ ). When children with ASD were excluded, associations remained significant between SSP-2 and SRS-2 ( $p = .039$ ), but RBS-R was no longer related to SSP-2 or the SEQ subscales ( $ps > .078$ ). Results from independent samples t-tests comparing groups high and low on ASD-related traits are summarized in Table 1. In comparison to those low on traits, the high traits group showed significantly higher SSP-2 scores and marginally higher RBS-R and SEQ hyper-reactivity scores, but no trend was seen for hypo-reactivity patterns. When excluding the children with ASD, groups still differed on SSP-2 ( $p = .038$ ), but marginal findings with RBS-R and SEQ hyper-reactivity became non-significant ( $ps > .490$ ).

#### Conclusions:

Overall, atypical sensory processing was associated with more ASD-related traits and more RRB. When the sample included children with ASD, in agreement with past work (Boyd et al., 2010), more RRB were related to hyper-reactivity patterns, but also to hypo-reactivity. Although children with more ASD-related traits exhibited greater atypical sensory processing, hypo-reactivity did not distinguish children high and low on ASD-related traits. Data collection for the current study has transitioned online, which will lead to an increased sample size. Additionally, future work will examine the underlying physiological measures that might play a role in RRB and sensory reactivity.

**441.010 (Poster)** Comparing Age-Related Sensory Processing Differences in Children with Autism Spectrum Disorder, Down Syndrome, Other Developmental Disabilities, and Typically Developing

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**Background:** Atypical sensory processing impacts children with a wide range of developmental disabilities (DD). Three categories of sensory processing have been identified: and sensory interests, repetitions, and seeking behaviors (SIRS). Sensory difficulties significantly impact development and learning across multiple domains, including , motor, and adaptive behavior. Previous research suggests age-related changes in sensory processing patterns for children with DD, including those with ASD. It is unclear if these age-related trajectories extend to other clinical groups such as children with Down syndrome (DS) and how sensory processing differs in these groups.

**Objectives:** The current study compared patterns of sensory processing patterns and age-related trajectories in children with ASD, DS, other DD, and typically developing (TD).

**Methods:** This analysis was conducted on cross-sectional data from a longitudinal study of sensory characteristics in children with ASD. The sample ( $m=5.06$ ). Assessments included caregiver questionnaires, the and Sensory Experience Questionnaire (SEQ), and an observational measure – Sensory Processing Assessment (SPA). Group HYPO, HYPER, and SIRS means were compared using an ANCOVA and contrasts. Multiple regression was used to assess the impact of age on sensory scores. Covariates included IQ, maternal education, sex, and, for the ANCOVA, age.

Results: All group comparisons were significant, except the SPA **HYPER** between the ASD and DS groups , Table 1. \*Denotes non-significant trend.

**HYPO**responsivity. On the SP and SEQ, we found For the SPA, researchers observed **ASD>TD $\geq$ DS $\geq$ DD\*** ( $F = 15.95$ ,  $p < .01$ ).

**HYPER**responsivity. While scores on the SEQ and SPA indicated **ASD>DS $\geq$ DD>TD** ( $F = 21.76$ ,  $p < .01$ ), on the SP, the DS group demonstrated lower symptoms than the DD group, **ASD>DD** ( $F = 19.66$ ,  $p < .01$ ).

**SIRS.** Based on caregiver report – SP ( $F = 16.42$ ,  $p < .01$ ) and the SPA ( $F = 24.18$ ,  $p < .01$ ), we observed **ASD>DD>DS $\geq$ TD\***. In contrast, SEQ scores were **ASD>DS** ( $F = 18.21$ ,  $p < .01$ ).

Sensory trajectories. Graphical analysis showed atypical sensory behaviors in the ASD, TD, and DS groups decreased with age, Table 2. In contrast, the other DD group exhibited increased **HYPO** on the SPA and SP, **HYPER** on the SEQ and SP, and **SIRS** on the SP. Age-related group sensory trajectories were significantly different between the ASD and DD groups for the SPA and SP **HYPO** and SP **HYPER** and from the TD group on the SEQ **SIRS**.

**Conclusions:** In this study, participants with ASD demonstrated more atypical sensory behaviors than their TD, DS, and other DD peers. Per caregiver report, children with DS and other DD showed relatively more atypical sensory processing features compared to TD peers. Across the HYPO measures and parent-reported HYPER measures, children with another DD demonstrated increasing age-related trajectories of atypical sensory behaviors. In contrast, children in the other groups showed stable or decreasing trajectories.

Inconsistencies were observed across caregiver reports and researcher observations. While previous research with a non-distinct DD group found no differences between DD and ASD groups for HYPO and HYPER measures, the current study highlights the need to distinguish between different diagnostic groups such as children with DS.

#### 441.011 (Poster) Component Analysis of a Novel Measure of Rigidity in Individuals with ASD

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#### Background:

Restrictive and repetitive behaviors (RRBs) cause significant distress to individuals with ASD and their families, impacting functioning on multiple levels. Current instruments measuring RRBs are mostly self- and caregiver-reported, have significant informer bias, and do not serve well as outcome measures in clinical trials. The Montefiore-Einstein Rigidity Scale-Revised (MERS-R) is a clinician-rated assessment developed by Bonnie Taylor, PhD and Eric Hollander, MD to measure insistence on sameness and rigidity. Hoffmann-La Roche included this measure in their ORBITING study, which examined outcome measures of RRBs in ASD.

#### Objectives:

We examined the MERS-R's component properties using the ORBITING study data.

#### Methods:

*Participants.* A total of 95 children/adolescents and adults with ASD completed the ORBITING study ( $N = 95$ ,  $M = 16.36$  years,  $SD = 7.45$ ; range 5 – 36).

*Study Design.* The study design mimicked that of a drug intervention study. Participants attended four in-person clinic visits, Screening, Baseline, Week 2, and Week 12, and completed phone visits at Week 6 and Week 8.

*Measures.* For the purposes of this analysis, focus is solely on the MERS-R, a clinician-administered scale designed to assess three domains of rigid behavior in children/adolescents and adults, (1) Behavioral Rigidity, (2) Cognitive Rigidity, and (3) Protest Domain using all available information including clinical observations and participant/caregiver interviews. It was completed at Baseline, Week 2, and Week 12.

#### Results:

The assumptions of sampling adequacy ( $KMO = .843$ ), multicollinearity and factor ability ( $\chi^2[66] = 595.145$ ,  $p < .001$ ) were met. The initial Principal Component Analysis (PCA) solution on the MERS-R Baseline data, calculated using the Kaiser Criterion, resulted in three components with eigenvalues greater than 1, explaining 67.8% of the variance. The items of the Behavioral Rigidity subscale clustered together in a separate component, while the items from the Protest Domain subscale and all but one of the items from the Cognitive Rigidity subscale (Time Spent) clustered in a single component. The Cognitive Rigidity Time Spent item fell into its own component. All items had component loadings greater than 0.4, with the majority above 0.7. The correlations between components were .525 (RC1:RC2), .35 (RC1:RC3) and .113 (RC2:RC3), indicating that the proximal oblique

rotation was appropriate. The scree plot inflection point for this PCA also presented a three- or four-component model as the best fit for the data.

### Conclusions:

This is the first PCA completed on the MERS-R scale. With the removal of a single item, the expected three-dimensional structure was identified, which directly corresponded to the already identified subscales, Behavioral Rigidity, Cognitive Rigidity and Protest Domain. The Cognitive Rigidity Time Spent item was identified as an independent component in a four-component solution and its removal increased the Cronbach's  $\alpha$  for the measure. Overall, the PCA structure is in line with the literature and theory behind the instrument, which identifies two separate but related constructs of rigidity, behavioral and cognitive, with protest being the resulting behavioral response to environmental and interpersonal challenges in either of these domains.

#### 441.012 (Poster) Development and Validation of the Parent-Rated Sensory Reactivity Scale for Children with Autism Spectrum Disorder

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**Background:** Unusual reactions to sensory stimuli are mostly experienced by children with autism spectrum disorder (ASD) and became part of the diagnostic criteria for ASD in the DSM-5. Therefore, it is important to accurately assess these symptoms with reliable and valid scales. Even a number of instruments have been designed internationally to gauge parents' perception and description of sensory behaviors in autism, none has been particularly developed for the Turkish sample. Hence, to address this gap, the current study investigated the psychometric properties of a new parent-rated scale to assess sensory reactivity.

**Objectives:** This study examined the reliability and validity of the new parent-report assessment, the Eyuboglu Sensory Reactivity Scale (ESRS) in children with ASD. It was also aimed to investigate the factor structure of the new ESRS, and its reliability and concurrent validity with previously validated measures. The ESRS designed to assess various sensory behaviors in children with ASD compatible with DSM-5.

**Methods:** A total of 167 children (male:133, age 6.4±4.1) with ASD and their families were included in the study. Parents were asked to fill in the ESRS and the Autism Behavior Checklist (ABC). In addition, the Childhood Autism Rating Scale (CARS) was administered by the clinician to evaluate autism severity. The psychometric properties of the scale were examined through reliability and validity analyses. Cronbach's  $\alpha$  was used to calculate internal consistency and the correlation coefficient was performed to assess concurrent validity and discriminant validity. Bivariate analysis was performed to explore the relationship between the ESRS, ABC, and CARS.

**Results:** According to the confirmatory factor analysis, our results suggest that the ESRS consist of a 15 five-point Likert-type have acceptable internal consistency and good validity for children ages 2 through 18. The Cronbach alpha value of the scale was 0.85. The scale also showed significant associations with both ABC ( $r=.72$ ) and CARS scores ( $r=.42$ ) that indicate good concurrent and external validity.

**Conclusions:** In this study, we have demonstrated that parent-rated ESRS is a psychometrically valid tool to assess sensory reactivity in children with autism. The ESRS has potential as a measure of unusual sensory reactions and can be used to follow up the outcome of sensory interventions in children with ASD. Moreover, the scale is suitable to be used in scientific research and clinical practice.

#### 441.013 (Poster) Do Males and Females with Autism Spectrum Disorder Show Distinct Age-Related Patterns of Restricted Repetitive Behaviors from Early Childhood to Adulthood? Trends across 16,000 Individuals

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**Background:** Repetitive restrictive behaviors (RRBs) are cardinal features of autism spectrum disorder (ASD) that emerge in early childhood and often persist into adulthood. However, given that RRBs have rarely been examined across these

developmental periods and that prior research is mixed with regards to sex differences in RRBs, it remains unclear the points in development at which these behaviors become most salient for males and for females.

**Objectives:** We aimed to characterize age- and sex-related differences in RRBs in a large cross-sectional study of individuals with ASD.

**Methods:** We aggregated three cohorts from clinic and community settings across the United States: Autism Genetic Resource Exchange (N=1,436), Simons Simplex Collection (N=2,752), and Simons Foundation Powering Autism Research (N=12,392), yielding a total sample of 16,580 participants with ASD (80.0% male), aged 3 to 20 years (mean=9.0, s.d.=4.2 years). Caregivers provided behavioral ratings using the Repetitive Behavior Scale-Revised (RBS-R; Bodfish et al., 2000). We charted scores for each RBS-R behavioral domain (Self-Injurious, Restricted, Stereotyped, Compulsive, Ritualistic, and Sameness), then modeled these scores by age, age<sup>2</sup>, age<sup>3</sup>, sex, and cohort in simultaneous regression analyses. For RRB domains which were significantly predicted by age<sup>2</sup> or age<sup>3</sup>, we further extracted ages of highest and lowest RRB domain scores.

**Results:** Males and females with ASD showed both largely overlapping age-related patterns in RRBs observed by their caregivers. Specifically, males and females only differed in restrictive behaviors, with females showing fewer restrictive behaviors than males. Of the lower-order motor behaviors, self-injurious behaviors were stable across age, whereas restricted and stereotyped behaviors generally declined steadily for males and females until age 16, when these behaviors rose slightly through age 20. Of the higher-order cognitive behaviors, compulsive behaviors followed similar trends to restricted and stereotyped behaviors, whereas ritualistic and sameness behaviors increased from age 3, peaked at age 8, then declined until at least age 16.

**Conclusions:** To our knowledge, this is the largest study to date characterizing both age-related and sex-related differences in RRBs for ASD. Our findings illustrate that the nature and intensity of RRBs are largely consistent between males and females yet shift substantially from ages 3 to 20. Restricted, stereotyped, and compulsive behaviors first peaked early in childhood whereas more complex ritualistic and sameness behaviors first peaked later in childhood, suggesting that different behavior domains may track with distinct aspects of cognitive, social, and emotional development. Furthermore, all RRBs except for self-injurious behaviors showed another increase after age 16 particularly for males, though this interaction did not reach significance. Notably, males and females with ASD demonstrated similar levels of RRBs across ages and across domains except for restrictive behaviors, which were more heightened in males than females. In clarifying developmental and sex-specific phenotypes for a core diagnostic symptom domain in ASD, our findings may bear relevance for refining clinical assessments and intervention targets.

**441.014 (Poster) Do You Sense What I Sense? a Comparison of Caregiver- and Self-Reports of Sensory Sensitivities in Children and How They Relate to Autistic Traits**

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**Background:** The Glasgow Sensory Questionnaire (GSQ; Robertson & Simmons, 2013) is a 42-item self-report questionnaire which measures the frequency and severity of sensory difficulties (both hyper- and hypo-responsiveness), giving a score ranging from 0 (no sensory issues) to 168 (Extremely severe and frequent issues in all sensory modalities). Research with this questionnaire in adult populations has shown that there are strong correlations of sensory score with self-reported autistic traits and significant differences in sensory scores between diagnosed autistic and control populations. We have previously shown, however, that the correlation with autistic trait level is less strong in children (INSAR, 2015) using an adapted version of the GSQ with added pictures and simplified questions. Here we aim to replicate this result on a new population of children whilst simultaneously collecting data from their caregivers for comparison.

**Objectives:** To re-investigate the dependence of GSQ sensory score on autistic trait level in children using both self- and caregiver-reports.

**Methods:** The questionnaire was completed by 166 children (mean age 10.0 years, age range 6-15 years) during the course of a public workshop at a local “hands-on” science museum and at similar workshops run at local schools and community groups. The caregiver of the child was asked to complete the Children’s version of the Autism Spectrum Quotient Questionnaire (AQ-Child; Auyeung et al, 2009) and a caregiver version of the GSQ (P-GSQ; Smees et al, 2020). Due to attrition we only have data from 157 caregivers.

**Results:** Overall results showed a non-significant correlation between the self-report GSQ data from children and the caregiver-report AQ score (Pearson’s  $r(157) = 0.05, p = 1$ ). The Caregiver-report GSQ showed a much stronger and significant correlation (Pearson’s  $r(152) = 0.47, p < 0.01, R^2 = 0.22$ ) with caregiver-reported AQ score. The correlation between children’s self reports

and their caregiver's reports of sensory features was significant but not strong (Pearson's  $r(150) = 0.23$ ,  $p = 0.01$ ,  $R^2 = 0.05$ ). Cronbach's alpha for children's GSQ (0.84) and parent's GSQ (0.75) revealed a good degree of internal consistency.

Conclusions: These results are curious given the multiply-replicated highly significant correlations between GSQ sensory scores and autistic trait levels found in adults (16+) and the similar relatively high correlations between caregiver-reported sensory scores and AQ scores found here. There is clearly a mismatch between what children consider their own sensory sensitivities are and what their caregivers think they are, possibly reflecting the "sensitivity-reactivity" divide frequently discussed in recent literature on sensory aspects of autism. One plausible explanation is that all young people have mild difficulties with sensory stimulation: the difference is how they *react* to it, and this "sensory reactivity" is what is picked up in caregiver questionnaires. Alternatively, young people may lack the insight necessary to self-report on their own sensory difficulties and/or the difficulties that they experience may be qualitatively different from those that adults experience. Whatever the explanation, the clear implication is that sensory experiences of autistic children, and adults, should be investigated as far as possible using self-report and first-person data.

**441.015 (Poster)** Effects of Creative Movement Interventions on Fine-Motor, Gross-Motor, and Functional Skills of Children with ASD

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Background:

Recently, we reported that 87% of school-age children with Autism Spectrum Disorder (ASD) are at risk for motor coordination impairments.<sup>1</sup> In our past studies, musical or yoga-based interventions led to generalized and task-specific improvements in gross-motor performance.<sup>2,3</sup> The present study expands on this work by comparing the effects of a Creative Movement (CM) intervention combining music, dance, and yoga to a standard-of-care, Sedentary Play (SP) intervention on the fine and gross-motor coordination and functional performance of children with ASD. Before COVID-19, a subset of children with ASD received face-to-face (F2F) intervention; however, after the pandemic, we are offering the intervention remotely through videoconferencing.

Objectives:

To compare the effects of CM or SP interventions on fine-motor, gross-motor and functional performance of children with ASD. We will also compare F2F and telehealth-based intervention delivery in both groups.

Methods:

24 children with ASD between 6 and 14 years. The study will last for 10 weeks with pretests and posttests conducted during the first and tenth weeks. Children will be matched on age, gender, and level of functioning and then randomly assigned to either CM or SP groups. Each child will receive 8 weeks of training @ 2 sessions/week. The CM group will engage in whole-body, music, dance, and yoga-based activities promoting interpersonal synchrony, visuo-motor, bilateral, and multilimb coordination as well as balance skills. The SP group will engage in tabletop activities such as reading, building, and arts and crafts to promote social interactions and fine motor skills. The Bruininks-Oseretsky Test of Motor Proficiency,<sup>4</sup> the Test of Gross-motor development,<sup>5</sup> and the 2-minute-walk/shuttle-run tests will be administered as a pre- and post-test. We will also code training-specific changes in motor coordination (unilateral, dual-limb, multilimb coordination) across an early, mid, and late training session.

Results:

Preliminary data from a subset of 7 children suggests significant generalized training improvements in running speed and agility (CM pretest =13.42(10.63); CM posttest=19.86(13.50),  $p<0.05$ ), bilateral coordination (CM pretest =18.57(5.41); CM posttest=20.86(4.18),  $p<0.01$ ), strength (CM pretest =9.71(5.50); CM posttest=15.57(4.65),  $p<0.05$ ), as well as locomotor (CM pretest =35.71(6.05); CM posttest=42(5.72),  $p<0.001$ ) skills on the BOT & TGMD standardized motor assessments. We hypothesize that irrespective of mode of intervention delivery (face-to-face or online), the CM group will demonstrate more gross-motor improvements on standardized and training-specific outcomes compared to the SP group who will demonstrate more fine-motor improvements.

Conclusions:

This study will highlight the fact that CM interventions can be used to promote gross-motor coordination in children with ASD. Moreover, we will also compare the effectiveness of delivering CM interventions using a telehealth platform versus F2F interventions and provide best practice guidelines. Movement clinicians working with children with ASD should use CM approaches to target their clients' motor coordination skills. This work will provide the support for inclusion of whole body movement experiences in the standard-of-care for ASD and for OTs/PTs to be motor advocates of their clients with ASD.

**441.016 (Poster)** Evaluation of Fine Motor Skills in Preschool-Aged Boys and Girls with ASD

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**Background:** Motor impairments are commonly reported in Autism Spectrum Disorder (ASD) and have been shown in previous studies to be related to more severe autism symptoms (Travers et al 2015) and difficulties with social communication skills (McPhillips et al 2014). We sought to replicate and extend these findings by examining fine motor skills in a large cohort of 2-4 year old boys and girls with ASD.

**Objectives:** 1) To test for sex differences in fine motor skills. 2) To investigate associations between fine motor skills and autism severity. 3) To evaluate correspondence between parent report and direct observation measures for fine motor skills in preschool-aged children.

**Methods:** Participants include 381 children with ASD (263 males, 118 females) and 165 typically developing controls (95 males, 71 females) (mean age 36.68 months). Fine motor skills were assessed using standard scores from both parent report (Vineland Adaptive Behavior Scales- 2<sup>nd</sup> Edition [VABS-II]) and direct observation (Mullen Scales of Early Learning [MSEL]). Sex by diagnosis interactions for fine motor skills were investigated using ANOVA. Pearson's correlation was used to investigate associations between fine motor scores and autism severity (ADOS Calibrated Severity Score [CSS]) as well as parent report and direct assessment.

**Results:** There was a significant sex by diagnosis interaction for VABS fine motor standard score ( $p = .0005$ ). Pairwise associations revealed that while TD females and males did not differ, females with ASD had lower fine motor scores than males with ASD. In females, but not males with ASD, there was a significant association between increased fine motor skills and reduced autism severity ( $r = .24, p = .01$ ). Fine motor ability as measured by parent report (VABS-II) was highly correlated with direct observation (MSEL) ( $r = .69, p < 0.0001$ ) across both diagnostic group and sex. However, analyses of MSEL fine motor t-scores revealed no significant sex by diagnosis interaction, but there was an association with autism severity in both males and females with ASD (females  $r = -.42$ ; males  $r = -.23, p < .01$ ).

**Conclusions:** In this cohort of preschool-aged children, sex differences in fine motor ability were observed when using parent report of fine motor skills but not direct assessment. Females with ASD exhibited greater impairments in fine motor skills than all other groups and females with weaker fine motor skills had more severe ASD symptoms. Interestingly, although scores for parent report and direct assessment of fine motor skills were highly correlated, we did not observe sex differences in fine motor ability using direct assessment, and lower fine motor scores were associated with increased autism severity in both boys and girls. Thus, there are differences between parent report measures, which may focus more on adaptive living skills, and direct assessment of fine motor skills that should be considered when evaluating motor function in young children with autism.

**441.017 (Poster)** Examining the Factor Structures of the Childhood Routines Inventory-Revised and the Adult Routines Inventory in Autistic Children, Adolescents and Adults

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**Background:** The Childhood Routines Inventory-Revised (CRI-R) and Adult Routines Inventory (ARI) are two companion questionnaire instruments designed to measure restricted, repetitive behaviours (RRB) in typical development and across a range of neurodevelopmental conditions, including autism, from childhood through to adulthood. These measures could provide valuable tools to quantify RRBs in autism spectrum disorder for basic research, clinical trials, and in clinical practice. However,

their factor structure and convergent validity with other autism symptom measures in a clinically ascertained autism sample remains unknown.

**Objectives:** The aims of this study were to (i) explore the factor structures of the CRI-R and ARI for the first time in well-characterised autism cohorts and (ii) examine the factor structures in relation to age, sex, IQ and additional symptomatology measures.

**Methods:** The CRI-R and ARI were administered to 275 autistic children, adolescents and adults aged 6-33 ( $M=16.4$ ,  $SD=6.1$ ;  $N=178$  CRI-R;  $N=79$  ARI) as part of the EU-AIMS Longitudinal European Autism Project (LEAP) and the oRBiting study. Item-level data were analysed using exploratory factor analysis. Reliability was assessed using Cronbach's alpha and item response curves. Convergent validity was established by relating the derived factors to the Repetitive Behavior Scale-Revised (RBS-R) and the Short Sensory Profile (SSP). Derived factor scores were interrogated in terms of associations with age, IQ and sex comparisons (Multivariate Multiple Regression; MMR).

**Results:** Both measures yielded five-factor measurement structure, four of which were common to the CRI-R and ARI and interpretable as: 'Just right' behaviors, Routines and Sameness behaviors, Sensory and Motor behaviors and Restricted Interests/Stereotypies. Each measure then showed an additional unique factor, interpretable as Food Rigidities on the CRI-R and Detail Focus/Sensory Sensitivities on the ARI. The novel factors showed good-to-excellent internal consistency ( $\alpha$  range: 0.82-0.94) and reliability across the trait range. No sex differences were observed on any factors ( $p>.1$ ). Higher scores on the CRI-R Restricted Interests/Stereotypies, Food Rigidities and Sensory & Motor behaviours factors showed significant, moderate associations with younger ages ( $r$  ranging -0.22 to -0.35, all  $p<.004$ ). Higher scores on the CRI-R Restricted Interests/Stereotypies and Food Rigidities factors also showed significant, moderate associations with lower IQ ( $r=-0.34$ ,  $p<.001$ ;  $r=-0.19$ ,  $p=.01$ ). The MMR model for the CRI-R factors showed a significant interaction between age and IQ for Restricted Interests/Stereotypies ( $p=.009$ ,  $b=-0.03$ ), such that older adolescents showed a stronger association with lower IQ than children. Higher scores on the ARI Routines & Sameness behaviours and Detail focus/Sensory Sensitivities factors showed moderate associations with older ages ( $r=0.35$ ,  $p=.0004$ ;  $r=0.30$ ,  $p=.003$ ). The Detail focus/Sensory Sensitivities factor also showed a moderate association with higher IQ ( $r=0.24$ ,  $p=.01$ ). Convergent validity of the novel CRI-R factor structure was demonstrated through expected associations with phenotypically similar subscales on the RBS-R/SSP.

**Conclusions:** We identified novel five-factor measurement structure for the CRI-R and ARI that demonstrate strong psychometric properties and convergent validity in ASD. The findings also indicate important developmental differences in RRB subtypes. These factors can be utilized in a range of future studies across a wide age range and highlight the importance of more research in adulthood.

**441.018 (Poster)** Examining the Hierarchical Structure of Parent-Reported Sensory Features in Autism Using Bifactor Models **Z. J. Williams<sup>1</sup>**, **J. I. Feldman<sup>2</sup>** and **T. G. Woynaroski<sup>1</sup>**, (1)Medical Scientist Training Program, Vanderbilt University School of Medicine, Nashville, TN, (2)Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN

**Background:** Research to date has grouped the sensory features of autism into four response patterns: hyperreactivity (HYPER), hyporeactivity (HYPO), sensory seeking (SEEK), and enhanced perception (EP), all of which can occur in multiple sensory modalities. Though available measures almost exclusively combine responsiveness patterns across multiple sensory modalities (e.g., auditory, visual, tactile, olfactory, gustatory) into unified "overall [HYPER/HYPO/SEEK/EP]" scales (e.g., Ben-Sasson et al., 2009; 2019), some researchers recommend measurement of sensory features within each modality separately (e.g., Tavassoli et al., 2019). However, there is little evidence to suggest which level of measurement and analysis is more appropriate for these constructs.

**Objectives:** Using modern psychometric techniques, the current study aimed to assess the degree to which the five canonical sensory response patterns listed above combine to form valid and interpretable superordinate constructs.

**Methods:** Parents of autistic children aged 2–12 years ( $n = 708$ ,  $M_{Age} = 7.95$  years, 83% male, 73.3% non-Hispanic White) were recruited from the Simons Powering Autism Research Knowledge (SPARK) participant pool (Feliciano et al., 2018) as part of a study on the genetic underpinnings of sensory differences in autism (RM0035Woynaroski). Modality-specific unidimensional measures of HYPER, HYPO, SEEK, and EP were derived from the Sensory Experiences Questionnaire Version 3.0 (SEQ-3.0). For each sensory response pattern, we first used exploratory regularized structural equation modeling (Scharf & Nestler, 2019) to assign items to specific factors. Factor solutions from these models were then used to construct pseudo-confirmatory bifactor models, which were fit to the data using a limited-information (WLSMV) estimator. To assess the strength of the general "overall [HYPER/HYPO/SEEK/EP]" factor in each case, we calculated (a) coefficient omega hierarchical ( $\omega_H$ ), (b) explained common variance (ECV) of the general factor, and (c) the proportion of items with poor loadings ( $<0.3$ ) on the general factor. For each

sensory response pattern, values of  $\omega_H \geq 0.8$ ,  $ECV \geq 0.60$ , and  $< 10\%$  poor loadings were established *a priori* as evidence of a strong general factor, supporting the combination of response patterns across modalities without much loss of information.

Results: A total of 17 HYPER, 12 HYPO, 19 SEEK, and 10 EP items were drawn from the SEQ-3.0 across the five selected modalities. Bifactor models fit the data well for each response pattern (HYPER: 4 specific factors; HYPO: 3 specific factors; SEEK: 5 specific factors; EP: 2 specific factors; all  $CFI_{cML} > 0.971$ , all  $RMSEA_{cML} < 0.055$ , all  $SRMR_u < 0.027$ ). Overall, bifactor indices failed to demonstrate a strong general factor for HYPER ( $\omega_H = 0.482$ ,  $ECV = 0.333$ , 25% poor loadings), HYPO ( $\omega_H = 0.436$ ,  $ECV = 0.294$ , 33.3% poor loadings), SEEK ( $\omega_H = 0.640$ ,  $ECV = 0.400$ , 15% poor loadings), or EP ( $\omega_H = 0.631$ ,  $ECV = 0.555$ , 10% poor loadings), indicating that all four response patterns were better analyzed at the single-modality level.

Conclusions: Multimodal “general reactivity” factors failed to account for large portions of common variance in each sensory responsiveness pattern, suggesting that these commonly used superordinate constructs do not adequately capture the patterns of sensory behaviors seen in autism. Future work should attempt to parse these constructs into single-modality response patterns such as tactile hyperreactivity or visual sensory seeking, which may better represent individual sensory phenotypes.

**441.019** (Poster) Examining the Relationship between Stereotypy and Attentional Problems and Diagnoses in Individuals with ASD

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Background: Motor stereotypies are a subcategory of restricted and repetitive behavior commonly associated with Autism Spectrum Disorder (ASD). However, motor stereotypy is not exclusive to ASD, and a visual description of the motor behavior is not enough to distinguish between stereotypy in those with and without ASD (Freeman et al., 2010). Individuals without ASD who have motor stereotypy are often diagnosed with another neurodevelopmental disorder, commonly Attention Deficit-Hyperactivity Disorder (ADHD), and have problems with attention and executive function, suggesting motor stereotypy may be related to attentional challenges (Mahone et al., 2014). Individuals with ASD often have comorbid ADHD and report issues with attention (Lyll et al., 2017). However, studies have not examined whether attention problems in ASD are related to measures of motor stereotypy. Understanding whether this is the case will help determine the mechanisms behind motor stereotypy.

Objectives: The goal of this study is to examine the relationship between restricted and repetitive behaviors in ASD and measures of attention problems and comorbid ADHD diagnosis.

Methods: Data were collected through the Simons Simplex Collection (SCC), a permanent repository of behavioral and genetic samples from 2,600 simplex families. Our sample included 2,550 children ages 4-18 years ( $M_{age} = 9.03$  years,  $SD_{age} = 3.56$  years) who had a diagnosis of ASD and complete data for the measures of interest. Stereotypy was measured using the Stereotypy factor derived in a prior factor analysis (Russell et al., 2019) from the Repetitive Behaviors Scale – Revised (RBS-R). Attention problems were measured using the Attention Problems T-Score from the Child Behavior Checklist (CBCL). Proband ADHD and current ADHD medication use were assessed via parent report. We conducted two hierarchical linear regressions to examine the relationship between attention problems and ADHD diagnosis and participants’ stereotypy. For both analyses, sex, age, and IQ were included in Step 1, and whether participants were currently on ADHD medication was included in Step 2. Step 3 included either ADHD diagnosis or attentional problems, depending on the analysis. Given the large sample size, we used a p-value of  $\leq .001$ .

Results: An ADHD diagnosis was not a significant predictor of stereotypy after controlling for age, sex, IQ, and medication use. In contrast, the Attention Problems T-Scores on the CBCL were significantly associated with increased stereotypy ( $p = .000$ ), even after controlling for the other variables. Interestingly, medication use was associated with a lower stereotypy ( $p = .001$ ), but only after controlling for attention problems in Step 3.

Conclusions: This research highlights a link between attentional problems and stereotypy in ASD. Further investigation of this link may offer important information on the mechanisms that influence stereotypy in children with ASD as well as other conditions.

**441.020** (Poster) Exploring Sensory Phenotypes in Autism Spectrum Disorder

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#### Background:

Atypical reactions to the sensory environment are often reported in autistic individuals, with a high degree of variability across sensory modalities. As our everyday lives are spent functioning in complex and unpredictable sensory environments, these sensory-processing differences have been shown to promote challenging behaviours and distress in autistic individuals. In addition, these sensory issues have been shown to have downstream effects on other functions including motor, social, and cognitive abilities.

Preliminary research suggests that specific sensory differences may cluster together within individuals creating discrete sensory phenotypes. However, the manner in which these sensory differences cluster, and whether the resulting phenotypes are associated with specific motor, social, and cognitive challenges is unclear.

#### Objectives:

The objective of this research was to gain a better understanding of how sensory differences cluster together within autistic individuals, and to determine whether there are distinct sensory phenotypes within the autistic population. A second aim of this research was to determine whether these sensory phenotypes are differentially associated with adaptive behaviour, social communication, repetitive behaviours, attention deficit and hyperactivity, and obsessive and compulsive traits.

#### Methods:

Data from 598 children between the ages of 1 and 21 years, with a clinical diagnosis of Autism, were extracted from the Province of Ontario Neurodevelopmental Disorder Network database. Data from the seven subscales of the short sensory profile was subjected to a K-means cluster analysis. The Bayesian Information Criteria and previous literature were used to determine meaningful sensory phenotypes. Follow-up ANOVAs were used to compare adaptive behaviour, social communication, repetitive behaviours, attention deficit and hyperactivity, and obsessive and compulsive traits across the resultant phenotypes.

#### Results:

The five-cluster model was found to minimize error variance and produce five meaningful sensory phenotypes: (1) sensory adaptive, (2) generalized sensory differences, (3) taste and smell sensitivity, (4) under-responsive and sensation seeking, and (5) movement difficulties with low energy (see Figure 1). Age, adaptive behaviour, obsessive and compulsive traits, restricted and repetitive behaviours, social communication, and attention deficits and hyperactivity traits were found to be significantly different across the five clusters (all  $p < .001$ ). IQ and gender were not found to differ across clusters. Notably, pairwise comparisons indicated that cluster 3 and 4 were significantly younger than other clusters. Also, cluster 2 had significantly poorer adaptive behaviour, and significantly greater obsessive compulsive traits and repetitive behaviours than other clusters. Children in cluster 1 were reported to have significantly less repetitive behaviours, obsessive compulsive traits, ADHD traits, and scored the lowest on the social communication questionnaire (indicative of less autistic traits; all comparisons significant at  $p < .05$ ; see Figure 2).

#### Conclusions:

These findings suggest that sensory difficulties in autistic individuals can be clustered into meaningful sensory phenotypes, representing a meaningful way to parse the heterogeneity in sensory issues in autism. These discrete sensory phenotypes are associated with unique behavioural/clinical profiles. Given that these sensory phenotypes do not differ in IQ, these results suggest that sensory issues may provide a novel, meaningful way to understand behavioural heterogeneity in Autism.

**441.021** (Poster) Functional Brain Mechanisms of Rapid Motor Control in Individuals with Autism Spectrum Disorder  
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**Background:** Sensorimotor issues are present in the majority of individuals with ASD and are associated with core symptoms. We previously have demonstrated reduced accuracy of initial force output characterized by rapid target overshoot and increased variability of sustained force in ASD, though functional brain processes associated with these behavioral issues in ASD have not been determined.

**Objectives:** Using a rapid visually-guided precision gripping task during functional neuroimaging (fMRI), we examined cortical-cerebellar networks associated with visuomotor control.

**Methods:** Twenty-five individuals with ASD (10-33 years) and 18 typically developing (TD) controls matched on age and IQ completed a test of precision gripping during fMRI. Participants pressed with their right thumb and forefinger on a force transducer while viewing a green FORCE bar that moved upwards with increased force toward a fixed white TARGET bar. Individuals were instructed to maintain the FORCE bar at the level of the TARGET bar for two seconds, alternating with two second rest periods. Two runs were administered in which target force levels were set at 20% or 60% of each participant's maximum voluntary contraction (MVC). Accuracy and trial-to-trial variability of initial and sustained force output were analyzed. Brain activation and functional connectivity (FC) also were examined.

**Results:** Individuals with ASD showed greater initial force output at 20% MVC and reduced initial force output at 60% MVC relative to controls. A significant force x group interaction revealed a pattern of reduced trial-wise variability of initial force output in ASD relative to controls at 20% MVC but increased trial-wise variability at 60% MVC, though post-hoc comparisons did not reach statistical significance. Accuracy and trial-wise variability of sustained force was similar across groups in both conditions. No between group differences in brain activation were seen at 20% MVC. At 60% MVC, compared to controls, individuals with ASD showed increased activation in right primary motor (M1) and somatosensory (S1) cortices and bilateral paracentral lobule. At 20% MVC, increased activation in left M1 and right cerebellar lobules IV-VI each were related to reduced initial force variability as well as increased initial and sustained force accuracy in controls, but not in ASD. For individuals with ASD, increased variability of initial force output was related to reduced severity of clinically rated symptoms. Results of FC analyses are pending.

**Conclusions:** Atypical control of initial force output in ASD suggests reduced integrity of internal action representations that are consolidated and stored within cerebellum and is consistent with previous reports of structural and functional cerebellar abnormalities in ASD. Individuals with ASD showed increased activation in ipsilateral M1 compared to controls which may reflect decreased hemispheric lateralization during precision manual motor actions. Trial-to-trial variability of initial and sustained force output each were associated with activation in contralateral M1 and ipsilateral cerebellar IV-VI in TD but not ASD indicating motor issues also may reflect reorganization of cortical-cerebellar motor systems. These findings collectively suggest cortical-cerebellar dysfunctions may contribute to precision sensorimotor issues and core clinical symptoms of ASD.

**441.022 (Poster)** Genetic Clustering of Repetitive Symptoms, Oppositional Defiant Disorder and Language Disorder and Delay in People with Autism: A Multivariate Genetic Variance Analysis of Genetic Relationship Matrices in the SPARK Sample  
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**Background:**

Autism spectrum disorders (autism) are complex, heritable and highly heterogeneous neurodevelopmental conditions. The majority of genetic variance and nearly half of the total variance in ASD liability can be attributed to common genetic variation. Clinical symptoms often co-occur with other conditions and there is mounting evidence for a considerable genetic heterogeneity between diagnostic subcategories of autism. Recent research showed that common risk variants appear to be similarly relevant to both high- and low-functioning autism, as well as to people with and without *de novo* mutations, involving at least partially distinct aetiological mechanisms. Here, we investigate whether clusters of co-occurring autism symptoms vary in their common genetic architecture and manifest as multiple, distinct, overarching genetic factors. We disentangle autism heterogeneity through multivariate genetic analysis of co-occurring autism symptoms using a case-only design, studying a representative sample of individuals with an autism diagnosis.

**Objectives:**

In this Simons Foundation-funded study, we aim to identify (1) evidence for genetically predictable symptom heterogeneity and (2) evidence for genetically predictable overarching symptom clusters.

### Methods:

Co-occurring autism symptoms were collected through online assessment. A total of 46 phenotypes related to cognitive, motor, social and language abilities and coexisting psychiatric diagnoses were selected from the Basic Medical Screening Questionnaire (BMS), the Background History Form (BGHX), the Lifetime Social Communication Questionnaire (SCQ), the Repetitive Behavior Scale-Revised (RBSR), and the Developmental Coordination Disorder Questionnaire (DCDQ). Approximately 5300 unrelated individuals with autism of Caucasian ancestry had phenotypic and genome-wide genetic data (Infinium Global Screening Array-24 v.1.0; Simons Foundation Powering Autism Research for Knowledge, SPARK). All measures were adjusted for age, age squared, sex and principal components. Univariate and bivariate genetic variance analyses were conducted using Genome-wide Complex Trait Analysis (GCTA) software, where SNP-heritability (SNP- $h^2$ ) estimates capture autism symptom heterogeneity, and genetic correlations ( $r_g$ ) among symptoms reflect shared underlying genetic influences. Overarching shared genetic factors, as captured by genetic relationship matrices (GRM), were subsequently modelled with multivariate structural equation models (SEM) (GRMSEM), analogous to twin modelling techniques. The best-fitting model was identified using likelihood ratio tests.

### Results:

The strongest evidence for genetically predictable symptom heterogeneity in autism was found for quantitatively assessed ritualistic behaviour using the RBSR scale (SNP- $h^2=0.38$ (SE=0.12),  $p=0.00093$ ) though the underlying genetic variation was largely shared across the repetitive RBSR symptom spectrum. Repetitive symptoms were genetically also related with multiple other symptoms. Using GRMSEM, the best-fitting structural equation model identified evidence of a shared genetic factor contributing to RBSR symptoms, behavioural problems/Oppositional Defiant Disorder (ODD), and language delay/disorder, corresponding to at least 50% of the respective SNP- $h^2$  estimates. Replication of these findings in the Simons Simplex Collection is planned.

### Conclusions:

Our findings suggest that symptoms in autism can be understood as complex quantitative traits, where symptom heterogeneity, especially across repetitive behaviours, can be predicted by common genetic variation. Furthermore, repetitive symptoms were genetically linked to ODD and language abilities, consistent with the existence of an overarching aetiological mechanism.

**441.023** (Poster) Girls or Boys, Does the Repetitive Behaviors in Young Autistic Children Differ during Object Exploration? **K. Sotelo<sup>1,2</sup>, V. Courchesne<sup>2</sup>, L. Mottron, M.D.<sup>2</sup> and C. Jacques<sup>1,2</sup>**, (1)University of Quebec in Outaouais, Gatineau, QC, Canada, (2)Autism Research Group, CIUSSS du Nord-de-l'Île-de-Montréal, Montréal, QC, Canada

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### Background:

Sex differences in repetitive behaviors and interests are reported in the developmental trajectory of autistic children. However, few sex differences were described in young autistic children (Harrop et al., 2015; Knusten et al., 2019). In our previous observational study using the Montreal Stimulating Play Situation (MSPS) (Jacques et al., 2018), we showed that three behaviors, namely *Arm movements*, *Hand flapping* and *Close gaze at objects* were significantly more prevalent in our sample of autistic preschoolers. Regarding interests, the objects explored did not significantly differ between autistic and typical children, but objects related to literacy tended to be more explored by autistic children. The differences between girls and boys of our sample was not explored.

### Objectives:

Document sex differences in prevalence, frequency and duration of repetitive behaviors and objects exploration in young autistic children (18-70 months) during the MSPS.

### Methods:

The MSPS includes 40 objects of interest for autistic children and is coded using a repertoire of 48 repetitive behaviors (Jacques et al., 2018). Age matched Autistic ( $n=78$ ; F:15; M:63) and typical ( $n=71$ ; F:26; M:45) children were exposed to the MSPS and

their repetitive behaviors and object exploration were coded using *Noldus Observer XT 11*. Mann-Whitney U and Fisher's test were conducted to compare the prevalence, frequency and duration of repetitive behaviors and objects explored. Bonferroni corrections were applied.

### Results:

Only *Pressing on objects* was marginally significant in proportion in typical boys compared to autistic boys: ( $p=0.009$ ). *Arm movement*, *Putting object in mouth*, *Close gaze at object*, *Lateral glances at object*, *Wiggling fingers* and *Hand-flapping* were found in a greater proportion of autistic boys compared to typical boys (significant or marginally significant,  $ps<0.001-0.009$ ). Frequency and duration of *Covering ears* was also marginally greater in autistic boys compared to typical boys (both  $p=0.008$ ). None of the objects were significantly more explored in either groups of boys. However, the frequency of *Literacy* related object exploration was marginally greater in autistic boys ( $p=0.007$ ).

None of the repetitive behaviors were found in a greater proportion of autistic girls compared to typical girls or had a significantly higher frequency and duration. Although the proportion of autistic and typical girls exploring each object did not significantly differ, *Balls with lights and sounds* was significantly more explored by autistic girls in frequency ( $p<0.001$ ).

### Conclusions:

Our preliminary results suggest that young autistic boys differ more from typical boys, in repetitive behaviors and objects explored, than autistic girls compared to typical girls. It suggests that our previous results mostly characterized the boys in our sample. When studying boys separately, in addition to the three behaviors that were more prevalent in autistic compared to typical children (*Arm movement*, *Close gaze at objects* and *Hand flapping*), three additional behaviors significantly differ in prevalence: *Putting objects in mouth*, *Lateral glances* and *Wiggling fingers*. None of these differences in prevalence were found in girls. Interest for literacy related objects also seems to distinguish only autistic and typical boys. A larger sample is warranted to further document sex differences in autistic preschoolers.

#### 441.024 (Poster) Interoceptive Awareness Is Associated with Autism Trait Severity

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### Background:

Interoception is broadly understood as the perception of the internal state of the body, including physiological sensations such as hunger, thirst, and temperature (Murphy et al., 2017). Recent research suggests that atypical interoception may be associated with autism spectrum disorder (ASD), although some findings are inconclusive (DuBois et al., 2016; Quattrocki & Friston, 2014). The current study investigates the relationship between interoceptive awareness and autism trait severity in order to better understand the link between interoception and ASD.

### Objectives:

To explore the relationship between interoceptive awareness and autism trait severity by examining group differences in a sample of adults with ASD and typically developed (TD) adults, and by examining how interoceptive awareness is correlated with autism traits within these groups.

### Methods:

*Participants.* This study uses preliminary data collected via questionnaire; collection is in progress. Participants were adults aged 18-40 (ASD  $n=11$ ; TD  $n=41$ ). ASD diagnoses were confirmed by clinicians with the Autism Diagnostic Observation Schedule-2 (ADOS; Lord, et al., 2000).

*Procedure.* As part of a larger study, participants completed two questionnaires. The Interoception Sensory Questionnaire (ISQ) assessed interoceptive awareness; an example item is "It is difficult for me to describe what it feels like to be hungry, thirsty, hot, cold or in pain" (Fiene, Ireland & Brownlow, 2018). Participants also completed the Social Responsiveness Scale (SRS; Constantino & Gruber, 2012) to assess autism trait severity.

### Results:

As variances were unequal, Mann-Whitney U tests were conducted to examine group differences. Participants with ASD exhibited higher total scores on the SRS ( $M=68.36$ ,  $SD=30.84$ ) than TD participants ( $M=35.09$ ,  $SD=19.37$ ),  $U=84.5$ ,  $p=.001$  one-tailed. Participants with ASD also exhibited higher total scores on the ISQ ( $M=41.54$ ,  $SD=22.82$ ) than TD participants ( $M=29.52$ ,  $SD=11.39$ ),  $U=138.5$ ,  $p=.031$  one-tailed.

As distributions were non-normal, Spearman's rank-order correlation tests were run to explore the relationship between interoceptive functioning and autism trait severity within both groups. Within both the TD and ASD groups, higher scores on the ISQ were associated with higher scores on SRS-Social Cognition, SRS-Social Communication, SRS-Social Motivation, and SRS-Restricted Interests and Repetitive Behavior. There was no significant association between the ISQ and the Social Awareness subscale in either group (see Table 1). Associations between the ISQ and SRS subscales were weaker within the TD group (ASD significant associations ranged from  $r=.708$  to  $r=.846$ , and TD significant associations ranged from  $r=.338$  to  $r=.393$ ; see Table 1).

#### Conclusions:

Participants with ASD scored lower on interoceptive awareness than TDs and demonstrated a strong positive association between interoceptive difficulties and autism trait severity in the domains of social cognition, social communication, social motivation, and RRBs. This association suggests that interoceptive difficulties are related to ASD trait severity. Within the TD group, the correlations between ASD traits and interoceptive awareness were weaker but still significant. In both groups, interoceptive awareness was not significantly associated with social awareness. As interoceptive challenges are higher in ASD and are related to core social-communicative and RRB symptomology, future research should evaluate whether interoceptive difficulties represent a meaningful intervention target for improving developmental outcomes in individuals with ASD.

**441.025 (Poster)** Investigating Perceptual Sensitivities and Sensory Atypicalities during Development in Children with an Elevated Familial Likelihood for Autism.

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#### Background:

Children diagnosed with Autism Spectrum Disorder (ASD) often show atypical responses to sensory stimuli, such as hyposensitivity, hypersensitivity, and sensory seeking behaviour. Apparently similar atypicalities have been found in infants and toddlers at an elevated likelihood for developing ASD. For example, some studies have reported increased levels of perceptual sensitivity – the ability to respond to and show an awareness of their surroundings – in individuals with ASD, but it's unclear whether these alterations reflect early-emerging manifestations of diagnostic sensory symptoms. In this study, we explored the relationship between infant perceptual sensitivity and sensory atypicalities in mid-childhood.

#### Objectives:

Our overarching goal is to evaluate the relationship between sensory atypicalities and perceptual sensitivity over development. We compare parent reported levels of perceptual sensitivity across development, from 4 months to 10 years, to see if there are any differences in perceptual development between groups who display typical vs elevated symptoms of ASD, and sensory atypicalities at mid-childhood.

#### Methods:

Children were tested as part of an ongoing longitudinal study of infants with an older sibling with ASD ( $n = 81$ ), or typical development ( $n = 52$ ). Parents completed the infant (4, 8, 14 months), early childhood (24 months) and children's (mid-childhood, 7-10 years) behaviour questionnaires which included a sub-scale on perceptual sensitivity. At mid-childhood parents completed the Short Sensory Profile (SSP), and Social Responsiveness Scale (SRS) measuring sensory sensitivity and ASD symptoms. We then split the sample into groups of low vs high sensory atypicalities and ASD symptoms based on the SSP total scores and SRS T-scores, respectively. We used t-tests to examine mid-childhood differences in sensory profiles by high or low

levels of ASD traits. We used mixed models to test differences in perceptual sensitivity over early development between groups with high vs. low sensory atypicalities or ASD symptoms in mid-childhood.

#### Results:

Children with elevated ASD traits had significantly more sensory atypicalities in mid-childhood ( $t(115) = 8.98, p < .001$ ; Figure 1). *Grouping by sensory atypicalities*: 34 children showed an elevated number of sensory atypicalities in mid-childhood. However, in the infant data these sensory groups did not differ on overall perceptual sensitivity or its change over time (Figure 2). *Grouping by ASD traits*: 30 children showed an elevated number of ASD symptoms in mid-childhood. Perceptual sensitivity scores varied significantly between those with high and low symptoms over time ( $p = .009$ ). The elevated ASD symptoms group showed significantly lower perceptual sensitivity at 4 months ( $p = .023$ ) and higher perceptual sensitivity at 24 months than other infants ( $p = .037$ ).

#### Conclusions:

Although children with higher levels of ASD traits showed alterations in the developmental trajectory of perceptual sensitivity over time, this was not found to be the case for children with higher level of sensory symptoms in mid-childhood. Our work finds some evidence consistent with the idea that perceptual sensitivity is altered in infants who go on to have high levels of ASD traits, but this doesn't seem to map onto later sensory symptoms, as readily as previously assumed. Further analyses are needed to investigate possible hypo/hypersensitivity differences.

#### 441.026 (Poster) Lower Verbal IQ Is Associated with Higher Presence of Repetitive Use of Objects with Autism Spectrum Disorder

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#### Background:

Restrictive and repetitive behaviors (RRBs) are a core feature of Autism Spectrum Disorder (ASD) and can be extremely impairing for individuals and their families (Richler et al., 2010). Previous studies have shown that RRBs related to object use (OBJ-USE) at an early age is associated with ASD in a prospective sample (Ozonoff et al., 2008) and these behaviours are observed to decrease over time (South et al., 2005). The correlation of Verbal IQ (VIQ) and OBJ-USE has not been explored.

#### Objectives:

VIQ is correlated with greater presence of OBJ USE in children with ASD with and without controlling for Nonverbal IQ (NVIQ).

#### Methods:

We used previously gathered Behavior and Sensory Interest Questionnaire (BSIQ) data from the Simons Simplex Collection and Boston cohort of the Autism Consortium analyzing the BSIQ parent measure. BSIQ items are coded on a 0-3 scale with 0= not present and 1-3 = present and increasing degree of impairment There were 280 children (males=240, females=40) groups using BSIQ item B4 which includes repetitive spinning (SPIN), repetitive watching of items fall (FALL), repetitive banging (BANG), repetitive throwing (THROW), and lining up objects (LINE) (Hanson et al., 2016). OBJ-USE included individuals with a code of "1, 2 or 3" on any of the five items and NO-OBJ-USE included individuals with a code of "0" on all five items). Additionally, there were three NVIQ clusters: HIGH = <110, AVG= 90-109 LOW = >89.

Using descriptive statistics, we analyzed the relationship between OBJ-USE and NO-OBJ-USE and VIQ, with and without using NVIQ. We then analyzed the occurrence of the five specific OBJ-USE behaviors in our population.

#### Results:

OBJ-USE group showed significantly lower VIQ than those in the NO-OBJ-USE group ( $p < 0.01$ ). OBJ-USE group also showed significantly lower VIQ than NO-OBJ-USE in two of the NVIQ clusters, HIGH ( $p < 0.01$ ), AVG ( $p < 0.01$ ) and although for the LOW NVIQ cluster the difference didn't reach significance ( $p = 0.1$ ).

Preliminary analysis looked at the occurrence of specific OBJ-USE items in our population. LINE=32%, SPIN=24%, FALL=14%, BANG=10% and THROW=6%. In subsequent analysis, we will run a regression analysis to find the correlation between each individual OBJ-USE and VIQ.

#### Conclusions:

This preliminary analysis supported our hypothesis OBJ-USE is correlated with lower VIQ. Additionally, we found that LINE was the most common OBJ-USE behavior in our population. Subsequent analysis will identify whether VIQ is related to specific OBJ-USE and other RRB's. Limitations included using parent report alone and not combined with direct observation. Future directions include using this information to aide in program planning.

#### **441.027** (Poster) Manual Motor Behavior in Individuals with Autism Spectrum Disorder and Their Parents

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Background: Sensorimotor impairments, including feedforward and feedback deficits of manual motor behaviors, are prevalent in individuals with autism spectrum disorder (ASD). Oculomotor issues previously have been documented in unaffected relatives of individuals with ASD. The extent to which manual motor control is disrupted in unaffected parents of individuals with ASD has not yet been determined.

Objectives: To examine the familiarity of manual motor control issues in ASD using a family trio study of individuals with ASD and their unaffected biological parents.

Methods: Fifty-four children with ASD (probands; ages 5-17 years) and 100 parents of children with ASD (ASD parents; ages 29-54 years) were studied. Thirty-five typically developing (TD) controls were matched to probands on age and nonverbal IQ. Forty-five controls were matched with ASD parents on age, sex, handedness, and nonverbal IQ. Participants completed two tests of precision grip force in which they pressed opposing load cells with their thumb and index finger. Participants viewed a static red/green target bar and a white force bar. They were instructed to press the load cells when the target bar turned green, so the force bar reached the level of the target bar. To assess feedforward control, participants completed a two second "rapid" test. We measured the accuracy of the initial force output and the peak rate of initial force increase. To assess feedback control of visuomotor behavior, participants completed an eight second "sustained" test. We measured the force variability and complexity of the force time series (approximate entropy). Both tests were completed at 15%, 45%, and 85% of each participant's maximum voluntary contraction (MVC).

Results: During the rapid test, probands showed reduced accuracy relative to TD controls including greater overshooting at 15% MVC and greater undershooting at 85% MVC; this was especially true at younger ages (group x age x force level interaction,  $p=0.004$ ). Probands also showed a higher peak rate of force increase than TD controls (group main effect,  $p=0.005$ ). During the sustained test, probands showed greater sustained force variability than TD controls; this difference scaled with force level and was more severe at younger ages (group x age x force level interaction,  $p=0.047$ ). ASD parents showed greater force variability than controls at 85% MVC using their dominant hand and at 45% MVC using their non-dominant hand (group x force level x hand,  $p=0.004$ ). Probands showed reduced dominant hand sustained force complexity relative to TD controls, but similar non-dominant hand complexity (group x hand interaction,  $p=0.005$ ).

Conclusions: We found that children with ASD show disruptions in feedforward mechanisms supporting precision motor control. However, feedforward motor control appeared to be intact in ASD parents suggesting that it may not be familial. We also found that children with ASD and their parents show increased sustained force variability which indicates that reduced motor control in response to sensory feedback may be familial. These studies implicate cortico-cerebellar circuits involved in sensory feedback control of precision motor behaviors in the pathophysiology of ASD and suggest sensorimotor issues may serve as important candidate intermediate phenotypes in ASD.

#### **441.028** (Poster) Measuring Multisensory Integration and Autistic Traits

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## Background:

Issues in multisensory integration are increasingly apparent in autism spectrum disorder (ASD). Atypical lower-level perceptual processes, like multisensory integration, can have cascading consequences for higher-level forms of cognition, like social and communication skills. However, no clear delineation exists between typically-developed adults with high levels of autistic traits and autistic adults. Thus, many adults experiencing social and behavioural issues associated with autism are overlooked because of their exclusion from the categorical definition of autism. This study seeks to fill this gap by testing whether integration issues seen in clinical ASD samples will be reflected across the broader spectrum of autistic traits.

## Objectives:

Determine the relationship between multisensory integration and autistic traits, specifically relating to social behaviour and communication.

## Methods:

Participants completed a battery of questionnaires on autistic traits including restricted interests and repetitive behaviours (RRBs) and social communication. Multisensory integration was assessed through a two-part behavioural experiment. First, each individual's psychophysical threshold level was identified using a psychophysical staircase procedure. Auditory stimuli consisted of 70 pure tones presented at every half decibel ranging in volume from 35-69.5 dB SLP. Visual stimuli consisted of 70 sinusoidal luminance gratings (Gabor patches) ranging in contrast-luminance from 0.0-0.1 Michelson contrast. In the second phase, stimuli were presented in auditory, visual, and audiovisual modalities within a small range around each participant's specified threshold, identified in phase one, to measure multisensory integration. Participants completed a detection task, with detection rates and response times recorded. Multisensory integration was measured as (1) the increase in detection rate and (2) the speed of response times during audiovisual relative to unisensory trials. Multisensory enhancement in detection rates and response times were then correlated with autistic traits.

## Results:

Multisensory enhancement was successfully indicated by both detection rates and response times. RRBs were significantly associated with increased multisensory detection rates, ( $r(113)=.21, p<.022$ ), but not multisensory response times ( $r(70)=-.03, p<.826$ ). Similarly, issues with social communication were significantly associated with detection rates, ( $r(113)=-.19, p<.042$ ), but not response times, ( $r(70)=-.08, p<.482$ ). No significant relationship was observed between pragmatic language and multisensory integration.

## Conclusions:

We expected to see decreased levels of multisensory integration associated with higher autistic traits, however we found mixed results. Social communication was negatively associated with detection rates, supporting the hypothesis that increased deficits in communication relate to reduced multisensory integration. Associations between RRBs and detection rates were positive. While this runs contrary to previous research, we hypothesize that this may be a result of matching for behavioural thresholds. Individuals with higher autistic traits exhibited lower thresholds, i.e. they were able to detect dimmer/quieter stimuli, and multisensory enhancement is commonly found to be strongest with weak stimuli, a phenomenon known as inverse effectiveness. These findings support the broader theory that sensory processing issues have cascading impacts on autism symptomatology, in this case, RRBs and social communication. These findings also indicate a potential relationship/interaction between the multiple sensory issues associated with autism, specifically sensory sensitivities and multisensory integration, which should be accounted for in future research.

### 441.029 (Poster) Microstructural Brain Correlates of Parent-Reported Sensory Symptom Severity in Children with ASD and Typical Development.

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Background: Children with autism spectrum disorder (ASD) often demonstrate differences in sensory responsivity compared to typically developing (TD) peers (Baranek et al., 2006). This atypical sensory responsivity can significantly impact overall quality of life (Ismael, Lawson, & Hartwell, 2018). A study of infants at high risk for ASD identified the genu of the corpus callosum

and the cerebellar peduncles as white matter tracts associated with sensory symptom severity (Wolff et al., 2017). However, it is unclear if these associations remain after infancy. Further, we do not know the degree to which the neural correlates of sensory symptom severity are similar or distinct in children with ASD and TD.

**Objectives:** Identify areas where white matter microstructure is 1) associated with sensory symptom severity and 2) distinctly related to sensory symptom severity based on diagnostic status.

**Methods:** 153 children (6-10 years old) completed a diffusion-weighted imaging (DWI) scan and sensory measures (57 children with ASD, 96 children with TD). Overall sensory symptom severity was assessed using the parent-reported Sensory Experience Questionnaire Version 3 (Ausderau et al., 2013). Multi-shell DWI was performed on a 3T GE Scanner with a 32-channel head coil and isotropic 1.8mm voxels. Voxel-based analysis with general linear modeling was used to identify brain areas where T-SPOON corrected fractional anisotropy (FA) was associated with sensory symptom severity (FA~sensory symptom severity\*diagnostic group + age + sex + average head motion). False discovery rate ( $p < .05$ ) was used for multiple comparisons with a cluster threshold of  $k > 10$  contiguous voxels.

**Results:** VBM analyses revealed 7 clusters (sizes: 20-195 voxels) where FA was similarly associated with sensory symptom severity across groups (i.e. sensory symptom severity main effects; Figure 1). Clusters with positive FA-severity correlations were located in the left and right middle cerebellar peduncle, left and right middle temporal white matter, and the right superior corona radiata. Clusters with negative FA-severity correlations were in the left inferior corticospinal tract and the body of the corpus callosum. Analyses also revealed 34 clusters (sizes: 10-436 voxels) where the relationship between FA and sensory symptom severity was dependent upon diagnostic status (i.e. sensory symptom severity x diagnosis interactions; Figure 2). These clusters showed a negative association in the TD group and a positive association in the ASD group. They included the left and right superior cerebellar peduncles, left cerebral peduncle, left and right internal and external capsules, corpus callosum splenium, and left and right superior parietal white matter.

**Conclusions:** Results corroborated previous work demonstrating an association between cerebellar peduncles microstructure and sensory symptom severity but also identified several additional neural correlates of sensory symptoms. Intriguingly, there were more diagnostic-specific neural correlates of sensory symptoms than trans-diagnostic neural correlates of sensory symptoms, potentially indicating a unique role of white matter in the sensory processing network of children with ASD. Many areas identified in these analyses have been associated with sensory gating and integration and thus may suggest that white matter microstructure contributes to sensory symptom severity via altered sensory gating and integration in key brain regions.

**441.030 (Poster)** Misophonia, Hyperacusis, and the Relationship with Quality of Life in Autistic and Non-Autistic Adults  
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**Background:**

Sound sensitivity in people diagnosed with Autism Spectrum Disorder is well documented but the precise sensitivities, and how they impact quality of life, are not well understood (Stiegler & Davis, 2010). Misophonia (sensitivity to specific sounds, often human-produced, such as chewing) and hyperacusis (reduced tolerance to sound) have been investigated in populations of non-autistic adults and may cause negative emotional, behavioural, and physiological reactions (Jastreboff & Jastreboff, 2014). However, their prevalence and associated impairments are not sufficiently understood in autistic populations.

**Objectives:**

Investigate the presence of misophonia and hyperacusis symptoms in autistic and non-autistic adults and assess the relationship between symptom severity and mental health, quality of life, and autism symptoms.

**Methods:**

Sixty-two autistic ( $M_{age} = 33.10$ ,  $SD = 11.83$ ; 12 non-binary, 10 men, 40 women) and ninety-nine non-autistic adults ( $M_{age} = 37.14$ ,  $SD = 12.34$ , minimum; 10 non-binary, 4 men, 85 women) completed a series of online questionnaires. All participants completed the Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) assessing autistic traits, Misophonia Questionnaire (MQ; Wu et al., 2014) assessing misophonia symptoms, Inventory of Hyperacusis Symptoms (IHS; Greenberg & Carlos, 2018)

assessing hyperacusis symptoms, Patient Health Questionnaire (PHQ-4; Kroenke et al., 2009) assessing depression and anxiety, and the World Health Organization Quality of Life–Brief (WHOQOL-BREF; WHOQoL Group, 1998). Autistic participants also completed the Autism Quality of Life Questionnaire (ASQoL; McConachie et al., 2018).

#### Results:

Relative to non-autistic participants, autistic participants had higher misophonia (MQ;  $t(159)=-3.266, p<.001$ ) and hyperacusis symptoms (IHS;  $t(159)=-5.201, p<.001$ ), and higher autistic traits (AQ;  $t(159)=-7.678, p<.001$ ). Autistic participants had lower quality of life in the Environment domain of the WHOQOL-BREF ( $t(159)=2.680, p=.008$ ). Fifty-three percent of autistic participants scored higher than the cutoff for clinical presence of hyperacusis symptoms compared to 23% of non-autistic participants. Forty-seven percent of autistic participants scored higher than the cutoff for clinically significant misophonia symptoms compared to 24% of non-autistic participants. MQ and IHS scores were significantly correlated in autistic ( $r(60)=.723, p<.001$ ) and non-autistic ( $r(97)=.840, p<.001$ ) participants. AQ scores significantly correlated with IHS scores in both autistic ( $r(60)=.316, p=.012$ ) and non-autistic participants ( $r(97)=.637, p<.001$ ). AQ scores were only correlated with MQ scores for non-autistic participants ( $r(97)=.550, p<.001$ ). The IHS was correlated with the PHQ ( $r(60)=.266, p=.037$ ) and ASQoL ( $r(58)=-.314, p=.015$ ) for autistic participants. For non-autistic participants, the PHQ was significantly correlated with IHS ( $r(97)=.536, p<.001$ ) and MQ ( $r(97)=.479, p<.001$ ) scores. IHS symptoms negatively correlated with all WHOQoL domains for non-autistic participants (Physical, Psychological, Social, and Environment), but only with the Environment domain for autistic participants ( $r(60)=-.377, p=.003$ ).

#### Conclusions:

The results suggest that both misophonia and hyperacusis are more common and severe in autistic adults, and are significantly related with one another. These sound sensitivities are related to lower environmental satisfaction (WHOQOL-BREF) and increased depression and anxiety (PHQ-4) in autistic and non-autistic adults. As the results are correlational in nature, additional research is needed to understand possible causal relationships between sound sensitivities, mental health, and quality of life.

**441.031 (Poster)** Motor, Praxis and Social Impairments in Children and Adolescents with Autism Spectrum Disorder, Developmental Coordination Disorder, and Typical Development  
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**Background:** For children with Autism Spectrum Disorder (ASD), social-communication impairments are part of the diagnostic criteria, although motor deficits also are present. Similarly, for children with Developmental Coordination Disorder (DCD), motor impairments are essential diagnostic criteria although social-emotional deficits may be present.

**Objectives:** This study examined social and motor/praxis deficits unique to ASD and DCD, and the relationships between them.

**Methods:** Tests included a motor skills assessment, Movement Assessment Battery for Children-2 (MABC-2) and two praxis measures: Postural Praxis test (PPr) of the Sensory Integration and Praxis Tests, and Florida Apraxia Battery (FAB) modified for children. Social measures included: Theory of Mind (ToM) and Affect Recognition (NEPSY-II subscales), Social Responsivity Scale-2 (SRS-2), Interpersonal Reactivity Index (IRI), and Empathy Quotient for Children and Adolescents (EMQ). Analyses controlled for age, sex, and IQ.

#### Results:

**Motor and Praxis Skills.** The ASD and DCD groups performed significantly worse than the TD group on all motor and praxis measures. The ASD and DCD groups did not differ on the MABC-2 nor the PPr. However, the ASD group performed worse than the DCD group on several FAB sections.

**Social Skills.** On the **SRS-2**, all three groups were significantly different (ASD>DCD>TD). On **ToM** Total and Verbal, the ASD group performed worse than DCD and TD groups. On **IRI** Perspective Taking (PT), the ASD group scored significantly worse than the TD group.

Relationship Among Social and Motor Skills. There were different significant correlations within groups.

TD. MABC-2 Total was correlated with IRI-PT. MABC-2 Manual Dexterity (MD) was negatively correlated with EMQ Cognitive Empathy; Balance was correlated with EMQ Cognitive Empathy and IRI-PT. MABC-2 Catching and Aiming was negatively correlated with ToM Total and Verbal. On the FAB, Gesture to Command was significantly correlated with SRS-2 Restricted and Repetitive Behaviors (RRB), and Tool Use was significantly correlated with ToM Total and Verbal. PPr was significantly negatively correlated with EMQ Prosocial.

ASD. MABC-2 Total and MD showed significant negative correlations with SRS-2 RRB; MD was also significantly correlated with SRS-2 Social Communication. Balance was significantly correlated with IRI PT. On the FAB, Imitation was significantly positively correlated with SRS-2 social motivation measures.

DCD- The only significant correlation between social and motor was MABC-2 MD with ToM Total.

Conclusions: Consistent with the literature, both DCD and ASD groups performed worse than TD on motor and praxis tests. However, the primary difference between clinical groups was the ASD group performed worse than the DCD group on the FAB. Thus, comparable motor impairments are present in both ASD and DCD groups, but praxis, which is considered to have a greater social-communicative value, was most impaired in the ASD group. In ASD, motor performance skills (MABC-2) were related to repetitive and restrictive behaviors, while praxis skills are related to social motivation. These relationships were not found in the DCD group suggesting that there are unique clinical implications for social and motor impairments for each group.

**441.032 (Poster)** New Device for Tip-Toe Behavior Treatment in ASD: A Proof of Concept Study Based on Sensory Impairment Pattern

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Background:

Toe walking is a possible finding in individuals with ASD. In a previous study, we documented the presence of this behavior also during the maintenance of standing position from which the term “tip-toe behavior” (TTB). In a further study, using the Short Sensory Profile (SSP) tool we found different patterns of sensory profile in TTB ASD individuals with two opposite forms: “Under responsive/Seeks sensation” or “tactile hypersensitivity” Since in a pilot study we found a TTB decreasing during standing on a mattress when compared on a hard surface, we have developed a device to be worn within shoes consisting in a special insole for subjects with tactile hypersensitivity.

Objectives:

The study aim is to offer a proof of concept behind a rational approach to TTB treatment based on individual sensory profile.

Methods:

The ASD diagnosis followed the DSM-5 criteria, and a diagnosis confirmation was performed using ADOS-2. Two subjects (subject A: male, 15 years; subject B: male, age: 10,5 years) were selected among a sample of 14 TTB ASD subjects to whom the SSP tool was administered. Subject A expressing a “definite difference” in “Under responsive/seeking sensation” section and a typical performance in “Tactile Sensitivity” section, while subject B expressing a “definite difference” in “Tactile Sensitivity” section and a typical performance in “Under responsive/seeking sensation” section.

We developed an insole made of soft material such as cellular rubber to be inserted inside each shoe. This insole has a constant thickness between 2.0 and 12.0 millimeters which is adapted to individual needs and a density between 0.10 and 0.20 g/cm<sup>3</sup>.

Both subjects wore the device for 48 weeks, 6 hours a day, five days a week. At baseline (T0) and every four months (T1, T2, T3) TTB intensity during standing position was assessed using video recordings taken during a static task (playing in front of a playing table for 90 seconds) without shoes and with socks, using a standardized methodology previously described. The test was repeated in three different days. An independent therapist not involved in test operation analyzed the videos of the static task trials by calculating the cumulative time in seconds spent along ninety seconds on full feet support versus one foot on toes versus

both feet on toes. The mean time of the three trials was then calculated for the three conditions. In this study, we considered as outcome measure the mean percentage of cumulative time spent with a foot on the tips plus both feet on the tips.

Results:

In subject A no changes in TTB intensity was found (T0 value = 71%; T1-T3 average value = 79%), while in subject B a marked reduction in TTB intensity was found (T0 value = 72%; T1-T3 average value = 36,3%) (Figure 1).

Conclusions:

The results obtained in these case reports constitute a proof of concept for the development of special devices to treat TTB according to sensory profile expressed. In particular in presence of “tactile hypersensitivity”, an intervention with special rubber insole seems rationale.

**441.033** (Poster) Parent Perspectives: Sensory Sensitivities Impact the Transition to Adulthood in Young Adults with ASD  
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**Background:** Sensory sensitivities are prevalent in individuals with autism spectrum disorder (ASD; Baranek et al., 2006; Tomcheck & Dunn, 2007). Most studies focus on sensory symptoms in younger individuals (Ben-Sasson, 2019), although they likely impact older individuals. Parents of young adults with ASD express concerns regarding their children’s transition to adulthood from vocational, daily living skills, and service perspectives (Cheak-Zamora et al., 2017; Cribb et al., 2019; Laxman et al., 2019), but it is unknown how parents conceptualize their children’s sensory sensitivities in relation to their transition to independence.

**Objectives:** We aim to examine the intersection of sensory sensitivities and the transition to adulthood from parental perspectives.

**Methods:** Participants were parents, mostly mothers (97%), of young adults with ASD (aged 16;0-25;11), who still live at home, and who, from a screener, have sensory sensitivities. 38 participants completed questionnaires about their children and a semi-structured interview about how their children’s sensory behaviors impact their transition. A composite variable was calculated to determine child independence based upon education, high school graduation plan, employment, driver’s license, and z-score transformed daily living skills standard score from the Vineland Adaptive Behavior Scales. Higher scores indicated greater independence. The Adult/Adolescent Sensory Profile determined if child sensory behavior severity was less than, similar to, or more than most people. The interviews were transcribed, and three questions were thematically analyzed, taking a qualitative approach regarding:

1. The intersection of sensory sensitivities and the transition to adulthood,
2. Sensory sensitivities as a mechanism towards independence, and
3. The sensory sensitivities’ impact on parental expectations for their child’s transition.

Derived themes were examined for frequency and in relation to independence, age, and sensory behavior severity.

**Results:** 84% of parents reported that their children’s sensory sensitivities intersected with their transition, mostly due to daily functioning (56%) and limiting job opportunities (25%). Over half (53%) of parents believed that their children’s sensory sensitivities were obstacles towards independence, citing daily functioning interference, anxiety, and job options. Only 5% of parents considered sensory sensitivities to be vehicles *helping* their child towards independence (e.g., facilitating vocations), 24% considered them to be both, and 18% considered them to be neither. Almost two-thirds (63%) of parents reported that their children’s sensory sensitivities impacted their expectations for their children’s independence, positively (4%) and negatively (33%). 29% of parents felt their children’s sensory sensitivities hindered independence (Table 1). 65% and, with some caution, 100% of parents who endorsed that their children’s sensory sensitivities were obstacles or vehicles towards their independence, respectively, had more independent children. Otherwise, neither independence nor age largely differentiated parental beliefs. Over half (53%) of parents who said their children’s sensory sensitivities intersected with their transition had children with more severe low registration (i.e., under-responsive) sensory behaviors (Table 2).

**Conclusions:** Parents strongly believe that their children’s sensory sensitivities impact their children’s transition to adulthood, primarily regarding daily functioning and job opportunities. Identifying how sensory sensitivities impact the transition to

independence may be important in determining relevant familial supports. Future work should examine these issues directly from individuals with ASD.

**441.034 (Poster)** Perceptual Processing Links Autism and Synesthesia: A Twin Study

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**Background:** Synesthesia is a non-pathological condition where sensory stimuli (e.g. letters or sounds) lead to additional sensations (e.g. color). It occurs more commonly in individuals diagnosed with Autism Spectrum Condition (ASC) and is associated with increased autistic traits and autism-related perceptual processing characteristics, including a more detail-focused attentional style and altered sensory sensitivity. In addition, autistic traits correlate with the degree of synesthesia (consistency of color choices on an objective synesthesia test) in non-synesthetes.

**Objectives:** We aimed to investigate whether the degree of synesthesia for graphemes is associated with autistic traits and perceptual processing alterations within twin pairs, where all factors shared by twins (e.g. age, family background, and 50-100% genetics) are implicitly controlled for, and across the cohort.

**Methods:** We investigated a predominantly non-synesthetic twin sample, enriched for ASC and other neurodevelopmental disorders, NDDs (n=65 individuals including 22 complete pairs, 14-34 years, 60% female, 12 with NDD diagnosis), modelling the linear relationships between the degree of synesthesia (=dependent variable) and autistic traits, sensory sensitivity, and visual feature integration (as independent variables), both within-twin pairs and across the entire cohort. The degree of synesthesia was assessed using a gold standard synesthesia consistency test where participants chose colors for digits and the letters of the alphabet three times. The score was calculated as the mean of the Euclidean distances in CIELUV color space between participant responses for the three different trials per item (Rothen et al. 2013), with lower consistency scores indicating higher levels of synesthetic color consistency (= more similar colors chosen). Autistic traits were assessed with the Autism Quotient (AQ, Baron-Cohen et al., 2001), sensory sensitivity with the Sensory Profile (Brown and Dunn, 2002) and visual feature integration ability with the Fragmented Pictures Test where participants identified incomplete (fragmented) images with as little visual information as possible (Kessler et al., 1993).

**Results:** Within twin pairs, a higher degree of synesthesia (= lower score) was associated with increased autistic traits only within the attention to details domain ( $\beta(95\%CI)=-.66 (-1.21, -.11)$ ,  $SE=.28$ ,  $p=.019$ ), with sensory hyper- ( $\beta(95\%CI)=-.60 (-1.14, -.06)$ ,  $SE=.28$ ,  $p=.031$ ), but not hypo-sensitivity and with being better in visual feature integration ( $\beta(95\%CI)=.47 (.08, .85)$ ,  $SE=.20$ ,  $p=.017$ ). Similar associations were found across the sample, although standardized regression coefficients were only about half the size and only the association with sensory sensitivity reached significance ( $\beta(95\%CI)=-.35 (-0.68, -.01)$ ,  $SE=.17$ ,  $p=.044$ ).

**Conclusions:** Consistent with previous findings, the results support an association between the degree of synesthesia and autistic traits within the attention to details domain and sensory hyper-sensitivity. Better visual feature integration in more synesthetic individuals indicates that they might be able to overcome a by default more detail-focused attentional style if task instructions demand it. Further, the results indicate that a twin design can be more sensitive for detecting these associations.

**441.035 (Poster)** Pressing a Button and Drinking from a Cup: Upper Extremity Movements during Activities of Daily Living in Children with Autism Spectrum Disorder

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**Background:**

Children with Autism Spectrum Disorder often struggle with activities of daily living (ADLs) even when their cognitive ability is average, possibly due to differences in motor development. Specifically, as many as 90% of children with ASD have clinically significant, persistent motor delays or dysfunction, which correlate with difficulties in performing ADLs. Upper extremity motor skills play a crucial role in children's ability to perform ADLs. Current standardized motor assessments and caregiver reports of ADLs reduce complex behaviors down to success or failure, potentially neglecting clinically-significant information that could

help to explain how children complete tasks, or why they may fail. Conversely, while laboratory tasks can improve our understanding of underlying motor mechanisms using quantifiable, objective measures, it is difficult to link performance on customized tasks to functional ability in daily living. To bridge this gap, we are evaluating two ADLs, pressing a button and drinking from a cup, using motion capture technology to objectively quantify how movement impacts the performance of ADLs.

### Objectives:

The objective of the current study was to quantify differences between children with ASD and typically developing (TD) children in the execution of upper extremity movements during ADLs. Specifically, we used spatial (e.g. path length) and speed (e.g. velocity, acceleration, jerk) based characteristics of movements to analyze differences in motor mechanisms that may disrupt performance of upper extremity ADLs in children with ASD.

### Methods:

Twelve age-matched pairs of children with ASD and TD children ( $M_{age}=9.31$ ,  $SD_{age}=3.43$ ,  $Range_{age}=4-14$ ) reached to press a button and to drink from a cup while instrumented for upper-body motion capture and binocular mobile eye-tracking (Figure 1). Participants completed 8 trials for each task, 4 per hand. The button and cup placement was standardized to the participant's 2<sup>nd</sup> metacarpophalangeal joint when their arms were stretched out in front of them. Participants in the TD group did not have a diagnosis of ASD, nor any first-degree relatives with a diagnosis of ASD.

### Results:

Preliminary analysis of the data indicated that children with ASD made less fluid movements when performing ADLs compared to TD children. Specifically, children with ASD showed increased jerk, an indicator of decreased fluidity, when reaching toward the button or cup compared to TD children. Figure 2 illustrates a pair of 5-year-old children with ASD and TD reaching to pick up and drink from a cup. Subsequent analyses include assessment of group differences between children with ASD and TD children in measures of movement fluidity during reaching to press a button and reaching to pick up a cup.

### Conclusions:

Results suggest that differences between children with ASD and TD children's performance of ADLs may be due to decreased spatial efficiency and fluidity of movements by children with ASD. By measuring movement during upper extremity ADLs, we can begin to understand why children with ASD succeed on some tasks but fail on others. The new data provided by this study will inform the development of interventions specifically tailored to the unique motor challenges observed in ASD.

**441.036 (Poster)** Relationships between Visual Fixation and Goal-Directed Body Movement Differ between Autism Spectrum Disorder, Developmental Coordination Disorder, and Typical Development.

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**Background:** Individuals with Autism Spectrum Disorder (ASD) exhibit significant sensorimotor differences. Notably, children with ASD have documented difficulties with oculomotor and postural control, as we and others have previously demonstrated. Despite these documented difficulties, few studies have quantified the relationship between vision and movement together in children with ASD, and most studies have focused on quiet standing rather than dynamic postural control. Further, few studies of sensorimotor control have compared ASD to other neurodevelopmental conditions with motor symptoms (e.g., Developmental Coordination Disorder, DCD). Here, we examined how children with ASD, children with DCD, and typically-developing (TD) children use visual information to guide goal-directed body movements.

**Objectives:** The first objective of this study was to quantify the relationship between oculomotor movements and dynamic postural control in children with ASD. Specifically, we examined where children were looking while completing the task (e.g., to the target object or the user-controlled object), and how long children used to complete the task. The second objective of this study was to determine whether oculomotor control and dynamic postural control differed between children with ASD, children with DCD, and TD children.

**Methods:** Thirty children (ASD  $n = 10$ ,  $M_{age} = 9.50$  years,  $SD_{age} = 1.51$  years,  $Range_{age} = 7-12$ ; DCD  $n = 10$ ,  $M_{age} = 9.30$  years,  $SD_{age} = 1.25$  years,  $Range_{age} = 8-12$ ; TD  $n = 10$ ,  $M_{age} = 9.60$  years,  $SD_{age} = 1.57$  years,  $Range_{age} = 7-12$ ) completed a goal-directed body movement task in a virtual environment while instrumented for full-body motion capture and binocular mobile eye-tracking. Participants moved a user-controlled object (blue ball) laterally to a target (green rectangle) at each of 4 positions

(near/far, right/left) for a total of 16 trials (Figure 1). The user-controlled object translated along a horizontal axis based on the position of a marker placed on the 7<sup>th</sup> cervical vertebra. All participants scored >70 on the nonverbal domain of the WASI-II. Participants in the DCD and TD groups did not have a diagnosis of ASD or any first-degree relatives with ASD.

**Results:** Preliminary analysis of 12 participants (ASD=4, DCD=4, TD=4) indicated differences in the mean proportion of time fixating the target object (ASD=0.15, TD/DCD = 0.20; Figure 2A) and the user-controlled object (ASD=0.05, DCD=0.12, TD=0.02; Figure 2B). The ASD group also had greater variability in task completion time compared to the TD/DCD groups (standard deviations: ASD=6.33, DCD=2.10, TD=3.41; Figure 2C), though the overall rate of task success was similar across groups (ASD=87.5%, DCD=79.7%, TD=81.3%).

**Conclusions:** These results suggest that differences in the use of visual information underlying goal-directed movement in ASD, DCD, and TD influence movement efficiency. Individuals with ASD may exhibit greater variability in task completion time due to inefficiency of motor planning and execution. Individuals with DCD may make a larger proportion of fixations to the user-controlled object relative to their peers due to difficulty mapping the relationship between their movements in the real world and the virtual world. Further work is necessary to clarify the role of visual input and motor output in atypical development.

#### 441.037 (Poster) Repetitive and Restricted Behaviours and Anxiety in Autism Spectrum Disorder: A Systematic Review and Meta-Analysis

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##### Background:

Many individuals with Autism Spectrum Disorder (ASD) experience anxiety, which compounds ASD related difficulties and inhibits daily functioning. However, identifying and treating anxiety in this population is challenging due to its atypical presentation and its overlap with the core features of ASD. Repetitive and restricted behaviours (RRBs) have been found to be positively associated with anxiety and could be used as observable markers to help clinicians identify anxiety in this population. Yet our understanding of the direction and magnitude of the association between anxiety and RRBs remains unclear.

##### Objectives:

Through a systematic review and meta-analysis, this study aimed to 1) assess the association between RRB subtypes and anxiety symptoms in individuals with ASD; 2) assess the association between the RRB subtypes in the context of the anxiety-RRB relationship; and 3) identify factors associated with both RRBs and anxiety symptoms.

##### Methods:

We systematically searched bibliographic databases, clinical trial registries, and dissertation databases as per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Titles, abstracts, and full texts were reviewed by two independent reviewers, whilst data extraction and risk of bias assessments were conducted by one reviewer. Random-effects meta-analyses were then conducted to calculate the pooled association between anxiety and RRB subtypes and the distinct RRB subtypes, whilst the risk factors associated with the anxiety-RRB relationship were narratively reported.

##### Results:

The systematic search identified 3,160 publications. Of these, 42 studies were included in the review. A significant, positive association was found between anxiety and repetitive movements, restricted interests, insistence on sameness, and sensory processing abnormalities ( $r = .22 - .47$ ). Among RRB subtypes, a strong association was identified between insistence on sameness and restricted interests ( $r = .69$ ), whilst there was no association between repetitive movements and restricted interests ( $r = .25$ ). Moderate associations were identified between all other RRB subtypes ( $r = .31 - .41$ ). Finally, this review collated 22 factors which may influence the anxiety-RRB relationship and found evidence for the influencing role of other RRB subtypes, social communication deficits, and intolerance of uncertainty.

##### Conclusions:

This was the first review to examine the association between anxiety and the four subtypes of RRBs in individuals with ASD. We found significant positive associations between anxiety and all RRB subtypes, and that these relationships are influenced by the presence of additional RRBs, intolerance of uncertainty, and the severity of social communication deficits. The identification of autistic traits does not rule out coexisting anxiety and the type and severity of these traits may assist clinicians to identify those at increased risk of anxiety, thus enabling early identification and intervention. However, further work is needed to understand the mechanisms underpinning these relationships. There are likely multiple, inter-twining causal pathways. Clinicians should strive to conduct comprehensive functional assessments of RRBs and anxiety and monitor if interventions targeting RRBs reduce anxiety or vice versa. Intervention studies targeting the factors thought to be involved in the RRB-anxiety relationship may improve outcomes for individuals with ASD.

**441.038** (Poster) Sensorimotor and Cortical-Cerebellar Lateralization in Autism Spectrum Disorder

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**Background:** Sensorimotor abilities are disrupted in most individuals with autism spectrum disorder (ASD). Atypical lateralization of sensorimotor functioning has been documented, implicating reduced hemispheric specialization of motor networks. Lateralization of sensorimotor brain function during behavior has not been systematically assessed in ASD, limiting insights into neurodevelopmental mechanisms. In the present study, we examined sensorimotor behavior and brain activation during left- and right-handed precision gripping in individuals with ASD to assess lateralization of sensorimotor behavior and brain function.

**Objectives:** To (1) characterize precision sensorimotor behavior across right and left hands in ASD, and (2) define functional brain networks associated with right- and left-hand precision sensorimotor control in ASD.

**Methods:** Forty-one individuals with ASD, including eight left-handed individuals, and 28 typically developing (TD) controls, including three left-handed individuals, matched on age (range: 10-34 years) and sex completed a visually guided precision gripping task during functional MRI (fMRI). During the task, participants gripped a force transducer while viewing two horizontal bars. Their task was to press on the transducer to move the lower “force” bar upwards to the height of the static “target” bar. The target bar was set at 45% of each individual’s maximum voluntary contraction (MVC). Participants completed three 26-s blocks of gripping separated by rest blocks. They completed separate runs for right and left hands. Mean force, force complexity, and force variability were examined separately for each hand. Percent BOLD signal change during gripping vs. rest was examined in cortical and cerebellar sensorimotor regions of interest (ROIs), including bilateral primary motor cortex (M1), somatosensory cortex (S1), inferior parietal lobule (IPL), cerebellar lobules V/VI, and cerebellar Crus I.

**Results:** Individuals with ASD showed reduced mean force, reduced force complexity, and greater force variability compared to TD controls across both hands. Both individuals with ASD and TD controls showed increased brain activation during gripping compared to rest across all ROIs, though group differences in activation varied as a function of hand and hemisphere. During right-hand gripping, individuals with ASD showed increased left M1 and left S1 activation relative to TD controls. During left hand gripping, individuals with ASD showed reduced activation in right M1, right S1, bilateral IPL, and left cerebellar lobules V/VI relative to TD controls. In TD controls only, increased activation in left M1 during right hand gripping and increased left cerebellar lobules V/VI activation during right and left gripping each were associated with increased force complexity.

**Conclusions:** Force variability and regularity each were elevated in individuals with ASD compared to controls during both right- and left-hand gripping suggesting bilateral sensorimotor disruptions. Individuals with ASD showed increased contralateral cortical activation relative to controls during right hand gripping, but decreased contralateral cortical and ipsilateral cerebellar activation during left hand gripping suggesting that brain mechanisms associated with reduced precision sensorimotor control in ASD vary as a function of effector side. Our finding that increased activation in left M1 and cerebellar lobules V/VI were associated with increased force complexity in TD controls only further suggests lateralized reorganization of sensorimotor networks in ASD.

**441.039** (Poster) Sensorimotor Gating in Autistic Children and Adolescents and Their Typically-Developing Peers

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**Background:** Sensory gating refers to the ability to focus on the most important aspects of one’s environment by filtering out extraneous stimuli from awareness. Sensory gating, often assessed as sensorimotor gating, is hypothesized to function atypically in autistic individuals. Key measures of sensorimotor gating include habituation/sensitization and prepulse inhibition of the startle

response. Habituation refers to a decrease in response to a novel stimulus after being exposed to it repeatedly. While sensitization is an indication of the opposite, suggesting an increase in response to a repeated stimulus. Prepulse inhibition refers to when perception of a weaker pre-stimulus produces an attenuated response to the startle-inducing stimulus. Recent findings suggest developmental changes in sensorimotor gating in ASD such that autistic children display higher startle reactions possibly due to slower habituation/stronger sensitization, and atypical prepulse inhibition. However, the development of sensorimotor gating in autistic children has not been well mapped.

**Objectives:** To measure sensorimotor gating within autistic children/adolescents and the broader autism phenotype (BAP) relative to their typically-developing peers.

**Methods:** Autistic children/adolescents, their siblings, and typically developing controls between the ages of 4-16 (N=32), completed an auditory startle task to assess the acoustic startle response, prepulse inhibition, and habituation/sensitization. Participants passively listened to a series of pulses ranging from 65-105 dB while viewing a silent film and their startle eye-blink response was measured by means of electromyography. Prepulse inhibition trials included an 85 dB prepulse 120 ms prior to a 105 dB pulse. In statistical analyses, autistic children/adolescents and their siblings were combined into one broad autism phenotypes (BAP) group and compared against the control group. This was done to increase the sample size of the ASD group and was justified on the basis that siblings of autistic individuals are considered higher risk for developing ASD and exhibiting autistic traits.

**Results:** A MM-ANOVA suggested individuals in the BAP group habituated more to the startle stimulus throughout the experiment, with a medium effect size,  $\eta^2=.120$ , as shown in Figure 1A. Although pulse intensity affected the amplitude of participants' startle responses,  $\eta^2=.347$ , this effect showed minimal differences between groups,  $\eta^2=.025$ , as shown in Figure 1B, suggesting individuals with the BAP have a typical acoustic startle response. Lastly, prepulse inhibition had a small effect size,  $d=.40$ , suggesting individuals in the BAP and control group did not differ in response inhibition.

**Conclusions:** These findings show that autistic children/adolescents and those with the BAP, display some differences in sensorimotor gating, specifically habituation. Previous work has suggested that there are sensory differences in ASD. However, our results do not support this. Since autistic children/adolescents and those with the BAP showed increased habituation, this suggests that their ability to filter redundant sensory information may actually be enhanced.

**441.040 (Poster) Sensory Mechanisms of Atypical Motor Variability and Regularity in Autism Spectrum Disorder**  
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**Background:** Deficits in sensorimotor integration are highly prevalent in persons with Autism Spectrum Disorders (ASD). Our prior studies of precision gripping demonstrate that increased motor variability and regularity are exacerbated when visual feedback is either enhanced or degraded in individuals with ASD, suggesting that they are over-reliant on visual feedback during basic motor actions. Other studies indicate over-reliance on proprioceptive feedback during motor learning in ASD, suggesting separate sensory feedback processes may be selectively altered in ASD.

**Objectives:** Given the pervasiveness of sensorimotor behavioral differences in ASD, understanding sensory and motor control processes is important for identifying physiological mechanisms and determining new targets for interventions. To clarify sensory mechanisms of increased motor variability and regularity in ASD, we characterized precision gripping behavior during conditions in which visual and proprioceptive feedback were altered.

**Methods:** Participants with ASD (N=43, 11F) and controls (N=23, 12F) matched on age (10-20 years) and non-verbal IQ completed tests of precision gripping. Participants pressed on force sensors with their index finger and thumb so that a moving bar corresponding to their force output reached and stayed as stable as possible at the level of a stationary target bar. Visual feedback was manipulated by changing the visual gain of the force bar (low, medium, high), which moved more per change in force output at higher gains. Proprioceptive feedback was manipulated by applying 80Hz tendon vibration at the wrist to induce an illusion of muscle contraction. This was compared to a condition with the tendon vibrator turned off. Force variability (standard deviation) and regularity (sample entropy) were examined.

**Results:** Controls showed increased force variability with the tendon vibration turned on compared to off (3.372,  $p < 0.001$ ); however, the ASD group showed no difference in force variability between the tendon vibration conditions ( $t = -0.960$ ,  $p =$

0.338). Individuals with ASD showed stronger age-associated reductions in force variability relative to controls across tendon vibrator and gain conditions (Group x Age:  $t = -4.05$ ,  $p < .001$ ). Individuals with ASD also showed greater age-associated increases in force regularity relative to controls, especially at higher gain levels (Group x Gain Level x Age:  $t = -3.22$ ,  $p = 0.001$ ). Unlike the ASD group for whom regularity increased with age in both tendon vibration conditions, controls only showed age-related gains when the tendon vibrator was off (Group x Vibration Frequency x Age:  $t = 2.46$ ,  $p = .014$ ).

Conclusions: Force output in controls was affected by disrupted proprioceptive and visual feedback, indicating that they integrate both sources to adjust fine motor behavior. However, persons with ASD did not change their force output when proprioceptive feedback was disrupted, suggesting that they rely primarily on visual feedback. Additionally, controls showed minimal change in force regularity and variability with increased age while persons with ASD showed age-associated improvements through adolescence suggesting sensorimotor issues may be more prominent in early development. Our findings help clarify the sensory integration deficits that contribute to motor issues in individuals with ASD and implicate distinct, atypical neurodevelopmental mechanisms in patients.

**441.041 (Poster) Sensory Phenotypes in Autism and Their Relationship with Anxiety**

**Z. Ding<sup>1</sup>**, N. E. Scheerer<sup>2</sup>, C. Yang<sup>3</sup>, B. Stojanoski<sup>4</sup>, E. Anagnostou<sup>4</sup>, R. Nicolson<sup>5</sup>, E. Kelley<sup>6</sup>, S. Georgiades<sup>7</sup>, X. Liu<sup>8</sup> and R. A. Stevenson<sup>9</sup>, (1)Western University, London, ON, Canada, (2)Psychology, Western University, London, ON, Canada, (3)Western University, London, ON, Canada, (4)Autism Research Center, Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (5)University of Western Ontario, London, ON, Canada, (6)Queen's University, Kingston, ON, Canada, (7)McMaster Autism Research Team, McMaster University, Hamilton, ON, Canada, (8)Genomics, Queen's Genomics Lab at Ongwanada, Kingston, ON, Canada, (9)Brain and Mind Institute, University of Western Ontario, London, ON, Canada

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Background: Sensory processing difficulties and high levels of anxiety are commonly found in autistic children, with these issues showing a high level of heterogeneity in the autistic population. When it comes to treating these sensory and anxiety issues, the treatments often do not account for the individual differences in the type and degree of sensory and anxiety issues. As a result, generic treatments are being applied to specific problems, potentially reducing the efficacy of these treatments. In an attempt to parse some of the heterogeneity in sensory and anxiety issues, studies have begun to focus on identifying patterns within these sensory and anxiety issues. However, the relationship between these sensory and anxiety issues remains unclear.

Objectives: The objective of this research is to examine whether anxiety issues in autistic children will cluster into meaningful phenotypes, and if so, whether there is a relationship between these anxiety phenotypes and sensory issues.

Methods: The present study used a secondary dataset collected via from the Province of Ontario Neurodevelopmental Disorders Network (POND). Data from 302 participants who had primary diagnoses of autism and had Short Sensory Profile (SSP) and Revised Child Anxiety and Depression Scale (RCADS) scores were included. A K-means cluster analysis was conducted on the subscale scores of SSP and the RCADS to determine whether meaningful sensory and anxiety phenotypes, respectively, could be generated. Follow-up ANOVAs were conducted to examine whether anxiety issues were related to specific sensory phenotypes.

Results: The cluster analysis of the anxiety symptoms did not yield meaningful phenotypes, rather the resultant phenotypes varied in anxiety severity but not anxiety subtype (see Figure 1). The cluster analysis of sensory data yielded a five-cluster model that minimized error variance and produced five meaningful sensory phenotypes, similar to previous research. These phenotypes can be generalized as (1) sensory adaptive, (2) generalized sensory differences, (3) sensory seeking, (4) low energy/weak, and (5) taste and smell sensitivity (see Figure 2a). Importantly, analysis of anxiety levels across these phenotypes revealed significantly differential results (see Figure 2b). "Sensory adaptive" phenotype showed significantly lower anxiety level than "generalized sensory differences" and "low energy/weak" phenotypes. The "generalized sensory differences" phenotype showed significantly higher anxiety levels than all phenotypes except the "low energy/weak".

Conclusions: Whereas meaningful sensory phenotypes could be identified, anxiety issues cluster based on the severity. The absence of a categorical organization of anxiety issues suggests that although different kinds of anxiety disorders have been found in ASD children, there is no identifiable pattern of co-occurrence of anxiety symptoms. Levels of anxiety did vary across the discrete sensory phenotypes, however. The "generalized sensory difference" phenotype, with the most severe sensory symptoms, was associated with the highest degree of anxiety. That is consistent with previous findings on the positive relationship between severity of sensory processing and anxiety problems in autism. Overall, identifying sensory phenotypes contributes to parse the heterogeneity of sensory characteristics and to develop more targeted treatment for ASD children. And anxiety problems should be given different consideration across five sensory phenotypes.

**441.042 (Poster) Sensory Processing, Prediction, and Anxiety in Autistic Children: Behavioral and Neurophysiologic Correlates**

**Background:**

Atypical sensory processing is common in autism and can influence a host of behavioral domains. Unfortunately, the behavioral and neural correlates of atypical sensory processing remain somewhat elusive, which limits the effectiveness of supports for individuals who need them.

The brain's ability to predict upcoming sensory events, based on past experience, is central to sensory function and mental health, and has been implicated in autism. For instance, long-term irregularities in prediction of sensory events could lead to development of an intolerance of uncertainty (IU) and anxiety. Examining prediction could provide a useful perspective regarding behavioral and neural correlates of sensory processing in autistic children.

Atypical functioning of both sensory cortices and neural processing outside of these areas (i.e., supramodal) could contribute to aberrant sensory responsivity. For instance, differences in cerebellar and amygdala processing have been shown in autism studies and have been connected to sensory and higher order neural processes. Because the cerebellum and amygdala are highly connected to cortical sensory regions and play an important role in prediction and anxiety, we propose that irregular function and connectivity in these regions likely contribute to atypical sensory processing, IU, and anxiety in autistic persons.

**Objectives:**

We aimed to examine the relationship between behavioral measures of sensory processing, IU, and anxiety, and the association between these measures and functional connectivity between sensory and supramodal brain regions. We hypothesized that the autistic participants would demonstrate significant relationships between sensory processing, IU, and anxiety, and that these measures would correlate with hypo-connectivity between sensory cortices, the cerebellum, and amygdala.

**Methods:**

Participants were 30 children with a confirmed diagnosis of autism (27 male; mean age=9.13 years) and 26 nonautistic peers (19 male; mean age=9.38). All participants underwent a resting-state functional magnetic resonance imaging scan (rs-fMRI). Parents also completed several questionnaires: Short Sensory Profile<sup>s</sup> (SSP), Intolerance of Uncertainty Scale (IUS-12), and the Screen for Child Anxiety Related Disorders (SCARED). One-way analysis of variance (ANOVA) was used to test between-groups differences for each behavioral questionnaire. Furthermore, relationships between the behavioral questionnaires were calculated using regression and mediation analyses. Finally, between-groups differences in functional connectivity were calculated and associations between functional connectivity and behavioral results were evaluated via regression analysis.

**Results:**

Results revealed that autistic children presented with significantly more sensory atypicalities, greater IU, and heightened anxiety, compared to nonautistic children. Additionally, regression revealed a significant predictive effect of SSP scores on anxiety scores. Mediation analysis showed that IUS-12 scores significantly mediated this relationship. Associations between these behavioral correlations and functional connectivity between sensory cortices, the cerebellum, and the amygdala will also be presented.

**Conclusions:**

Our study suggests that heightened sensory processing irregularities in autistic children may be related to increased anxiety, an association that is mediated by IU. These findings provide evidence that irregular predictive abilities could play a role in behavioral phenomena common to autism. These results also implicate certain brain regions, such as sensory cortices, the cerebellum, and amygdala, which could eventually become targets for supportive action, improving services for autistic individuals.

**441.043 (Poster)** Sensory Responsivity in Social and Non-Social Contexts of Toddlers at Risk for Autism Spectrum Disorder  
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**Background:** Children with ASD present with a variety of sensory behaviors that overall differentiate them from their typically developing peers. The 'social brain' of individuals with ASD may underlay specific deficits in the processing or perception of social stimuli or stimuli situated within a social context (Pelphrey, Shultz, Hudac, & Wyk, 2011). However, empirical evidence of sensory responsiveness in young children who later develop ASD remains relatively limited, and it is unclear whether contextual aspects of sensory responsivity are meaningful to the expression of sensory features in children with ASD.

**Objectives:** The primary goal of this study was to examine whether social versus non-social context impacted the expression of sensory response patterns in infants at high risk for ASD and to examine if responsivity in social or nonsocial contexts were associated with severity of ASD symptoms.

**Methods:** Participants were from the Infant Brain Imaging Study, an ongoing longitudinal study of infants at high and low familial risk for ASD. The Sensory Experiences Questionnaire 2.1 (SEQ; Baranek et al., 2006) was collected for participants at 12 (n=292) and 24 (n=276) months of age. Linear mixed-effects models were used to examine SEQ social and non-social scores across 12 and 24 months of age for infants who did (HR-ASD=77) and did not develop ASD (HR-Neg=263). Correlations were examined to identify the strength of association between SEQ social and non-social scores and the Autism Diagnostic Observation Schedule severity scores (ADOS; Lord et al., 2000), Mullen early learning scales composite scores (MSEL-ELC; Mullen, 1995) and Vineland adaptive behavior scales-II composite scores (Vineland-II ABC; Sparrow, Balla, & Cicchetti, 2005).

**Results:** Significant differences in sensory responsivity across both social ( $F(2,338)=44.19, p<.001$ ) and non-social contexts ( $F(2,338)=24.05, p<.001$ ) were observed for HR-ASD infants relative to HR-Neg infants starting at 12 months of age. Group differences in responsivity scores for both social and non-social contexts widened by 24 months of age ( $F(2,226)=16.68, p<.001$ ). The results were relatively consistent when examine the influence of responsivity patterns (hypo responsivity, hyper-responsivity, sensory seeking) on social and nonsocial scores. However, within the non-social domain the effect of Group by Time was accounted for by the sensory seeking items ( $F(2, 225)=13.92, p<.001$ ). The social and non-social scores were negatively associated with adaptive behavior, but not significantly associated with IQ or ASD severity.

**Conclusions:** High-risk infants who later meet diagnostic criteria for ASD showed elevated sensory responsiveness in both social and non-social contexts at 12 months of age. Differences between groups expanded over the second year of life. Higher responsivity in both contexts for individuals with ASD indicates that there are generalized effects in sensory responsivity and/or registration that is not necessarily particular to socially salient information or social contexts. In addition, associations related to ASD severity and adaptive functioning were comparable between both social and non-social contextual scores, adding to the evidence that social versus non-social context is not particularly meaningful in the expression of sensory responsivity in ASD.

#### **441.044 (Poster) Sensory-Phenotype Clusters across Children with Autism and ADHD**

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**Background:** Sensory-processing issues in Autism are heterogeneous, occurring across modalities and presenting in seemingly unique ways across individuals. Previous research has shown that certain sensory symptoms tend to cluster together in Autistic individuals, creating meaningful sensory phenotypes. Sensory issues are not unique to Autism but are also seen in other neurodevelopmental disorders including Attention-Deficit/Hyperactivity Disorder (ADHD). Despite their distinctions in diagnostic criteria, these disorders share many overlapping sensory issues (i.e. tactile sensitivity, low energy and movement difficulties). It is unclear whether the sensory symptoms across these clinical diagnoses cluster similarly, or whether Autism and ADHD have distinct sensory phenotypes.

**Objectives:** 1) Validate sensory phenotypes in Autism and identify novel, meaningful sensory phenotypes for ADHD; 2) Examine potential overlap in sensory phenotypes across diagnoses.

**Methods:** Data from 570 children with a primary clinical diagnosis of Autism Spectrum Disorder ( $M_{age}=10.0$  years,  $SD_{age}=4.48$  years) and 439 children with a primary clinical diagnosis of ADHD ( $M_{age}=10.0$  years,  $SD_{age}=3$  years) were extracted from the Province of Ontario Neurodevelopmental Disorder Network. The Short Sensory Profile, a well-validated questionnaire consisting of seven sensory subscales (tactile sensitivity, taste/smell sensitivity, movement sensitivity, under-responsive/seeking sensation, auditory filtering, low energy/weak, and visual/auditory sensitivity) was used to assess sensory issues. Data from the seven subscales of the Short Sensory Profile were subjected to a K-means cluster analysis for each disorder group. The Bayesian Information Criteria and previous literature were used to determine meaningful sensory phenotypes. Final cluster solutions were then compared across diagnostic groups.

**Results:** A five-cluster model was found to minimize error variance in both Autism and ADHD. These five meaningful sensory phenotypes can be described as Sensory Adaptive, Generalized Sensory Differences, Taste and Smell Sensitivity, Under-responsiveness and Sensory Seeking, and Low Energy/Weak (see Figures 1 and 2). Interestingly, for the Autism group, the Low Energy/Weak phenotype also showed movement difficulties, while for the ADHD group movement difficulties were not apparent in the Low Energy/Weak phenotype.

**Conclusions:** Sensory issues in Autism and ADHD cluster into meaningful sensory phenotypes. These phenotypes showed a high degree of overlap across diagnostic groups. Aside from the Low Energy/Weak phenotype where movement difficulties were also present for the Autism group, but not the ADHD group, the phenotypes were virtually identical. Importantly, these results suggest that sensory issues are qualitatively similar across both Autism and ADHD. These results support previous research suggesting that, while sensory issues are more severe in Autism than ADHD, they follow the same pattern of presentations. These results suggest that sensory issues are transdiagnostic and that these issues may result from similar mechanisms and cognitive underpinnings. Future research will explore how these phenotypes relate to other characteristics of Autism and ADHD.

**441.045 (Poster)** Somatosensory Profiles of Children with ASD, Carriers of a 16p11.2 Deletion and Typically Developing Children Using a Multi-Method Approach

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**Background:** Sensory processing difficulties are frequent in neurodevelopmental disorders (NDD), and particularly in Autism Spectrum Disorder (ASD). Individuals present different sensory processing profiles, even within disorders. Considering the heterogeneity of clinical symptoms in ASD, it is challenging to outline a clear picture of the sensory profile of this disorder and its neural correlates. Carriers of the 16p11.2 deletion share a predisposing factor for NDD, including ASD. This genetically defined cohort offers a unique opportunity to identify specific sensory profiles in a population with more homogeneity and to compare sensory profiles across NDD. Additionally, the sensory phenotype of del16p11.2 carriers has not been assessed to date.

**Objectives:** The aim of this study is to assess and compare the sensory profiles in carriers of a 16p11.2 deletion, children with idiopathic ASD, and typically developing children and using a multi-method approach.

**Methods:** Participants included 121 ASD children, 17 carriers of the 16p11.2 deletion (del16p11.2) and 45 typically developing (TD) children. All participants were aged between 2 to 12 years. Behavioral responses to sensory stimuli were assessed using a parent-report questionnaire (SPM: Sensory Processing Measure). A small subset of this sample was additionally assessed using a lab-based observational paradigm (TDDT-R: Tactile Defensiveness and Discrimination Test-Revised) and underwent an EEG protocol to investigate neural responses to passive somatosensory stimuli. Statistical analyses included MANCOVA and regression analyses, as well as exploratory ERP analyses.

**Results:** ASD children show significantly higher levels of sensory processing difficulties, as rated by parents on the SPM questionnaire. Del16p11.2 also scored higher than TD on all subscales except for tactile and olfactory/taste processing, in which they score similarly to TD. The TDDT measure differentiated ASD and del16p11.2 on the Seeking but not on Tactile Defensiveness Scales. The exploratory analysis of somatosensory ERPs showed a differentiated pattern in P1 and N2 components in ASD children, suggesting that the neural processing of tactile stimulation might be different in ASD, compared to the other two cohorts.

**Conclusions:** Behavioral responses to touch and olfaction/taste stimuli seem to be particularly affected in ASD, as measured by parent-report. Lab-based observation suggests that there are potential differences across clinical groups in terms of the pattern of response to tactile stimuli. Exploratory findings from the somatosensory ERPs hint at further differences between the groups. These results highlight the importance of using a combination of methods to assess different levels of sensory processing. This is a much-needed approach to achieve a better comprehension of sensory phenotypes and their impact on daily functioning.

Defining sensory profiles in ASD and other NDD and will help tailor therapies in order to alleviate the impact of sensory processing difficulties in children's overall functioning and quality of life.

**441.046 (Poster)** Temperament and Self-Injurious Behavior Among Infant Siblings of Children with Autism

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**Background:** Temperament characteristics, such as negative affectivity, regulatory/effortful control, and surgency have been identified as predictive of externalizing behavior in neurotypically developing children (e.g., Eisenberg et al., 2005). Similarly, among children with autism spectrum disorder (ASD), high negative affectivity, high surgency, and low effortful control has been found to predict problem behavior (Adamek et al., 2011; Korb et al., 2020). Specific types of problem behavior, such as self-injurious behavior (SIB), have not been examined in relation to early temperament characteristics.

**Objectives:** The purpose of this study was to examine temperament at 6 and 12 months of age among children at high risk for ASD. The specific research questions included: 1) Are there differences in temperament factors at 6 and 12 months of age between children with and without SIB? 2) What temperament characteristics at 12 months predicted SIB at 36 months?

**Methods:** Participants were from a longitudinal study of infants at familial risk for ASD. The present sample included 114 high-risk infants (65% male, 23% ASD) who completed the following assessments at 6,12,24, and 36 months of age: Infant Behavior Questionnaire (IBQ-R), Mullen scales of Early Learning (MSEL), and Repetitive Behavior Scales-Revised (RBS-R). The RBS-R was used to identify SIB and the IBQ-R was used to characterize temperament. SIB endorsement (i.e., any SIB endorsement verses none at 36 months) was used to group participants. Descriptive analyses, independent samples t-tests, and a hierarchical multiple regression model were utilized to examine 12 month predictors for SIB at 36 months.

**Results:** SIB prevalence estimates at 12, 24, and 36 months were 38%, 31%, and 17%, respectively. Mean SIB severity scores were 1.63 (0.95), 1.94 (1.73), and 3.26 (3.93). Statistically significant mean differences were observed between SIB and no SIB groups for surgency at 6 months (SIB group, mean=-2.05, sd=4.49; NoSIB group, mean= 0.42, sd= 3.71) and 12 months of age (SIB group, mean= -1.73, sd=3.97; NoSIB group, mean= 0.35, sd= 3.62). The regression model was used to evaluate the contribution of 12 month negative affect, regulatory capacity, and surgency to severity of SIB at 36 months. Mullen scores were entered at Step 1 and temperament characteristics were entered at Step 2. The first step resulted in 4.6% of the variance being accounted for,  $F(1,111) = 5.39, p = .02$ . Step 2 accounted for 8.8% variance,  $F(4, 108) = 2.62, p = .04$ . None of the temperament characteristics were found to independently predict the severity of SIB at 36 months.

**Conclusions:** SIB was less prevalent at 36 months but more severe compared to 12 and 24 months of age. Children with SIB endorsement at 36 months had lower surgency at 6 and 12 months than children without SIB. Our previous study indicated that children with a diagnosis of ASD also exhibited lower surgency at 12 months compared to children without a diagnosis (Paterson et al., 2019). Overall, the models accounted for very little variance. Temperament may need to be assessed with other early behavioral characteristics to better predict SIB and inform early intervention targets.

**441.047 (Poster)** The First Fundamental Movement Skill Intervention Delivered As Applied Behavior Analysis: Preschoolers with ASD Gain the Equivalent of 2.5 Years of Skills

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**Background:** It is increasingly clear that motor skill deficits are intertwined with autism symptomatology. Researchers have gained interest in the motor delays in children with Autism Spectrum Disorder (ASD) and resultant motor intervention programs yield promising results. However, these programs are largely delivered by highly trained motor experts in movement-friendly environments.

**Objectives:** The purpose of this study was to assess the preliminary efficacy of fundamental movement skill (FMS) training integrated in early intensive behavioral intervention (EIBI) centers, an ecologically valid environment with wide reach. Intervention feasibility was a secondary aim.

**Methods:** Fourteen preschoolers with severe ASD and thirteen EIBI behavior technicians participated in this randomized controlled trial. Baseline data included ADOS-2, Mullen Scales of Early Learning, and Vineland Adaptive Behavior Scales – 3. The intervention consisted of daily, 15-minute, discrete trial training sessions targeting motor skills over 20 weeks. The

behavioral technicians regularly engaged in Applied Behavior Analysis (ABA) therapy together with the preschoolers for thirty-five hours per week. Blinded motor assessment via the Test of Gross Motor Development – III occurred pre-intervention, post-intervention, and at 4-week follow-up. Feasibility outcomes were assessed using a survey of behavior technician implementers delivered post-intervention.

Results: Motor scores significantly improved compared to the control group in FMS relative to the control group across 3 repeated measurements ( $F(1, 12) = 4.983$ ;  $p = 0.016$ ;  $ES = 0.312$ ). Behavior technicians implementing the study expressed polarized views on the feasibility of the intervention, rating the intervention low in feasibility overall despite high intervention efficacy.

Conclusions: These results hold relevance for interventionists attempting (a) movement programs with children with severe ASD, and (b) implementation in EIBI centers.

**441.048 (Poster)** The Impact of ADHD Symptoms and Age on Sensory Features in Autism

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Background:

Children with Autism Spectrum Disorder (ASD) exhibit differences in sensory processing patterns compared to typically developing peers. Differences in sensory processing patterns have also been reported in children with Attention-deficit/hyperactivity disorder (ADHD). Given the substantial overlap between features of ASD and ADHD, the purpose of the current study was to examine the extent to which ADHD symptoms and age, separately and together, impact sensory processing patterns associated with ASD traits in a sample of children with ASD aged 6-17 years.

Objectives:

The current study sought to examine sensory processing patterns using the Sensory Profile in children with ASD while controlling for ADHD symptoms, and age. In examining the extent to which ADHD symptoms, and age, impact sensory processing patterns reported in children with ASD across each of the four sensory quadrants in Dunn's (1997) theoretical framework, we sought to gain insight into whether, and which, sensory features are uniquely related to ASD after controlling for age and co-occurring ADHD symptoms.

Methods:

Participants included 61 children aged 6-17 years with ADOS-2 and ADI-R confirmed ASD. Extant data was used that included participants' scores on various caregiver questionnaires. Sensory features were assessed using the Sensory Profile, ADHD symptoms were measured using the Hyperactivity and Attention Problems T-scores on the Behavior Assessment System for Children, Second Edition (BASC-2), and ASD traits were measured using the Autism Spectrum Quotient (AQ). Our measure of sensory features included the four following constructs: sensation avoiding, sensation seeking, registration, and sensory sensitivity.

Results:

Hierarchical multiple regression analyses indicated no significant effects of age. The addition of ADHD symptoms to the prediction of Autistic traits led to a statistically significant increase in  $R^2$  of .107,  $F(2, 57) = 3.425$ ,  $p = .039$ ; adjusted  $R^2 = .065$ , in which Hyperactivity was significantly associated with Autistic traits ( $p = .012$ ). The addition of sensory features to the prediction of Autistic traits further led to a statistically significant increase in  $R^2$  of .276,  $F(4, 53) = 5.987$ ,  $p < .001$ ; adjusted  $R^2 = .307$ . Sensory features accounted for a significant portion (30.7%) of the explained variance in Autistic traits after controlling for the significant effect of ADHD symptoms. Specifically, after controlling for age and ADHD symptoms, the sensory feature Sensitivity was significantly predictive of Autistic traits ( $p = .025$ ).

Conclusions:

Results suggest that of all sensory features associated with ASD, sensory sensitivity is the strongest predictor of ASD traits, even after controlling for comorbid ADHD symptoms as well as age. These findings provide implications for Autism theories that have linked sensory hypersensitivity to enhanced perception in ASD. Our findings further emphasize the importance of strengths-

based conceptualizations of the unique sensory perceptual experiences in ASD for earlier identification and individualized support.

**441.049 (Poster)** The Relationship between Body Language, Enjoyment, and Performance during Motor Skill Tasks in Children with Autism Spectrum Disorder (ASD)

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Background: Autism spectrum disorder (ASD) affects approximately 1 in every 66 children in Canada and is characterized by deficits in social communication and restricted interests. Motor skill deficits are less-recognized, but can have potentially serious additional consequences on participation in recreational activities. Motor skill acquisition occurs through a child's development and is greatly aided by practice during physical activity with peers. However, children with ASD are often less involved in physical activities with other children, relative to typically developing peers. Reasons for this include the presence of stereotypic behaviours that might influence their ability to participate, lack of interest, fear of getting hurt, and physical activity instructors having limited knowledge about ASD and how to engage children with ASD. To address these participation barriers, it is important to understand the motivation, confidence, affect, and physical ability of a child with ASD to participate (i.e., their physical literacy).

Objectives: To understand the relationship between body language, enjoyment, and gross motor skill performance of children with ASD aged 6-12 years.

Methods: Thirty-one participants were recruited who: (a) were 6-12 years of age, (b) had a diagnosis of ASD, (c) had no contraindications to participate in physical activity, and (d) could understand/respond to complex 3-step instructions. Participants completed the *Ignite Challenge* (videotaped), a 13-item advanced gross motor skills assessment suitable for children with ASD, followed by the *Personalized Enjoyment Scale*, a visual analogue scale developed for this study that assessed *Ignite Challenge* item enjoyment using personalized pictorial format anchor points. The first author scored the *Ignite Challenge* videos using the *Body Language Coding Scale (BLCS)* to measure the body language displayed during the assessment. The *BLCS* was developed by our team, and is divided into positive, negative, and neutral cues. The number of cues shown per *Ignite Challenge* item was recorded and totalled for each of the positive, negative, and neutral cue sections.

Results: Data from twenty-eight participants (mean age 9.0 years [SD 1.7]; 5 females) were analysed. The *Ignite Challenge* mean total score was 41/60 [SD 8.0; item score range 1.5-3.3/4]. The *Personalized Enjoyment Scale* mean total score was 91.6/130 [SD 19.6; item score range 6.0-8.15/10], and *BLCS* mean score for positive body language cues observed was 52.5% [SD 16.1%; range 41.0%-74.0%] and 33.4% [SD 16.3; range from 17%-44%] for negative body language cues observed. There was a moderate positive correlation (minimum  $r = 0.40$ ,  $p < 0.05$ ) between *Ignite Challenge* and *Personalized Enjoyment Scale* scores for 4 of 13 *Ignite Challenge* items, but an unexpected moderate negative correlation ( $r = -0.5$ ,  $p = 0.04$ ) between enjoyment and body language for the overall assessment.

Conclusions: There was a positive association between higher motor skill performance scores and higher ratings of enjoyment on some items. However, the *BLCS* scores were not associated with individual enjoyment or motor performance scores. This begs the question: do children with ASD display feelings in ways that are easily observed and/or match how they feel in conventional ways, or were there measurement issues with our *BLCS* tool? Further investigation is underway.

**441.050 (Poster)** The Relationship between Developmental Coordination Disorder and Concurrent Deficits in Social Communication and Repetitive Behaviors Among Children with Autism Spectrum Disorder

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Background: Children with Autism Spectrum Disorder (ASD), characterized by core deficits in social communication and restrictive behaviors, can exhibit concurrent motor incoordination and/or intellectual disability (ID). While pervasive delays in motor behavior are common, formal diagnosis of Development Coordination Disorder (DCD) is uncommon. It is not clear how DCD and ID impact core deficits in ASD.

Objectives: This study utilized the Simons Foundation SPARK cohort to describe the scope of motor incoordination among children with ASD and examine the interrelationships between DCD risk, ID, and ASD core deficits.

Methods: 10,234 children with ASD, between the ages of 5 and 15 years, were included in the analysis. Parents completed online versions of the DCD Questionnaire (DCD-Q), Social Communication Questionnaire (SCQ) and Restrictive Behavior Scale (RBS-R). 85% of children with ASD had DCD-Q scores consistent with being at-risk for DCD, but only 14% reported a formal diagnosis.

Results: Children with ID exhibited significantly greater motor incoordination compared to children without ID ( $p < .001$ ). Significantly greater core deficits were identified in both children at-risk for DCD ( $p < .001$ ) and with ID ( $p < .001$ ). However, the effects of DCD risk were independent of ID and exhibited a medium effect size for SCQ ( $\eta^2_p = .063$ ) and a small effect size for RBS-R ( $\eta^2_p = .04$ ) scores.

Conclusions: Collectively, study outcomes reinforce the pervasiveness of motor incoordination among children with ASD, both with and without concurrent ID, and provide further justification for the inclusion of motor behavior in the early intervention and prescription for children with ASD.

**441.051 (Poster)** The Relationship between Sensory Reactivity Differences and Mental Health Symptoms in Preschool-Age Autistic Children

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Background: Children with an autism spectrum condition (ASC) often have sensory reactivity differences, such as being overwhelmed by sounds, which can elicit distress in their everyday life. Furthermore, autistic children often present with a greater frequency of mental health symptoms compared to their typically developing peers. However little research has examined the impact or relationship of these sensory reactivity differences on broader mental health symptoms.

Objectives: This study set out to explore the relationship between sensory reactivity and mental health symptoms in pre-school aged autistic children.

Methods: Data from parent-reported and observational measures of sensory reactivity (Sensory Processing Scale Inventory - SPSI, and Sensory Assessment of Neurodevelopmental Differences - SAND) and parent-reported measure of mental health symptoms (Behavioural Assessment System for Children – 3, BASC-3) were collected for 54 preschool-aged children with an Autism Spectrum Condition (ASC) (41 males and 13 females, 3 - 5 years,  $M = 4.02$ ,  $SD = 0.77$ ). Correlational analyses were used to analyse the data.

Results: Our results showed a relationship between sensory reactivity and mental health symptoms in autistic preschool-aged children. At a sensory construct level, our results indicate a positive relationship between sensory seeking and externalising symptoms, including for hyperactivity ( $r_s = 0.62$ ,  $p < 0.01$ ) and aggression ( $r_s = 0.46$ ,  $p = 0.01$ ). This relationship was seen in both children who were verbal, and those with few to no words. We also found that hyper-reactivity was significantly positively related to internalising problems in autistic pre-schoolers, including for symptoms of anxiety ( $r_s = 0.30$ ,  $p = 0.03$ ), depression ( $r_s = 0.33$ ,  $p = 0.02$ ) and somatisation ( $r_s = 0.52$ ,  $p < 0.001$ ). However, this relationship only held in participants with few to no words. Further, we found little evidence of a relationship between hypo-reactivity and mental health symptoms outside of anxiety.

Conclusions: For the first time this study has revealed a relationship between sensory hyper-reactivity, as well as sensory seeking, and mental health symptoms outside of anxiety in autism. Of note, this relationship appears to be driven by those with few to no words, and has both research and clinical implications in understanding the drivers underlying mental health symptoms in different autistic phenotypes, as well as the possible role of functional communication in mitigating the development of mental health symptoms.

**441.052 (Poster)** The Relationship between Sensory Sensitivity and Fine Motor Function across Neurodevelopmental Disabilities: A Case for the Research Domain Criteria (RDoC) Framework

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Background: Sensory sensitivity (SS) was recently included as a diagnostic symptom in autism spectrum disorder (ASD) (APA, 2013). Additionally, individuals with ASD often have fine motor delays early in life (Licari et al., 2020). These two deficits have potential to be linked in ASD given neurobiological evidence that sensory processing and motor output are highly integrated (Salinas & Abbott, 1995). However, motor and sensory difficulties also exist in other neurodevelopmental disabilities (NDDs) (Soorya et al., 2018; Hen-Hebst et al., 2020), suggesting these symptoms are not unique to ASD. In fact, recent findings have

suggested that SS, with other factors, best predicted motor ability in children regardless of diagnostic category (Surgent et al. 2020). Thus, there may be value in researching sensorimotor behaviors and responses as individual differences within ASD and NDD phenotypes rather than discrete diagnostic categories.

**Objectives:** To determine if an ASD diagnosis or ASD symptom severity (ASD-SS) will improve the predictive ability of the relationship between SS and fine motor function (FMF) in a clinical sample. Based on the heterogeneity of our clinical sample, we predicted that an ASD diagnosis and ASD-SS would not significantly add predictive value to FMF.

**Methods:** The participants for this study were from a database composed of children referred and clinically evaluated for an ASD diagnosis at a tertiary care clinic between 2006-2020. Participants were identified as having sensory concerns and diagnostically characterized as non-ASD (i.e. ADHD, developmental delay, language delay/impairment, etc.) or ASD. ASD-SS was evaluated using comparison scores (CS) of the ADOS, SS was measured via the total score (TS) of the Short Sensory Profile (SSP), and FMF was assessed via the fine motor quotient (FMQ) of the Peabody Developmental Motor Scales 2nd Edition (PDMS-2). Two hierarchical regressions (HR) on the PDMS-2 FMQ were computed with SSP TS as a step 1 predictor, and then either ASD diagnosis or ADOS CS were the step 2 predictors.

**Results:** Participants included 72 individuals (86% male;  $M_{age}=4.04$  years,  $SD=1.22$ ) and 40% of the sample had ASD. The two groups significantly differed on ADOS CS ( $M_{ASD}=6.621$ ,  $M_{nonASD}=3.070$ ,  $t(70)=7.615$ ,  $p<.001$ ). As predicted, step 1 of both HRs was significant for SSP TS being a significant predictor of PDMS-2 FMQ ( $R^2=.073$ ,  $F(1, 70)=5.472$ ,  $p<.05$ ). With the addition of either an ASD diagnosis or ADOS CS, the change in  $R^2$  was not significantly different from 0 ( $R^2=.074$ ,  $F(1, 69)=.103$ ,  $p=.750$ ;  $R^2=.121$ ,  $F(1, 69)=3.784$ ,  $p=.056$ ). At step 2, the HR became insignificant for ASD diagnosis ( $F(2, 69)=2.752$ ,  $p=.071$ ) and remained significant for ADOS CS ( $F(2, 69)=4.737$ ,  $p<.05$ ).

**Conclusions:** In a clinical sample of children with NDDs who had a sensory concern, neither ASD diagnosis nor ASD-SS added predictive value to our model of FMF from SS. Additionally, ASD-SS was predictive with SS in predicting FMF, but ASD diagnosis was not. Findings support the Research Domain Criteria (RDoC) framework of investigating individual differences among all individuals with NDDs and deemphasizing diagnostic criteria to ensure a greater understanding of the underlying symptomatology regardless of diagnosis.

**441.053 (Poster) Towards Mechanistic Quantification of Motor Challenges in Autism during a Functional Dressing Task**  
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**Background:** Sensorimotor challenges have been shown to relate to poorer daily living skills in individuals with autism spectrum disorder (ASD) (Jasmin et al., 2009; Travers et al., 2017) even after controlling for key variables like age and IQ (Travers et al., 2017). In particular, dressing -as an integral part of individuals' daily routines- is an area for caregiver concern for adolescents with ASD based on the increased duration of time required to complete the task (Bagatell, et al., 2016; Campbell et al., 2015; Tomchek et al., 2017). However, to our knowledge no study has quantitatively and systematically studied the motor mechanisms underlying the increased dressing time in youth with ASD compared to their typically developing (TD) peers. This would inform what aspects of movement may be different in ASD during a functional tasks, which could potentially inform intervention targets.

**Objectives:** 1) To use a controlled and quantifiable dressing task to establish that dressing time is different between ASD and TD; 2) To quantify movement during a dressing task by capturing kinematic and postural sway data; and 3) To examine whether the movement and postural sway measures mechanistically account for longer dressing times in ASD.

**Methods:** 49 participants with ASD and 31 age-matched TD participants (7-17 years-old) underwent motor (BOT-2) and diagnostic testing and completed our Motor Rainsuit Assessment During Dressing (M-RADD) task in which participants put on a clear rain suit (pants and a jacket) over their clothes while we recorded whole-body kinematics using a Kinect camera and postural sway using a Wii Balance Board. We compared these measures across the ASD and TD groups, while controlling for age and BMI. Finally, mediation analyses examined which measures explain slower dressing times in youth with ASD.

**Results:** The ASD group took significantly longer to complete the dressing task compared to the TD group,  $t(79) = -4.46$ ,  $p < .001$ . The ASD group had significantly larger postural sway areas during dressing (both in terms of ellipse area [ $p = .02$ ], and X-Y interquartile ranges [ $p = .01$ ]). However, angular tilt of midline structures during dressing (median and interquartile range of the angle from upright) did not differ between the groups,  $p$ 's  $\geq .24$ . Mediation analyses demonstrated that standardized motor scores accounted for group differences in dressing time, but the postural sway measures during dressing did not.

**Conclusions:** These findings show that youth with ASD take longer to dress and exhibit larger shifts in balance during dressing. However, our measures of gross motor movements during dressing (i.e., kinematics) did not differ between the groups. Mechanistically, the composite motor score (which includes fine and gross motor assessment) fully mediated the relationship between diagnostic status and longer dressing times, but the larger shifts in balance during dressing did not. Overall, these findings more directly suggest the important role of motor skills for dressing in youth with ASD. Future analyses will examine gross motor versus fine motor contributions to this functional task to more precisely define potential intervention targets.

**441.054 (Poster)** Understanding the Non-Social Domain of Autism in Autistic Adults

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**Background:** The social domain of autism has been studied in depth, and shown to be a unitary construct. However, the relationship between the non-social traits of autism has received less attention. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) outlines four criteria that make up the non-social domain including repetitive motor movements, insistence on sameness, restricted interests and sensory sensitivity. It is important to consider whether the non-social traits of autism should be conceptualised as a unitary or multidimensional construct. In addition, the majority of this research has been conducted with autistic children and adolescents. There is a lack of research into the relationship between the four DSM-5 non-social criteria for autism.

**Objectives:** This study aimed to evaluate the relationship between the non-social traits of autism in a large sample of autistic adults. It explored whether these traits are best conceptualised as four distinct factors, or exist along a single dimension.

**Methods:** Participants included autistic adults from the Netherlands Autism Register. The sample consisted of 833 autistic adults (478 females and 355 males). The four components identified within the DSM-5 non-social domain were measured by items from the Adult Routines Inventory, the Autism Spectrum Quotient short and the Sensory Perception Quotient short. Confirmatory factor analysis, as well as exploratory factor analysis and exploratory structural equation modelling was implemented to examine the relationship between these four criteria.

**Results:** The one-factor model evaluating whether the non-social traits of autism fall along the same unitary dimension did not provide a good fit to the data, highlighting that the non-social domain of autism is not a unitary construct. Additional two and three factor models consisting of repetitive motor movements, insistence on sameness and restricted interests factors had goodness of fit values outside the recommended thresholds, indicating that they did not provide a good fit. Overall, the results indicated that a four-factor model provided the best fit, mapping onto the DSM-5 criteria, including repetitive motor movements, insistence on sameness, restricted interests and sensory sensitivity. These four factors were moderately correlated, suggesting that four distinct, yet related factors best describe the non-social domain of autism.

**Conclusions:** This study provided evidence for the multi-dimensional nature of the non-social domain of autism. Given only two of the four criteria within the non-social domain need to be endorsed for a diagnosis of autism, there is room for substantial variation across individuals, who will have a unique profile within the non-social domain. The results have implications for our understanding of the heterogeneous nature of autistic traits, as well as for how we conceptualise autism as a diagnostic category. This is important for the provision of diagnosis and support within research and clinical practice.

**441.055 (Poster)** White Matter Microstructural Correlates of Parent-Reported Sensory Hyporesponsivity, Hyperresponsivity, Sensory Seeking, and Enhanced Perception in Children with ASD and Typical Development

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**Background:** Sensory responsivity differences are common across neurodevelopmental disorders and are especially prevalent in autism spectrum disorder (ASD; Baranek et al., 2006; Ausderau et al., 2014). These sensory differences in ASD have been associated with lower IQ, poorer motor performance, and impaired adaptive behaviors (Sans Cerva et al., 2015; Ismael et al., 2020; Surgent et al., 2020). Recently, there have been preliminary investigations into the neural basis of the specific sensory response patterns (hyporesponsiveness, hyperresponsiveness, sensory seeking behaviors, and enhanced perception) using a variety of neuroimaging methodologies (Wolff et al., 2017; Tavassoli et al., 2019; Simon et al., 2017). However, it is still unclear what the specific microstructural neural correlates of sensory response patterns are in children with ASD and how they might differ from children with typical development (TD).

Objectives: Determine the microstructural correlates of sensory response patterns in children with ASD and children with TD.

Methods: 153 children (6-10 years old) completed a brainstem-optimized diffusion-weighted imaging (DWI) scan and sensory measures (57 children with ASD, 96 children with TD). Overall sensory symptom severity was assessed using the parent-reported Sensory Experience Questionnaire Version 3.0 (Ausderau et al., 2013). Multi-shell DWI was performed at 3T with isotropic 1.8mm voxels. Voxel-based analyses with general linear modeling was used to identify brain areas where TSPOON corrected fractional anisotropy (FA) was associated with each response pattern severity (FA ~ response pattern severity +age+sex+average head motion) within the ASD and TD groups separately. False discovery rate ( $p < .05$ ) was used for multiple comparisons with a cluster threshold of  $k > 10$  contiguous voxels.

Results: The TD group showed a high degree of similarity among FA associations with sensory severity across response patterns (Figure 1). In the TD group, sensory response patterns were all associated with the posterior parietal white matter, frontal white matter, and bilateral internal capsules. In the ASD group, hyporesponsiveness, hyperresponsiveness, sensory seeking behaviors, and enhanced perception generally mapped onto different, non-overlapping brain areas (Figure 2). For example, seeking behaviors were highly associated with FA in the splenium of the corpus callosum, whereas hyperresponsiveness was associated FA in the superior corona radiata. The exception was the middle cerebellar peduncle where hyporesponsiveness, hyperresponsiveness, and seeking behaviors were associated with FA and posterior parietal cortex where all response patterns were similarly associated with FA.

Conclusions: While sensory response patterns in TD were largely associated with similar white matter areas, sensory response patterns in ASD were largely associated with unique white matter areas. These results provide evidence for altered neural mechanisms of sensory responsiveness in children with ASD and TD. Given the role that the internal capsule plays in transmitting sensory and motor information between cortical and subcortical areas, its robust cross-pattern associations in TD and minimal associations in ASD suggest that the internal capsule may be highly involved in mitigating atypical sensory driven behaviors. Additionally, the cross-pattern associations with the middle cerebellar peduncle in ASD may suggest a brainstem-specific compensatory mechanism for sensory responsivity in children on the autism spectrum.

## Service Delivery/Systems of Care

### PANEL SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

#### Panel 214 - Using Novel Implementation Tools for Evidence-Based Practice Delivery (UNITED) for Under Resourced Settings

**Panel Chair:** Jill Locke, *Speech & Hearing Sciences, University of Washington, Seattle, WA*

**Discussant:** David Mandell, *Penn Center for Mental Health, University of Pennsylvania, Philadelphia, PA*

There is a growing number of evidence-based practices for children with autism, but few are successfully implemented in under resourced communities and with families from traditionally disenfranchised groups. Conducting research in community-based settings creates opportunities to build capacity in existing service systems to ensure evidence-based practices are readily accessible, relatively low-cost, and sustainable. In order to have a lasting impact, autism research must focus on broadening access, expanding reach, and facilitating widespread availability of services in the community. Utilizing implementation strategies defined as “methods or techniques used to enhance the adoption, implementation, and sustainment of a clinical program or practice” is critical to support organizations and providers use evidence-based practices. We will present data from four studies that use novel implementation strategies to facilitate evidence-based practice delivery and enhance access to care in under resourced community settings. The four studies engage different implementation strategies (e.g., multi-system training, parent navigation, remote training, use of advisory boards and stakeholder workgroups) to: 1) promote earlier access to specialized intervention for toddlers with autism; 2) support parents of newly diagnosed children with autism; 3) increase the use of JASPER in community settings; and 4) adapt a disruptive behavior intervention for school-aged children with autism.

**214.001 (Panel)** A Multi-System Approach to Improving Access to Early Detection and Intervention for Toddlers in Underserved Communities

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**Background:** Early detection of ASD is the critical first step to providing children with the highly specialized treatment required to optimize outcomes. Yet, many obstacles limit access to early, evidence-based treatments for children with ASD. First, primary care providers (PCPs) often lack knowledge about the early signs of ASD and/or fail to use validated screening tools as recommended by the American Academy of Pediatrics. Second, in the publicly-funded Part C Early Intervention (EI) system, which offers treatment for toddlers with developmental delays, few providers have specialized training in ASD. Third, many evidence-based interventions are expensive and time-consuming to learn and implement, rendering them unrealistic for use within the EI system, where providers may spend only one hour/week with families due to heavy caseloads. This lack of specialized ASD intervention services in the community further creates a disincentive for PCPs to screen or identify children with ASD.

**Objectives:** We developed the Screen-Refer-Treat (SRT) model to address these service access challenges. This model comprises a multi-system health care intervention designed to increase capacity across the primary care and early intervention sectors *within the same community*. We provided evidence-based tools that were tailored for each group of providers, with the goal of mitigating practical challenges to ASD screening and specialized intervention, and measured their use of these tools as well as changes in their practices and self-efficacy 18 months post-intervention.

**Methods:** The SRT model was implemented in four underserved counties in the East, West, and Central regions of the state. PCPs (n=59, from 10 practices) and EI providers (n=87, from 9 programs) received surveys at 2 time points prior to the SRT intervention and 3 times following the intervention (i.e., 6, 12, and 18 month follow-ups). PCPs received a 2-hour office-based workshop describing the early features of ASD, how to talk to parents about concerns, and local ASD resources. They also received a REDCap-based version of the Modified Checklist for Autism in Toddlers Revised/with Follow-up (i.e., the webM-CHAT-R/F) that automatically presents follow-up interview questions when indicated, and were encouraged to use it universally during 18-month well-child visits. Training for EI providers included a full-day workshop on implementing an inexpensive, play-based, easy-to-use ASD-specialized intervention, Reciprocal Imitation Training (RIT).

**Results:** At the 18-month follow-up, PCPs reported significantly higher levels of knowledge regarding the early features of ASD, as well as higher levels of self-efficacy in providing care for these children and families. The majority of practices continued their use of the webM-CHAT-R/F well after the conclusion of the study. EI providers reported higher levels of self-efficacy for recognizing signs of ASD, discussing ASD concerns with caregivers, and providing treatment services to families of children

with ASD symptoms. The majority of EI providers were using RIT with children (84%) and had coached parents in its use (73%).

**Conclusions:** Relatively brief training activities designed to mitigate common obstacles to ASD screening and intervention can increase the use of evidence-based tools by PCPs and EI providers in community practice.

**214.002 (Panel) Remote Supports for Practitioners and Parents: Community Jasper Implementation**

**S. Y. Shire<sup>1</sup>, L. Baker Worthman<sup>2</sup> and C. Kasari<sup>3</sup>, (1)University of Oregon, Eugene, OR, (2)Department of Health and Community Services, St. John's, Newfoundland and Labrador, Canada, (3)University of California, Los Angeles, Los Angeles, CA**

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**Background:** For rural and remote communities, few specialists and large geographic service areas limit regularly scheduled in-person interventions (CDC, 2016). Remote tools are one option to provide both direct services to families of children with autism and professional development for providers.

**Objectives:** To examine the use of remote implementation strategies to support community delivery of the Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2006) intervention. Study 1 focuses on training practitioners through a randomized comparison of Peer Feedback versus Intensive Refresher with a supervisor on interventionists' fidelity and children's social communication and play skills. Study 2 focuses on remote parent coaching through a concurrent multiple baseline study examining caregivers' fidelity and children's social engagement.

**Methods:** Study 1: Thirty community interventionists working in urban and remote regions of Atlantic Canada, served 37 boys and 14 girls with ASD ( $M=4.78$  years,  $SD=1.52$  years). Interventionists were supervised by five local JASPER supervisors. Interventionists were randomized to either (a) Peer Feedback: local interventionist at fidelity provides feedback for 12 weeks or (b) Intensive Refresher: a 12-hour supervisor led training.

Interventionists' fidelity was scored from ten-minute adult-child interactions. Each video was coded for 32 items rated on a Likert scale from 0 (low quality/accuracy) to 5 (high) strategy implementation. Children received assessments at baseline and exit including: (a) Structured Play Assessment (SPA: Sigman & Ungerer, 1981) and (b) Early Social Communication Scales (ESCS: Mundy et al., 2003). Assessments were video recorded and delivered by masked community assessors (fidelity  $M=81.87\%$  ESCS,  $M=93.05\%$  SPA). Independent, reliable coders blinded to timepoint and condition coded number of spontaneous: (a) unique play acts; and (b) initiations of joint attention and requesting.

Study 2: Six caregivers and their male children with autism ( $M=4.44$  years,  $n=2$  Inuit) from rural communities in Atlantic Canada were included. A concurrent multiple baseline design across participants was applied to examine the effects of synchronous remote caregiver coaching on children's joint engagement with caregivers and caregivers' strategy implementation.

Each session, caregivers completed a 10-minute unsupported interaction with their child using a standard toy set (separate from intervention materials). Independent, reliable coders scored the videos for children's joint engagement (total seconds) and caregivers' implementation (see study 1).

**Results:** Study 1: Interventionists receiving Peer Coaching made significantly greater gains in fidelity than those in Intensive Refresher ( $F(1,126)=4.23, p=0.042$ ), reaching means of 85.44% and 87.32%, respectively by exit. Children paired with interventionists in either group made significant gains in initiations of joint attention and requesting ( $F(1,25)=4.94, p=0.036$ ) and total play types ( $F(1,23)=4.78, p=0.039$ ). There were no significant between group differences for children.

Study 2: Children demonstrated greater time jointly engaged (baseline  $M=41.71$  seconds; intervention  $M=315.04$  seconds) and caregivers demonstrated greater use of strategies (baseline  $M=38.79\%$ ; intervention  $M=71.05\%$ ) showing shift in level and trend in intervention over baseline phases (Tau-U= 0.94-1.00).

**Conclusions:** Synchronous remote caregiver coaching and mixed remote/in-person professional development show promise for community intervention implementation and children's outcomes. Weekly peer discussions offer a less costly and more efficient training option.

**214.003** (Panel) Mind the Gap, a Caregiver-Engagement Focused Intervention for Traditionally Underserved Families with a New Autism Diagnosis

**S. Iadarola<sup>1</sup>**, M. Pellecchia<sup>2</sup>, A. C. Stahmer<sup>3</sup>, A. Gulsrud<sup>4</sup>, H. S. Lee<sup>5</sup>, W. I. Shih<sup>5</sup> and C. Kasari<sup>5</sup>, (1)University of Rochester Medical Center, Rochester, NY, (2)University of Pennsylvania, Philadelphia, PA, (3)UC Davis MIND Institute, University of California, Davis, Sacramento, CA, (4)UCLA Semel Institute for Neuroscience & Human Behavior, Los Angeles, CA, (5)University of California, Los Angeles, Los Angeles, CA

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Background: Early service access is critical for children with autism spectrum disorder (ASD) and their families. Children may experience access disparities based on race, ethnicity, and family income (Mandell et al. 2009). Caregivers are key advocates for their children's services, but many feel underprepared to effectively navigate complex service systems. Through a community-partnered participatory research process, we developed an intervention, Mind the Gap (MTG), which aims to address barriers and needs for under-represented families. MTG explicitly focuses on implementation strategies (e.g., community engagement, user-centered design, flexibility) to support caregiver engagement, to thereby increase retention in children's treatment (Ingoldsby, 2010) and improve child outcomes (Haine-Schagel & Walsh, 2015).

Objectives:

1. Describe a community-partnered process for developing a caregiver-focused intervention (i.e., Mind the Gap)
2. Report on the feasibility of the MTG intervention and the relationship between demographics and family social networks to baseline service access in our sample.

Methods: Mind the Gap is an intervention to support families from low-income households post ASD diagnosis. It includes features designed to enhance implementation in real-world settings. First, MTG was developed with a community partnership of key stakeholders. Content includes modules that partners indicated would be important post-diagnosis. Second, MTG utilizes a flexible, modular design, such that intervention content and targets are individualized. The intervention is delivered flexibly, driven by participants' individual needs (e.g., location: home or community and modality: in-person or virtually). Third, MTG utilizes a peer navigator model (i.e., other parents of children with ASD) to build trust with families. Fourth, parent engagement strategies increase relevance of MTG to under-represented communities (e.g., translation, matching navigators with participants based on key characteristics).

Participants were parents of children with new ASD diagnosis who were under 8y/o and from low-income households. We first conducted a pre/post pilot study design (n=7) without concurrent comparison across four recruitment sites. Data from the pilot informed an RCT: 118 families were randomized to receive MTG or enhanced information. We explored how demographics and social networks predicted services access.

Results: In the pilot, retention was high (79%), and we had high attendance (M=85% sessions) and completion of measures (range 86-100%). For the RCT (n=118), we recruited a diverse sample and characterized their family social networks and service use. At baseline in the RCT, families received a mean of 1.95 (SD = 1.54) (i.e., number of identified services) and had social networks of 5.15 (2.41) people. Social network size positively predicted service access; demographic characteristics were not predictive. English speakers were more likely to have services in 3 of 4 sites; at one site non-English speakers had more services.

Conclusions: MTG was developed in partnership with community stakeholders. Given previous literature on family-mediated interventions, our use of implementation strategies (e.g., home visits, parent-driven, peer navigators) likely influenced outcomes. MTG is a promising way to improve child and family outcomes post-diagnosis by capitalizing on caregiver leadership. Baseline data from the RCT can inform research and clinical services for under-represented families, with an emphasis on engagement strategies and opportunities to expand social networks.

**214.004** (Panel) Using Advisory Boards and Stakeholder Workgroups to Adapt the Rubi Program for Use in Educational Settings

**J. Locke<sup>1</sup>** and K. Bearss<sup>2</sup>, (1)Speech & Hearing Sciences, University of Washington, Seattle, WA, (2)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA

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Background: There is a need to improve community-viable, empirically supported interventions targeting disruptive behavior for children with autism in schools. RUBI is a proven-efficacious intervention that addresses disruptive behavior in children with autism. Although RUBI is an empirically supported intervention for children with autism and disruptive behavior, adaptations are needed for its use in schools.

**Objectives:** The goal of this presentation is to discuss a novel implementation strategy – engaging advisory boards and stakeholder workgroups – to collaboratively redesign a proven-efficacious intervention, RUBI, with targeted end users for use in a novel context, schools, with different end users, educators. We use the Discover, Design/Build, Test (DDBT), a human-centered design and implementation science framework to enhance the usability, contextual fit, uptake, and effective implementation of an intervention, to iteratively redesign the RUBI intervention to improve the likelihood that it is useful and useable in elementary schools.

**Methods:** Thirty-five school staff (administrators, general and special education teachers, paraeducators, school counselors, and speech pathologists) that support a child with autism in general and special education classrooms from 22 elementary schools were included in this study. In the first stage, we used a day-long observation and retrospective think-aloud interview protocol to identify the contextual constraints and work processes relevant to the management of disruptive behavior in the classroom. In the second stage, we used an in-depth intervention demonstration of RUBI paired with behavioral rehearsal, a prospective think-aloud interview protocol, and structured assessment methods to identify targets for RUBI redesign (adaptation or pruning needs related to RUBI content and structure). In the third phase, we engaged in collaborative redesign feedback sessions to iteratively adapt RUBI content and procedures with our advisory boards and stakeholder workgroups, and we measured the usability, feasibility, acceptability, and appropriateness of the redesigned RUBI intervention, which we named RUBI in Educational Settings (RUBIES).

**Results:** Conventional content analysis was used to code qualitative data. Feedback from stakeholders suggested: 1) special education teachers feel adequately prepared to use behavioral management strategies; 2) general education teachers reported having little time to actively intervene one to one with children with ASD; 3) challenging behaviors are a key prognostic indicator that disrupts inclusion; 4) the target end user for RUBIES ought to be paraeducators as they are best suited to support the transition from special to general education settings due to their consistent contact and access to the child across classrooms; and 5) paraeducators are in need of targeted training in classroom behavioral management strategies given their minimal autism-specific behavior management training but extensive time with children with ASD. Quantitative ratings (on a 5-point scale) indicated that while RUBI was usable (4.1), acceptable (4.7), and appropriate (4.3), there were some concerns around feasibility (3.9). Recommendations were provided for which RUBI sessions should be retained, eliminated, or modified to address the needs of the school context and end-users.

**Conclusions:** The use of a human-centered design and implementation science approach driven by community stakeholders to redesign a proven-efficacious intervention may provide greater usefulness and usability in real-world contexts.

## PANEL SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

### Panel 221 - Bridging the Gap: Mitigating Barriers to Autism Service Access in Rural Populations

**Panel Chair:** **Hannah Morton**, *Binghamton University, Binghamton, NY, Geisinger, Lewisburg, PA, Binghamton University, Binghamton, NY, Geisinger, Lewisburg, PA*

**Discussant:** **Zachary Warren**, *Vanderbilt University Medical Center, Nashville, TN*

Families in rural communities experience barriers to accessing diagnostic evaluations and evidence-based interventions for Autism Spectrum Disorder (ASD). These include high service cost, lack of autism-specific service providers, and a far geographic travel distance to access services. This panel presents findings from a variety of novel delivery methods that seek to increase access to autism services in rural areas. The first paper identifies predictors of parent follow-through with a pediatrician referral for neurodevelopmental assessment at a rural hospital clinic and examines the impact of a virtual intake appointment to increase retention. The second paper presents a novel training program for early intervention providers in rural locations to increase recognition of ASD symptoms and facilitate telediagnostic evaluation. The third paper describes use of a mobile autism clinic and telehealth modalities for ASD assessment and parent psychoeducation in a rural community. The fourth paper reports on implementation of a consultation intervention to increase use of evidence-based practices for ASD in rural schools. Dr. Zachary Warren (discussant) will draw on his expertise adapting and implementing evidence-based autism services in a rural community to make recommendations for application of novel delivery methods to reduce barriers to care and directions for future research.

**221.001 (Panel)** Barriers to Engagement with the Neurodevelopmental Diagnostic Assessment: Predictors of Retention in a Rural Hospital Clinic

**H. E. Morton<sup>1,2</sup>, L. Walsh<sup>2</sup>, D. Welsh<sup>2</sup>, M. Mitchell<sup>2</sup>, H. R. Fisher<sup>2</sup>, C. M. Taylor<sup>2</sup> and S. M. Myers<sup>2</sup>, (1)Binghamton University, Binghamton, NY, (2)Geisinger, Lewisburg, PA**

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**Background:** Children can be diagnosed with developmental disabilities, such as Autism Spectrum Disorder (ASD), as young as two years-old; however, the average age of ASD diagnosis in the United States is not until age five. An ASD diagnosis facilitates access to services, which are associated with positive outcomes. Later age of ASD diagnosis may occur via lack of follow-through with assessment referrals and is also related to female gender, lower socioeconomic status (SES), difficulty finding a psychology provider, and limited parent English-language proficiency. These factors may be especially salient in rural communities, where there are relatively fewer opportunities for services.

**Objectives:** Identify barriers to retention with the neurodevelopmental diagnostic assessment process for families in rural Pennsylvania; and examine the impact of an initial in-person or virtual intake appointment on completion of the evaluation process.

**Methods:** Participants were 975 families of children <72 months of age (72.56% Male, 73.87% White, non-Hispanic) who were referred to a rural specialty hospital clinic in central Pennsylvania for a neurodevelopmental evaluation, including ASD diagnostic assessment, by their primary care provider. Families ( $n=285$ ) were contacted to schedule an evaluation after completing a questionnaire packet that was mailed to their home. To increase engagement, the procedural approach was modified such that referred families were scheduled for an intake interview prior to completing diagnostic questionnaires ( $n=690$ ). During COVID-19, intakes were conducted virtually. An ordinal logistic regression model was used to identify predictors of retention with the neurodevelopmental assessment (i.e., initial intake, clinical evaluation).

**Results:** Participating in the intake interview significantly increased likelihood to attend the neurodevelopmental evaluation visit ( $M=84.49\%$ ,  $SD=36.22\%$ ) compared to completing a questionnaire packet prior to scheduling this appointment ( $M=76.84\%$ ,  $SD=45.42\%$ ;  $t(973)=2.85$ ,  $p = .002$ ). Conducting the intake virtually versus in-person had no impact on retention ( $t(688)=2.19$ ,  $p=0.99$ ). Predictors of assessment retention were older child age (Odds Ratio (OR)=1.93, 95% Confidence Interval (CI): 1.13, 3.29), already receiving services (OR=4.59, 95% CI: 1.89, 11.20), and shorter latency since first developmental concern (OR=0.95, 95% CI: 0.91, 0.99). Child male sex also trended towards predicting retention (OR: 2.21, 95% CI: 0.92, 5.31). There was no impact of race/ethnicity, language spoken, SES, or distance from clinic on retention.

**Conclusions:** Rural families' engagement with the neurodevelopmental assessment process was improved by scheduling an intake interview following pediatrician referral. Completion of the intake virtually, during COVID-19, maintained this improved retention rate. Parents with less recent first developmental concern, whom have younger children, or are not already receiving services may require additional support to remain engaged with the assessment process. Families may also benefit from psychoeducation regarding neurodevelopmental concerns in girls. Evaluation of clinic procedures is limited by non-random assignment of families to conditions (i.e., questionnaire packet, intake, virtual intake). Development of additional procedures and programs that increase autism and developmental service access and retention for rural families is needed.

**221.002 (Panel)** Engaging Part C Services Providers As Facilitators of Early Identification and Evidence-Based Intervention Services for Children with ASD in Rural and Under Resourced Communities

**A. Stainbrook<sup>1</sup>, M. Fleck<sup>2</sup>, K. Simcoe<sup>1</sup>, L. Corona<sup>2</sup>, L. Wagner<sup>3</sup>, A. S. Weitlauf<sup>4</sup>, J. F. Hine<sup>4,6</sup>, P. Juárez<sup>1</sup> and Z. Warren<sup>4</sup>, (1)Vanderbilt University Medical Center- Treatment and Research Institute for Autism Spectrum Disorder, Nashville, TN, (2)Vanderbilt University Medical Center- Treatment and Research Institute for Autism Spectrum Disorder, Jackson, TN, (3)Vanderbilt University Medical Center - Treatment and Research Institute for Autism Spectrum Disorder, Nashville, TN, (4)Vanderbilt University Medical Center, Nashville, TN, (5)Vanderbilt Kennedy Center, Vanderbilt University Medical Center, Nashville, TN, (6)Dept of Pediatrics, Vanderbilt University Medical Center- Treatment and Research Institute for Autism Spectrum Disorder, Nashville, TN**

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**Background:** Families of young children with autism spectrum disorder (ASD), especially those in rural areas, experience barriers to accessing diagnostic evaluations and evidence-based early intervention services [1-4]. Many of these families turn to their state's Part C system for support, but these service providers vary in training, skill set, and familiarity with ASD [5-7]. Telemedicine presents a unique opportunity to involve Part C providers in the diagnostic process while also building their capacity to support and educate families [9-12]

**Objectives:** We will present the development and preliminary outcome data from a novel telemedicine model of service delivery designed to support early identification and follow-up behavioral intervention for children with ASD via Part C providers in rural locations. The model builds on a more established model that has served more than 700 families through both traditional and

telemedicine models of service delivery over the past 6 years [13, 14]. This extension includes training Part C providers in two critical areas: 1) screening young children for ASD and facilitating telediagnostic consultation and 2) providing support and education to caregivers in how to implement evidence-based intervention practices in the natural environment.

**Methods:** Participants included 11 Part C providers and families of children < 36 months of age showing symptoms of ASD. Providers participated in training on a play-based ASD screening tool to increase understanding of recognizing and eliciting ASD symptoms. They then participated in an ongoing monthly virtual learning community focused on evidence-based practices for supporting caregivers. Each service provider then had the opportunity to refer families for telediagnostic evaluation of ASD, participate in and observe those telediagnostic visits and mediate follow-up behavioral consultation services offered by a remote Behavior Analyst. We assessed parent and provider satisfaction with the model as well as child outcomes.

**Results:** Data collection and analysis of this model are ongoing. However, preliminary results align with findings from our more established model that includes both traditional (N = 49) and tele delivery (N = 46) of diagnostic and intervention services but with more limited involvement from Part C providers. Those findings suggest caregivers report satisfaction with the service model, service provider and service outcomes (see Table 1) with no significant differences in caregiver satisfaction emerging between groups. Community providers (N = 40) also report high levels of satisfaction with most reporting they would recommend participation in the intervention model to other families (90% endorsed “strongly agree”).

**Conclusions:** These results provide preliminary support for the feasibility of providing diagnostic and intervention services via telemedicine and in partnership with Part C providers in rural regions. Both models were developed by listening to the concerns of the providers already in these communities, engaging them in both the development and implementation of each component, and emphasizing sustainable modalities for ongoing training and practice. Building this model within an existing, large-scale system for young children has helped not only in sustaining the model but also in its ability to be replicated and grown over time.

**221.003 (Panel) Novel Methods of Delivering Autism Assessment and Psychoeducation in Rural Southwest Virginia: A Pilot Study**

**J. R. Bertollo<sup>1,2</sup> and A. Scarpa<sup>1,2</sup>, (1)Virginia Polytechnic Institute and State University, Blacksburg, VA, (2)Virginia Tech Autism Clinic & Center for Autism Research, Blacksburg, VA**

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**Background:** Early detection and intervention facilitate optimal outcomes for youth with autism spectrum disorder (ASD); however, service access is often reduced in rural communities. The later average age of diagnosis in rural areas puts children at a disproportionately high risk for missed intervention opportunities and poorer outcomes. In rural Southwest Virginia specifically, caregivers report several major barriers to accessing ASD services, including few providers knowledgeable in ASD, high cost of services, and geographic remoteness. Additionally, caregivers report not receiving ASD resources or educational materials after an ASD diagnosis, leaving families ill-equipped to seek proper services for their child.

**Objectives:** (1) To evaluate the relative feasibility of two novel delivery formats of evidence-based ASD assessment: mobile assessment and tele-assessment; and (2) to assess the effects of our assessment and psychoeducation protocol on caregiver empowerment and ASD knowledge.

**Methods:** Participants included 30 children between 1.7 and 14.9 years of age ( $M=8.43$ ,  $SD=3.85$ ; 80% male; 83.3% white) and one or both primary caregivers ( $n=34$ ) ages 24 to 61 ( $M=37.44$ ,  $SD=8.71$ ; 91.2% female). To address the aforementioned barriers, the current pilot study assessed the feasibility of delivering ASD assessment to children through a Mobile Autism Clinic ( $n=15$ ). During COVID-19, the study then shifted to assess the feasibility of ASD teleassessment ( $n=15$ ). After a diagnostic feedback session, caregivers were randomized to attend psychoeducation sessions or receive psychoeducation materials about ASD. Caregivers then completed a satisfaction measure of the services received. Caregivers also reported on their ASD knowledge and empowerment throughout the study, utilizing the Autism Stigma and Knowledge Questionnaire and Family Empowerment Scale, respectively. Repeated measures ANOVA was conducted for each of the two caregiver outcome metrics. Time (i.e., intake, post-feedback, post-psychoeducation) was entered as the within-subjects factor, and psychoeducation condition (i.e., sessions or materials) and assessment type (i.e., mobile or teleassessment) were included as between-subjects factors.

**Results:** While flexibility in scheduling was necessary, all families completed the assessment and psychoeducation protocol. The primary reason for rescheduling mobile assessments included weather-related cancellations. Primary reasons for rescheduling teleassessments during COVID-19 included family emergencies and work-related scheduling conflicts. Caregivers rated high satisfaction of both assessment formats; t-tests revealed slightly higher general satisfaction with mobile assessments ( $p<.05$ ; see Table 1). Caregiver empowerment within the family and community improved with time, as did total ASD knowledge and knowledge of ASD treatment ( $\eta^2=.114-.235$ ,  $ps<.05$ ; see Table 2); no interaction effects were significant in this sample.

**Conclusions:** The current pilot study demonstrates high feasibility and satisfaction with two novel assessment delivery methods that are both affordable and accessible for families in this underserved, low-resource region, surmounting aforementioned barriers of geography and limited providers. Additionally, receiving a comprehensive assessment and ASD psychoeducation, whether face-to-face or through educational materials, improved aspects of caregiver knowledge and empowerment over time. Teleassessment has been relied upon to an unprecedented degree during COVID-19 and is likely to be needed throughout future waves of this pandemic, while both mobile and teleassessment can be used regularly to overcome access-to-care barriers in rural or other hard-to-reach locales.

**221.004 (Panel) Compass: Considerations for Implementing an Evidence-Based Consultation Intervention in Rural Schools**  
*L. N. Ogle<sup>1</sup>, L. A. Ruble<sup>1</sup> and J. H. McGrew<sup>2</sup>, (1)Special Education, Ball State University, Muncie, IN, (2)Psychology, Indiana University - Purdue University Indianapolis, Indianapolis, IN*

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Background:

Consultation interventions such as the Collaborative Model for Promoting Competence and Success (COMPASS) are ideal for promoting the use of EBPs in rural schools. COMPASS starts with a parent-teacher consultation facilitated by a consultant producing goals and intervention plans individualized to the student with ASD, teacher, and environmental context using an evidence-based practice in psychology framework (McGrew, et al., 2015). This is followed by coaching organized around teaching plan implementation fidelity feedback and student progress monitoring. Three previous studies found that COMPASS doubled the IEP progress of students with ASD, but in each of these studies the developers served as the consultants.

Objectives:

The current study sought to develop and validate a training and supervision package for school-based consultants in both rural and urban areas. A secondary objective was to understand how much and what type of coaching (written feedback vs. face-to-face problem solving) is needed by teachers to achieve implementation fidelity and maximize student goal attainment progress.

Methods:

COMPASS training consisted of a 2-day in person training complemented by a web-based training website and data-driven supervision. Twelve consultants (age 24-60) were trained in three cohorts and each worked with 2-4 teacher-parent dyads. Eleven worked in rural schools. Thirty-one teachers (age 23-55) were recruited, along with one student (n=31, age 4-13) with ASD and their parent randomly chosen from their caseload. Each parent-student dyad received a 3-hour initial consultation. Teachers were then randomly assigned to one of four follow-up conditions: 1) four coaching sessions, 2) two coaching sessions, 3) four written performance feedback emails of student's goal attainment progress and teacher intervention plan adherence, or 4) no follow-up, initial consultation only. Consultants received data-driven supervision via video conferencing and written performance feedback following each initial consultation and follow-up coaching session that rated the consultant's adherence to protocol and teacher/parent satisfaction. Teaching plan quality, teacher adherence to plan, and student goal attainment progress were also rated.

Results:

Satisfaction with the COMPASS training package (10-items, 1=Strongly Disagree - 5=Strongly Agree) was high for both days of training (M=4.71 and M=4.63). Parent and teacher satisfaction with the consultation (M= 4.76, 5=Strongly Agree) and teacher satisfaction with coaching were also high (M=4, 4=Strongly Agree). Consultant adherence to the COMPASS consultation and coaching protocols and teaching plan quality increased with practice and supervision by the researchers. However, researcher assessment of adherence did not correspond to self-report assessment. Teacher adherence to the teaching plans and students' goal attainment progress increased relative to the amount of coaching or written feedback they received. No differences were observed in rural vs. urban schools.

Conclusions:

COMPASS is an effective intervention in rural schools with high satisfaction that helps support and strengthen the relationships between consultants, teachers, and parents. Rural school administrators were more open to trying COMPASS. However, rural schools were also more likely to either not have a designated ASD consultant or have consultants in multiple roles within the school. Special considerations for consultation in rural schools will be discussed.

## PANEL SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

### Panel 228 - Decentralizing ASD Knowledge, Resources, and Services Away from ASD Specialists into Diverse Communities

**Panel Chair:** Serene Habayeb, *Children's National Hospital, Washington, DC*

**Discussant:** Sarah Dababnah, *University of Maryland, Baltimore, Baltimore, MD*

ASD awareness has increased, internationally and in historically disenfranchised communities, at a faster rate than has the growth of the specialized ASD workforce (Zhang and Cummings, 2019). In turn, there is a paucity of ASD specialists providing evidence-based resources to those who require them. Further, many traditional ASD clinics report lengthy wait times delaying children with/suspected to have ASD from receiving necessary services (Gordin-Lipkin, Foster, and Peacock, 2016). This panel will describe the benefit of decentralizing the receipt of ASD resources from specialized ASD professionals to community stakeholders in order to increase equitable access of these tools and supports. This panel will highlight projects that have successfully engaged diverse community stakeholders, including early childcare providers and parents, to disseminate evidence-based ASD knowledge, resources, screening protocols, and treatments to children and families. Projects will share examples from different timepoints along a family's diagnostic journey, beginning with monitoring for atypical development through receiving therapy once a diagnosis has been made. Presentations will emphasize how stakeholder engagement in resource dissemination can decrease health disparities among ethnic and racial minority youth and improve access to needed services in historically underserved communities in the US and internationally.

**228.001 (Panel)** Bridging the Gap: Increasing Access to ASD Knowledge and Resources through Hospital-Community Partnerships Focused on Training and Supporting Early Childhood Education Community Providers

**S. I. Habayeb<sup>1</sup>, A. Inge<sup>2</sup>, Y. Myrick<sup>1</sup>, A. Hastings<sup>1</sup>, O. Soutullo<sup>1</sup>, R. Williams<sup>3</sup> and L. Godoy<sup>1</sup>,** (1)*Children's National Hospital, Washington, DC,* (2)*Center for Autism Spectrum Disorder, Children's National Hospital, Rockville, MD,* (3)*Child Health Advocacy Institute, Children's National Hospital, Washington, DC*

**Background:** Early childhood education (ECE) providers ("educators") play a critical role in identifying Autism Spectrum Disorder (ASD) in young children and connecting families to resources. While developmental monitoring and screening is increasing in ECE settings, educators continue to report limited knowledge about ASD and related resource navigation. Limited research has investigated how consultation and training, specifically for ASD-related concerns, may impact educators.

**Objectives:** The primary objective of this mixed-methods feasibility pilot is to improve community-based educator knowledge of ASD using a train-the-trainer model to maximize sustainability and dissemination.

**Methods:** ASD specialists from a children's hospital (psychologists and a parent professional) developed replicable trainings to increase educators' knowledge about ASD, engage families in care, and navigate local services, using input from community stakeholders and national resources. Trainings were provided to two groups of educator participants (Training 1 N = 62; Training 2 N = 19). Several participants then co-facilitated a training with the ASD specialists for other ECE stakeholders (N = 19) via a train-the-trainer model and co-led a four-part webinar series for educators (N = 254 registered from 20 community agencies). Trainings were assessed using pre- (Time 1) and immediate post-training (Time 2) ratings of ASD knowledge and measures of feasibility and acceptability. Four to six months post-training, endpoint questionnaires (Time 3) were collected, and focus groups (2) and interviews (7) were conducted with participants who co-led trainings.

**Results:** Following the three in-person trainings, over 90% agreed or strongly agreed that trainers were effective and topics covered were relevant to their work. All but one participant felt somewhat (47.6%) or very (51.2%) prepared to share the information with their community sites, and 100% would recommend the training to other ECE professionals. Participants reported increased knowledge, confidence, and behaviors, in all domains assessed, at Time 2 and Time 3 (Figure 1). Following the webinars, over 90% of educators agreed or strongly agreed that they had the knowledge to recognize atypical development and to identify and connect families with community ASD resources, understood developmental monitoring and screening, and had the confidence to engage parents in conversations about their child's development. At Time 3, participants identified challenges they continued to face in ASD care, including lack of timely access ASD evaluations (64%) and treatment (36%) and limited family engagement in services/stigma (42%). They also identified ways to improve ASD care, including increased care/peer navigation (68%), more ASD-focused trainings (35%), and technical/individualized support (35%). Key focus group and interview themes included: 1) the training and technical assistance increased knowledge and positively impacted practices, 2) family education and engagement are keys to quality ASD care, 3) greater knowledge increases equitable access, but current systems are unable to handle demand, and 4) educators should be more involved in ASD work.

Conclusions: Findings suggest that brief trainings are feasible and can improve educator knowledge of ASD and resource navigation in a community setting while also maximizing dissemination. Based on findings, a city-wide collaborative was launched and is currently developing workplans to address community needs identified in this study.

**228.002** (Panel) Addressing Health Disparities in Early Detection of ASD: Bilingual Screening in Part C Early Intervention  
*A. S. Carter<sup>1</sup>, R. C. Sheldrick<sup>2</sup>, A. Eisenhower<sup>3</sup>, T. Mackie<sup>4</sup>, F. Martinez-Pedraza<sup>5</sup>, N. A. Hoch<sup>6</sup> and S. M. Brunt<sup>7</sup>, (1)Department of Psychology, University of Massachusetts Boston, Boston, MA, (2)Boston University School of Public Health, Boston, MA, (3)University of Massachusetts Boston, Boston, MA, (4)Institute for Health, Health Care Policy and Aging Research, School of Public Health, Rutgers Univer, New Brunswick, NJ, (5)Center for Children and Families, Florida International University, Miami, FL, (6)Clark University, Worcester, MA, (7)Psychology Department, University of Massachusetts Boston, Boston, MA*

Background: Whether suspected of ASD or not, a high percentage of children who are referred to and engage in Part C Early Intervention (EI) services will ultimately receive an ASD diagnosis. Even after a positive pediatric ASD screener, developmental concerns (e.g., language delays) are acknowledged without referral to ASD diagnostic evaluation. Families who successfully connect to EI services may still face access barriers associated with health disparities in early diagnosis and ASD-tailored interventions. We partnered with community-based EI agencies to implement multi-stage ASD screening and referral to university-based diagnostic evaluation to increase access to early detection of ASD, minimizing health disparities in rates of diagnosis.

Objectives: To determine if a community-based, EI-administered multi-stage screening protocol administered in English and Spanish coupled with referral to university-based diagnostic evaluation increases rates of ASD diagnosis and minimizes health disparities access to ASD diagnosis. Assess parent experiences of EI-based screening and the diagnostic evaluation.

Methods: A mixed methods approach was employed. Quantitative analyses involved tracking 4943 children (mean age: 22.0 months; 62.9% boys, 73.3% children of color, 34.9% non-English-primary language, 64.5% publicly-insured) who were eligible for screening through the multi-stage screening and diagnostic protocol. Stage 1 screening included the Brief Infant-Toddler Social Emotional Assessment and Parent Observations of Social Interactions, Second stage screening involved the Screening Tool for Autism in Toddlers. A positive questionnaire screener or parent or provider concern determined eligibility for further screening/diagnostic evaluation. State-level administrative demographic and diagnostic data from the Department of Public Health were used to conduct difference-in-difference analyses comparing rates of diagnosis in partner screening sites relative to contrast sites with similar trajectories of diagnostic rates in the pre-intervention period. Qualitative analyses of 65 longitudinal interviews with 22 parents provide insight into parent experiences of the multi-stage screening process.

Results: Screening and diagnostic evaluation participation were high (64.9% and 65.3% at first-and second-stage screening, 84.6% at diagnostic evaluation), with 83.7% of children participating in a diagnostic evaluation receiving an ASD diagnosis. Difference-in-difference analyses document that rates of diagnosis improved significantly at each partner screening EI site relative to comparison sites (See Figure). Spanish speaking families showed relatively stronger diagnostic benefits. Logistic regressions identified the following predictors of ASD diagnosis relative to the full screen eligible sample: children receiving diagnoses were older [Exp(B)=1.03, p=.004, 95% C.I.=1.01-1.05], more likely to be boys [Exp(B)=0.40, p < .001, 95% C.I.=0.31-0.52], and more likely to be children of color than all other eligible children [Exp(B)=1.39, p=.026, 95% C.I.=1.04-1.86]. No differences in language [Exp(B)=0.96, p=.71, 95% C.I.=0.75-1.21] or insurance [Exp(B)=1.20, p=0.16, 95% C.I.=0.93-1.54] were observed. Parents reported the written and observational screening tools facilitated understanding their child's behaviors within an ASD interpretive framework in unique and synergistic ways, facilitating shared decision-making with the EI provider.

Conclusions: Our EI-implemented multi-stage screening model increased rates of ASD diagnosis and addressed linguistic health disparities in receipt of ASD diagnosis. Expanding screening to EI settings affords opportunities to aid parents in understanding their children's ASD symptoms and facilitates shared decision-making and access to ASD-tailored interventions.

**228.003** (Panel) Evaluation of a Novel Remote Cascade Training Curriculum of the Who/As Caregiver Skills Training Program (CST) in Response to the COVID-19 Pandemic  
*A. Ibrahim<sup>1</sup>, H. R. Pickard<sup>2</sup>, A. Kiafar<sup>3</sup>, A. Yusuf<sup>3</sup>, P. Dixon<sup>4</sup>, S. Dababnah<sup>5</sup>, A. Shih<sup>6</sup>, A. Pickles<sup>7</sup>, M. Elsabbagh<sup>2</sup>, S. Y. Shire<sup>8</sup> and T. W. CST Team<sup>9</sup>, (1)McGill University, Montreal, QC, Canada, (2)Social, Genetic and Developmental Psychiatry, King's College London, London, United Kingdom, (3)Neurology and Neurosurgery, McGill University, Montreal, QC, Canada, (4)Wayne State University, Ann Arbor, MI, (5)University of Maryland, Baltimore, Baltimore, MD, (6)Autism Speaks, New York, NY, (7)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, (8)University of Oregon, Eugene, OR, (9)Department of Mental Health and Substance Abuse, World Health Organization, Geneva, Switzerland*

**Background:** The Caregiver Skills Training Program (CST), a caregiver-mediated intervention model, was developed by the World Health Organization and Autism Speaks to offer an open access and relatively low dose package for use by trained non-specialists. Intervention fidelity - i.e., the degree the intervention is implemented the way it was designed maintaining all components - has been a long-standing challenge in the translation of research into wider community benefits. CST approaches this challenge by using a cascade training and supervision model beginning with the training of Master Trainers (MTs), who in turn deliver the intervention with caregivers. However, to date very few studies have examined the extent to which fidelity can be achieved when training professionals in community settings before implementation. Significant barriers to training have been introduced with the COVID-19 pandemic, limiting in person professional development activities.

**Objectives:** Pre pandemic, all MTs had participated in a 5-day in person didactic and skills-based training. This would typically be followed by in person CST practice with children. We developed a remote cascade training curriculum to substitute this practice. The extent to which CST scoring reliability and MTs' perceived knowledge/confidence improved relative to the baseline was examined over the course of 12 weeks of training.

**Methods:** We enrolled 19 Master Trainers in the MT training curriculum (adapted for COVID-19) from Canada (n=11), USA (N=1), Argentina (n=3), Egypt (n=1), Ethiopia (n=2) and Iran (n=1). Participating MTs were professionals providing autism intervention services in their communities. Of the 19 MTs, 11 completed all modules and their rates of attendance in structured group interactions was very high. The MTs' skills on scoring adult-child interactions were assessed by CST experts using the 11-item CST Fidelity Rating Measure at baseline, midpoint and at the end of training. Each item was scored from 0 (not yet) through 4 (high quality, consistent implementation). The focus was to achieve scoring reliability on this measure. Adapted training included (a) 7 weekly group meetings to discuss MTs' independent scoring reliability of one adult-child interaction video and (b) independent coding of 10 new videos followed by two scoring discussions. We also evaluated perceived knowledge/confidence using the "MTs Perspectives on CST" survey.

**Results:** Repeated measures ANOVA revealed a significant effect of training on scoring reliability ( $F(2, 20) = 3.562, p = 0.04$ ). Post-hoc analyses using paired *t*-tests showed that the mean CST scoring reliability rating at midpoint ( $M = 4.08, SD = 2.25$ ) was significantly higher than at baseline ( $M = 2.62, SD = 0.76$ ) ( $t(12) = -2.33, p = .038$ ). However, no significant difference was found between midpoint and post training reliability scores. In contrast, MTs Perspectives on CST increased significantly over time from baseline to midpoint to post-training ( $F(2, 10) = 6.28, p = .017$ ).

**Conclusions:** The results provide evidence for increase of MTs' CST skills as a result of a newly developed remote training curriculum. Results also suggests increase of MTs' knowledge and perceived confidence of CST during the course of the training, including all modules.

**228.004 (Panel) Revisiting a Parent Education Program for Latinx Families: Are Positive Effects Maintained Overtime?**  
**S. Magaña<sup>1</sup>, W. Zeng<sup>1</sup> and K. Lopez<sup>2</sup>, (1)Steve Hicks School of Social Work, University of Texas at Austin, Austin, TX, (2)Arizona State University, Phoenix, AZ**

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**Background:**

Latinx children with ASD and their families experience disparities in information and treatment. Parents Taking Action (PTA) is a culturally tailored parent education intervention that was developed to address disparities faced by Latinx families of children with ASD. Parent peer-leaders delivered the 14-session program through face-to-face home visits after receiving training on the content and intervention protocol. A randomized waitlist-control trial found positive parent and child outcomes for the treatment group compared to the control between baseline and four months across two sites: Illinois and California.

**Objectives:**

The purpose of this study is to examine the maintenance of intervention effects from baseline to eight-months post baseline to determine longer-term effects of the intervention.

**Methods:**

The participants were 93 (intervention=41, control=52) Latinx mothers of children with ASD aged 8 years or younger, who completed assessments at three timepoints: baseline, four months, and eight months. Parent and child outcomes included family empowerment (Family Outcome Scale; FOS), mother's confidence in using evidence-based (EB) strategies, and frequency of using EB strategies; child challenging behaviors, child social communication (Social Communication Questionnaire; SCQ), and the number of services received. We assess maintenance of intervention effects by conducting repeated measures analysis of

covariance (ANCOVA) models for all parent and child outcomes between baseline and eight months. Maternal education was controlled for since it was the only significant between-group demographic variable. We also analyzed differences in intervention effects by site by running OLS regression models at eight months.

#### Results:

Compared to control mothers, intervention mothers achieved 4.4 points higher in confidence ( $F_{[1, 90]}=8.61, p<.001$ ), and 3.8 points higher in frequency ( $F_{[1, 90]}=3.83, p=.02$ ) of using EB strategies scales between baseline and eight months. Children whose mothers were in the intervention groups on average received 1.4 additional services ( $F_{[1, 90]}=3.16, p=.04$ ) across these two timepoints. Overall, there were no significant treatment differences in family empowerment, the child's challenging behaviors, or SCQ scores. When analyzed by site, however, we found significant treatment differences in FOS' *assessing community resources* subscale ( $F_{[1, 23]}=7.33, p=.002$ ) and in child's SCQ scores ( $F_{[1, 23]}=9.08, p<.001$ ) in the California sample, but not in the Illinois sample.

#### Conclusions:

Intervention mothers at both sites reported greater confidence in and frequency of using EB strategies eight-months post baseline compared to the control. Additionally, our findings indicated greater receipt of services by children of mothers in the intervention groups compared to those in controls eight-months post intervention. Together, these findings suggest that the content, structure, and delivery mode of PTA may contribute to maintenance of effects beyond the timeframe of the intervention program. We found differences in some outcomes between the two sites. Policy and service differences in each state may contribute to these differences. Therefore, the intervention may show more robust improvements for families depending on state policies and availability of services.

## ORAL SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

### Oral 314 - Measuring and Maximizing Access to Services

**314.001** (Oral) Service Experiences of Autistic People and Family Carers in Europe: Access-EU Study  
**J. Man<sup>1</sup>, R. Holt<sup>1</sup>, T. Parsons<sup>2</sup>, A. N. Ruigrok<sup>3</sup>, C. Allison<sup>1</sup>, A. Baranger<sup>4</sup>, J. Cusack<sup>5</sup> and S. Baron-Cohen<sup>1</sup>**, (1)Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom, (2)Autism Research Centre, University of Cambridge, Cambridge, United Kingdom, (3)University of Cambridge, Cambridge, United Kingdom, (4)Autism Europe, Brussels, Belgium, (5)Autistica, London, United Kingdom of Great Britain and Northern Ireland

**Background:** The worldwide prevalence of autism is approximately 1-2%, leading to estimates of seven and a half million autistic people in Europe. Many of those people, as well as their families, rely on a variety of services, yet many report difficulties with service access.

**Objectives:** This study is the first of its kind to explore a broad range of service experiences across Europe and the aim is to consider the state of service quality and access to services for autistic people. Findings will be used to inform European policy makers with a view to improving service experiences for autistic people and their families.

**Methods:** Autistic people and family carers were invited to take part in an online survey (available in English and seven European languages) which asked about their experiences with services within the past two years. The survey included a range of services such as physical and mental health services, social care, education, employment and therapy/allied health services.

**Results:** Initial findings based on UK data consist of 558 participants, of whom 358 were autistic people, and 200 were family carers reporting on behalf of an autistic person. Approximately half (52%) of all the autistic participants (self- and carer-report combined) identified as male, 40% as female, and less than 10% as non-binary or 'other'. 80% were adults, and 20% were under 18 years old. Mental health, therapy/ allied health and autism diagnostic services were reported to be the most difficult services to access. Long wait times were commonly reported for autism diagnostic services, with 87% waiting more than one month, 59% more than six months and 40% more than 12 months. Of those attempting to access mental health services in the last two years, 80% reported being successful at least once, but 40% reported being unsuccessful at least once. A similar pattern was seen for therapy services/ allied health services (68% successful and 43% unsuccessful) and for diagnostic services (85% successful, 22 unsuccessful). Overall, one of the most frequently reported barriers to service access was the service not being suitable (or not being deemed eligible for the service). The most frequently reported suggestions for improvements to diagnostic, mental health and therapy/allied health services involved improving resources, specifically including funding. Improving autism-related training was also commonly suggested for mental health and therapy/ allied health services.

**Conclusions:** Autistic people experienced many barriers to service access. A majority of those receiving services within the past two years stated that the service needed to improve. Some suggested improvements included a need to adapt to the specific needs of autistic people, improve the autism expertise of those providing the services and improve resources of services. Here we include preliminary data from this survey, subsequently we will provide a more in depth exploration including investigation of other service types and data from additional European language versions.

**314.002** (Oral) Changes in Equitable Access to Autism Services in Utah after Transitioning to Telehealth during the COVID-19 Pandemic: Identifying Socio-Demographic Gaps

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**Background:** The University of Utah Child Development Program (CDP) serves families across the Intermountain West with developmental concerns, most frequently related to autism. While some telehealth visits were done prior to the pandemic, when the options for in-person visits became more limited at the onset of the pandemic (March 2020), CDP pivoted towards more telehealth-based assessments. It has been suggested that telemedicine may simultaneously open doors for families previously unable to access specialized services, such as those in rural/frontier communities and create barriers to care for those without adequate resources (Ameis, 2020). To date, changes in socio-demographic characteristics of families accessing care at an autism evaluation clinic preCV19 and during CV19 have not been described.

**Objectives:** To compare socio-demographic characteristics and rurality of patients served by CDP prior to the pandemic (July 2018 -February 2020) and since March 1, 2020.

**Methods:** We compared characteristics of children (age, race/ethnicity, sex) and families (location [urban/rural/frontier], medically underserved area/population [MUA/P] status, primary language, insurance type) and visit type (telehealth vs in-person). We also compared the proportion of families seen via telehealth. We examined associations between telehealth and equitable access for underserved populations. Logistic regression was used to estimate factors that influenced whether a person was able to access telehealth. All scheduling and productivity of clinicians remained unchanged during the pandemic.

**Results:** The transition to telehealth that is occurring during the pandemic, compared with in-person visits that predominated pre-pandemic appears to increase access for urban, English speaking families and for commercial insurance carriers. Access did not appear to be impacted by sex, race, or rurality; however, a trend towards decreased rural access was noted. Less equitable access was observed based on ethnicity (Hispanic families), insurance (MCAID) and language (See Table 1). Further, a significant decrease in age at first visit was observed during the pandemic suggesting that access to telehealth may decrease wait time (See Table 2).

**Conclusions:** Results from our study suggest specific targets for increasing equitable access to autism services during the pandemic based on socio-demographic variables. With telehealth CDP, was able to maintain pre-pandemic capacity for serving families of children with developmental concerns. Children seen during the pandemic are younger suggesting that children with developmental concerns can be evaluated in a timelier manner via telehealth. The telehealth technology used during the pandemic was associated with improved access for families living in urban areas but worsened access for non-English speaking families and those with MCAID. Telehealth did not appear to adversely impact rural access to care; however, we will be examining this further as we continue to collect data. This suggests that disparities in access to care that were present prior to the pandemic remain present and possibly more resilient. Previous research has identified socio-demographic issues as barriers to care for underrepresented families (Colbert et al., 2017). However, these issues are complex and not well understood especially during a pandemic. It behooves us to remain vigilant and build equitable systems of care as we move into this new era of telemedicine.

**314.003** (Oral) Autistic Adults' Experiences with Palliative Care and End-of-Life Services

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#### **Background:**

Australia's National Palliative Care Strategy (2018) recognises the importance of identifying and respecting the needs of people from under-served population groups and improving their access to culturally appropriate palliative care services. However, to date there have been no studies on the service experiences, preferences or needs of autistic adults with Autism Spectrum Disorder (Level 1) regarding palliative care.

## Objectives:

The aim in this study was to examine autistic adults': 1. understanding of and attitudes towards death as a concept; 2. experiences with palliative care and end of life services; 3. experience of and adjustment to grief due to bereavement; and 4. explore potential relationships between autism, death anxiety, attachment and grief.

## Methods:

The study, conducted by an autistic researcher, used a concurrent mixed methods design including semi-structured interviews with autistic adults (n=20) and health care and service professionals (n=22) from palliative care services, autism services, funeral providers and bereavement specialists. Interview data was analysed using grounded theory (Charmaz, 2014) including initial and focused coding and conceptual categories. An online survey was also conducted to examine potential relationships between autistic traits, death anxiety, adult attachment styles and indicators of prolonged grief disorder (PGD). A total of 298 survey responses were analysed and open-ended questions about respondents experiences with end of life service contexts were also included in the online survey.

## Results:

Grounded theory analysis resulted in 92 initial codes, 79 focused codes and 8 conceptual categories: concept of death, death anxiety and desire, autism is invisible, information needs, interaction with others, core components of palliative care, memorialisation practices and grief and bereavement. The survey results support qualitative findings, and also revealed the following: Autistic traits were correlated with avoidant ( $r = .36$ ) and anxious ( $r = .45$ ) attachments; Anxious attachment was correlated with death anxiety ( $r = .38$ ) and cognitive, emotional and behavioural symptoms > 6 months after bereavement ( $r = .30$ ); Cognitive, emotional and behavioural symptoms were correlated with separation distress > 6 months after bereavement ( $r = .36$ ).

## Conclusions:

There is a lack of autism awareness and education across palliative care and end of life services, including the funeral industry and specialist bereavement support services. Autistic adults' experiences with palliative care and end of life services indicate that the presence of autistic traits influences the delivery and quality of palliative care provided. The expression of grief due to bereavement presents uniquely in autistic adults and health care professionals need to be aware of the nuances of autistic responses to grief and loss. The presence of separation distress and/or cognitive, behavioural and emotional symptoms more than 6 months after bereavement are indicators of PGD. Autistic adults with an anxious attachment style and high levels of death anxiety may be at higher risk of developing PGD.

### 314.004 (Oral) Identifying Components of Autism Friendly Healthcare: A Modified Delphi Study

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**Background:** Individuals with Autism Spectrum Disorder (ASD) are reported to have higher rates of healthcare services utilization<sup>1-3</sup>. However, despite higher utilization rates, individuals with ASD and their families are also more likely to report lower satisfaction with the care that they receive<sup>4,5</sup>. Currently, there is no definitive set of "best practice" standards in providing care for patients with ASD.

**Objectives:** This study aims to identify the components of what would make a healthcare practice "Autism Friendly" according to key stakeholders (i.e., professionals whose interests include ASD or who regularly works with individuals with ASD, individuals with ASD, and family members of individuals with ASD).

**Methods:** We conducted a modified three-round Delphi<sup>6</sup> study. A list of statements about possible components of an "Autism Friendly" healthcare practice was compiled using insights from the Autism Friendly Initiative at Boston Medical Center's steering committee, which consists of researchers, clinicians, hospital staff, and parents of individuals with ASD. These statements were entered into an electronic survey, which was distributed to selected members of our professional networks and families/patients mailing list.

In the first two rounds, participants were asked to score statements from a scale of 1-9 in terms of their importance as a component of Autism Friendly healthcare (1 = not important at all; 9 = very important). Scores were analyzed and statements with low scores (i.e., bottom 50%) across all stakeholder groups were eliminated. In the first round, participants had the

opportunity to add new statements if there were other components of an Autism Friendly healthcare practice that were not represented in the original list. Newly added statements were integrated with the higher-ranked statements from the first round. In the second round, participants had the opportunity to “rescue” eliminated statement(s) for the final round. “Rescued” statements that received more than three votes were included in the final list. In the third round, participants were asked to rank statements from most important to least important.

Results: In the first round, 78 participants scored 37 statements on a scale of 1-9. After analysis and integration of newly suggested statements, 21 statements were presented in the second round and scored by 51 participants. To date, 29 participants (20 professionals; 9 individuals with ASD and family members of individuals with ASD) have responded to the final round of the survey, which consists of 16 statements. The top 10 statements to date in the final round are presented in Table 1.

Conclusions: Themes that emerged from the highly ranked statements include patient advocacy for individuals with ASD, staff training to support patients with ASD in healthcare settings, and environmental or operational modifications to accommodate the needs of patients with ASD. In all three rounds, there appear to be differences in scores provided by professionals and non-professionals (e.g., individuals with ASD and family members of individuals with ASD). More research is needed to explore avenues to implement the findings of this study as well as the differences in perspectives of professionals and families/individuals with ASD about Autism Friendly healthcare practice.

## ORAL SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

### Oral 328 - Access to Primary and Preventive Care

**328.001** (Oral) National Inpatient Hospitalizations in Autistic Youth in the U.S.

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Background: Addressing healthcare needs is complex in autistic youth for many reasons. Increased inpatient care that has been noted in this population may be a marker of inadequate primary and outpatient care.

Objectives: The goal of this study is to examine characteristics of inpatient hospital stays for autistic youth, examine racial and ethnic differences in experiences, and compare to youth with other mental, behavioral, or neurodevelopmental disorders (MBND). The aims are to 1) present demographic and inpatient stay characteristics of autistic and MBND youth, 2) examine the most common reasons for inpatient hospitalizations in autistic youth by race and ethnicity and by MBND youth, and 3) describe the cost and length of inpatient stays among autistic and MBND youth. This research builds on existing literature to underscore the need to prioritize policies and programs that incentivize treatment of ambulatory care sensitive conditions (ACSC) to prevent unnecessary hospitalizations.

Methods: This study used data from hospital inpatient discharges from the Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ) National Inpatient Sample (NIS) 2017. NIS 2017 captured more than 7 million stays from 47 states plus the District of Columbia, covering 97% of the U.S. population. The prevalence, average length of stay, and average cost per day of the 10 most common principal diagnoses for index stay were calculated for autistic youth (ages 0-17) overall (n=7890) and by race and ethnicity. Comparisons were made to youth with mental, behavioral, and neurodevelopmental disorders (MBND) (n=70,150).

Results: Of every 1000 stays, 7.3 were for autistic youth and 65.2 for youth with MBND, the rate varied by U.S. region and zip code-level household income. The most common principal diagnosis in autistic youth was mood disorders, as in youth with MBND. Nearly all top 10 principal diagnoses for autistic youth were for ACSCs. Race and ethnicity impacted the rate of principal diagnosis in autistic youth: mood disorders were more common in white, non-Hispanic youth (19%) than black, non-Hispanic (13%) and Hispanic (8%) youth; while asthma and schizophrenia were more common in black youth (8% and 4%) than in white (both 2%) and Hispanic (4% and 1%) youth. The highest average cost per day for autistic youth was for physical injuries (\$4320 per day) followed by epilepsy (\$3480 per day) (Figure 1). Average length of stay varied by race and ethnicity in autistic youth for schizophrenia, conduct disorders, and mood disorders, but cost per day did not vary greatly (Figure 2).

Conclusions: High occurrence of ACSCs in autistic youth suggest that primary care many not adequately address health and mental health needs. Long length of stay suggests that clinical complexity and autism characteristics may be impacting care received in the hospital. Care complexity also appears to be impacted by race and ethnicity in autistic youth, unsurprising due to

more common mis- and under-diagnosis and misinterpretation of ASD associated behaviors in minority youth. More work is needed on improving systems of care to prevent unnecessary hospitalizations and providing optimal care to vulnerable populations.

**328.002** (Oral) Specialized Primary Care Center for Autistic Adults Is Linked with Increased Receipt of Preventive Care Services

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**Background:** Preventive healthcare services, like immunizations, disease screenings, and behavioral counseling, are a critical component of health maintenance. However, autistic adults face barriers to healthcare at the patient, provider, and systems levels, resulting in autistic adults receiving significantly fewer preventive services than non-autistic peers. As the population of autistic adults grows, there is an urgent need to address this disparity in the receipt of preventive services by developing and testing evidence-based models of healthcare delivery that may better meet this population's needs. The Center for Autism Services and Transition (CAST) at The Ohio State University is a patient-centered primary care clinic aiming to remove many barriers to care for autistic adults. For example, CAST patients may receive modifications to the standard patient workflow (e.g., bypass the waiting room due to sensory sensitivity) and are seen by physicians with extensive experience working with the autistic adult population.

**Objectives:** To compare the receipt of preventive services among patients who receive care through CAST to US national samples of autistic adults with private insurance or Medicare.

**Methods:** We conducted a cross-sectional retrospective study of medical billing data. The sample included CAST patients (N=490) who were propensity score matched to national samples of Medicare-enrolled autistic adults (N=980) and privately insured autistic adults (N=980) using demographic characteristics. The primary outcome measure was the receipt of any preventive service, as defined by the Medicare Learning Network and AAPC (formerly the American Academy of Professional Coders). Secondary outcome measures included receipt of five specific preventive service types (i.e., general health and wellness services; screenings; counseling and therapies; vaccinations; and sexual/reproductive health services). We used logistic regression to compare CAST patients to national samples of autistic adults with Medicare or private health insurance on the odds of receiving any preventive service, as well as the odds of receiving each of the five specific types of preventive services.

**Results:** CAST patients had significantly greater odds of receiving any preventive service than Medicare-enrolled (OR=10.3; 95% CI=7.6-13.9) and privately insured (OR=3.1; 95% CI=2.3-4.2) autistic adults. CAST patients were also significantly more likely to receive screenings and vaccinations than either Medicare beneficiaries (screenings OR=20.3; 95% CI=14.7-28.0; vaccinations OR=5.5; 95% CI=4.3-7.0) or privately insured autistic adults (screenings OR=2.0; 95% CI=1.6-2.5; vaccinations OR= 3.3; 95% CI=2.6-4.1).

**Conclusions:** Our findings support a specialized, patient-centered approach in the care of physicians who are knowledgeable about autism as a promising solution to improve healthcare delivery for this population. There are a number of characteristics of CAST that may be responsible for the increased receipt of preventive care services, screenings, and vaccinations such as care coordination and patient-centeredness. CAST, however, differs from other patient-centered approaches in its customization for autistic adults and it may, in fact, be these customizations that contribute to the observed increase in receipt of preventive care. In future work, it will be important to identify the most significant drivers of CAST patient outcomes in preparation for replication in other communities.

**328.003** (Oral) Feasibility of a Telediagnostic Model for ASD Evaluation in Clinically-Referred Young Children

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**Background:** In response to the COVID-19 pandemic, U.S. federal and state-level governments have created policies that promote and facilitate the use of telehealth tools to provide healthcare services to patients. Diagnostic services for autism spectrum disorder (ASD) were in high demand prior to the pandemic, and the temporary closing and then limited in-person re-opening of diagnostic centers during this public health crisis have increased already lengthy wait times for evaluations (Solomon & Soares, 2020). Delays in diagnosis restrict access to treatment, and this is particularly problematic for young children with

ASD, who particularly benefit from early identification and intervention. Telehealth diagnostic (telediagnostic) models for assessing ASD are being piloted and may provide a critical service to families during the pandemic.

**Objectives:** To explore the feasibility of a telediagnostic model piloted at the Seattle Children's Autism Center (SCAC) for young children referred for ASD diagnostic evaluation.

**Methods:** Figure 1 summarizes the SCAC telediagnostic pilot protocol. Figure 2 shows complete screening data. Of the 300 patients interested and reached from the waitlist aged approximately two to four years, 35.6% ( $n=107$ ) screened in. Patients were most often screened out due to the child having too much language per recommended TELE-ASD-PEDS (Corona et al., 2020) guidelines or family preference for in-person evaluation. Data from 80 patients were available based on intakes completed to date. Patients ranged in age from 22-59 months ( $Mean=37.3$  months, 68.8% male). Sixty percent of patients identified as Non-White and 26.9% identified as Hispanic/Latino. Patients resided in 13 counties throughout WA State, ranging from 0 to 159 miles from clinic.

**Results:** After accounting for patients lost to follow-up, most patients (88%) completed their diagnostic evaluation entirely via telehealth. Approximately 11% of patients had to return to clinic for additional evaluation (7.5% of patients after intake, 3.3% after teleassessment). Common reasons included issues with technology, medical or psychosocial complexity, language barriers, and discrepancy between parent report and clinician observation. Sixty-one patients have been seen for teleassessment to date using the TELE-ASD-PEDS and ABAS-3, and 96.7% of these evaluations were completed entirely via telehealth. The majority of patients ( $n=54$ , 93%) with diagnostic outcome data available received an ASD diagnosis. Total TELE-ASD-PEDS score was significantly higher ( $M=16.3$  vs. 9.0,  $p<.001$ ) and ABAS-3 General Adaptive Composite significantly lower ( $M=70.8$  vs. 82.8,  $p=.04$ ) in patients diagnosed with ASD versus without ASD. Provider confidence in providing a diagnosis via telehealth was high ( $Mean=4.6$ , range=3-5).

**Conclusions:** A telediagnostic model for a focused ASD assessment appears feasible in young children referred to an ASD specialty clinic for diagnostic evaluation. Providers reported feeling confident in using a telediagnostic model, and 88% of patients completed their assessment from start to finish via telehealth. Patient and provider satisfaction data are being evaluated. Telehealth has played a critical role in maintaining patients' access to services during the COVID-19 pandemic, and results from this study suggest that it can be used sufficiently for diagnostic purposes. Further study is needed, but this modality may also expand access to care and decrease physical barriers to services.

**328.004 (Oral) Physician Voices on the Impact of Echo Autism in a LMIC Setting- a Qualitative Study of a Telementoring Model to Build Physician Capacity in Diagnoses and Management of Pediatric ASD**

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**Background:** A significant treatment gap exists in Low & Middle-Income Countries (LMICs) for children with Autism Spectrum Disorder (ASD), ranging from delays in initial detection to inadequate access to effective management of commonly associated psychiatric and medical co-morbidities. Possible solutions include training first-line and specialist physicians using sustainable, evidence-based models.

**Objectives:** To explore physician perspectives about process and perceived impact of ECHO Autism - a tele-mentoring model to increase physician access to best-practice care for children with ASD in a LMIC context.

**Methods:** The Extension for Community Healthcare Outcomes (ECHO) framework shown to be effective in improving self-efficacy and ASD-specific practice parameters of primary care physicians in the U.S. was culturally modified based on initial feasibility results and feedback from a pilot cohort conducted by a "hub" team of multi-disciplinary experts and a parent at a child-development center in Mumbai. In the current study, 13 bi-weekly sessions focused on best practice methods in screening, early diagnoses of autism, principles of intervention, management of challenging behaviors, psychiatric and medical co-morbidities were conducted using secure video-conferencing technology. Specific adaptations included increasing duration of didactic component, including more videos of clinical features and intervention techniques and a strong focus on strengths-based, family-centered approach woven in across the sessions. Across two cohorts, 64 "spokes" participated-including primary care and developmental pediatricians, psychiatrists and neurologists working with children with ASD in India and other LMICs. On completion of the program, qualitative data was collected from 28 physicians who volunteered to participate. 6 focus groups were conducted online by trained moderators, using an interview guide with open-ended questions about the process and impact of ECHO. Audio recordings were transcribed, all data was coded using iterative and reflexive sifting by two coders and

discrepancies were resolved consensually. Using principles of thematic analysis, themes were identified inductively from the categories.

**Results:** Participants represented a broad geographic reach across 15 cities in 4 countries-India, Nepal, Turkey and Ethiopia. Common themes reflected the andragogical processes of ECHO Autism that participants considered beneficial, yet different from previous training experiences (accessible format, interactive case-based discussion, peer-learning, “expert” guidance, layering of topics, access to resources, respectful mentoring, parent as “expert” and cultural relevance) and the perceived impact of the program on their work (shift in clinical practice to structured, transdisciplinary, comprehensive care, change in attitude, increase in self-efficacy and direct impact on children and families). Participants’ recognition of need for ongoing developmental monitoring, parents as partners-in-care and importance of caregiver mental health emerged strongly. Disruptions in internet connectivity, scheduling conflicts and limited access to therapy services in certain settings were cited as challenges.

**Conclusions:** ECHO Autism has emerged as a model that can potentially improve both access and quality of care in pediatric ASD for underserved communities. The model reinforces the need for local stakeholders in leading such initiatives to enable emphasis on locally relevant issues and challenges in LMICs, thereby enhancing cultural congruence and ensuring sustainability. Such initiatives also create opportunities for meaningful collaboration between global teams and valuable cross-cultural learning.

## POSTER SESSION — SERVICE DELIVERY/SYSTEMS OF CARE

### Poster 442 - Service Delivery/Systems of Care Posters

**442.001 (Poster)** A Collaborative Psychiatric-Genetics Inpatient Service and Outpatient Clinic Improves Accessibility to Genetics Evaluation and Testing for Patients with Autism Spectrum Disorder and Intellectual Disability  
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**Background:** Genetic testing is indicated for children with neurodevelopmental disorders, including autism spectrum disorder and intellectual disability. Much of this testing is initiated by genetics physicians in the outpatient setting. Children with neurodevelopmental disorders with more severe behavioral phenotypes receive much of their care by neurodevelopmental psychiatrists, who are a key source of referrals for genetic testing. Unfortunately, many patients in this population who are referred to genetics are lost to follow up after inpatient or outpatient psychiatric evaluation.

**Objectives:** A psychiatric genetics collaboration was established at Cincinnati Children’s Hospital in March of 2019 to provide genetic evaluation and genetic testing to children with neurodevelopmental disorders in the psychiatric inpatient setting, as well as the psychiatric outpatient clinic, in order to improve care for this population of patients. Our goals were to reduce both the wait time to see a geneticist, and to reduce the number of patients who were lost to genetics follow up after an outpatient referral for evaluation was placed.

**Methods:** A retrospective chart review was conducted on all patients at Cincinnati Children’s Hospital that were evaluated by neurodevelopmental psychiatrists and referred to genetics from July 1, 2010 to October 31, 2020. Patients were divided into two groups; those that were referred to genetics prior to the psychiatric genetics collaboration (March 1, 2019), which forms our pre-collaboration cohort (N=40) and those who were referred to genetics after the initiation of the psychiatric genetics collaboration, which forms our post-collaboration cohort (N=51). We analyzed the time to genetics evaluation after a referral was placed, and the percentage of patients lost to follow up in each group.

**Results:** Patients in the pre-collaboration group had an average wait time of 393 days before they were seen in the genetics clinic after a referral was placed, which was significantly higher than the average wait time of 29 days experienced by post-collaboration patients. 32% of patients in the pre-collaboration group were lost to follow up and did not present to their referred genetics evaluation. This was significantly higher than the 6% of post-collaboration patients who were lost to follow up for genetics evaluation.

**Conclusions:** After implementation of a collaborative psychiatric genetics program for children with neurodevelopmental disorders in the care of psychiatry, we noticed a decrease in wait time to genetics evaluation, as well as a decrease in patient attrition due to lost follow up. Some of the reasons for the improved patient care include accessibility to genetics evaluation in the inpatient setting, accessibility to genetics evaluation in the outpatient psychiatric clinic, improved communication between psychiatric and genetics physicians for joint care management decisions, convenience for families to receive care in a

multidisciplinary fashion, and ability to deliver care in the psychiatric care setting allowing for additional behavior supports increasing family comfort and patient ability to tolerate more familiar settings for evaluation.

**442.002 (Poster)** A Systematic Review of Healthcare Professionals' Knowledge, Self-Efficacy and Attitudes Towards Working with Autistic People

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**Background:** Healthcare professionals play a vital role in identifying and supporting their patients on the autistic spectrum. Dependent on context, this could include the diagnostic process itself, in addition to managing the high levels of physical and psychological difficulties often co-occurring in this population. It is necessary for health workers to be knowledgeable of the core characteristics of autism and how they present to provide high quality care tailored to the needs of autistic people and their families. However, relatively little is known about healthcare professionals' knowledge of autism, or their self-efficacy and attitudes to providing care to this group. The existing literature demonstrates significant variability in method, measures and results, which is difficult to interpret across disparate studies.

**Objectives:** The present study aimed to systematically review the available empirical research examining healthcare professionals' knowledge, self-efficacy and attitudes to working with autistic people, in addition to the factors potentially associated with these elements.

**Methods:** An initial database search was conducted using SCOPUS, PsychInfo, PubMed and Web of Science, followed by manual searches of the included articles. Studies were included in the date range of 1994 to the present, to reflect the substantial changes in diagnostic criteria and prevalence rates of autism during this time. Unpublished and qualitative research was excluded. Thirty-five studies were included in the final total out of the 2574 identified by the initial search. The included studies sampled a wide range of countries of origin (such as the USA, UK, Nigeria, Pakistan, Australia) and professional backgrounds (such as medical students, occupational therapists, nurses, general practitioners and doctors).

**Results:** A modified quality assessment tool found the overall quality of the included studies was moderately good. A narrative synthesis of the results was performed. The results indicated that healthcare professionals continue to report only moderate levels of knowledge (ranging between 47% to 71% correct knowledge) and moderate self-efficacy related to working with autistic people. Several negative beliefs about autism were noted in some studies, such as viewing autistic patients as difficult or feeling uncomfortable working with them. There were also some beliefs and attitudes highly incongruent with current research and medical guidance, particularly concerning potential causes of autism. Variation in knowledge, self-efficacy and attitudes both within and between countries and professional background were not adequately explained by demographic factors, such as gender or age. However seven studies reported greater autism knowledge was associated with increased experience.

**Conclusions:** These results indicate that autism knowledge, self-efficacy and attitudes are highly variable across samples and individuals working in healthcare, and even in samples with reasonable knowledge scores, there is still room for improvement. Even within individual countries, there was substantial disparity of results, suggesting autism knowledge is highly variable irrespective of country. The reviewed evidence suggests that health professionals' limited knowledge, and self-efficacy in working with autistic people continues to be a challenge to the provision of high quality healthcare for autistic individuals.

**442.003 (Poster)** Adaptation and Piloting of the Who Caregivers Skills Training Programme for Remote Delivery

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**Background:** The Caregiver Skills Training (CST) is a caregiver-mediated program for neurodevelopmental disorders developed by WHO (Salomone et al. 2019). Based on principles of behavioural and developmental science and positive parenting, the program consists of 9 group sessions and 3 home visits. Due to the COVID-19 emergency in Italy in-person participation to CST, previously found to be feasible and acceptable, was suspended. A remote adaptation of CST was developed to respond to families' needs.

**Objectives:** The study reports on the process of adapting CST to online delivery and examines feasibility and acceptability data.

**Methods:** Clinical psychologists with experience of CST implementation and a WHO CST Team member adapted the program for online delivery through group and individual videocalls ('Group Sessions' and 'Home Visits'). Core contents remained

unchanged; adaptations were based on principles of active learning. The live modelling of strategies was replaced with pre-recorded videos based on the manuals' scripts. Caregiver role play was substituted by enhanced planning of the home practice with additional time dedicated to discussion of scenarios in small groups. Sharing of a videorecording of a play/home routine with the child was added after Sessions 3 (play) and 7 (daily living skills), with feedback provided the following session. Caregivers of children (4-6 years,  $M=4.88$ ) with a clinical diagnosis of ASD ( $n=8$ ; extra-EU nationality,  $n=5$ ; high-school diploma,  $n=5$ ) and two program interventionists completed adapted WHO CST feasibility and acceptability measures (5-point scales; 'satisfactory' = 3, 'good' = 4). Observers completed fidelity ratings. Data is available for sessions 1-3; data collection is ongoing. At baseline, 5 caregivers had previous experience of telehealth and considered it as less valuable than in-person consultations.

Results: All recruited caregivers attended the first three sessions (via a smartphone,  $n=4$ ). Usability ratings of the videocalls were high across sessions. Feasibility ratings for all sessions were above satisfactory levels across standard and adapted activities. Fidelity ratings were excellent (range = 3.5-4). Caregivers reported practising with strategies on average 3.5 times/week (range = 3-5). For the adapted activities, caregivers' ratings of comprehensibility and relevance and interventionists' ratings of caregivers' involvement and interest were good for at least 6 caregivers across sessions. Caregiver-reported confidence levels were above satisfactory levels for 6 out of 8 caregivers across sessions. All sessions were rated as having the same value of face-to-face consultations by at least 5 out of 8 caregivers.

Conclusions: Preliminary feasibility ratings of CST delivered online through simple technology were high and comparable with those of in-person implementation, including for the adapted components. The sessions were highly acceptable and relevant, and considered as valuable as in-person contacts, despite a negative attitude towards telehealth at baseline. Advantages of this adapted remote delivery model include reducing barriers to attendance and facilitating additional contact (videorecordings); however, potential challenges (in-home distractions, group dynamics) should be monitored. Full data, including measures of therapeutic alliance and uptake of intervention strategies, will be examined to explore the usefulness of this delivery method beyond the current health emergency and the potential for use in other contexts.

**442.004** (Poster) Applied Behavior Analysis Disparities for Medicaid-Enrolled Individuals with Autism: A Multilevel Analysis  
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Background: Studies have demonstrated that children with ASD from rural areas and those who are Black or Hispanic/Latinx experience *diagnostic and service access* disparities.

Objectives: Examine whether disparities also exist in *service use* for traditionally underserved children with ASD who receive services within a publicly funded system.

Methods: Medicaid claims from one region of a midwestern state in the U.S. from April of 2017 through March of 2018 for 1,028 youth with ASD under age 21 were analyzed. The individuals were treated by 69 agencies (42% rural) that provide applied behavior analysis (ABA) services. Youth were predominantly White (71%), non-Hispanic (88%) and male (80%), with an average age of 7.56 years. Racial and ethnic groups in the sample were unevenly distributed. Thus, a single race/ethnicity variable with four categories was coded: 1) White, non-Hispanic; 2) Black, Hispanic or non-Hispanic; 3) Other Race, non-Hispanic; or 4) Hispanic (non-Black). Agency rurality was defined according to HRSA.

The outcome variable was the number of 30-minute billing units of one-on-one ABA sessions per month. A series of multilevel models using restricted maximum likelihood were used to predict hours of ABA as a function of either race/ethnicity or agency rurality, controlling for age and sex. Random effects included an intercept variance to account for nonindependence due to agency.

Results: Three models were estimated. Model 1 predicted ABA as a function of agency rurality (effects coded), sex (effects coded), age (grand mean centered), and racial/ethnic minority status (effects coded). We could not include agency rurality and each racial/ethnic group within the same model because there were only 8 observations of Black individuals served by a rural agency. Model 2 predicted hours of ABA as a function of the four categories of race/ethnicity (categorical coding), sex (effects coded), and age (grand mean centered). Model 3 was identical to Model 2 but only included non-rural agencies.

In Model 1, hours of ABA were predicted as a function of age, sex, minority status, and agency rurality. The analysis indicated a significant main effect of agency rurality,  $F(1, 122) = 7.89, p = .006$ , as well as a significant effect of age,  $F(1, 862) = 105.12, p < .001$ . The effects of sex and minority status were not significant. Holding sex, minority status, and age constant, youth that received services from rural agencies received an average of 10.86 fewer hours of ABA per month compared to those in non-rural areas. Younger children received more ABA. See Table 1 for regression coefficients.

Model 2 indicated a significant main effect of age,  $F(1, 964) = 118.28, p < .001$ , but not for race/ethnic group or sex. Results from Model 3 (non-rural agencies only) were nearly identical with Model 2. See Table 2 for estimated marginal means.

Conclusions: Publicly funded service systems such as the Medicaid system may provide more equitable provision of services to individuals of racial/ethnic minority backgrounds. Service systems must address challenges for families from rural regions, increase the healthcare workforce in rural areas, and consider rurality in policies.

**442.005 (Poster)** Assessing Child Life Specialists' Knowledge, Competency, and Comfort Levels Caring for Pediatric Patients with Autism Spectrum Disorder

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Background: Healthcare environments involve many factors that can be stressors to children with autism spectrum disorders (ASD), such as bright lights, strongly-scented cleaning products, and interactions with many unfamiliar adults (Johnson et al., 2012). Understanding how children with ASD cope with hospitalization is especially important given that children on the spectrum are more likely to be hospitalized than their typically-developing (TD) peers (Zwaigenbaum et al., 2016). One important way that hospitals promote positive pediatric outcomes is via Certified Child Life Specialists (CCLS). CCLS play a vital role on interdisciplinary healthcare teams as they aid in positive coping, promote psychosocial care, and reduce the risk of healthcare-related trauma. Previous research has found that CCLS interventions improve outcomes for hospitalized TD children (Thompson et al., 2018), but little work has directly examined the interaction between CCLS and pediatric patients with ASD (Jensen et al., 2019). Thus, an important research step is to identify how well-prepared CCLS are for providing care to children with ASD.

Objectives: The present study investigated knowledge, competency, and comfort levels in caring for pediatric patients with ASD amongst CCLS healthcare professionals.

Methods: Participants included a total of 131 practicing CCLS (100% female, 94% White). Most held a graduate degree (68.4% Graduate, 30.1% Bachelor's). Participants completed an online survey that assessed (1) their experience and previous training regarding challenging or maladaptive behaviors common in ASD (e.g., self-harm or throwing objects) and (2) their perceived competency and comfort levels in managing these behaviors.

Results: Almost all participants (96.99%,  $n=129$ ) reported having experienced one or more challenging behavior when working with children with ASD in a healthcare setting. On 7-point Likert scales assessing self-reported competence and comfort in working with such behaviors, average scores were slightly above the midpoint for both competence ( $M = 5.27, SD = .56$ ) and comfort ( $M = 5.40, SD = .55$ ). Very few CCLS reported high levels on both scales (i.e., fewer than 15% with average scores above 6). As hypothesized, knowledge about childhood autism positively correlated with perceived competence ( $r(130) = .20, p < .05$ ) and comfort ( $r(130) = .23, p < .01$ ) in managing challenging behaviors. The perceived competency of CCLS in managing challenging behavior was significantly higher if the participant had gained their knowledge through academic education ( $M = 5.38, SD = .49$ ) compared to other domains such as professional development or training outside of work ( $M = 5.12, SD = .56; t = 2.09, p < .05$ ). However, only 17.3% of those who reported receiving training received theirs via academic coursework, and 13.5% had received no training in working with children with ASD at all.

Conclusions: Results suggest that Child Life programs should focus more on ASD care and behavioral management, as such training directly results in more comfort with handling challenging behaviors. Increasing ASD-specific training will equip CCLS to accommodate the unique support needs that often correspond with ASD, leading to better overall health outcomes, as well as reduced stress and anxiety for pediatric patients with ASD experiencing hospitalization.

**442.006 (Poster)** Caregivers-Mediated Intervention in Brazil through Who CST Program Implementation in Public and Universal Health Care System.

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Background:

Neurodevelopmental disorders (ND) and autism cause significant losses to child's and family members' quality of life. Training parents to promote the acquisition of their children's skills is a viable and effective alternative in less favored scenarios, since recommended treatments have a high cost. The Caregivers Skills Training (CST) program trains families of children (2 to 9 years) with ND to apply stimulation techniques.

#### Objectives:

This study aimed to adapt the CST to the Brazilian socio-cultural context, to verify the acceptability and feasibility of the program implementation, as well as to measure the impacts (goals / outcomes) on children and caregivers.

#### Methods:

The Phase 1 was the adaptation of the program to the Brazilian context. It included consultation with specialists, translation and revision of materials and two Focal Groups with professionals and families. The Phase 2 evaluated feasibility and acceptability by caregivers (n = 10) and Master Trainers (MT) (n = 4). Quantitative data were obtained by the World Health Organization recommended measures and qualitative data were obtained through Focal Groups and analyzed by the Descending Hierarchical Classification. The Phase 3 is expected to be completed by December 2020, it was adapted to happen remotely, due to the COVID-19 pandemic. It started with 50 caregivers divided into five groups, with two facilitators each, and one MT supervisor. Quantitative measures will be evaluated through questionnaires that assess both children and caregivers' changes with the program. Qualitative data will be obtained by six Focal Groups (one with all the facilitators and MT and five with the family groups) after the program.

#### Results:

Phase 1 was completed with a positive perception from the caregivers. In Phase 2, the parents' results showed an improvement of behaviors on all children, an improvement on parental knowledge and skills on 77.77% out of the 36 questions and that the sessions were understandable, relevant, acceptable and useful. From the MT's perceptions, the caregivers showed agreement with ideas, engagement, relevance of contents and acceptability. The program implementation fidelity average was 2.71 (ranging from 1 to 3). Regarding qualitative data, five themes emerged from the caregivers' Focal Group: changes in caregivers' behavior, support for caregivers, development of the child's skills, challenges of inclusion and treatments and understanding. From the MT's qualitative data emerged the themes: supervision, method and material, field activity, achievements and planning. Phase 3 is still being implemented.

#### Conclusions:

Both qualitative and quantitative, showed consistent initial results, which demonstrates that the implementation of CST in Brazil is feasible, acceptable, relevant and it meets a local need. Participant's data suggest that group sessions and home visits were well accepted and valued in the local context. The practical issues were the main obstacles to participation in training and that the organization of handouts and supervision of trainers needs to be improved. The program test demonstrated positive changes in caregivers, creation of a support network and improvement of symptoms in children with ND. These findings in Brazil may be relevant for countries with few resources and similar socio-cultural characteristics.

**442.007 (Poster)** Cost-Benefit and Cost-Effectiveness of a Specialized, Patient-Centered, Primary Care Clinic Designed with Autistic Adults and Their Caregivers

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Background: Autistic adults are significantly more likely to have mental health conditions than non-autistic peers. With inadequate care, these conditions can lead to emergency department visits or hospitalizations for mental health conditions and increase healthcare costs. Primary care management of mental health conditions increases access to services and reduces stigma, but there are currently few patient-centered, holistic approaches to primary care for autistic adults. The Center for Autism Services and Transition (CAST) is a patient-centered clinic that was co-designed with autistic adults and their caregivers to minimize barriers to care. For example, CAST offers accommodations to best meet the needs of autistic adults (e.g., patients with anxiety may bypass the waiting room) and has providers with extensive experience providing care for this population.

Objectives: To determine whether CAST is more cost-effective and cost-beneficial than primary care provided to national samples of autistic adults.

**Methods:** We conducted a cross-sectional retrospective study with data from our institutional Information Warehouse, IBM MarketScan, and Medicare Standard Analytic Files. The sample included CAST patients (N=524) who were propensity score matched to national samples of privately (N=1048) and publicly insured autistic adults (N=1048) using demographic characteristics. Our outcome variables were: (1) costs, quantified by direct charges billed for primary care (i.e., general medicine, internal medicine, pediatric, geriatric, family medicine, or preventive care providers); (2) benefits, quantified by direct charges billed for mental health-related inpatient hospitalizations and emergency department visits, collectively termed “admissions”; and (3) effectiveness, quantified by the number of mental health admissions. We calculated incremental cost-benefit ratios and cost-effectiveness ratios to compare CAST patients to each of the other samples. To estimate variability in our outcomes, we obtained 95% confidence intervals by bootstrapping with 50% subsamples 500 times. We performed two-sample t-tests on the estimates from the bootstrapping analysis to compare CAST patients to each of the other two samples.

**Results:** Table 1 provides sample characteristics and bootstrapped estimates. Average per-person primary care costs were lowest for Medicare beneficiaries (\$722), followed by CAST patients (\$886), and privately insured autistic adults (\$943). On average, CAST patients had significantly fewer and lower cost of mental-health related admissions than either national sample. Compared to care provided to privately insured autistic adults, every \$38 spent on CAST is associated with a 10-visit decrease in the number of mental health admissions and \$2000 decrease in cost of mental health admissions. Every \$48 spent on CAST primary care above the cost of care provided to Medicare-enrolled autistic adults is associated with a 10-visit decrease in the number of mental health admissions and \$578 decrease in cost of mental health admissions.

**Conclusions:** CAST is more cost-effective and cost-beneficial than primary care provided to a national sample of privately insured autistic adults. Relative to primary care provided to a national sample of Medicare-enrolled autistic adults, CAST is more expensive but yields significant savings by reducing the number and cost of mental health admissions. Overall, the findings support patient-centered approaches, like CAST, as promising models of primary care delivery for autistic adults.

**442.008 (Poster) COVID-19 Health and Social Care Access for Autistic People and Individuals with Intellectual Disability: A European Policy Review**

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**Background:** The global COVID-19 pandemic has had an unprecedented impact on European health and social care systems, with demands on testing, hospital and intensive care capacity exceeding available resources in many regions. This has led to concerns that some groups, including autistic people and those with intellectual disability (ID), may become excluded from services.

**Objectives:** To assess COVID-19 health and social care provision for autistic people.

**Methods:** A two-step methodological approach was implemented. First, COVID-19 health and social care policies from 15 European member states (Figure 1) - published March-July 2020 - were collated and reviewed by researchers, clinicians and non-profit groups from AIMS-2-TRIALS network and a panel of five representatives from the autism community. Policies were reviewed across three priority areas: 1) access to COVID-19 tests; 2) provisions for treatment, hospitalisation and access to intensive care units (ICU); and 3) changes to standard health and social care. Second, Autism-Europe provided de-identified secondary data from their large-scale survey of the impact of COVID-19 on the lived experiences of 1,301 autistic people and caregivers.

**Results:** Autistic people and those with ID experienced significant barriers accessing COVID-19 services. First, despite these groups being at elevated risk for severe illness due to co-occurring health conditions, there was a lack of accessibility to COVID-19 testing. Second, many COVID-19 outpatient and inpatient treatment services were reported to be inaccessible - predominantly resulting from individual differences in communication needs. Third, ICU triage protocols in many European countries (directly

or indirectly) resulted in discriminatory exclusion from lifesaving treatments. Last, interruptions to standard health and social care left over 70% of autistic people without everyday support.

**Conclusions:** The COVID-19 pandemic has further exacerbated healthcare inequalities for autistic people and those with ID, likely contributing to disproportionate increases in morbidity and mortality in these groups (Public Health England; 12th November 2020). Current policies and guidelines regarding the accessibility of COVID-19 services require revision to prevent the widespread exclusion of autistic people and those with ID from services, which represents a violation of international human rights law. To our knowledge, this is the first analysis of inequalities in access to COVID-19 health and social care services for autistic people and those with ID across Europe. Based on this evidence, we provide specific recommendations for informing an aligned European strategy on the fair allocation of resources in public health emergencies, which include strategies for enhancing the accessibility of testing, hospital/ ICU care and mitigation measures for the continued safe and effective delivery of health and social care services for potentially vulnerable groups.

**442.009 (Poster) Disruptions to Services Accessed By Families of Autistic Individuals during the COVID-19 Pandemic**  
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*Background:*

Prior to the COVID-19 pandemic it was well-established that caregivers of autistic individuals were particularly vulnerable to heightened stress and mental health concerns. Autism is often accompanied by associated conditions, including mental health concerns, attention-deficit/hyperactivity disorder, intellectual disability, language disorders, and disordered sleep, which require support from a range of supports. The unique needs of autistic children, coupled with barriers families often face in accessing services to address their needs, can contribute to high levels of caregiver stress. These challenges are likely exacerbated by the effects of social distancing guidelines and regulations in place due to COVID-19. Many face-to-face social, educational, and therapeutic programs were paused, cancelled, offered less frequently, or modified (e.g., offered virtually). These interruptions in routines have likely been distressing for families and have led to caregivers adopting multiple additional roles and responsibilities.

*Objectives:*

The main goals of the present study are: 1) to describe service use patterns and disruptions to services experienced by families during COVID-19; 2) to determine whether there is a relation between service disruptions and perceived parental stress levels and family distress/crisis; and 3) to identify the current service needs and priorities of families.

*Methods:*

A sample of 635 Canadian caregivers (59% mothers) completed an online questionnaire between June and July 2020 that included demographic information, information related to parent and child well-being, and information about disruptions and difficulties due to the COVID-19 pandemic. Caregiver stress was measured using the Perceived Stress Scale (PSS-10), and family distress or crisis was measured using the Brief Family Distress Scale (BFDS). Caregivers were asked to identify services accessed prior to the pandemic and changes to these services experienced due to the pandemic. Finally, caregivers were asked to select up to five services that they currently wanted or needed, as well as up to five services that they predicted they would want or need in the future (post-quarantine and moving forward) from a list of 26 services.

*Results:*

95% of families surveyed were accessing services prior to the pandemic, with the most popular being speech-language therapy (37%), behavioural therapy (30%), and occupational therapy (29%). A vast majority of families (88%) experienced a change (e.g., face-to-face to virtual) or disruption to at least one service. The most frequently changed/disrupted being behavioural therapy, with 81% of families accessing that service reporting that it had been changed or interrupted in some way. Additional analyses will investigate the association between service disruption, caregiver stress and family distress.

*Conclusions:*

The current study will describe the impact of the physical restrictions of COVID-19 pandemic on the service utilization of autistic individuals and their families. Further, the study will provide insight into whether service disruptions contribute to caregiver stress and family distress, which may have implications for how families, who are already vulnerable to stress and mental health concerns, can be better supported during this time.

**442.011** (Poster) Do Family Characteristics Influence Providers' Use of Evidence-Based Practices?

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**Background:** Evidence-based mental health treatments have been underutilized in community settings, especially in under-resourced communities (Brookman-Frazee, Taylor, & Garland, 2010). Autistic children from racial and ethnic minority groups or low socio-economic backgrounds are more likely to experience delays in the onset of intervention services and are less likely to receive evidence-based practices (EBPs), as compared to their white peers (Nelson, 2002; Algeria, Vallas, & Pumariega, 2010). The reasons for these disparities in access to care are multi-layered and likely related to systemic- and individual-level barriers. Previous research has indicated that providers' attitudes and beliefs related to an intervention's fit with an individual family or client influence their use of those interventions (Stahmer & Aarons, 2009; Irvin, McBee, & Boyd, 2012; Siller et al., 2014). However, this research has never been applied to understanding the barriers to implementing evidence-based practices for autistic children in under-resourced community settings. Understanding how providers intend to implement evidence-based practices, and the factors that influence their decisions to implement EBPs for poor or ethnic minority children is a critical step in developing strategies to improve the implementation of EBPs in under-resourced settings.

**Objectives:** This study aimed to learn about community practitioners' experiences with and perspectives about using a particular evidence-based intervention, parent coaching. Specifically, the study sought to identify barriers and facilitators to implementing parent coaching with families of young autistic children within publicly funded early intervention systems.

**Methods:** Semi-structured interviews were conducted with 30 early intervention providers across two distinct geographic regions serving highly under-resourced populations within the United States. Interview questions probed about providers' use of evidence-based parent coaching strategies and barriers and facilitators to using these types of strategies with families. Transcripts were analyzed iteratively based upon an integrated approach incorporating both inductive and deductive features.

**Results:** Common themes relating to family characteristics, such as culture and home environment, were mentioned by providers as barriers to successfully implementing evidence-based parent coaching strategies. They often mentioned their belief that the intervention approach did not "fit" well with families who may be experiencing financial strife and living in poverty. Providers' use of evidence-based parent coaching strategies is influenced by the extent to which families are experiencing external stressors.

**Conclusions:** This study is one of the first to provide first-hand perspectives regarding community providers' use of evidence-based parent coaching strategies within under-resourced service settings. Early intervention providers described specific family characteristics that influence their use of evidence-based parent coaching. Specifically, they described the presence of characteristics that are most commonly ascribed to under-resourced or ethnic minority families (i.e., non-English speakers, chaotic households, and financial burdens) as influencing their decision to implement parent coaching. These findings highlight the need to improve culturally competent practices among these providers and develop implementation strategies to improve the use of evidence-based parent coaching for this population in order to improve equity and access to EBPs for ethnic minority and under-resourced families.

**442.012** (Poster) Does Hcbs Enrollment Bridge Racial-Ethnic Gap in Community-Based Service Use Among Autistic Adults?

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**Background:** Although no differences in prevalence by race or ethnicity have been found, Black children are less likely to be diagnosed and receive early intervention than white children (Maenner et al., 2020). A previous study on autistic children showed that Medicaid HCBS enrollment significantly reduced the likelihood of having unmet needs among Black autistic children compared to white children (LaClair et al., 2019). However, there has been no research on racial and ethnic differences in the use of Home and Community-based Services (HCBS) among autistic adults.

**Objectives:** To provide a preliminary exploration of (1) the HCBS enrollment status by race and ethnicity and (2) the Medicaid paid amount of HCBS by racial and ethnic groups among autistic adults enrolled in the HCBS.

**Methods:** Data from the Medicaid Analytic eXtract 2012 were used. The sample included adults with ASD who were 18 years old or older. All HCBS utilization and associated costs were assessed. Race and enrollment status were the primary independent

variables. There was three enrollment status: (1) enrolled, (2) not enrolled, and (3) status change during 2012. HCBS enrollment included programs for intellectually disabled/developmentally disabled or autism/autism spectrum disorder. Four racial and ethnic groups – non-Hispanic white, non-Hispanic Black, Hispanic/Latino, and Asian, were examined.

Results: Our sample had 88,513 adults with ASD, with most of them being male (74.8%) and an average age of 28.27 (SD=10.88). Most of the sample were non-Hispanic white (60.5%), followed by non-Hispanic Black (15.9%), Hispanic/Latino (6.8%), Asian/Pacific Islander (2.6%), and other (14.2%). At the national level, among the HCBS enrollees, the proportion of Asian adults (55.8%) was higher than the other groups, followed by 43.9% of Hispanic/Latino, 40.2% of non-Hispanic Black, and 38.9% of non-Hispanic white. A smaller proportion of Hispanic/Latino autistic adults (38.0%) were not enrolled in the HCBS than the other three groups. No considerable differences were found among those who changed enrollment status during 2012. Please see Table 1 for selected states. Regarding the Medicaid paid amount of HCBS, the average payment per person were relatively higher for non-Hispanic white (M=58350.91) than the other three groups, followed by non-Hispanic Black (M=53516.7), Asian (M=43882.1), and Hispanic/Latino adults (M=41744.9). For specific services, Non-Hispanic white had a higher average payment of round-clock services and home-based services, while non-Hispanic Black had a higher average cost of day services. The Asian group had the lowest amount in all three services.

Conclusions: This study showed some preliminary results demonstrating the racial and ethnic differences in terms of HCBS enrollment and the average Medicaid paid amount. Although a smaller proportion of non-Hispanic white adults were enrolled compared to other groups, the differences varied in different states. Although a higher proportion of Asian adults was enrolled in HCBS, Asian waiver enrollees had the lowest Medicaid paid amount. Other individual characteristics (e.g., ASD severity, comorbidities, and service planning) need to be considered to explain the racial/ethnic differences. Since the current analysis is unadjusted, regression analyses will be performed in the next step to adjust for other individual characteristics.

**442.013** (Poster) Echo Autism: Characterizing Children Diagnosed with Tier 1 Autism By Echo Graduates in Missouri  
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Background: The Extension for Community Healthcare Outcomes (ECHO) Autism STAT is a new program aimed at increasing the local expertise regarding autism among Missouri pediatricians. It uses telehealth to connect pediatricians to an interdisciplinary team of autism experts, increasing the number of providers who can evaluate, diagnose, and manage children with Autism Spectrum Disorder.

Objectives: Since there are no data on the patients diagnosed by the program graduates, the focus of this study was to determine key demographic and clinical diagnostic characteristics of children with Tier 1 autism in Missouri. By understanding these key identifiable characteristics, we hope to not only learn what types of children can be diagnosed reliably by Tier 1 Providers but also work towards establishing a clinical decision algorithm that will help clinicians more accurately diagnose these children.

Methods: Retrospective chart reviews of 69 patients evaluated by four graduates of the ECHO Autism STAT Program were completed. Data regarding the patient's age at evaluation, ethnicity/race, testing scores, and DSM-5 criteria were collected and analyzed using STATA R software.

Results: Following the national trend, the children evaluated through STAT ECHO were prominently male and identified as Non-Hispanic White. Unlike the national trend, however, the age of patients diagnosed through our program were 1.9 years younger than the national average. There was no distinction in the two most prominent behavioral concerns between Tier 1 and Non-Tier 1 patients, both groups reporting high prevalence of aggression and self-harm. When comparing Tier 1 to Non-Tier 1 patients, a statistical significance was present in all criteria for DSM-5 diagnosis, except B2 and B4. Lastly, we found that the MCHAT, a test highly relied upon by pediatricians to screen for Autism, only had a positive predictive value of 33%.

Conclusions: We can say with confidence that the ECHO autism program has the promise to improve the prognosis of children through diagnosis at an earlier age. Unfortunately, given the low power and lack of major statistically significant findings, no conclusions can be made in regard to specific behaviors that distinguish Tier 1 and non-Tier 1 Patients at this time. Future research is imperative to better understanding the types of patients that can be diagnosed through the program versus those that be referred to a next level diagnostic provider.

**442.014 (Poster)** Echo Autism: Innovations in Workforce Development to Bridge the Specialty to Generalist Gap and Optimize the Continuum of Autism Care.

**K. Sohl<sup>1</sup>, R. Brown<sup>2</sup>, N. C. Cheak-Zamora<sup>3</sup>, V. Nanclares-Nogues<sup>4</sup> and M. O. Mazurek<sup>5</sup>,** (1)Department of Child Health, University of Missouri, School of Medicine, Columbia, MO, (2)KUMC, Wichita, KS, (3)Health Sciences, University of Missouri, Columbia, MO, (4)Pediatric Developmental Center, AIMMC, Advocate Children's Hospital, Chicago, IL, (5)University of Virginia, Charlottesville, VA

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#### Background:

Advances in autism diagnostic accuracy and understanding of autism co-occurring conditions have led to earlier, more effective diagnostic and intervention practices. However, these advances tend to be limited to highly specialized professionals. There continue to be increasing service gaps for individuals with autism and their families. Standard professional development curriculum for general clinicians often lacks specificity in core elements critical for serving the autism population and lack the adaptability to address professional's clinical and learning demands.

ECHO Autism is an innovative approach that scales the dissemination of scarce specialist knowledge through virtually training generalist clinicians using de-identified, case-based learning (an "all-teach, all-learn" collaborative model). The ECHO Autism model originated in 2015 and first focused on pediatric primary care. It has since expanded to train a much broader range of professionals serving individuals with autism.

#### Objectives:

- Describe ECHO Autism as a workforce development tool to support generalist clinicians to build clinical expertise and increase capacity to serve the ASD community.
- Discuss generalist clinician outcomes demonstrated across ECHO Autism programs highlighting impact of the program on the professional workforce to scale knowledge dissemination and address the gaps in the continuum of care.

#### Methods:

ECHO Autism programs are uniquely designed to fill specific professional/workforce development gaps in the autism care continuum. Evaluation measures are designed for each ECHO Autism program to assess changes in self-efficacy, knowledge, barriers to care and practice patterns while participating in ECHO Autism. Post-ECHO Autism session qualitative comments are also collected for ongoing program evaluation. Mixed methods review of existing program data was analyzed for professional type, frequency of attendance per ECHO Autism program, and satisfaction with ECHO Autism model.

#### Results:

To date, ECHO Autism has set up 27 training hubs across the United States and provided more than 13,700 hours of learning to approximately 2,300 generalist clinicians.

Results consistently show improvement in generalist clinician self-efficacy in understanding autism, resource utilization, medical and psychiatry co-morbidity management. Additionally, results demonstrate promising improvements in key quality indicators across the life course including screening practices for early identification of autism and elements of healthcare transition. Perceived barriers to care are also reduced following ECHO Autism participation.

#### Conclusions:

Since 2015, ECHO Autism has trained approximately 2,300 professionals in the United States through case-based learning. ECHO Autism's unique blend of evidence-based, high quality professional development with collegial, iterative learning collaboration is building the workforce capacity across the autism care continuum. While barriers to systematic changes to professional accreditation requirements persist, ECHO Autism is an acceptable, feasible and effective model to scale the dissemination of clinical skills and knowledge to equip professionals to serve individuals with autism. Future directions include economic analysis and partnership with payors and professional accrediting organizations to consider sustainable workforce development strategy.

**442.015 (Poster)** Echo Education: Autism in Schools – Pilot Data from a Teleconsultation Model Providing Educational and Behavioral Supports to Educators of Students with Autism

*R. E. Nevill, G. E. Lovette and M. O. Mazurek, University of Virginia, Charlottesville, VA*

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**Background:** Many special educators have limited training and background on supporting students with autism within the classroom. Displaying challenging behavior in the classroom can limit students' opportunities to make educational gains and form positive social connections with teachers and peers.

**Objectives:** Presenters will share results from a pilot study testing the effects of a teleconsultation program using the ECHO model to provide behavioral and educational consultation to educators of students with autism in K-12 settings across Virginia.

**Methods:** Participants in the pilot study were educators of children with autism in Virginia's K-12 schools ( $n = 9$ ). Educators were delivered a combination of case-based problem solving opportunities and workshops through an 8-session network. Data collection was comprised of pre- and post-test measures of participants' autism knowledge, autism self-efficacy, beliefs about behavior, and self-confidence. Program satisfaction data were also collected at post-test.

**Results:** This presentation will report on the participant group's demographics, changes from pre- to post-test in participants' outcomes, and program satisfaction. Effect sizes for significant improvements in outcomes will be shared. Finally, we will provide descriptive information about case presentations to better characterize the types of challenges for which educators most commonly requested support. Pilot data showed significant improvements in autism self-efficacy and confidence in managing challenging behavior ( $ps < .05$ ), with a small effect on confidence and moderate effect on autism self-efficacy.

**Conclusions:** The ECHO Education: Autism in Schools is a promising model for delivering support and consultation to educators of students with autism in K-12 settings. Advantages of this model are that it can be offered at zero cost and can increase participants' sense of social support and connectedness with colleagues. To conclude, we will present our follow-up plans to evaluate this program using larger participant groups and a waitlist control design. To conclude, this presentation shares additional examples of other applications of the ECHO Autism model for professionals across Virginia.

**442.016 (Poster)** Emergency Department Utilization Among Youth with Autism Spectrum Disorder: Exploring the Role of Preventive Care, Medical Home, and Mental Health

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**Background:** Children with autism spectrum disorder (ASD) have complex medical, dental, and mental health care needs, which are often unmet. The continuum of care for youth with ASD begins with basic preventive healthcare. The medical home is an especially helpful healthcare delivery model for children with ASD, given its emphasis on coordinated, comprehensive, and family-centered primary care. Although emergency department (ED) services should be considered a "last resort" of the continuum of care in children, children and adolescents with ASD are at an especially high risk for ED utilization when compared to the general population. It's likely that the level of unmet need, access to preventive care and access to medical home are associated with ED use, yet no study to date has examined these associations.

**Objectives:** The aim of the study was to examine preventive care (dental, medical), unmet healthcare needs (medical, dental, mental health), and access to a medical home as predictors of the frequency of ED service use among children with ASD.

**Methods:** Using data from the 2016 National Survey of Children's Health (NSCH), children who had a current parent-reported diagnosis of autism were selected for these analyses ( $N = 1,131$ , Mean Age=11.22,  $SD=4.07$ ). A hierarchical ordinal logistic regression was used to examine the relationships among the dependent variable of ED utilization (i.e., 0, 1, 2+ past-year visits) and other levels of care. Step 1 were the covariates of child age, sex, race, ID, behavior problems, federal poverty level percentage, and insurance type. Step 2 were whether preventive dental care and preventive medical care were received in the past year. Step 3 were unmet medical needs, unmet dental care needs, and unmet mental health care needs. Step 4 was access to a medical home. Whether each step (i.e., block of variables) contributed significantly to the model was determined by Wald tests.

**Results:** The Wald tests indicated that demographic variables, unmet healthcare needs, and medical home blocks of variables provided significant contributions to the nested model; preventative care block of variables did not significantly contribute to the nested model. Unmet mental health care needs in children with ASD was associated with 3.33 times greater odds of visiting the ED. Having unmet dental and medical healthcare needs were not significantly associated with ED use. Children with a medical home had decreased odds of visiting the ED twice or more in a year by 73% as compared to once or zero times.

**Conclusions:** Given the association between unmet mental health care and ED use, it is essential that high-quality outpatient mental health services be accessible to this population to prevent the need for psychiatric-related ED visits. Furthermore, our findings indicated that although preventive care was not significantly associated with ED use, having a medical home decreased the likelihood of frequenting the ED twice or more in a year. This suggests that simple access to preventive care may not be enough to reduce the likelihood of ED use, but rather that a comprehensive and holistic medical home model is needed.

**442.017 (Poster)** Emergency Department Utilization By Adolescents and Young Adults with Autism Spectrum Disorder  
**D. A. Iannuzzi<sup>1</sup>, M. Hall<sup>2</sup>, N. Oreskovic<sup>3</sup>, E. Aryee<sup>3</sup>, S. broder-Fingert<sup>4</sup>, J. M. Perrin<sup>5</sup> and K. Kuhlthau<sup>6</sup>,** (1)125 Nashua Street, MassGeneral Hospital, Boston, MA, (2)National Association of Children's Hospitals, Lenexa, KS, (3)Pediatrics, Mass General Hospital, Boston, MA, (4)Boston Medical Center, Boston, MA, (5)Harvard Medical School, Boston, MA, (6)Massachusetts General Hospital, Boston, MA

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**Background:** Adolescents and young adults (AYA) with autism spectrum disorder (ASD) often experience co-occurring medical and psychiatric conditions that can exacerbate the core symptoms of ASD. It has been well documented that individuals with ASD have increased rates of medical and psychiatric co-occurring conditions including epilepsy, gastrointestinal disturbances, sleep issues, anxiety, depression, and respiratory, food, and skin allergies, which may at times necessitate utilization of an emergency department (ED).

**Objectives:** This study examined ED utilization by adolescent and young adults (AYA) with ASD. We investigated principal reason for an ED visit, likelihood of hospital admission following an ED encounter of ASD, and the presence of an ambulatory care sensitive condition (ACSC), as compared to non-ASD cohort, controlling for age, sex, and demographic region. Ambulatory care sensitive conditions are illnesses or health conditions where appropriate ambulatory care can prevent or reduces the need for hospital admission.

**Methods:** We used data from the most recent 2016 Nationwide Emergency Department Data Sample (NEDS), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality (AHRQ). Information regarding principal diagnoses for the ED encounter were extracted using (ICD-10) codes and the Clinical Classification Software (CCS) categorization schema. The CCS developed by the Agency for Healthcare Research and Quality (AHRQ) collapses ICD10 diagnoses codes into clinically meaningful groups. An ED visit was considered to be for an individual between 12-30 years of age with ASD, if there was a documented diagnosis of ASD based on ICD-10 codes for Autistic disorder(F84.0); Rett's syndrome (F84.2); other childhood disintegrative disorder (F84.3); Asperger's syndrome (F84.5); other pervasive developmental disorders (F84.8); and pervasive developmental disorder, unspecified (F84.9). Other data extracted included sex, insurance, region of residence, the hospital's location, and median household income. Median household income was reported as estimated median household income of residents in the patient's ZIP Code.

**Results:** Among the Non-ASD group, the most frequent principal diagnoses were sprains and strains (6.5 %), superficial injuries and contusions (5.6%), and upper respiratory infections (5.2%). In contrast, for the ASD cohort, the most frequent ED principal diagnoses were, mood disorders (8.6%), epilepsy, and convulsions (8.6%), followed by attention deficit disorders (ADD) and conduct and disruptive behavior disorders (4.6%). In addition, the results indicated that the ASD cohort had more ACSC diagnoses as compared to the Non-ASD cohort. The relative risk of a hospital admission following an ED discharge in the ASD cohort was 3.7 times greater than in the non-ASD cohort.

**Conclusions:** These findings suggest that individuals with ASD may present to the ED with neurological and psychiatric symptoms, as well as, a higher proportion of ACSCs as compared to the non-ASD cohort. By definition, had these conditions been treated and managed through community-based outpatient care, these ED visits may have been avoided. Given that among AYA with ASD, ED visits are nearly four times more likely to result in an inpatient hospital admission as compared to the non-ASD cohort; increasing available community healthcare supports could potentially reduce both ED visits and inpatient admissions.

**442.018 (Poster)** Examining Sociodemographic Disparities in Amount and Type of Intervention Use  
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**Background:** Research suggests that intervention in the preschool years plays a particularly vital role in beneficial outcomes (Zwaigenbaum et al., 2015). Unfortunately, many children do not receive intervention as early as they should for a myriad of reasons. Children from sociodemographic minority groups in the United States are at a particular disadvantage for receiving early interventions (Nguyen, Krakowiak, Hansen, Hertz-Picciotto, & Angkustsiri, 2016). Although there is emerging evidence

documenting disparities for some sociodemographic groups in Autism Spectrum Disorders treatment use, previous research has focused on a dichotomous variable of treatment receipt and typically examines a narrow definition of treatment types.

**Objectives:** The current study conducted a closer examination of a specific number of hours for multiple different types of intervention service usage per week across several sociodemographic groups. Importantly this study looked at service utilization for the classically studied under five-year-old group as well as for children ages six to twelve.

**Methods:** This study examined data collected from 2974 participants enrolled in the Simons Simplex Collection (SSC), a genetic and phenotypic database of individuals diagnosed with ASD (Fischbach & Lord, 2010). We examined the specific number of weekly hours of therapy in four different domains: Speech Therapy, Occupational Therapy, Intensive Therapy, and Classroom Intervention. We additionally examined Psychotropic Medication usage. We looked at two age groups, children under five and elementary aged children (five to twelve-years-old). We looked to see if either age group differed on amount of weekly therapy based on sociodemographic variables including, mother and father education, annual household income, family structure, race, ethnicity, relationship status, and occupation.

**Results:** Amount of Under 5 occupational therapy (OT) was significantly related to mother education  $F(7,167) = 3.89, p = .001$  and father education  $F(8,167) = 3.45, p = .001$ . Such that, individuals with an associate degree had significantly more hours of OT than individuals that did not complete high school  $p = .005$ . On average, individuals whose father had an associate degree received a mean of 3.49 hours of OT per week, whereas those with some high school only received a mean of .268 hours per week. Similarly, children with mothers who completed only some high school received significantly less OT hours than mothers with additional education (GED, some college, associates, or bachelor's; highest  $p = .002$ ). Amount of OT was not significantly related to any of the other examined independent variables. We did not find significant sociodemographic differences in any of the other types of therapy examined for either age group.

**Conclusions:** In alignment with disparity reduction models that call for a better understanding of the inequities (Kilbourne, 2006), this research helps to demonstrate the extent of the problem by quantifying in what types of treatment disparity is greatest and by how much, through an examination of group differences in total numbers of weekly treatment. We found that parent education specifically impacted number of weekly hours of OT.

**442.019 (Poster)** From Science to Service: Seeking Evidence for the Translation of Basic Research into Community-Based Practice

*P. Doehring, ASD Roadmap, Chadds Ford, PA*

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**Background:** It is generally understood that basic research on the characteristics, trajectory, correlates, and possible causes of ASD will eventually translate into applied research to develop assessment and intervention tools, and then to demonstrate that these can be used to measurably improve outcomes in the community. We have designed a research roadmap that categorizes individual studies to track this progress. We have previously used such a roadmap to describe the distribution of research funding over a 8 year period in the United States intended to improve ASD diagnosis. Despite a shift over time in the proportion of applied research focused on community-based outcomes, almost 2/3s of funding was still directed towards basic research. It is possible that this evolution from basic to applied research takes place, however, over a longer period of time.

**Objectives:** We sought to apply a research roadmap to articles published over a 40 year period in the Journal of Autism and Developmental Disorders (JADD) to answer the following questions. Has applied research increased relative to basic research over this period, reflecting the translation of basic research into specific assessment or intervention practices? If not, could factors like shifts in the design of assessment or intervention research studies explain this? Has applied research sought to improve outcomes in the community, or to better understand factors influencing these outcomes?

**Methods:** We searched PSYCINFO for all articles published in JADD in 1979, 1989, 1999, 2009, and 2019, with "aut\*" in the title or abstract. We scanned abstracts to select original empirical research and exclude case studies. We distinguished between Basic and Applied Research, and between three stages of the latter (Assessment, Intervention, and Other Applied Research). Applied research seeks to directly achieve a specific clinical, behavioral, or educational outcome through services provided to a clinical population. For assessment and intervention research, we noted the study design sample size, and the reliance upon community-based programs or professionals. Other applied research documented community outcomes or examined factors influencing these outcomes.

**Results:** Of the 413 basic and 204 applied research studies identified, more than 90% were published since 2009 and 60% in 2019 alone (see Figure 1). Basic research remained steady throughout this period, peaking at about 80% in 1999 before dropping down to 67% in the decades since. Intervention research studies comprised about one quarter of research studies early on, dropping by one half later. Preliminary analyses suggest that this shift coincides with a relative increase in studies involving larger samples

and more complex designs. Few assessment and intervention research studies focused, however, on community-based service delivery.

Conclusions: Despite an explosion of research over the past two decades, there has been no appreciable shift over the past four decades in the proportion of research seeking to directly improve assessment and intervention. Combined with the relative lack of research on intervention, especially involving community-based programs, this suggests that specific efforts will be required to assure that basic research is translated into practice.

**442.020** (Poster) Health Related Quality of Life of Children with ASD Experiencing Inpatient Psychiatric Hospitalization  
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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social, behavioral, and communicative impairments. Approximately 72% of youth with ASD experience psychiatric comorbidities (Leyfer et al. 2006) putting this population at high risk for psychiatric hospitalization (Bhaumik et al. 2008). However, the effect of inpatient care for improving health-related quality of life (HRQL) outcomes is unknown in this population.

Objectives: The objective of this study was to describe HRQL outcomes before, on admission, and after hospitalization in patients with ASD admitted to a children's hospital psychiatric and behavioral medicine unit (PBMU) and compare these outcomes to hospitalized patients without ASD.

Methods: Parent-reported HRQL data were collected between 11/2017 and 03/2020 from a convenience sample of patients ages 5 – 25 to the PBMU at Seattle Children's Hospital. We administered either the Pediatric Quality of Life Inventory (PedsQL™) or the Functional Status II Revised (FS2R) Scale (for parents who reported their child had a severe disability) to obtain three HRQL assessments: before admission (baseline), during admission, and 6-12 weeks after hospital discharge. Patients were categorized as having ASD if they had an ICD-10 code for an autism spectrum disorder on admission or discharge, otherwise they were categorized as patients without ASD. We used t-tests to examine differences in HRQL between groups at each time point.

Results: We obtained HRQL data from 301 parents (52 patients with ASD and 249 patients without ASD) for all three assessments. Mean baseline scores (59.6 versus 65.6; difference -5.9 (95% CI -11.57, -.31,  $p < 0.05$ ) and admission scores (69.0 versus 78.1; difference -9.1 (95% CI -15.35, -2.92,  $p < 0.05$ ) for the PedsQL™ for patients with ASD were significantly lower than patients without ASD. Both groups showed increased HRQL after discharge with no significant differences between groups at these assessments.

Conclusions: Our findings suggest that HRQL outcomes in patients with ASD are lower than patients without ASD prior to admission and during inpatient admission. By examining health related quality of life (HRQL) before, during and after an inpatient stay, hospitals can establish a set of clinical outcomes for the ASD population. Future research should establish a more granular understanding of these disparities and work to target quality improvement strategies related to the care continuum for ASD patients requiring hospitalization.

**442.021** (Poster) How Can We Deliver Timely and High Quality Diagnostic Assessment for Children with Possible Autism in the UK: A Rapid Realist Review of Autism Service Delivery Literature.  
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Background:

Referrals and waiting times for diagnostic assessment of possible autism in children have increased substantially within UK National Health Service (NHS) recently, delaying opportunities for intervention and frustrating families. Research exploring which service models could improve quality and timeliness of autism assessment is a key NHS priority.

## Objectives:

- Explore evidence from research and grey literature about which autism assessment pathways work well, for whom and under what circumstances, to deliver high quality and timely diagnosis.
- Inform subsequent stages of our Realist Evaluation/study.

## Methods:

We performed a Rapid Realist Review (RRR), a well-established approach to synthesising evidence to identify service delivery models achieving desired outcomes. RRRs seek to develop programme theories (PTs), or explanations, of how, why and in what contexts an intervention works. The focus was a clearly defined intervention (diagnostic pathway), specific outcomes (high quality and timely) within particular parameters (Autism diagnostic services in UK). This was carried out in five iterative stages (see figure). We collected 129 grey literature and policy/guidelines from the background search, and 220 articles from primary search (Jan 2011-Dec 2019; seven databases, terms: autism, diagnostic pathway, model of service provision, assessment process). Following duplicate removal and screening of abstracts, two researchers carried out data extraction by hybrid approach: basic details from each included article (n=79) were recorded in an Excel data extraction form; highly relevant articles (n=45) were coded in NVivo. PTs were developed by cross comparison and synthesis of evidence from the articles and findings were discussed with expert stakeholders.

## Results:

1. If frontline health/education professionals are confident in recognizing symptoms of autism, understand referral pathways and take parents' concerns seriously, then children and young people (CYP) will be referred appropriately, in a timely manner.
2. If services provide clear guidelines for referrers on what information is needed, time will be saved and fewer CYP will be assessed unnecessarily.
3. If a structured and consistent approach to service delivery is adopted, making best use of available staff and expertise then the number of assessments per individual may be reduced.
4. If feedback takes an assets-based approach and management plans are individualized, then parental expectations will be moderated.
5. If parents have a single point of contact, are provided explanations throughout and included in decision-making then diagnostic pathway may be less stressful.
6. If "experts" including CYP and parents work together and knowledge generated is embedded into local services, this will build capacity and support service planning.
7. If professionals have access to tailored training appropriate to their role, and services engage in development and evaluation, then there will be a higher degree of consistency.

## Conclusions:

This first theory informed review of childhood autism diagnostic pathways has identified important aspects that may contribute to more efficient, high quality and family friendly service delivery. We will test whether the resulting PTs are met, and how service design could be further enhanced through a national survey of current practice and in depth case study of exemplar services.

**442.022** (Poster) Impact of ASC/LD (Autistic Spectrum Disorder/Learning Disability) Specific Training for North West Prison and Probation Staff.

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## Background:

In 2017 the National Prison and Probation Service began working with a national autism non-profit organisation on a project funded by the Ministry of Justice, aimed at improving services for offenders with learning disabilities and autism (HMI Probation & HMI Prisons, 2015). Building on previous work in 2017-2018 improving support for autistic offenders in a probation cluster, one key component was to roll out LD/ASC specific training to improve understanding of autism amongst 200 staff across five prisons and five probation clusters. Topics covered included introduction to LD/ASC in the criminal justice system, sensory issues, stress and anxiety, navigating the social care system and applying frameworks such as the care act.

A mixed method longitudinal evaluation of the training was undertaken over the course of a year.

**Objectives:**

The objectives were (1) To measure improvement in knowledge, understanding and confidence of staff (including sex offender treatment programme facilitators) before, concurrently and six months after delivery of training (2) To consult prisoners on their experience with transitions within the service along with their suggestions to improve future support.

**Methods:** A Theory of Change (ToC) was developed to identify the expected short and long term outcomes of the project; key elements of the ToC were used to inform the structure of questionnaire tools and topic guides; telephone interviews were undertaken with trainees before (n=56) and six months after training (n=31); questionnaires were completed during the training (n=208); participant information sheets and consent forms were provided for prisoners; prisoners (n=10) were consulted face to face; quantitative data collected via 10-point and 5-point scales in questionnaires and interviews was summarised; thematic analysis of qualitative data obtained was undertaken.

**Results:** Analysis revealed high satisfaction of delivery, format and relevancy amongst a cross section of trainees. Main themes identified included: deeper insight and confidence in distinguishing autism from co-occurring conditions, opportunity to consolidate current knowledge, feel more confident applying legislative frameworks, improved relationships with service users and confidence in educating/advising other staff. During COVID-19 lockdown periods some probation staff were able to make creative adjustments when delivering sex offender treatment programmes whereas others lacked opportunities to put knowledge into practice. Whilst there is some evidence of improvement in how knowledge is embedded across staff networks in prisons, there still needs to be more solid models of 'autism resource infrastructure' which can be upscaled nationally. A recurring theme was that it may be beneficial to schedule reflective practice sessions after training to reinforce confidence when applying new knowledge to cases.

Transitions within, between and out of prison can pose specific challenges for autistic prisoners. Recommendations included development of peer support, awareness of misinterpretation of behaviour from staffs' perspective and offering alternative mediums of communication.

**Conclusions:**

Compliance of staff and prisoners participating in telephone interviews, questionnaires and face to face consultations has enabled a rigorous mixed methods process, for in depth analysis and reporting to key stakeholders. Such evidence will be used to inform future proposals to maintain quality, funding and increase reach.

**442.023 (Poster) Improving Health Care Access and Hospitalization Rates in Patients with Autism Spectrum Disorder and/or Intellectual Disability through Utilizing a Nurse Care Management Model**

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**Background:** Pediatric patients with autism spectrum disorders (ASD) and/or intellectual disability (ID) present with high complexity due to wide variation in symptom severity paired with additional medical and social complications. However, studies demonstrate this population possesses significant unmet medical needs and would benefit from improved care coordination. Nurse care management (NCM) models, employed with success in other populations, represent an opportunity for enhancing care access and reducing hospital utilization for patients with ASD and/or ID.

**Objectives:** 1) To better understand the chronic health conditions and social needs of the patients with ASD and/or ID who are enrolled in the nurse care manager program. 2) To assess patterns of patient access to both specialty and outpatient service providers through review of visits and referrals. 3) To assess the rates of emergency room visits, inpatient psychiatric and medical admissions, as well as hospital length of stay following program enrollment.

**Methods:** All patients with ASD and/or ID enrolled in the NCM program for at least one year were included in the retrospective chart review. Data regarding specialty care access, outpatient services access, and hospital utilization was extracted from the twelve months before and after enrollment in the program for comparison. The variables included number of diagnoses, specialty providers and visits, outpatient services, completed referrals, inpatient hospital admissions and emergency room visits. A signed rank test was completed for hospitalization variables to determine significance.

Results: A total of 79 patients met criteria for inclusion, including 55 males and 24 females. The average age at time of enrollment was 12.1, and a majority of patients were White/Caucasian (n=56) and from Ohio (n=61). Fourteen patients were diagnosed with ASD, 16 with ID, and 49 with both. All patients had at least one comorbid psychiatric diagnosis, and 74 patients had at least one comorbid medical diagnosis. Patients visited the emergency room for psychiatry-related concerns significantly less in the twelve months following program enrollment, with an average of 1.57±1.68 visits before and 1.08±1.48 after (p=0.011). The average number of inpatient psychiatric admissions decreased following enrollment, but this finding was not significant (p=0.085). Most patients accessed the same number of or more specialty providers (78.4%) and outpatient services (74.6%). Additionally, 76% had one or fewer incomplete referrals within the study period, indicating fulfillment of recommended care.

Conclusions: The NCM model provides a framework for improving specialty and outpatient service access and reducing psychiatry-related emergency room visits. Patients specifically demonstrated increase in access to therapy providers including psychologists, social workers and licensed counselors. They also demonstrated increased access of specific specialties, such as ophthalmology, audiology, endocrinology, and orthopedics, which meet unique health needs. The patients also showed increased access specifically for home-based healthcare and therapy services, enabling treatment outside of a hospital setting. This intervention may reflect enhanced ability of families to practice self-management of behavior with regular support from nurses and warrants further longitudinal study.

**442.024 (Poster)** Increasing Access to Diagnostic Evaluations and Ongoing Care for Autism across Washington State  
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Background: Project ECHO (Extension for Community Healthcare Outcomes) connects primary care providers (PCPs) with subject matter experts using a telementoring model. ECHO sessions consist of redacted PCP case presentations and expert-delivered didactic presentations to increase PCP capacity to provide specialized care. *ECHO Autism* has increased PCP self-efficacy in identifying and caring for individuals with autism spectrum disorder (ASD), adherence to ASD screening guidelines, and use of ASD-specific resources (Giachetto et al., 2019; Mazurek et al., 2017; 2019). Pilot data suggest that the model may be a feasible option for enhancing local access to ASD-specific care (Mazurek et al., 2019), thereby decreasing patient travel and wait times.

Objectives: *ECHO Autism Washington* launched its first cohort of 28 PCPs across Washington State in December 2019 to support participants in the diagnosis and management of ASD. The majority of participants are designated Autism Centers of Excellence (COEs) by the Washington State Health Care Authority. Although ASD diagnoses and treatment plans from COE providers are accepted by Medicaid insurance plans, COEs report care delivery barriers including a lack of knowledge about ASD resources, symptoms, and treatment.

Methods: Participants (n=28) received a questionnaire pre-ECHO participation (Time 1), halfway through *ECHO Autism Washington* (Time 2), and will receive it once more upon program completion (Time 3). 61% completed the questionnaire at Times 1 and 2 (n=17; 82% female). Three participants discontinued prior to Time 2 due to unforeseen circumstances. Respondents reported practice barriers to diagnosing and caring for individuals with ASD and completed a modified version of the Primary Care Autism Self-Efficacy survey (Mazurek et al., 2017). ASD screening items were replaced with ASD diagnosis items since the focus of *ECHO Autism Washington* is on diagnosis. This resulted in 56 items, not 57 items as originally published. Items are rated on a Likert scale ranging from 1 (no confidence) to 6 (highly confident/expert). Items yield a Total Score and six subscale scores: diagnosis across age groups, diagnostic criteria, referrals and resources, medical comorbidities, psychiatric symptoms, and additional aspects of care.

Results: A paired samples t-test compared PCP self-efficacy levels at Times 1 and 2. There was a significant increase in overall PCP self-efficacy levels from Time 1 (M = 196.94, SD = 37.37) to Time 2 (M = 228.41, SD = 35.88);  $t(16) = -4.30, p < .001$ . See Figure 1 for changes in subscale scores. Respondents reporting a lack of knowledge about ASD resources, a lack of prior training in ASD, and a lack of knowledge about ASD symptoms decreased from 47.1% to 17.6%, 41.2% to 11.8%, and 35.3% to 0%, respectively.

Conclusions: Participants reported a significant increase in self-efficacy levels related to ASD diagnosis and care and reduced barriers to completing diagnostic evaluations after 6-months participation. This suggests that telementoring models such as Project ECHO may be one way to build provider capacity and expand ASD expertise. Further results will be reported after data is collected at completion of the program in December 2020.

**442.025 (Poster)** Innovations in Caregiver Skills Training: Amplifying the Reach through Echo Autism and Virtual Delivery in Rural America.

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**Background:** A 9-week Caregiver Skills Training (CST) initially developed by the World Health Organization and Autism Speaks was adopted by Easterseals Midwest in partnership with ECHO Autism to be applicable to parents of children with autism living in rural Missouri. This CST program (ECHO Autism: CST) was then implemented via the traditional in-person method and virtually via videoconferencing. - This is the first study utilizing the CST model in a rural setting in the United States and the first to use the ECHO Autism model to train and provide a learning community for new master trainers and facilitators to engage in collaborative, interactive, iterative program implementation.

**Objectives:** The objectives of the pilot project were 1) to assess the feasibility of implementing the CST program in rural Missouri, 2) the feasibility and acceptance of implementing CST via telehealth methods, and 3) the impact of utilizing an ECHO Autism approach for training and supporting facilitators implementing the CST program.

**Methods:** Four families from Central Missouri completed the in-person pilot of the ECHO Autism: CST program. An additional 15 rural Missouri families completed the telehealth version of the ECHO Autism: CST program. Families completed pre- and post-surveys regarding their knowledge and perceptions of their child's behavior, as well as satisfaction surveys at the end of each session. An expert team of professionals or "Hub Team" who trained to be "Master Trainers" within CST supported the new parent trainers (facilitators) during weekly ECHO Autism sessions. Four new CST facilitators participated in weekly ECHO Autism sessions which reviewed content of the upcoming CST workshop and reviewed case studies to discuss recommendations regarding structure of the workshops and child strategies. These participants completed weekly surveys regarding the helpfulness of the ECHO Autism model in support the implementation of CST material and program goals.

**Results:**

Overall the program implementation was found to be feasible in rural Missouri. Families in both groups found the key information applicable to their children with average ratings of 4.7 out of 5 for telehealth surveys (n=99) and 4.94 for in person surveys (n=36).

The majority of facilitators who attended the weekly ECHO Autism sessions indicated that they felt "very confident" in their ability to demonstrate, explain, and coach parents in CST-specific strategies. CST facilitators engaged in ECHO Autism: CST reported that practicing presenting the concepts and reviewing session case studies were the most helpful and supported their implementation of CST via telehealth and in person.

**Conclusions:**

ECHO Autism enhanced Caregiver Skills Training model is a feasible and acceptable model for educating caregivers living with a young child with Autism Spectrum Disorder in rural Missouri. The model was found feasible in both an in-person and a telehealth format. ECHO Autism: CST is a promising innovation to accelerate the scale of Caregiver Skills in rural and underserved locations globally while maximizing fidelity to the content to ensure quality program implementation.

**442.026 (Poster)** Integrating Input from Service Providers and Service Recipients Relative to Autism Spectrum Disorder and Mental Health Issues: Toward Knowledge for Action.

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**Background:**

The prevalence of autism spectrum disorder (ASD) in Canada according to the 2018 National Autism Spectrum Disorder Surveillance System (NASS) Report is 1 in 66. Parents raising children with ASD require an array of services across sectors such as health, social services and education. Unfortunately, the system of care is often fragmented, suboptimal, and difficult to navigate. Particularly concerning are the 30-70% of individuals who present with ASD and a co-existing mental health problem

(dual diagnosis) (Moseley et al., 2011). These individuals and their families face additional challenges accessing appropriate and unified care, often encountering multiple barriers within and between systems of care.

#### Objectives:

As part of a larger study, the objective is to identify navigation processes that are working well, and barriers or challenges, as perceived by stakeholders.

#### Methods:

A Community Based Participatory Research orientation guided the interviews and focus groups that were conducted with 57 service providers and service recipients in relation to navigational services for children with a dual diagnosis in urban, rural and remote communities in Alberta. Interviews were based on a semi-structured interview guide. NVivo data management and analysis software was used. Analysis was comprised of 1) line-by-line coding, 2) review of codes for textual linkages both within and across transcripts and 3) examination of the emerging categorization of codes in yielding themes. Interrater review of data by leaders in the ASD and MH field verified themes.

#### Results:

Based on families experiences a multi-level model emerged consisting of four care levels (universal support, specialized services, complex care and crisis care). Crisis was often identified as a service catalyst for families. At every level, service providers and families indicated that there was a need to make information more assessable to families, that more coordinated services were needed, especially in rural areas, and that parents play a key role, although parental care, preparation for the long haul, and training are sorely lacking. Peer support for families was highly valued and recommended as it addresses parent isolation, is non-judgemental, and offers hope to families.

#### Conclusions:

Navigational support programming requires coordinated service network across sectors (health, social services, and education), particularly in rural and remote communities. There is also a need to involve people impacted by and /or with lived experience in service planning and policy development.

**442.027 (Poster)** Investigating Access to State-Funded, Part C Early Intervention Services in Children Evaluated for Autism Spectrum Disorder

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#### **Background:**

Optimal developmental outcomes for individuals with autism spectrum disorder (ASD) rely on early detection and intervention. As ASD prevalence continues to increase, there is a growing need to make early intervention more accessible. The Part C, Early Intervention (EI) system may be one viable way to increase access to these services, as they can be received prior to a diagnosis: an important provision given that the average age-of-diagnosis is 51 months. Importantly, as many as 10% of children who receive EI services eventually obtain an ASD diagnosis, making it a first-line intervention. Unfortunately, service disparities are well-documented within the ASD field. To mitigate these disparities, we must first understand the extent to which these disparities exist within the EI system. Here, we evaluate how access to state-funded EI services is distributed among a population of children referred to an ASD-specific clinic. In doing so, we hope to identify children at higher-risk of being “missed” and where further resources should be allocated.

#### **Objectives:**

To examine whether access to state-funded, EI services differs on the basis of child race, ethnicity, primary home-language, insurance status, and age-of-first parental concern.

#### **Methods:**

Demographic information and parent-reported developmental data from N=3624 children seen at an ASD-specific clinic from March 2019 through October 2020 were extracted from intake forms. The sample was 38% White (n=1379), 36% African American (n=1309), and 13% identified as Hispanic or Latino (n=484). As part of intake, families indicated whether they accessed state-funded EI services at any point. Variables of interest included: race, ethnicity, home-language, insurance type, and age-of-first parental concern. Between-group differences were tested by t-tests and chi-squared analyses.

### Results:

Overall, results showed only 34% of all children accessed state-funded EI services. Chi-squared analyses revealed no significant differences in EI service access by race or ethnicity group (both  $p > 0.05$ ). Additional chi-squared analyses revealed a significant difference in insurance type among the groups,  $\chi^2(1, N=3293) = 22.84, p < 0.001$ . After re-coding home-language as English, Non-English, and Some-English, chi-squared analyses revealed no significant differences in home-language composition in the groups ( $p > 0.5$ ). Finally, a t-test revealed a significant difference in age-at-first parental concern among the groups ( $t=13.92, p < 0.001$ ).

### Conclusions:

Despite this sample being composed of individuals who eventually accessed an ASD-specific evaluation, the majority of families in the sample reported not receiving EI services. Here, race, ethnicity, and home-language did not predict access to these services. Results suggest that individuals with public health insurance are more likely to access EI services. Additionally, a lower age-of-first concern was observed in individuals who did access EI services, indicating that parental concern may be an important precursor to the receipt of these services. These findings begin to elucidate the extent to which children receive services within an important system of care and the extent to which disparities exist in accessing these services. Future work will use diagnostic data to evaluate whether a subsequent diagnosis predicts access to these services.

**442.028 (Poster)** Looking at the Big Picture: Stakeholder Perspectives on the Implementation Outcomes of a CBT Program for Students with ASD and Anxiety within Diverse Public Schools

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Background: Cognitive behavioral therapy (CBT) for youth with ASD and anxiety is effective, but disparities exist in accessing these programs within clinic-based settings. Training interdisciplinary school providers to deliver CBT may help to address these disparities and may also build school capacity to implement and sustain these programs. To date, little is known about how CBT programs are implemented by interdisciplinary school providers within public schools, and the broader impact of these programs for diverse students. Established frameworks such as Reach, Effectiveness, Adoption, Implementation, and Maintenance (REAIM) can be used to examine broader outcomes (Glasgow et al., 2019). This study was part of an implementation trial that examined the effectiveness of a group CBT program for youth with ASD and anxiety [Facing Your Fears: School-Based; (FYF-SB)] implemented across 25 public schools (27 school teams) across three school districts.

Objectives: (1) To understand the broader impact of translating FYF-SB into public school settings by examining provider perspectives on the reach, effectiveness, adoption, implementation and intended maintenance of FYF-SB; and (2) To examine factors that providers perceive as impacting the implementation of FYF-SB in public school settings.

Methods: Sixty-five providers across 26 of 27 school teams participated in a semi-structured exit interview. School teams consisted of 2-4 interdisciplinary school providers who implemented FYF-SB together as a group. Interview questions were guided by the REAIM framework. All interviews solicited general perceptions of implementing FYF-SB in addition to: 1) the students *outside* of the research study who received FYF-SB (i.e., reach); 2) the *perceived* effectiveness of FYF-SB; 3) the process by which school teams implemented FYF-SB; 4) factors that impacted FYF-SB implementation; and 5) to what extent school teams planned to maintain their use of FYF-SB. Standard content analysis was used to analyze qualitative data (Hsieh & Shannon, 2005).

Results: Primary themes emerged across REAIM constructs in a way that suggested that FYF-SB had a pervasive positive impact. These themes included: 1) the delivery and fit of FYF-SB for students outside the scope of the research project and without ASD; 2) the perceived effects of FYF-SB on students' use of coping skills, bravery, and school participation and engagement, as well as providers' understanding and identification of anxiety symptoms; and 3) planned maintenance and expansion of FYF-SB in future years. Regarding the implementation of FYF-SB, participants consistently highlighted the program's accessibility for school providers without a mental health background. This was viewed as important given the

shortage of mental health staff within public schools. Finally, several school teams made adaptations to FYF-SB in response to perceived student needs and school context.

Conclusions: Results from this study suggest that FYF-SB may have a broader impact on school providers. It also highlights the importance of task sharing across interdisciplinary providers to overcome the challenges of staff shortages within public schools. Programs that can be implemented flexibly and adapted are also critical given the variability in school structures and student needs. Limitations and future directions will be discussed.

**442.029 (Poster)** Measuring the Association between Behavioural Interventions and Outcomes in Young Children with Autism Spectrum Disorder

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Background: Behavioural interventions, defined as one-to-one structured programs, such as applied behaviour analysis, Discrete Trial Training or Pivotal Response Treatment, are widely used for autism spectrum disorder (ASD) in preschool-aged children. The design and the effectiveness of such early intervention programs depend on whether they are provided in a community or in a specialized clinical or research setting. Evaluating community-based interventions is challenging since both the treatment model and service delivery model may vary between jurisdictions and treatment fidelity may be uncertain.

Objectives: The objective was to examine the association between parent-reported, multi-jurisdictional, community-based behavioural interventions received by preschoolers and various outcomes during primary school years (ages 7 to 11) and determine which factors related to the child and family affect this association.

Methods: A cohort of 414 preschool-aged children diagnosed with ASD were enrolled at five Canadian sites (Nova Scotia, Quebec, Ontario, Alberta and British Columbia) and followed to 11 years of age. Children were assessed within four months of diagnosis (T1, mean age at enrollment = 39.9 months (SD = 9.04)), six months later (T2), 12 months later (T3), at school entry (T4), and then annually (T5-T8). An association between the receipt of behavioural interventions during preschool years (T1-T3) and outcomes at T6 or T8 related to intellectual ability, language, adaptive behaviour and autism severity was modelled using separate linear regressions adjusted for immigrant status, family income, child age at ASD diagnosis, site, sex, and baseline (T1) value of outcome measure. Missing data were addressed using multiple imputation methods.

Results: In total, 186 (68.4%) participants received behavioural interventions at least once during the preschool years and 58 (21.3%) received these interventions during T1, T2 and T3. Almost all of the children who got behavioural interventions also received developmental interventions or services which were not specialized for children with disabilities. The receipt of behavioural interventions differed significantly among the five sites. Higher household income was positively associated with the receipt of these interventions. Children who received behavioural interventions at least once at some point during preschool years did not have significantly different outcomes at T6 or T8 than children who did not receive any such interventions.

Conclusions: The variation in the structure of behavioural interventions for ASD and the heterogeneity in ASD symptoms and functional abilities hinder the ability to measure ASD program effectiveness. Given the importance of and challenges in estimating long-term effects of ASD interventions in different jurisdictions, it is recommended that prospective studies collect data on design, fidelity, eligibility, type, intensity and duration of the interventions, as well as demographic and clinical data, so that similar interventions could be compared between groups that are matched on or adjusted for demographic and baseline differences. Increasing sample size and taking steps to reduce attrition would facilitate examining the interactions between intervention types and effect modifiers and facilitate analysis to identify groups of children displaying similar patterns of response to interventions. Such studies would enhance the quality of evidence used to inform public ASD policy and service provision.

**442.030 (Poster)** Obtaining a First Diagnosis of Autism Spectrum Disorder: Process Characteristics and Parent Perceptions from a National Sample

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**Background:** Parents of individuals with autism spectrum disorder (ASD) experience poor outcomes, such as stress and depression, at a higher rate than parents of typically developing children. One particularly salient challenge for parents is obtaining a formal ASD diagnosis for their children. However, while the diagnostic process is commonly cited as challenging and unsatisfying for parents, it also remains largely understudied in the United States.

**Objectives:** The purpose of this study was to better understand the process of obtaining a formal ASD diagnosis for American families.

**Methods:** A total of 406 parents of children with ASD were recruited across the United States using the SPARK (Simons Foundation Powering Autism Research for Knowledge) research registry. All parents had children aged 2 to 9 years who had been formally diagnosed with ASD in the last 3 years. Participants were administered a survey covering demographic information and detailed characteristics of the ASD diagnostic process.

**Results:** Sample participants were mostly mothers (93%) with a mean age of 36.41 years ( $SD = 5.88$ ). Their children were mostly boys (80%) with a mean age of 6.03 years ( $SD = 1.40$ ). Common early concerns were related to delays in social skills and communication. Average age of these concerns was prior to age 2 ( $M = 1.64$ ,  $SD = .88$ ). Parents most commonly sought initial help from pediatricians ( $N = 274$ , 67%), but sometimes consulted other professionals first. Average wait time for subsequent referral appointments was about 5 months and parents attended an average of 3-4 different appointments prior to obtaining a formal diagnosis. Formal diagnosis was made by a wide range of professionals, most commonly developmental psychologists ( $N = 110$ , 27%). Mean age at diagnosis was 3.26 years ( $SD = 1.29$ ). Average diagnostic delay (i.e. between first visit and final diagnosis) was 1.20 years ( $SD = 1.13$ ). Over 70% of parents reported being somewhat satisfied or very satisfied with the process, yet over 70% also indicated the process was somewhat stressful or very stressful.

**Conclusions:** Mean age of formal diagnosis was lower than in previous studies, perhaps reflecting a greater awareness of ASD and/or better referral systems in American pediatric care. However, parents continue to experience long diagnostic delays, attending many referral appointments and experiencing long wait times for these appointments. While parental satisfaction with the diagnostic process was notably higher than in previous studies, most parents still found the diagnostic experience stressful. These findings provide greater insight into the challenges experienced throughout the ASD diagnostic process. Researchers can use these findings to pinpoint specific areas where the process can be improved to ease the burden on families.

#### **442.031 (Poster) Occupational Therapy Service Utilization in Children with ASD**

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**Background:** Demographic and personal characteristics, such as family income, parental education, and child's age (Cidav et al., 2013; McIntyre & Zemantic, 2016; Mire et al., 2015; Nguyen et al., 2016), impact the type and amount of therapy services received by children with autism spectrum disorder (ASD). The impact of ASD severity and other clinical features on service utilization, however, has mixed evidence (Bilaver et al., 2015; Zuckerman et al., 2017). Occupational therapists (OTs) commonly work with children with ASD to address challenges related to sensory processing and adaptive functioning (Case-Smith & Arbesman, 2008). However, there is limited evidence regarding factors that predict OT-specific service utilization, which may be useful to clinicians for making more informed decisions for assessment and intervention planning.

**Objectives:** This paper aims to explore clinical, demographic, and service history factors that are associated with OT service utilization for children with ASD. It is expected that severity of sensory processing and adaptive behavior challenges will be most strongly associated with OT service utilization, followed by history of receiving OT. Lower income and education are also expected to be associated with lower likelihood of receiving OT services due to access issues.

**Methods:** Participants included 703 2-12-year-old children with ASD. Data was collected as part of a longitudinal national survey across two time points, approximately 1 year apart. Measures of clinical characteristics included the Vineland Adaptive Behavior Scales (VABS, Sparrow et al., 2005), the Sensory Experiences Questionnaire v3.0 (SEQ, Baranek, 2009), and the Social Responsiveness Scale (SRS, Constantino & Gruber, 2005). Demographic and service use data was collected via a background information questionnaire. Hours of OT per week were tallied over one year. See Table 1 for sample demographics. Hierarchical Poisson linear regression was conducted to examine predictors of hours per week of OT services.

**Results:** Sensory interests, repetitions, and seeking (SIRS), VABS adaptive behavior composite, and age were the strongest predictors (Table 2). Non-significant demographic variables were not included in the hierarchy in order to avoid any attenuating effects on clinical factors of interest.

Conclusions: In contrast with previous studies, demographic factors were not significant predictors of hours of OT. This could be due to this predominantly school-aged sample, such that children might have access to services in school regardless of demographic differences. SIRS may be a strong predictor of amount of OT due to the potentially disruptive nature of such behavior that could prompt a referral to OT services. Adaptive behavior and ASD severity appear to overlap in prediction of hours of OT, potentially because severe ASD presentation and limited adaptive behavior could each warrant OT services. VABS score and age uniquely predicted hours of OT, suggesting that amount of OT services per week increases with lower age and lower adaptive behavior scores. This is consistent with the literature and underscores that children with lower adaptive behavior scores may be in particular need of OT services (Case-Smith & Arbesman, 2008; Cidav et al., 2013; McIntyre & Zemantic, 2016; Mire et al., 2015).

**442.032 (Poster) Outcomes Among Caregivers of Toddlers with ASD Concerns Following Implementation of Screen-Refer-Treat, a Novel Service Delivery Model for Early ASD Detection and Intervention**

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Background: In line with the American Academy of Pediatrics guidelines for early ASD screening in primary care settings (Hyman et al., 2020) and evidence demonstrating that specialized early intervention leads to more optimal outcomes among children with ASD (Landa, 2018), ongoing implementation efforts are aimed at increasing ASD screening and access to evidence-based early intervention (EI) in the community (Broder-Fingert et al., 2019). Recently a novel service delivery model, Screen-Refer-Treat (SRT; Ibañez et al, 2019), was developed to increase routine use of the M-CHAT-R/F (Robins et al., 2014) at 18-month well-child primary care visits and expedite delivery of ASD early intervention (i.e., Reciprocal Imitation Training [RIT]; Ingersoll, 2010) within Part C EI programs for toddlers who screen positive for ASD risk, but who have not yet received a formal ASD diagnostic evaluation. SRT was implemented within four Washington State counties by training primary care providers (PCPs) and EI providers on components of the SRT model. PCPs were trained to administer an online version of the M-CHAT-R/F (webM-CHAT-R/F) that automatically presents the follow-up questions. In addition to RIT, EI providers were trained on a Stage 2 screen (Screening Tool for Autism in Toddlers (STAT; Stone et al., 2004) to confirm ASD risk. Two separate cohorts of families were recruited to assess the effects of the SRT model on families of toddlers with ASD concerns.

Objectives: We sought to examine the effects of SRT on family-centered care, parenting stress, parent quality of life, and parenting self-efficacy.

Methods: 120 families with ASD concerns for their toddlers in the pre-SRT cohort (n=57) and the post-SRT cohort (n=63) completed caregiver measures at multiple timepoints to measure family-centered care, parenting stress, parent quality of life, and parenting self-efficacy. Preliminary analyses using independent samples *t*-tests were used to compare time-averaged scores from the pre-SRT and post-SRT cohorts on all outcomes.

Results: Preliminary findings revealed higher reported family centered care among the post-SRT cohort ( $M = 5.37, SD = 1.64$ ) compared to the pre-SRT cohort ( $M = 4.79, SD = 1.47$ );  $t(118) = -2.1, p = .042$ . Based on preliminary analyses, there were no apparent differences between the pre-SRT and post-SRT cohorts on measures of parenting stress, quality of life, or parenting self-efficacy ( $ps > .05$ ).

Conclusions: These preliminary findings suggest that SRT may be associated with improvement in family centered care for families of toddlers with ASD concerns. Given reported barriers to high quality care for families of children with ASD concerns leading up to a diagnostic evaluation, these preliminary findings further suggest that ongoing efforts to increase evidence-based ASD care in the community may improve families' experiences with care. Based on these findings, we plan to conduct a series of multi-level mixed models, accounting for the nested structure of the data and covariates, that also include outcome data from families of toddlers with non-ASD developmental concerns and no concerns to test the effects of SRT on ASD-related experiences.

**442.033 (Poster) Predictors of Service Priorities during COVID-19 and Beyond**

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Background: The pandemic and subsequent stay-at-home orders have greatly impacted service provision for individuals on the autism spectrum (Pellicano & Stears, 2020). Prior to COVID-19, this difficulty finding adequate support services was especially salient for (a) families experiencing high levels of stress (Kazdin & Wassell, 2000), (b) autistic individuals with more serious challenging behaviors (Siegel, 2018) and (c) those with complex social-emotional profiles (Croen et al., 2017). To improve

service delivery during and after COVID-19, it is essential to learn more about characteristics of autistic individuals that contribute to caregiver-reported service priorities.

**Objectives:** To explore the effect of child emotion regulation, child age, child cognitive level and socioeconomic status on the likelihood of choosing specific service priorities during COVID-19.

**Methods:** Cross-sectional data were collected from caregivers via an online Qualtrics survey that was published from late May 2020 to early July 2020. Eligible participants ( $n = 339$ ) included parents or other legal guardians of autistic individuals (aged 2 or older) in the U.S. Binomial logistic regressions were performed to ascertain the effects of child's age, EDI dysphoria and reactivity scores, child cognitive scores and socioeconomic status on the likelihood of caregivers choosing a behavioral service (social skills, disruptive behavior, daily living skills, or "other" services) as their top service priority for their autistic child during and after COVID-19.

**Results:** Social skills services were the highest endorsed service priority by caregivers (39% of sample). The logistic regression models examining the likelihood of choosing services that target social skills ( $\chi^2 = 48.249$ ,  $df = 5$ ,  $p < .0001$ ), disruptive behaviors ( $\chi^2 = 57.514$ ,  $df = 5$ ,  $p < .0001$ ) and "other" services ( $\chi^2 = 20.521$ ,  $df = 5$ ,  $p < .000$ ) were statistically significant. Higher age and emotional reactivity scores, as well as lower cognitive scores, were associated with reduced likelihood of respondents choosing social skill services as their priority during COVID-19. On the other hand, higher emotional reactivity scores and lower child cognitive scores were associated with an increased likelihood of caregivers choosing disruptive behaviors services as their priority during COVID-19. Lastly, increasing age was associated with an increased likelihood of parents reporting a service not listed in the survey, such that a one-year increase in child's age increased the odds of a parent choosing "other" services by 87%.

**Conclusions:** Despite being the most popular service choice, the likelihood of selecting social skills services varied across caregivers. Increasing child's age and emotional reactivity scores, as well as lower perceived intellectual functioning, predicted lower likelihood of selecting social skills services as a top service priority. These findings add to the existing body of knowledge indicating the diverse service needs of autistic individuals (Chamak & Bonniau, 2016; Vivanti et al., 2014), and suggest that child's emotion regulation, perceived intellectual functioning, and age are important predictors of family's service priorities.

**442.034 (Poster) Project Echo Autism: Building Capacity Among Community Mental Health Providers**

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**Background:** Approximately 92% of autistic individuals are also diagnosed with co-occurring mental health (MH) conditions (Brookman-Frazee et al., 2018). Though community MH centers are one of the most prevalent and accessible service delivery options in the United States, serving more than 1 in 12 people across rural and urban locations (Rosenbaum et al., 2018), few autistic individuals receive services at these centers. Many community MH practitioners report they lack training to treat autistic individuals and instead refer out to specialty clinics, leaving families waiting up to two years to access specialized intervention (Smith-Young, Chafe, & Audas, 2020). With Medicaid reform that aims to integrate physical and behavioral health care and encourage the provision of services within individuals' home communities, a clear need has arisen to build capacity for community-based MH services for autistic individuals. Project ECHO Autism, a tele-mentoring platform which connects physicians to interdisciplinary ASD experts, has demonstrated improvement in primary care providers' ASD related knowledge, self-efficacy, and practice (Mazurek et al. 2017, 2019a, 2019b) and shows high potential to effect similar meaningful change for MH providers.

**Objectives:** Within the broader context of Medicaid transformation and the need for increased access to MH services for autistic individuals within their home communities, this study aimed to develop and implement an adaptation of Project ECHO Autism designed to increase rural MH providers' autism knowledge, self-efficacy, and knowledge application.

**Methods:** The Project ECHO Autism pilot program consisted of a 6-month ASD-focused curriculum for MH providers ( $N=41$ ) across 21 counties in North Carolina. Ten biweekly 90-minute sessions included a brief didactic (e.g. treatment for anxiety, ADHD) followed by provider case presentations. Providers received CEUs for participating. Pre/post assessments measured change in ASD knowledge via an Autism Knowledge test and provider self-efficacy via an adapted version of the Primary Care Autism Self-Efficacy (PCASE) survey (Mazurek et al., 2017). A subset of participants ( $n=35$ ) also provided written case conceptualizations in response to applied vignettes as a measure of provider knowledge application. Satisfaction surveys were collected at posttest.

**Results:** At posttest, providers demonstrated significant improvement in their knowledge of ASD ( $t(41)=7.12$ ,  $p<.001$ ), self-efficacy ( $t(41)=-14.57$ ,  $p<.001$ ), and clinical problem solving abilities ( $t(34)=5.25$ ,  $p<.001$ ). Additionally, participants reported

high satisfaction with their experience ( $M=1.34$ ,  $SD=.31$ ) on a 5-point scale with “1” indicating the highest degree of satisfaction. Follow up data was also collected to examine maintenance of knowledge and self-efficacy changes over time and will be summarized.

**Conclusions:** This study demonstrates that Project ECHO Autism may be an effective tele-mentoring model for improving MH practitioners’ knowledge and self-efficacy in treating autistic individuals with co-occurring MH conditions. This has important public policy implications as it suggests that this model could build capacity among rural community health providers and reduce unmet service needs for autistic individuals by increasing access to evidence-based services within their home communities.

**442.035 (Poster) Psychological Wellbeing and Service Satisfaction during COVID-19 and Beyond**

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**Background:** In the early stages of COVID-19, parents of autistic children reported higher anxiety, meltdowns, and aggressive behaviors as a result of disruptions to routines (SPARK, 2020). The COVID-19 pandemic may particularly impact autistic individuals who experience emotion dysregulation, which has been implicated as a core feature of mood and anxiety disorders (Ameis et al., 2020; Mazefsky, Day, et al., 2018). This underscores the importance of targeting emotion regulation and coping skills in autism treatment services. It remains to be determined whether the families of autistic individuals who experience greater emotional distress are satisfied with autism support services during COVID-19.

**Objectives:** To explore child emotional distress and emotion regulation as predictors of parent-reported satisfaction with services during COVID-19.

**Methods:** Cross-sectional data were collected from caregivers via an online Qualtrics survey from late May 2020 to early July 2020. Participants included 339 parents or other legal guardians of autistic individuals ( $M = 13.7$  years,  $SD = 7.8$ ) residing in the U.S. The survey included: service access and satisfaction questions for each endorsed service; the *Perceived Stress Scale* (PSS; Cohen et al., 1994) for parent stress; and the *Emotion Dysregulation Inventory* (EDI; Mazefsky, Day, et al., 2018), a parent-report measure that captures emotional distress (Dysphoria) and problems with emotion regulation (Reactivity). Sociodemographic and child cognitive variables were not significantly correlated with satisfaction with services and were thus excluded from the following multiple linear regression models in SPSS 27.

**Results:** Child’s reactivity, dysphoria, age, and parent stress explained 9.8% of the variance in average service satisfaction ratings across all received services ( $R^2 = 9.8$ ;  $F_{4,196} = 5.32$ ,  $p < .001$ ). Higher child dysphoria significantly predicted lower parent-reported satisfaction in this model ( $B = -.204$ ,  $t = -2.32$ ,  $p = .022$ ). The next linear regression model examined satisfaction with ABA/ other behavioral therapy services specifically. Child’s reactivity, dysphoria, age, parent stress, and service delivery medium (telehealth, hybrid, or in person) accounted for 30.9% of the variance in behavioral service satisfaction ratings ( $R^2 = 30.9$ ;  $F_{6,72} = 5.37$ ,  $p < .001$ ). Higher dysphoria significantly predicted lower behavioral therapy satisfaction ( $B = -.312$ ,  $t = -2.57$ ,  $p = .012$ ). Parents reported significantly lower satisfaction for behavioral services delivered via telehealth ( $B = -.301$ ,  $t = -2.87$ ,  $p = .005$ ) or via a hybrid of in-person and telehealth ( $B = -.438$ ,  $t = -4.08$ ,  $p < .001$ ) as compared to services delivered in person.

**Conclusions:** Findings indicate that parents of autistic individuals experiencing greater emotional distress reported decreased satisfaction across all services that their children were receiving during COVID-19. Taking a closer look, parents of autistic individuals with higher dysphoria reported lower satisfaction with ABA/ behavioral therapy services, and satisfaction was also lower for behavioral services delivered via telehealth or a hybrid model. These findings suggest that child emotional distress is one important contributor to variance in satisfaction with services during COVID-19. Behavioral therapists and other service providers may renew their efforts to promote emotion regulation skills in order to improve child’s emotional distress and parental satisfaction.

**442.037 (Poster) Service and Support Needs in Families of Autistic Children during the COVID-19 Pandemic**

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**Background:** The COVID-19 pandemic has amplified existing health and social inequities in our society. The impact on autistic children and their families is particularly striking due to the elimination of a network of essential school, family and community support services. Previous studies found that during health emergencies, children with disabilities experience greater negative psychological symptoms and are less likely to be prioritized in resource allocation (Fong & Iarocci, 2020). There is an urgent need to tackle this inequity by examining caregiver perceptions of service and support needs during the current pandemic. This will lead to research informed policy and planning that can prevent further hardship for autistic children and their families in the current public health emergency but also, helps to promote resilience in the longer term.

**Objectives:** Our research questions were three-fold: (1) What services and supports are prioritized by families? (2) What are families' schooling and educational needs for their child? and (3) What online supports do families need or find helpful?

**Methods:** The current study adopted a community engagement approach, collaborating with the executive director of a non-profit organization called ACT – Autism Community Training. Our partner was involved in all stages of the research process, including setting the research priorities, formulating the research questions, developing the online survey, recruitment, and disseminating research findings. Participants of the study included 238 caregivers living in British Columbia, Canada between the ages of 25 to 64 years ( $M=42.82$ ;  $SD=6.65$ ). Their autistic children were between the ages of 2 to 21 years ( $M=10.47$ ;  $SD=6.65$ ). The online survey comprised of open-ended questions, specifically “What Ministry of Children and Family Development supports did you need?”; (2) “What information, services, or supports did you need for your child's education that you did not have access to during this time?”; and (3) “Is there any form of online support that you believe could have helped you more during the COVID-19 outbreak? The online survey was hosted by Qualtrics from July 30 to September 26, 2020. Responses were independently coded by two authors blind to each other's coding decisions and inter-rater reliability across coders was calculated.

**Results:** Caregivers prioritized a number of areas related to government supports and services such as greater flexibility in funding, availability of respite, and mental health supports. Many families also reported being unaware of new policies and supports implemented during the pandemic. Education needs identified included more Educational Assistant support, social opportunities for students to interact online, and consistent communication between teachers and parents. Families prioritized online supports such as parental counselling and information related to child behavioural management.

**Conclusions:** Findings highlight the importance of understanding caregivers' service and support needs in order to improve families' capacity for resilience during the current and future pandemics. Results will help guide decision-makers in implementing policies that better address the needs of autistic children and their families.

**442.038 (Poster) Systematic Review of ASD Intervention Services and Treatment Programs in Africa**

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**Background:** Autism spectrum disorder (ASD) has become a global burden due to its increasing prevalence (Baxter et al., 2015). An estimate of one in 132 individuals throughout the world have ASD (Global Burden of Disease, 2010) with certain countries showing higher incidences (e.g., one in 54 American children; Center for Disease Control and Prevention, 2020). Access to and knowledge of intervention services and treatment programs provide the best outcome for individuals with ASD and their families. Yet, there is a paucity of ASD intervention services and treatment programs especially in low- and lower-middle-income countries (LAMICs) such as throughout Africa (Ruparella et al., 2016).

**Objectives:** This research systematically identified existing literature on ASD intervention services and treatment programs conducted in Africa's 54 countries.

**Methods:** The trained multidisciplinary research team used DISCOVER search engine and PsycINFO database to search the following keywords: 1) Autism or ASD or autism spectrum disorder; 2) intervention or services or treatment or therapy or programs; and 3) Africa or Sub Saharan Africa. Each of the 54 African countries was also searched in combination with the first and second set of aforementioned keywords. Publications' titles were screened according to the keywords. Then, three researchers screened abstracts of the selected publications using the keywords. In addition, reference lists of the selected publications were manually searched to identify additional relevant publications. Publications that met the keyword criteria were then read in full and coded. A standardized coding system was developed by the research team for data extraction from the full articles.

**Results:** A total of 1,269 publications populated during the searches when using the keywords. Additionally, 42 publications were identified from manual searching of the reference lists. Publications that were not in English, not accessible, or that were duplicates were excluded ( $n = 1176$ ). Abstracts of 135 publications were then screened to determine eligibility for full review. Twenty publications met criteria and were read in full. Eight articles were then excluded. See Figure 1. All articles were published since 2008. The 12 articles that met eligibility included various methodologies (e.g., pilot, feasibility, mixed-methods) from six African countries. See Figure 2. Intervention services and treatment programs targeted skills such as language and social development in young children ( $M_{age} = 7$  years). Synthesis of key findings is ongoing.

**Conclusions:** This systematic review provides critical information on intervention and treatment research in Africa for individuals with ASD – including suitable implementation methods. It highlights the six African countries that have published research and focused efforts on ASD intervention - although it is limited. It illustrates the sparsity of publications, further exemplifying the

dearth of empirical resources for individuals with ASD in Africa. Additionally, it provides a compelling case for policy makers and stakeholders to address the service gaps for Africans with ASD. Conclusively, intervention services and treatment programs have shown an array of short-term and long-term benefits (National Research Council, 2001); however, the service demands for ASD remain unmet in Africa, inclusive of multiple LAMICs, as this research encapsulates.

**442.039** (Poster) Systemic Racism Continues: Disparities in Eligibility for U.S. Public Health Programs and Spending Among Autistic Adults

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**Background:**

Research on children with autism spectrum disorder (ASD) historically revealed racial and ethnic disparities in access to care and health services utilization, often from Medicaid-only samples or privately insured samples. Parallel research to understand how disparities persist as individuals age into adult systems of care is understudied. With more autistic individuals aging into adult systems of care each year, it is essential to understand eligibility for public benefits in the U.S. via Medicare and/or Medicaid and underlying inequities in resource allocation.

**Objectives:**

RQ1: What racial and ethnic differences exist in eligibility for Medicare and/or Medicaid programs among adults with ASD?  
RQ2: What racial and ethnic differences exist in out-of-pocket and program spending for medical care among Medicare and/or Medicaid-enrolled adults with ASD?

**Methods:**

We conducted a cross-sectional study of U.S. autistic adults using 2012 Medicare-Medicaid Linked Enrollee Analytic Data Source. Adult ASD individuals aged 18+ years with records in either Medicare and/or Medicaid and complete race-ethnicity data were analyzed ( $n=172,071$ ). We used chi-square tests to evaluate differences in race-ethnicity and eligibility status (Medicare-only, Medicaid-only, Full-Dual). Adjusted logistic models were used to predict eligibility by race-ethnicity while controlling for age, gender, state of residence, and intellectual disability (ID) status. We describe spending using median annual spending in 2012 with 95% centile confidence intervals. General linear modeling with gamma distribution were used to analyze mean spending between race-ethnicity groups.

**Results:**

Demographics are shown in Table 1. In 2012, the majority of White adults (49.87%) were full-dual eligible for both Medicare and Medicaid. In contrast, only 37.53% of Black, 34.65% Asian/Pacific Islander (PI), and 35.94% of Hispanic individuals were full-dual eligible, with the majority only eligible for state-funded Medicaid. Adjusted models support bivariate findings, with Black, Asian/PI, and Hispanic individuals having significantly lower odds of being dual-eligible (aOR=0.64, SE=.01; aOR=0.82, SE=.03, aOR=0.80, SE=.02). Across these three eligibility types ( $n=168,638$ ), total spending among adults aged 18 and over with ASD in 2012 totaled \$10,494,060,057. Median annual spending per individual for White adults (\$59,013) was approximately 20-29% greater than median annual spending per individual as compared to Black (\$47,405), Asian/PI (\$42,097), and Hispanic (\$46,252) individuals.

**Conclusions:**

Black and Hispanic individuals were significantly less likely to be dual eligible for Medicare and Medicaid than White individuals after adjusting for age, gender, ID, and state. Black, Asian/PI, and Hispanic full-dual adults had significantly lower Medicare-Medicaid spending per individual than White individuals likely suggesting differences in care patterns. Overall, across all race-ethnicity groups, spending exceeded \$10.5 billion dollars in 2012, representing 1.3% of total Medicare and Medicaid spending in that fiscal year. Research focused on costs of care across all age groups are likely underestimates. As autistic adults age into public-payer systems such as Medicare and Medicaid, policy makers and healthcare administrators require sustained and collaborative efforts to reduce inequities, improve coordination across systems, prevent high-cost mental health crisis and emergency department care, and consider the effects that lack of regular employment, affordable housing, and qualified care

providers will have on the future health of autistic adults.

**442.040** (Poster) The Impact of COVID-19 on the IDD Community in California: Service Delivery and Regional Centers  
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**Background:** Within the State of California, services for children and youth with intellectual and developmental disabilities (IDD), such as behavioral and occupational therapy (OT), can be allocated through insurance, regional centers, medical clinics, and school settings. Due to COVID-19, parents and individuals with autism experienced a disruption in services, forcing them to quickly adapt to online services (i.e., telehealth) when offered. Little is known about the accessibility of services, whether online or in-person, to these families during the pandemic.

**Objectives:** The aim of this study was to capture how COVID-19 has disrupted service delivery and regional center services for the IDD community in the State of California.

**Methods:** This study is a secondary analysis of survey data provided by the Autism Society of California to understand the impact of COVID-19 on youth with IDD and their families. An electronic survey was disseminated in English and Spanish using Survey Monkey and was open for two weeks from May 9-19, 2020. Descriptive statistics and frequencies were run to analyze quantitative data.

**Results:** A total of 1,082 individuals responded to the survey, which included 40 individuals with a disability and 1,042 parents, family members, or guardians of a person with a disability. The diagnosis of the person with a disability or family member with a child with a disability included Autism Spectrum Disorder (ASD; n=794) and other IDD (n=288). Overall, 52% of the participants identified as White or Caucasian, 42.4% identified as Hispanic or Latino, 7.8% as Asian, 4.1% as Black, and 2.7% as American Indian. Respondents reported services obtained during COVID-19 such as ABA, communication therapy (CT; e.g., speech, language, or augmentative and alternative communication), OT, social skills groups, and physical therapy (PT). The most frequently reported services were: ABA (telehealth n=282; in person n=84), communication therapy (telehealth n=318; in person n=20), and OT (telehealth n=238; in person n=17). Respondents also reported receiving no services at all during the pandemic as follows: no ABA n=512, no CT n=533, no OT n=591. Most of the respondents reported being a regional center client (n=850) and were asked a series of questions regarding support provided by their regional center caseworker. Of those associated with a regional center, 72.1% (n=613) of respondents reported receiving adequate support from their caseworker since COVID-19 began; 27.9% (n=237) did not. Ongoing analyses will determine if services were equally offered across the state, ethnicity/race, and disability.

**Conclusions:** Individuals and families affected by COVID-19 have had to quickly adapt to changes due to COVID-19 such as adapting to telehealth or, unfortunately, experiencing dismissal of services. Regional Center clients received adequate support from their caseworkers but some reported a lack of support during the pandemic.

**442.041** (Poster) The Impact of Learning to Play the Piano on the Emotion and Behaviour Regulation of Autistic Teenagers.  
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**Background:** In typically developing children, behavioural benefits of instrument learning have been demonstrated (Palmer, 2001; Herholz & Zatorre, 2012). However, the autism literature largely reports on interventions focused on music making and listening (Edgerton, 1994; Hammel & Hourigan, 2013). There is far less evidence about the impact of learning to play an instrument for autistic individuals, though personal accounts indicate benefits (Koleman, 2013).

**Objectives:** This research asks: does learning to play an instrument have a beneficial effect for autistic individuals? The research was conducted in two phases. The objective of phase one was to engage with experienced music teachers to gain a better understanding of good practice when teaching autistic adolescents. This information was used to design a one-to-one instrument lesson plan for autistic learners. The objective of phase two was to review the impact of these lessons on autistic adolescents by investigating pupil and teacher experiences, and parent perspectives.

**Methods:** Study 1 investigated teachers' (n=7) experiences of teaching beginner piano to adolescents, including teaching autistic individuals, through semi-structured interviews and questionnaires. All teachers had at least 10 years of experience of one-to-one instrument teaching. In study 2, nine autistic individuals (aged 12-15) received an average of ten beginner piano lessons over the course of 14 weeks. Semi-structured interviews were conducted with the pupil, their parents and the teachers at the start and end of the learning period. All data were transcribed and underwent thematic analysis.

**Results:** Study 1: Three themes were identified from teacher interviews: Individuality, Familiarity and Impact. Individuality refers to the need to engage with the pupil's own motivations and preferences, and to make adaptations that evolve over time. Familiarity refers to the need for the lesson structure to be consistent and that the teachers and pupils were clear about their expectations of each other. Teachers expressed that the lesson should be a safe space. Impact refers to the teachers' observations about how pupils can benefit from instrument learning in terms of emotional expression, attitude to learning and opportunities for community participation.

The evaluation of study 2 is ongoing at the time of writing, with lessons due to be completed in December 2020 and analysis completed by March 2021. A single case study pilot revealed evidence of pupil benefit from the weekly lessons. Being able to practice and go to the piano gave him a safe space to go and work through any emotions he was experiencing and helped calm him down when feeling overwhelmed. It also helped ease his anxiety and gave him the opportunity to engage with peers in social settings.

**Conclusions:** Teacher interviews indicate that autistic people can and do take part in instrument learning but may require enhanced understanding and some adaptations to gain maximum enjoyment. This information can be used to create a model for one-to-one lesson learning which shows very preliminary evidence of benefit.

**442.042 (Poster)** The Importance and Availability of Adjustments to Improve Access for Autistic Adults Who Need Mental and Physical Healthcare: Findings from a UK Survey

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**Background:** Autistic people are more likely to experience mental and physical health conditions than neurotypical people. Poor health predicts poorer quality of life. Life expectancy for autistic people is significantly lower than the general population. Autistic people frequently encounter barriers that prevent access to effective healthcare. Such barriers prevent autistic people from arranging and attending healthcare appointments. UK NHS clinical guidance recommends providers adjust their procedures to best meet the needs of autistic people - understanding how best to do this represents an autism community research priority. However, the importance and availability of specific adjustments to autistic adults across UK healthcare settings are currently unknown.

#### **Objectives:**

- Investigate autistic adults' views on the importance and availability of adjustments to mental and physical healthcare.
- Explore whether specific categories of adjustments can be empirically identified and to explore differences in their importance and availability between mental and physical healthcare.

**Methods:** Data were combined from two cross-sectional studies; one focused on mental health services and the other on physical health services. Autistic adults were recruited from the Adult Autism Spectrum Cohort- UK (ASC-UK; <https://research.ncl.ac.uk/adultautismspectrum/>), and invited to complete a survey about mental or physical healthcare. 537 (51% response) participants completed the mental health survey and 407 (49%) completed the physical health survey; 221 participants completed both surveys. Both surveys included an identical list of adjustments identified to improve accessibility and inclusivity of healthcare. Participants rated the importance and availability of each adjustment using a 5-point Likert scale. Exploratory factor analysis (EFA) was conducted to explore whether the adjustments could be empirically grouped in a meaningful way. Differences in adjustments between mental and physical healthcare were explored using McNemar's test to compare nominal data in the paired sample who completed both surveys.

**Results:** EFA identified three categories of important adjustments: *sensory environment, clinical and service context, and clinician knowledge and communication*. The adjustment rated as being most important was 'access to a clinician who understands autism' (rated as being important by 98.3% and 96.5% of participants in mental and physical healthcare respectively). Despite this high importance, this adjustment was rated as being 'rarely or never available' to 71.8% of autistic adults accessing mental healthcare and 73% accessing physical healthcare. This pattern of high importance and low availability was observed across the majority of adjustments. Only 'access to appointments with familiar clinicians and/or healthcare locations' were regularly available to over half of respondents. 'Access to a clinician who is willing to adjust their approach to suit my needs' was significantly more important in mental health compared to physical health settings ( $p = .001$ ). No other significant differences between healthcare settings were identified.

**Conclusions:** The limited availability of important adjustments for autistic people in current healthcare settings may lead to unmet health needs. To address this and reduce health inequalities currently faced by autistic people, healthcare providers should consider offering adjustments relating to the three identified factors, most of which are inexpensive to implement. Future research should focus on identifying and addressing service-provider barriers to implementation of adjustments.

**442.043 (Poster)** The Role of Advocacy and Empowerment in Shaping Service Development for Autism and Other Developmental Disorders

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**Background:** Empowerment of families with children with autism and advocacy for autism are essential to service development using a rights-based approach to disability. The World Health Organization (WHO) identified empowerment as key to the development of services for children with autism and other developmental disorders (DDs). Caregiver and professional advocacy is one of the key pillars of empowerment and include obtaining support or services for a child with autism, creating opportunities, and educating the child's environment and the broader community about the condition. Engaging in advocacy is described to be shaped by caregivers' access to social capital and resources.

**Objectives:** The aim of this study was to investigate advocacy and empowerment in a global context in relation to service development for families of children with autism and other DDs. We studied a) meanings of empowerment; b) stakeholder perceptions on the role that advocacy and empowerment play in service development; c) the use of evidence for advocacy and empowerment.

**Methods:** This qualitative study took a phenomenological approach. The study questions were applied to service development for caregivers of children with a DD and to a specific caregiver intervention, the WHO's Caregiver Skills Training (CST). This programme was chosen as it represents a global effort to make services available for caregivers irrespective of their socio-economic setting. Participants were clinicians, caregivers, researchers representing five continents, and representatives of WHO and Autism Speaks. All participants were involved in advocacy and caregiver interventions, like CST. First, two focus group discussions (FGDs) were conducted with 15 participants. After the preliminary analysis of FGDs, 25 semi-structured individual interviews were conducted. All data were analysed thematically. The codebook was developed by two independent coders. Themes were developed in iterations, using investigator, method, and data triangulation.

**Results:** Three themes were developed: a) Meanings of empowerment; b) Advocacy for services; c) Caregivers as active stakeholders in services. Many professional participants defined empowerment within the realms of their profession: for example, having skills to improve the child's symptoms or economic empowerment. They thought that an empowered caregiver has self-confidence, relies less on others and is knowledgeable about how best to help a child with a DD. Caregivers expressed that this expert-oriented view of empowerment fails to acknowledge the intuitive knowledge of caregivers. Professionals and caregivers thought that advocacy is a key to service development and that personal connections and being opportunistic were important aspects of advocacy. Informants agreed that caregivers can be powerful advocates and take an active role in shaping service development for DDs. Empowerment practices and participation in caregiver interventions can facilitate this role. Some thought that there is a gap between rights of caregivers and services and professionals available and added that one of the goals of empowerment is to overcome this gap.

**Conclusions:** Empowerment of caregivers and advocacy can contribute to service development for DDs in different contexts worldwide. Definitions of empowerment should take into account caregiver perspectives. Caregiver and professional advocacy can facilitate achieving an inclusive, rights-based approach to making services available for all families globally.

**442.044 (Poster)** Understanding Provider and Family Experiences with Telehealth Services for Children with Autism and Developmental Disabilities

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**Background:** Telehealth is a platform of healthcare that delivers services through the use of technology. Although reported advantages of telehealth include improved access to clinical services, the rapid transition to telehealth in spring 2020 (due to COVID-19) may have occurred before consistent work flows and systems to fully support telehealth visits were developed, thereby creating challenges with subsequent delivery of and/or receipt of care. This may have especially affected diagnostic clinics for autism spectrum disorder (ASD) and related conditions that rely heavily on standardized, in-person assessments and behavioral observations. Given the likely permanence of some ASD-telehealth services, there is value in gauging acceptability and sufficiency of telehealth to guide quality-improvement efforts.

**Objectives:** To characterize telehealth visits for children with suspected ASD/developmental delays at a tertiary autism/developmental center in a large metropolitan area from both caregiver and provider perspectives.

**Methods:** REDCap surveys, adapted from the Vanderbilt Kennedy Center's Telemedicine Feedback form, were designed separately for providers (i.e., developmental behavioral pediatricians, psychologists, neurologists) and families and distributed via email with instructions to complete the form with a given appointment in mind. All families scheduled for a telehealth visit received an email within four hours following their scheduled visit. Providers were emailed a survey link within the same timeframe for every third visit to avoid response fatigue. Surveys were distributed regardless of whether the visit was completed, attempted, or no-showed. Up to two email survey reminders were sent to families every two days. Survey distribution spanned two months (5/18/2020-7/27/2020). Data were imported into SPSS and analyzed descriptively.

**Results:** A total of 90/637 (14.1%) caregiver surveys and 122/241 (50.4%) provider surveys were returned. The most common visit type was diagnostic intake (46.7%) and the most common telehealth format was Vidyo (video; 89.3%). 47/90 (53.2%) families stated that this was their first time working with their provider; 78/90 (86.7%) families said their provider recommended a subsequent follow-up visit, with 47/77 (61.0%) of these being an in-person visit. 79/121 (65.3%) provider surveys reported making a diagnosis via telehealth that was shared with the family. Although 71/90 (78.9%) caregivers agreed that equipment used for their telehealth visits worked well, 46/90 (51.1%) were neutral/disagreed that telehealth was more convenient compared to in-person and 8/15 (53.3%) open-ended comments about inconvenience specifically noted technical and/or communication issues. 48/121 (39.7%) provider surveys endorsed technical difficulties during telehealth visits; additionally, 7/34 (20.6%) reported lack of family preparedness (i.e., appointment reminders, visit readiness) in open-ended feedback about their telehealth visits. Further information about families' and providers' experiences with telehealth is provided in Tables 1 and 2.

**Conclusions:** Telehealth can provide a safe method of service delivery for children being evaluated for ASD during COVID-19. However, technological difficulties can make service provision inefficient or incomplete, thus leading to delayed diagnoses and recommendations for subsequent, in-person appointments. Moreover, telehealth may be perceived as less convenient because of technological or other logistical challenges. Qualitative analyses of caregiver and provider feedback are underway to provide a more complete understanding of challenges with the telehealth-service platform.

**442.045 (Poster)** Use and Intention to Use Mental Health Services Among College Students with Autism Spectrum Disorder  
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**Background:** Autism Spectrum Disorder (ASD) prevalence estimates have increased over time. Despite core and associated symptoms of ASD persisting beyond childhood, research exploring how adult individuals with ASD use mental health services is limited. With college serving as a major pathway for transitioning into adulthood, it is important to understand how individuals with ASD engage with mental health services in a higher education context.

**Objectives:** Identify whether use and intention to use mental health services differs among students with ASD, students with other diagnosed mental disorders, and students with no diagnosed mental disorder.

**Methods:** Participants were respondents from an annual cross-sectional, self-report survey conducted at a major university in the southwestern United States (n=4,580). Survey data were collected in-person and respondents answered questions about demographics, previously diagnosed mental disorders, and insurance status. ASD status and history of other mental disorders were based on self-report of whether the respondent had ever been diagnosed with ASD or another mental disorder. For the analyses,  $\chi^2$  - statistics and logistic regressions were used. Students who had a diagnosis of ASD were compared to a) students with a history of other mental disorders; and b) to students with no history of mental disorders.

**Results:** Of the respondents, 0.6% (n=29) reported ever being diagnosed with ASD, 34.3% (n=1,569) reported ever being diagnosed with at least one other mental disorder, and 65.1% (n=2,982) reported no history of mental disorder diagnosis. Chi square analyses showed that students with ASD were significantly more likely to have used professional mental health services in the last 12 months than students with no mental disorder (p<0.001). Respondents with ASD were significantly more likely to intend to seek out mental health services in the future than students with another mental disorder (p=.049). In controlling for demographics (e.g. race, gender) and insurance variables (including removing respondents who had insurance that specified what provider could or could not be seen), respondents with ASD had significantly greater odds of using professional mental health services than students without ASD (OR=22.7; 95% CI=9.1-57.0). Controlling for demographics and insurance variables also

eliminated the significant association between respondents with ASD and the intention to seek out mental health services in the future, compared to students with another mental disorder (OR=0.8; 95% CI=0.3-2.2).

Conclusions: College students with ASD were significantly more likely to use professional mental health services than students with no diagnosed mental disorder, which is consistent with data showing students with a diagnosed mental disorder are more likely to use mental health services than students without diagnosed mental disorders. Interestingly, students with ASD did not have different intentions to seek out mental health services in the future when controlling for demographics and insurance status. These results imply that students with ASD use services differently than students without ASD. Future research could explore what role other variables (e.g. mental distress, discrimination) play in determining what resources students with ASD use to address mental health challenges.

**442.046 (Poster)** Using the Telemedicine during the COVID-19: A Working Model to Meet the Needs of Parents and Children with Autism Spectrum Disorder

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Background: The COVID-19 has had a profound impact on healthcare services. The institutions that deal with the diagnosis and intervention of children with autism spectrum disorder (ASD) required rapid functional adaptation to respond to patients' needs. The possibility of using technology to activate and manage diagnostic (preliminary diagnosis) and intervention processes was explored.

Objectives: The main aim of this contribute is to share telemedicine working models for preliminary diagnosis and intervention adopted at CETRA. CETRA is a highly specialized center for ASD (accredited by the Italian National Health Service and with a scientific agreement with IRCCS Stella Maris that is a tertiary referral hospital) sited in Pisa, Italy. Usually, it offers in-person services, including diagnosis and evidence-based parent-mediated interventions. The in-person working model of CETRA involves the use of video feedback with parents during the intervention (inspired by the PACT model of Green et al. (Lancet,2010)) and the analysis of the videos used during the diagnostic process. Additional clinical offerings include support groups for parents, training for therapists and clinical research. Since the beginning of the COVID-19 era, most of the clinical activities have been remotely reorganized, developing a working in telemedicine.

Methods: Two developed telemedicine working models for diagnosis and intervention, including synchronous and asynchronous transmissions, are presented. The diagnostic step (see Figure 1) is composed by two different and consecutive phases: (A) pre-specialistic consultation (PSC) and (B) specialistic assessment (SA). During the PSC, parents filled out questionnaires and they sent five short videos to the ASD team (see Figure 1). During the SA (three days) the ASD team watch the five asynchronous videos and also three synchronous connections (in real time) were carried out. In the first synchronous connection, the anamnesis, ADI-R and Vineland-II were acquired. In the other two synchronous connections the child with a parents were observed by the ASD team. The ADOS item, as suggested by Fusaro (PlosOne,2014) and DSM-5 checklist were used for the global clinical scoring of the synchronous and asynchronous videos. The intervention step (see Figure 2) implemented well-recognized evidence-based model (i.e. ESDM) for preschoolers, school-aged, and older children in an online format. Parents' support was also included.

Results: The 26,3% of assessed children were at their first diagnosis of ASD (ma=3,2 years; sd=1,1); 44,3% were follow-ups (ma=4,6; sd=1,9) and 29,4% were preschoolers engaged in intervention sessions. These last children (and their families) were engaged in the Early Start Denver Model (ESDM) one of few evidence-based treatment for children with ASD with a specific parent-coaching developed program.

Conclusions: The described working models have the purpose of carrying out preliminary specialistic answers to the families without aiming to replace preferable in-person assessment. Based on previous research findings, the telemedicine approach is accepted by parents, increases their sense of competence, increases the parent intervention adhesion and improves the social communication competencies for children with ASD. In conclusion, the presented working models should be considered partial and ethic responses to the current emergency status and at the same time as possible integrations into traditional approaches.

**442.047 (Poster)** Who Caregivers Skills Training Delivery Adaptation during COVID-19 Pandemic in a Public Service at Brazilian Health Care Context

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Background:

The Caregivers Skills Training (CST) is a program designed to help parents promote the acquisition of their children's skills, aimed at families of children with neurodevelopmental disorders. Originally CST was intended to have a face-to-face delivery, but due to the Covid-19 pandemic, that had to be adapted.

Objectives:

This study aimed to evaluate the CST adaptation to an online setting in the Brazilian context.

Methods:

CST in Brazil is on the pilot testing, it was translated and adapted to the Brazilian context, evaluated acceptability and feasibility and applied to a small sample size. Pilot phase started with 50 families, 10 facilitators and 4 master trainers, they were divided in 5 groups. Each group was accompanied by a research member, responsible to send the online questionnaires to the families and facilitators. Facilitators training happened with daily online classes and access to an online platform with the materials and daily tasks. The families training took place with weekly online sessions and access to a platform where the materials and questionnaires were available. The materials were also made available at the health center nearest to the family's home. The families were selected considering their availability to participate in the online training, those who couldn't were transferred to a waiting list. Sessions were recorded and if any parent couldn't make a session its video was sent to them. The scheduled home visits had to be adapted, the parent was requested to record a 5 to 10 minutes interaction with the child and send it to the facilitators, who watched it and talked about it to the parent on an online meeting.

Results:

The facilitator training happened without great problems. In the families training various difficulties appeared: almost none of the parents accessed the platform where the materials and questionnaires were, so the team switched to social network apps that proved more effective; as parents were home, some had to divide their attention between the training and the children or other home activities; technical difficulties arose, such as bad internet connection, learning how the videoconferencing app worked (especially in the first few sessions) and lack of (other people in the house were using it) or incompatibility of the devices; "visits" were greatly impacted by this change as the recorded video left out important aspects of the interaction; all sessions needed to be shorter, due to the strain of long hours of online sessions; the content of the sessions became more theoretical and lacked experience; and in some groups the families didn't interact much with each other, impacting the development of a support network. Despite these difficulties, there were some benefits: families that had transportation difficulties managed to participate and the availability of the recorded sessions was regarded as very important if the family missed some session.

Conclusions:

The administration of the CST online was impacted, but, as observed by the results of parental skills development and frequency child problem behaviors. Considering it all, it can be a viable alternative, especially with the facilitators training.

**442.049 (Poster)** "They Looked at Me As a Person, Not Just a Diagnosis": A Qualitative Study of Barriers and Facilitators to Care at a Specialized Patient Centered Primary Care Clinic for Autistic Adults

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Background: The Center for Autism Services and Transition (CAST) is a patient-centered primary care clinic that aims to remove barriers to care for autistic adults. CAST patients may receive modifications to the standard patient workflow (e.g., bypass the waiting room due to sensory sensitivity) and are seen by physicians with expertise in providing care for autistic adults. In a previous study using survey data (Hand, Coury, et al., 2020), we demonstrated that CAST patients had significantly higher

satisfaction with the care they receive than a national sample of autistic adults. We conducted this study to add depth and context to our survey findings by describing factors that increased or decreased patient and caregiver satisfaction with CAST.

Objectives: To characterize factors that increased or decreased patient and caregiver satisfaction with CAST.

Methods: We used a phenomenological approach and conducted 30-60-minute semi-structured interviews with CAST patients (N=9) and caregivers of CAST patients (N=12). All interviews were transcribed verbatim and entered into NVivo. We conducted a thematic analysis following the steps in the qualitative data analysis process. Two researchers (BH and LH) began the analysis by identifying codes and grouping them into facilitators or barriers to satisfaction. The researchers independently coded the transcripts and met to calculate inter-coder agreement. The agreement rate for all codes was over 90%. To achieve trustworthiness of our qualitative findings, we: (1) used investigator and data triangulation; (2) checked for representativeness by only including final themes that were present in at least 30% of the interviews; (3) used audit trails; and (3) performed member checks by sending all participants a 1-page summary of the results to solicit views on the credibility of our interpretations.

Results: Factors that increased participants' satisfaction included: (1) CAST providers' experience with autism, which led to a more positive experience at CAST relative to experiences with other providers; (2) rapport between the provider and the patient or caregiver; and (3) spending less time waiting and more time with the provider. Factors that decreased participants' satisfaction included: (1) lack of access to services like on-site mental health counseling; (2) patients' difficulties communicating the way they're feeling to the provider; and (3) system-level barriers such as policies, practices, or procedures. Most participants confirmed that our interpretation was consistent with their experiences but wanted to point out that *"any negatives in no way outweigh the positives; not even close."*

Conclusions: Our findings demonstrate the importance of linking autistic patients with providers who are knowledgeable about autism to create positive healthcare experiences and rapport, thereby improving healthcare satisfaction. Additionally, we identified some aspects of CAST that can be targeted for continued improvement initiatives. In the short-term, our findings will help inform continued efforts to improve the quality of care provided to autistic adults who receive their healthcare through CAST. This work also adds to the growing body of literature demonstrating the effectiveness of patient-centered healthcare for autistic adults and the importance of having knowledgeable providers who are willing and able to care for this population.

## Social Cognition and Social Behavior

### PANEL SESSION — SOCIAL COGNITION AND SOCIAL BEHAVIOR

#### Panel 235 - Global Insights on Understanding and Reducing Autism Stigma

**Panel Chair:** Eilidh Cage, *Department of Psychology, University of Stirling, Stirling, United Kingdom*

**Discussant:** Jacqueline den Houting, *Macquarie University, Sydney, Australia*

Stigma involves the discrediting of an identity or a negative perception of differentness. Research shows that autism is a stigmatised identity, with non-autistic people holding both explicit and implicit negative biases against autistic people. Furthermore, stigma can be a life-limiting experience for autistic people: Exposure to stigmatising events and attitudes has been shown to relate to worse mental health outcomes and higher psychological distress for autistic people both in cross-sectional and longitudinal studies. Therefore, understanding stigma is an important endeavour within research, in order to reduce and prevent stigma. This panel brings together cutting-edge and novel research exploring autism stigma from the perspectives of non-autistic and autistic researchers, using a range of methods, in different settings, from multiple geographic regions. For example, the panel brings together research on stigma in educational settings in Scotland, the efficacy of a stigma-reducing intervention in non-autistic college students in the United States, qualitative experiences of stigma and community connectedness from a worldwide autistic sample, and a comparative cross-cultural study of stigma between the United States and South Korea. Insights from this panel will highlight means for reducing stigma and improving autism acceptance globally.

**235.001 (Panel)** “It’s Being a Part of a Grand Tradition, a Grand Counter-Culture”: A Qualitative Investigation of Autistic Community Connectedness, Stigma, and Identity

**M. Botha<sup>1</sup>, B. Dibb<sup>2</sup> and D. M. Frost<sup>3</sup>,** (1)*Psychology, University of Stirling, Stirling, United Kingdom,* (2)*School of Psychology, University of Surrey, Guildford, United Kingdom,* (3)*Thomas Coram Research Unit, University College London, London, United Kingdom*

**Background:** There is little research investigating the experiences of autistic community connectedness (ACC). This may be because autism is traditionally associated with lack of social motivation, or community. Yet, there are numerous social media groups, events, and community groups that autistic people use. Researchers, however, have yet to fully engage with the experiences that autistic people may have within this community. Studying community within minority groups is important because community may buffer against stigma.

**Objectives:** This study aimed to qualitatively investigate concepts of ACC in the autistic population.

**Methods:** Twenty autistic people were interviewed using a range of methods. Four formats for interviews were available – face to face, virtually using video-based software, over a text-based platform, or email. This was done to also allow for the inclusion of autistic individuals who struggled with face-to-face social interaction, who were situationally mute, or found text-based communication easier. We used critical grounded theory tools to guide study design and data analysis - including using theoretical sampling, and the constant comparative approach. Theoretical sampling means reviewing who has been included in a sample during data collection, and expressly aiming for particularly under-reached populations to ensure representative data. The constant comparative approach means continually reviewing the data as you collect it, and comparing it to what other participants are saying and what questions are being asked, and adapting the interview schedule according to data received by adding topics if they repeatedly come up. This allows the process to stay grounded in the data. The interviews were coded line by line, using grounded theory techniques to discern core categories, and sub-categories, and how they relate to each other.

**Results:** Core categories were ACC, stigma, and identity. Three elements of ACC were apparent in the data – belongingness, social, and political connectedness. Belongingness was described as a feeling of immense similarity to other autistic people. Social connectedness referred to the individual friendships formed within the community and included attending social events made by and for autistic people. Political connectedness referred to a connectedness to other autistic people as a minority group, and included activism around securing rights, reframing autism, reclaiming language, and combating stigma. Participants described the benefits of ACC as being increased self-esteem, a sense of direction, and access to a sense of community. Most participants were connected to the community in at least one way, yet two described themselves as completely unconnected. Stigma and discrimination seemed to push autistic people towards ACC, whereas an internalisation of that stigma seemed to push people away. The participants who were unconnected also did not consider autism central to their identity, unlike connected participants.

**Conclusions:** Despite autism being associated with a lack of motivation around friendships, there appears to be a vibrant autistic community. Three domains (belongingness, social, and political connectedness) appear to inform the broad construct of ACC. This community level togetherness may provide a form of social resource to help protect against stigma and discrimination, and work to further the political causes of the autistic community.

**235.002 (Panel)** Investigating the Implicit and Explicit Attitudes of Primary School Educators in Scotland Towards Autism  
*E. Cage and T. Doyle, Department of Psychology, University of Stirling, Stirling, United Kingdom*

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**Background:** In Scotland, autistic children and young people are most often taught in mainstream schools, with Scottish policy and legislation aiming for inclusion and equality. However, in recent years, issues with policy being reflected in reality have been highlighted, which has led to further efforts to improve the inclusion of autistic pupils. For example, the Scottish Government developed “The Autism Toolbox” in 2019 to support educator’s inclusive practices. Despite this, there have been few studies investigating the knowledge and attitudes of educators in Scotland towards autism, despite the fact that educator’s attitudes could be a significant barrier to effective inclusion.

**Objectives:** This study firstly aimed to investigate Scottish educator’s explicit and implicit attitudes towards autistic children. Secondly, we aimed to understand the relationships between educator’s attitudes, knowledge and experience.

**Methods:** Seventy primary school (i.e. elementary school) educators currently working in Scotland took part. The mean age was 43 and most were female ( $n = 64$ ), with an average 12 years of experience working in primary schools. Most participants were teachers (54%), but the sample also included other roles such as classroom support assistants (20%). The study was completed online and used both experimental and quantitative survey methods. Participants first completed a Single-Category Implicit Association Test (SC-IAT), designed to assess their implicit attitudes towards autistic children. They also completed two explicit attitude measures (behavioural intentions and cognitive attitudes towards educating autistic children), as well as measures of autism knowledge and their previous level of contact with autistic people.

**Results:** Overall, participants held positive attitudes towards autistic children in both explicit and implicit attitude measures. Some participants (24%) did express negative attitudes within the implicit measure – suggesting that they may have input socially desirable answers into the explicit measures. Correlation analyses indicated significant relationships between the explicit attitude measures (behavioural intentions and cognitive attitudes,  $p=.01$ ), but no relationships between the variables and implicit attitudes. Additionally, there were correlations between explicit attitudes, age and years of experience in education – such that older ( $p=.007$ ) and more experienced staff ( $p=.043$ ) had more negative attitudes. In regression analyses, only higher autism knowledge was a significant predictor of more positive explicit cognitive attitudes towards educating autistic children ( $p=.01$ ).

**Conclusions:** The findings indicate that in this sample, Scottish educators tended to have mostly positive explicit and implicit attitudes towards autism. Younger educators with less experience may in fact have more positive attitudes, perhaps reflecting societal changes in perceptions and greater exposure to autistic experiences in recent years. Enhanced knowledge also predicted more positive attitudes, replicating findings noted elsewhere in the literature. Together, these findings suggest that targeting knowledge may be an effective means of improving certain attitudes, and that Scotland’s educational policies do have the potential for supporting the inclusion of autistic children in schools. More work is needed with larger and more diverse samples of educators, as well as longitudinal research to monitor the ongoing effects of inclusive educational policy in Scotland.

**235.003 (Panel)** Effects of Autism Acceptance Training on Explicit and Implicit Biases Towards Autism  
*D. R. Jones, K. M. DeBrabander and N. J. Sasson, University of Texas at Dallas, Richardson, TX*

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**Background:** Despite efforts to improve autism awareness, stigma towards autistic people remains high (Gillespie-Lynch et al., 2020), with non-autistic (NA) individuals showing negative attitudes towards autistic people based on the behavioral and expressive differences that characterize autism (Sasson et al., 2017). These biases build exclusionary environments that contribute to poor personal and professional outcomes for autistic adults. However, because increased autism knowledge and familiarity are associated with more positive attitudes towards autistic people (Sasson & Morrison, 2019), training that targets these two factors may improve perceptions of autism.

**Objectives:** To determine whether training to improve autism knowledge and familiarity in NA adults is associated with more favorable attitudes about autism compared to general mental health awareness training and a no-training control condition.

**Methods:** 238 NA adults (mean age = 21.5) were randomly assigned to one of three conditions: 1) autism acceptance training (AAT), in which they viewed a 25-minute video featuring firsthand accounts from autistic adults (Boucher et al., 2020); 2) mental health training (MHT), in which they viewed a comparable video about mental health conditions other than autism; or 3) a

control condition, with no training video. After viewing the training, participants watched 20 brief videos of autistic adults and rated each on six social traits and provided their interest in interacting with them. Participants then completed measures assessing their autism knowledge, perceptions of autistic functional abilities, and autism stigma, as well as an implicit association task (IAT) to measure associations between autism and personal attributes.

**Results:** Participants in the AAT condition were less likely to agree with misconceptions about autism, including beliefs that autistic people are violent ( $p < .05$ ), do not show attachment ( $p < .01$ ), and are disinterested in friendship ( $p < .05$ ). AAT was also associated with more favorable explicit attitudes towards autistic people compared to both comparison conditions, including a higher desire to hang out with ( $p < .01$ ) or start a conversation with autistic adults ( $p < .05$ ), a greater openness to marry or date an autistic person ( $p < .05$ ), and greater perceptions of autistic social abilities ( $p < .05$ ).

In contrast, AAT was not associated with significant differences in implicit biases. Here, an association between autism and unpleasant personal attributes was detected ( $p < .001$ ) and did not differ significantly between training conditions.

**Conclusions:** While interventions to improve the social experiences of autistic adults have typically focused on encouraging autistic people to adopt more normative behaviors, the current study implements a training program focused on the behaviors of *non-autistic* adults. Here, we found that a brief video training was associated with more accurate autism knowledge and more favorable attitudes towards autism compared to both a general mental health training video and a control condition. However, the benefits of training were restricted to explicitly held attitudes, with negative implicit beliefs about autism present across training groups. It is unknown whether the training program would produce lasting effects or translate to increased inclusivity in real-world environments. Future studies investigating these effects are encouraged.

**235.004 (Panel)** A Cross-Cultural Comparison of Stigma Toward Autism in the US and South Korea

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**Background:** Stigma, defined as an attribute that is deeply discrediting (Goffman, 1963), negatively influences autistic individuals by instigating poor mental health, social exclusion, and discrimination. People in cultures that are considered more collectivistic tend to report higher autism stigma than people in the United States (US) (Someki et al., 2018). However, recent work suggests that a different cultural dimension than collectivism, vertical orientation, or accepting competition as a natural part of human interactions, predicts heightened autism stigma (Gillespie-Lynch et al., 2019). Through interviews with mothers of autistic children in South Korea, Grinker and Cho (2013) provided evidence that autism stigma is heightened in South Korea. They speculated that Korean mothers might reject the autism label to separate their children from a diagnosis they believe is hereditary and to protect the marriageability of relatives while avoiding community concerns about how an autistic child might impact other children's academic productivity. Despite these intriguing findings, no previous studies have compared autism stigma in South Korea to other cultures. Therefore, we conducted a cross-cultural comparison of autism stigma (i.e., desired social distance) in South Korea, a relatively collectivistic and ethnically homogeneous country, and in the US, a relatively multicultural and individualistic country.

**Objectives:** We aimed to: 1) determine if autism stigma is higher in South Korea than in the US, 2) examine if predictors identified in previous autism stigma literature (i.e., gender, autism knowledge, pleasantness and quantity of previous contact, openness to experiences, vertical individualism, horizontal collectivism, and concerns about productivity and bloodline) and 3) the broader prejudice literature (i.e., cultural tightness, or strict belief in societal norms, in-group enhancement, and out-group derogation) are associated with autism stigma.

**Methods:** Two-hundred ninety-six American and 494 Korean participants completed online surveys using Amazon's MTurk and Data Spring, respectively. Table 1 presents participant characteristics and a complete list of variables measured. A multiple regression predicting stigma was conducted with variables that were significantly correlated with stigma entered as predictor variables.

**Results:** Koreans reported higher autism stigma than Americans. As expected, the belief that an autistic person negatively impacts the romantic prospects of family members was associated with heightened stigma. Unexpectedly, this belief was heightened in the US relative to Korea. Heightened vertical individualism, lesser accurate autism knowledge, less pleasant and frequent previous contact with autism, and higher cultural tightness predicted greater stigma (Table 2).

**Conclusions:** As Grinker and Cho (2013) predicted, Koreans reported heightened autism stigma but only partially due to the reasons suggested in their qualitative work. Unexpectedly, Americans more strongly viewed autism as hereditary and as negatively impacting romantic prospects than Koreans. Cultural tightness, which is believed to be activated by ecological

catastrophes and predicts prejudice towards a range of other minority identities (Jackson et al., 2019), was associated with autism stigma. Given the ecological catastrophes we are currently facing, efforts to increase autism knowledge and foster pleasant and frequent contact with autistic individuals are needed to combat potential tendencies toward increases in autism stigma in both the US and South Korea.

## POSTER SESSION — SOCIAL COGNITION AND SOCIAL BEHAVIOR

### Poster 443 - Social Cognition and Social Behavior Posters

**443.001** (Poster) A Cross-Cultural Comparison of the Relation between Autistic Traits and Adherence to Politeness Norms  
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**Background:** Recent research on autism spectrum disorders (ASD) has drawn attention to camouflaging, or deliberately enacting neurotypical social behaviors (e.g., Hull et al., 2017; Lai et al., 2017). Such literature suggests that heightened autistic traits may result in over-adherence to social rules, even in situations that neurotypical individuals think merit exceptions. A contrary hypothesis—stemming from more conventional literature on social cognition in ASD—is that increased levels of autistic traits should predict increased difficulty with social norms. The norm of prosocial lying (e.g., lying to be polite) presents an interesting test of these two perspectives, as prosocial lying is a complex behavior with strong culturally-influenced expectations (Szarota & Cantarero, 2019). Examining the relation between autistic traits and prosocial lying can offer insight into social understanding and deliberate social performance in ASD.

**Objectives:** We examined the relation between prosocial lying and autistic traits in the U.S. and the Netherlands, two countries which differ on norms surrounding lying to be polite.

**Methods:** American participants ( $N=261$ , 148 males, aged 21-71, mean=36.5y) and Dutch participants ( $N=178$ , 41 males, aged 19-78, mean=39.8y) completed an online survey in which they reported on their likelihood of telling prosocial lies versus blunt truths across various scenarios (e.g., receiving a disappointing gift; giving feedback about a bad drawing). Participants also completed the Autism Quotient (AQ; Baron-Cohen et al., 2001; Hoekstra et al., 2008) to assess autistic traits. Participants were from the general population given that camouflaging may impact a broad spectrum of individuals.

**Results:** We first examined cultural differences in prosocial lying tendencies, collapsing across social scenarios. Consistent with past work, we found that Americans were significantly more likely to report both outright lying and masking (e.g., changing the subject; Wice et al., 2019) than Dutch respondents (masking Cohen's  $d=.60$ ). For Americans, increased autistic traits were associated with increased masking ( $r=.18$ ,  $p=.003$ ), particularly when giving feedback and discussing politics. In contrast, for the Dutch sample, AQ scores were not related to any specific prosocial lying strategies, and the difference in correlations between cultures was significant ( $p<.05$ ). This cross-cultural patterns of results held when examining male and female participants separately.

**Conclusions:** In American culture, social norms emphasize avoiding blunt truths and Americans with more autistic traits showed increased adherence to this norm via increased prosocial lying and masking. In contrast, heightened ASD traits were not related to prosocial lying behaviors in a Dutch sample, a culture which does not have such strong prosocial lying norms. These results suggest that individuals with ASD may show an adherence to culturally-emphasized social norms exceeding that of neurotypical individuals, potentially due to internalizing scripts governing interaction (e.g., do not tell hurtful truths). Our results are contrary to the hypothesis that increased ASD traits would relate to decreased sensitivity to social rules, but results may vary in clinical populations. Future work should consider the real-world prevalence of prosocial lying, given clinical work on prosocial lying in ASD (Bergstrom et al., 2016), as well as interpersonal consequences of over-adherence to social norms.

**443.002** (Poster) ASD Traits Predict Preference Towards Social Mimicry in a Subclinical Sample  
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**Background:** Individuals on the autism spectrum (ASD) show reduced tendency to spontaneously mimic others during social interaction (Hamilton, 2008). Ability to naturally mimic the actions of others within the context social communication confers benefits. It helps individuals form meaningful connections (Ashton-James et al., 2007), and creates generally favourable impressions of social interactions (Chartrand & Bargh, 1990). To-date no research has investigated whether poor social mimicry

skills are specific to autism or are a part of broader autism phenotype. To investigate responses to social mimicry, we employed a novel paradigm based on first impression ratings of social interaction. The experiment contained two critical conditions. Actors engaged in social interaction with mimicry present or in social interaction with no mimicry present. We hypothesised that given social mimicry indicates increased empathy and friendship between engaged parties (Chartrand & Bargh, 1999), participants would rate images containing mimicry more favourably than images where mimicry was not present.

**Objectives:** The study aimed to determine if images of individuals engaged in social mimicry would be rated more favourably than those engaged in interaction with no social mimicry. Further we investigated whether responses were modulated by traits associated with ASD.

**Methods:** 35 participants were recruited with age ranging 18 to 55. Participants completed the Autism Quotient. Four conditions were used in the study. These include images of individuals interacting with observable acts of social mimicry and individuals interacting without social mimicry. Images in these two conditions was reversed so that the two actors in each picture were facing away. The study employed a within participant design and participants viewed all images. Each image was displayed for 500ms and were asked to rate on a 7-point Likert Scale with “How pleasant do you find the image?”.

**Results:** As predicted, participants rated social mimicry images more favourably ( $M = 4.71$ ,  $SD = .58$ ) than interaction images ( $M = 4.17$ ,  $SD = .54$ ) and the results was statistically significant, ( $p = .006$ ). Participants were divided using median split (mdn = 21) of the AQ scores. Low AQ group rated the mimicking images more favourably ( $M = 5.03$ ,  $SD = .46$ ) than high AQ group ( $M = 4.45$ ,  $SD = .55$ ) and the result was statistically significant ( $p = .002$ ). Correlation analysis, including all participants, demonstrated strong negative correlation ( $r = -.71$ ,  $p < .01$ ) between first-impression rating of social mimicry images but not between AQ and interaction only images ( $r = -.13$ ,  $p = .47$ ).

**Conclusions:** To our knowledge, our study is the first to show that social mimicry affects the impressions viewers, who are not part of the interaction. Importantly the study demonstrates that this appreciation of social mimicry is reduced in individuals who do not have autism but score high in autism traits. Our study suggests that individuals with high autistic traits may experience different perception of social interaction and are less likely to pick up cues that indicate positive/friendly interaction. Further research is needed to determine whether lack of appreciation for these cues results in alerted social attention.

**443.003 (Poster)** Application of the Joint Engagement Rating Inventory to Preschool- and School-Aged Children with Autism Spectrum Disorder and Typical Development during a Parent-Child Free Play Interaction

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Background:

Parent-child interactions (PCI) are used to measure social and communication development (e.g., Adamson et al., 2004, 2010). Engagement states coding (Bakeman & Adamson, 1984) quantifies joint attention and social communication of infants, toddlers, and young children with autism spectrum disorder (ASD) during PCIs (e.g., Kasari et al., 2010, 2015). The Joint Engagement Rating Inventory (JERI; Adamson et al., 2018) is a seven-point scale measuring the quantity and quality of engagement states, and child-specific and dyadic behaviors. To date, the JERI has been used with toddlers and preschoolers; less is known about the JERI as a measure of preschool- and school-aged children’s social engagement.

Objectives:

In two studies, we examined how the JERI performed as a measure of social behaviors of preschool- and school-aged children with ASD (Study 1 and 2) and typical development (TD; Study 2) during PCIs. In both studies, we examined relationships between JERI items and clinical measures in ASD children. In Study 2, we explored JERI-derived composites and compared scores in ASD and TD groups.

Methods:

Participants included children with ASD (Study 1: N=145, Mean (Range) Age=63.73 (27-95) months; Study 2: N=81, Age = 71.68 (41-99) months) and TD (Study 2: N=18, Age=66.5 (37-96) months). A six-minute, lab-based, parent-child free play was rated using JERI items (Study 1: seven items; Study 2, eleven items). Clinical measures included: Vineland Adaptive Behavior Scales (VABS); Differential Abilities Scale-II (DAS-II)/Mullen Scales of Early Learning (MSEL); Clinical Global Impressions – Severity (CGI-S); Aberrant Behavior Checklist (ABC); Pervasive Developmental Disorder Behavior Inventory (PDDDBI). Analyses include descriptive statistics and Spearman correlations of JERI items with clinical measures, and ANCOVA comparing ASD and TD groups.

#### Results:

Distributions of JERI scores vary for items and groups (Tables 1, 2). For both ASD groups, JERI items and composites correlate with clinical variables in similar patterns (Table 1, 2). In Study 1, older age correlates with higher coordinated and symbol-infused joint engagement (JE) and lower unengaged (UN) ratings. In Study 2, older age correlates with higher ratings of all JE items, expressive language level (ELL), dyadic fluency/connectedness (FC), and both composites. In both studies, higher nonverbal cognition (NVIQ) and higher VABS socialization and communication correlate with higher JE and attention to caregiver (ATC), and lower UN. In Study 2, higher NVIQ and VABS scores also positively correlate with ELL, FC, responsiveness to partner's communication (RPC), and composites. ASD/TD group differences include JE, supported JE, ATC, RPC, and composites ( $F_s = 10.96-19.36$ ,  $p_s = .0001-.001$ ). Remaining JERI items have main effects of age and/or group. A main group effect and group by age interaction were detected for FC.

#### Conclusions:

Results demonstrate that the JERI can be used in preschool- and school-aged children with ASD and TD with some coding modifications to accommodate for wider language, age and developmental levels. For both ASD groups, JERI items correlate with age, developmental level, and clinical measures. JERI items and composites also distinguish ASD from TD groups. Composite JERI variables should be assessed for their ability to measure change in response to ASD interventions.

**443.004** (Poster) Attentional Bias to Positive and Negative Social Scenes Differs Based on Traits Related to Social Anxiety  
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**Background:** The social avoidance behaviors exhibited by individuals with autism spectrum disorder (ASD) closely resemble phenotypes of social anxiety disorder (SAD), a condition often co-morbid with ASD. Individuals with ASD and SAD have consistently shown variance in their implicit attentional biases to emotional facial stimuli although less research has investigated attentional biases to social scenes.

**Objectives:** The purpose of this study was to test whether participants varying in traits related to autism and social anxiety experience an attentional bias related to positive and negative images depicting social and non-social scenes.

**Methods:** Undergraduate students (n=146) completed a dot probe task. Images were selected from the International Affective Picture Systems. For each trial, two images were presented on either side of a computer screen. Whether the images were shown on the left or right was randomized, as well as where the dot was placed. In each trial, one image was always neutral, paired with either a positive or negative image. Images were presented for 500 ms before a dot appeared on one side of the screen. Participants then responded to where the dot was presented, and response time and accuracy were measured. Each participant then completed the Social Phobia and Anxiety Inventory (SPAI), Autism Quotient (AQ), and Broad Autism Phenotype Questionnaire (BAPQ).

**Results:** A 2 (Target Valence: Positive, Negative) x 2 (Target Subject: Person, Non-Person) x 2 (Non-Target Subject: Person, Non-Person) x SPAI mixed-model ANOVA with SPAI as a within-subjects variable was conducted. Results revealed a marginally significant 4-way interaction. When the analyses were conducted for Target Non-Person, there was no 3-way interaction. However, for Target Person, there was a marginally significant 3-way interaction,  $F(1, 138) = 2.82$ ,  $p = .095$ . For the positive target, there was not a 2-way interaction but for the negative target there was a significant Non-Target Subject x SPAI interaction,  $F(1, 138) = 4.72$ ,  $p = .032$ . For the condition in which the non-target did not depict a person there was not a significant correlation between social anxiety and attentional bias to the targets,  $r = -.10$ ,  $p = .242$ . When the non-target did show a person there was a significant correlation, such that participants with more social anxiety showed more attentional bias when there were negative targets depicting people when the non-target depicted a person,  $r = .21$ ,  $p = .011$ . There were no significant effects associated with measures of autistic behaviors.

Conclusions: The present results contribute to a growing literature that, although there is a clear correlation between autistic traits and social anxiety, these measures predict different outcomes on behavioral tasks. Therefore, it appears that there are underlying differential processing differences between mechanisms that contribute to autistic behaviors and those that contribute to social anxiety that need to be further elucidated. The present findings indicate that the SAD related traits showed more attentional bias towards stimuli that were negatively valenced that depicted people, fitting well into the existing literature that suggests anxiety in SAD is mediated by fear of negative evaluation by peers.

**443.005 (Poster) Autism/Autistic Traits and Belief in a Just World**  
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### **Background:**

In the social psychology literature, “general belief in a just world” refers to a self-serving illusion whereby, in general, people get what they deserve. A strong belief in a just world can be beneficial to one’s subjective well-being, but it can also increase one’s tendency to unjustifiably blame victims for their fates. In sum, believing that the world is generally just is a fallacy with both positive and negative implications.

Formally diagnosed autistic people and undiagnosed people high in autistic traits may be less likely to believe that the world is generally just compared to non-autistic people and people low in autistic traits. The literature suggests four reasons for this: autistic people and people high in autistic traits perceive themselves to be treated less justly (i.e., they possess a weaker “personal belief in a just world”), have a higher external locus of control, tend to be less self-deceptive, and tend to be less influenced by their environments in terms of social norms.

### **Objectives:**

Two studies investigated the hypothesis that autistic people and people high in autistic traits are less likely to believe in a generally just world than non-autistic people and people low in autistic traits. In addition, potential reasons for this assumed relationship were analyzed.

### **Methods:**

Study 1: A diverse sample of 588 participants from the USA (including 60 with formal autism diagnoses) completed established psychometric scales on general belief in a just world and autistic traits. A subsample of 388 participants also completed scales on personal belief in a just world, locus of control, and the tendency for self-deception.

Study 2: A diverse sample of 249 participants from the USA (social norm: strong belief in a just world) and 241 participants from Great Britain (social norm: weak belief in a just world) completed scales on general belief in a just world and autistic traits.

In addition, in the two studies, control variables, such as cognitive ability, were assessed.

### **Results:**

Study 1: Formally diagnosed autistic participants were less likely to believe in a generally just world than non-autistic participants,  $p < 0.001$ ,  $d = 0.73$ . Among non-autistic participants, autistic traits correlated negatively with general belief in a just world,  $r = -0.23$ ,  $p < 0.001$ . As expected, these relationships were mediated by personal belief in a just world, locus of control, and the tendency for self-deception.

Study 2: As expected, the cultural environment moderated the negative relationship between autistic traits and general belief in a just world (USA:  $\beta = -0.25$ ,  $p < 0.001$ ; Great Britain:  $\beta = -0.07$ ,  $p = 0.24$ ); see Figure 1.

### **Conclusions:**

In cultural environments where general belief in a just world is relatively pervasive, autistic people and people high in autistic traits seem to be less likely to internalize the social norm of belief in a just world. These studies point to autistic strengths (realistic views and a low tendency for self-deception) and well-being risks (weak self-serving views). Self-honesty and views on justice may play relevant roles in autism-related therapies.

**443.006 (Poster)** Autistic Adults, but Not Non-Autistic Adults, Accurately Detect Social Interest of Conversational Partners  
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**Background:** High meta-accuracy, or the degree to which individuals perceive how they are viewed by others (Vazire & Carlson, 2010), is associated with positive social interaction outcomes (Steinmetz et al., 2017). In autism, studies of meta-accuracy have produced mixed results, with those measuring it in real-world scenarios (Usher et al., 2018) failing to show the impairments reported from more indirect assessments (Locke & Mitchell, 2016; McMahon & Solomon, 2015; Sasson et al., 2018).

**Objectives:** The current study examines metaperceptive abilities of autistic and non-autistic (NA) adults during real-world social interaction.

**Methods:** Sixty-seven autistic males and 58 NA males comparable on race and IQ were assigned to one of three dyadic conditions: autistic only (22 pairs), NA only (23 pairs), or autistic and NA (25 pairs). Participants completed a 5-minute “get-to-know-you” conversation with an unfamiliar partner, then evaluated the interaction and their partner using The Social Interaction Evaluation Measure (SIEM) and the First Impression Scale (FIS), with both measures also reworded participants to assess metaperceptions. Finally, the Beck Depression Inventory (BDI) was completed to control for depression in analyses.

**Results:** Data were analyzed using dyadic analysis and the truth and bias model. Participants who rated the interaction as higher quality, and their partners as more attractive and trustworthy, predicted that their partners would rate them positively on these items. However, participants underestimated how their partner perceived the quality of the interaction ( $p < .001$ ) and overestimated how dominant/aggressive ( $p = .008$ ) they were perceived. NA’s metaperception for intelligence was negatively related to partner’s ratings, such that NA participants who perceived themselves to be more intelligent were rated as less intelligent by partners ( $b = -.038$ ,  $SE = .015$ ,  $p = .02$ ), but this relationship was not found for autistic adults ( $b = .018$ ,  $SE = .013$ ,  $p = .16$ ). An interaction of actor diagnosis with the partner’s social interest ( $p = .003$ ) revealed that autistic actors’ metaperception for social interest was related to how their partners evaluated them ( $b = .47$ ,  $SE = .17$ ,  $p = .007$ ), such that autistic adults were accurate in predicting their partners’ social interest (e.g., autistic adults who believed their partner would rate them low on social interest actually did rate them low). This did not occur for NA participants.

**Conclusions:** These findings indicate that for some traits and social interest, both autistic and NA adults use their own perceptions as a baseline for predicting how they are perceived by others. In contrast, meta-accuracy for social interest differed between the autistic and NA participants regardless of the diagnosis of their partner. Autistic adults, but not NA adults, accurately predicted when their partner expressed low interest in future interaction with them.

This higher level of meta-accuracy for social interest among autistic adults is inconsistent with a social cognitive deficit model and differ from the “self-enhancement bias” found in NA adults in which they tend to overestimate how others’ perceive them. Findings from this study suggest that social interaction difficulties for autistic adults are likely driven by complex and dynamic processes rather than a simple social deficit model.

**443.007 (Poster)** Autistic Community Connectedness As a Moderator of the Effect of Minority Stress on Mental Health in the Autistic Population

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**Background:** Autistic people often have worse mental health than non-autistic people. Stigma, discrimination may play roles in mental health. The minority stress (MS) model predicts that socially marginalised groups will be exposed to an increased stress burden, while having fewer social resources with which to cope, resulting in health disparities. Previously, extending the MS model to understand mental health in the autistic community proved useful. In a cross-sectional study, exposure to MS explained a significant and large degree of the variance of mental, social, and emotional health. There was no non-autistic comparison group however, and the study did not take in to account potential community level coping resources, such as community connectedness. Intra-community connectedness may help to ease the burden of minority stress.

**Objectives:** This study aimed to investigate whether there are intergroup differences in mental health, wellbeing, and social resources (as the MS model hypothesizes) between a comparative autistic and non-autistic sample. It also aimed to test whether MS predicted worse mental health in the autistic community, and whether ACC moderated the impact of MS on mental health.

**Methods:** A sample of 195 autistic and 188 non-autistic people was used. Validated scales of MS, social resources, mental health, and ACC were administered. While we administered measures of social resources to test whether there was a gap in social

resource scores, ACC was the only social resource we had interest in testing moderation for specifically because it is a community level resource. Focusing on individualistic social resources can result in victim blaming minorities for worse outcomes. It was hypothesized that the autistic cohort would have significantly lower mental health and social resource scores, that minority stress would predict a significant variance of mental health scores, and that higher ACC would moderate the impact of MS on mental health.

**Results:** The autistic sample were more likely to be above the threshold indicating severe psychological distress, higher depression, and lower psychological, social, and emotional wellbeing, and rated themselves as having significantly lower social resources compared to the non-autistic sample, with the exception of resilience (with medium to large effect sizes). Moderated hierarchical regression analysis showed that exposure to MS predicted a large degree of variance in mental health and wellbeing in the autistic sample, despite controlling for key demographics and general life stress, and lastly, that higher ACC moderated the impact of MS on mental health.

**Conclusions:** There are large disparities in the mental health, wellbeing, and social resources between autistic and non-autistic people. Autistic participants were more likely to have mental health scores suggestive of mental ill-health, and lower social resources. The MS model continues to provide a coherent theoretical and empirical model for understanding mental health in autism. Despite the autistic community being associated with a lack of community, this research demonstrates the utility of ACC. The results suggest that addressing systemic inequality that results in stigma, discrimination, while promoting autistic community connectedness MS may be key to addressing mental health disparities in the autistic community.

**443.008 (Poster)** Autistic Girls Smile More Than Autistic Boys during Natural Conversations: Insights from Computer Vision  
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**Background:** Autism in females is understudied and poorly understood, leading to underdiagnosis and missed intervention opportunities. This may stem from autistic females displaying more contextually appropriate social cues, sometimes attributed to “camouflaging” or actively conforming to social expectations. We examined the effects of sex and autism diagnosis on a key social behavior that carries gendered expectations – smiling. We hypothesized that autistic females would conform to typical sex-based social norms, by smiling more often – and more typically – during social interactions compared to autistic males.

**Objectives:** (1) Use novel computational methods to characterize smiling behavior during brief, naturalistic conversations; (2) Test for sex differences in the magnitude and quality of smiling behavior using a 2 (autism/neurotypical) x 2 (male/female) design; (3) Examine how smiling behavior influences social partners’ perceptions of autistic males and females.

**Methods:** We used state-of-the-art computer vision to characterize smiling in 60 autistic (20 female) and 67 age- and IQ-matched neurotypical (25 female) participants during unstructured conversations with unfamiliar, non-expert adults. Immediately following the conversation, the adult completed a brief rating scale regarding his/her perception of the quality of the interaction. Autistic males and females were matched on autism characteristics per established clinical scales (ADOS-2, SCQ). Using automated facial analysis, smiling was digitized frame-by-frame and operationalized as the average magnitude (area under the curve) of the two standard facial movements that comprise a smile (lip corner pulling and cheek raising). Smile quality was operationalized as the degree of correlation between the activity in these two standard facial movements (because co-occurring activity across these two locations constitutes a prototypical smile).

**Results:** A diagnosis x sex ANOVA indicated that females smiled more than males ( $p=.01$ ,  $\eta^2=.09$ ) and neurotypical participants smiled more than autistic participants ( $p<.001$ ,  $\eta^2=.05$ ), with no diagnosis x sex interaction. Autistic females’ smiling was increased relative to autistic males ( $p<.01$ ), and was more comparable to neurotypical males. The same pattern emerged for smile quality – smiles were more prototypical in females relative to males ( $p=.02$ ,  $\eta^2=.05$ ) and in neurotypical participants relative to autistic participants ( $p<.001$ ,  $\eta^2=.09$ ), with no interaction. Spearman correlation indicated that the relationship between smile magnitude and interaction quality ratings approached statistical significance within the autism group as a whole ( $r_s=.27$ ,  $p=.067$ ). However, when the same analysis was broken down by sex, this pattern seemed to be driven only by autistic males ( $r_s=.30$ ,  $p=.108$ ) and not autistic females ( $r_s=-.07$ ,  $p=.80$ ).

**Conclusions:** Results suggest that sex-based societal display rules for normative facial expressiveness may leave autistic females appearing more typical in their social behavior than male peers. Failing to analyze autistic males and females separately (and compared to sex-matched peers) may mask important differences in their behavior, and in how they are perceived by social partners. Furthermore, the failure of established autism assessments to consider sex differences in core social behaviors may drastically reduce sensitivity for detecting autism in females. Objective, granular computational behavior analysis has vast

potential for detecting these underrecognized sex differences in autism.

**443.009 (Poster) Autistic Traits, Psychosocial Factors, and Depressive Symptoms**

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**Background:** Higher rates of depression and of depressed mood are associated with autism and autistic-like traits (Lever & Geurts, 2016; Lundström et al., 2011). In addition, both autistic traits and depressive symptomology are associated with social interaction factors, such as social self-efficacy (Rosbrook & Whittingham, 2010), social motivation (Corbett et al., 2014, Swain et al., 2015) and loneliness (Hedley et al., 2018; Reed et al., 2016). Those with autistic-like traits may differ in both their social motivation and social self-efficacy when interacting with others which may in turn have an impact on depression and loneliness. It is important to test the pathways between autistic-like traits, psychosocial difficulties and depressed mood.

**Objectives:** 1) Test whether autistic-like traits are correlated with social self-efficacy, social motivation, and loneliness; 2) Determine potential pathways linking autistic-like traits to depressive symptoms via psychosocial predictors.

**Methods:** 660 participants (529 women) completed measures of autistic-like traits (AQ), social self-efficacy (Social Self-Efficacy Scale), social motivation (Social Striving Assessment Scale), loneliness (UCLA Loneliness Scale) and depressive symptoms (Beck Depression Inventory II). Relationships between psychosocial factors and depressive symptoms were examined with linear regressions. The potential pathway of these relationships was then assessed using a mediation analysis.

**Results:** Autistic traits ( $\beta = .21, t(653) = 10.53, p < .001$ ) and loneliness ( $\beta = .45, t(594) = 7.34, p < .001$ ) were positively related to depressive symptoms, while social self-efficacy ( $\beta = -.28, t(602) = -11.4, p < .001$ ) and social motivation ( $\beta = -.37, t(531) = -7.33, p < .001$ ) were negatively related. The relationship between autistic traits and depressive symptoms was fully mediated by the other three factors ( $\beta[\text{indirect}] = .005, z = 2.63, p < .01$ ;  $\beta[\text{direct}] = .05, z = 1.58, p > .05$ ), forming a pathway from autistic-like traits, to social self-efficacy, to social motivation, to loneliness and finally to depressive symptoms.

**Conclusions:** Results indicate that autistic-like traits are related to depressive symptoms via social self-efficacy, social motivation, and loneliness. These results suggest that targeting social self-efficacy may break this pathway and disrupt this relationship. Interventions should consider the double empathy problem when addressing social domains to provide adapted support (Crompton et al., 2020; Milton, 2012).

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**443.011 (Poster)** Behavioral Synchrony and Empathic Response to an Interaction Partner's Distress in Adolescents with and without ASD

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**Background:**

Behavioral synchrony, the spontaneous coordination and congruence of behaviors between interacting partners in both form and timing, is an important component of successful social interaction, which has been linked to perspective taking and expressions of empathy. Notably, it has been suggested that flexibly going in and out of synchrony reflects adaptive social reciprocity and fosters empathic response. Behavioral synchrony and flexibility in synchronization, as well as empathic behavior, has been shown to be altered in many individuals with ASD. However, findings are mostly based on questionnaires and computerized tasks, and further examinations using ecologically valid paradigms are needed.

**Objectives:**

To examine behavioral synchrony dynamics during social interaction in two contexts – friendly conversation, and empathic concern.

**Methods:**

Twenty-two adolescent males with ASD (clinical diagnosis verified using ADOS-2) with no intellectual impairment, and twenty-two typically developing (TD) male controls, matched on age and cognitive abilities, were video-recorded while participating in a social interaction sequence that included a friendly conversation with a confederate, a sudden expression of distress by the confederate (following a disturbing text message), and a return to a friendly conversation. Socio-emotional behaviors during these three stages were coded minute by minute by trained blind raters, for participants' commenting and asking questions, prosocial behavior and synchronization of nonverbal behavior. In addition, movement synchrony was analyzed using Motion Energy Analysis (MEA; Ramseyer, 2020), an automated method quantifying frame-to-frame difference.

**Results:**

On average, adolescents with ASD were rated as less synchronized with the social partner throughout the interaction. Group by stage interaction was found, revealing that while TD adolescents were less synchronized in the distress stage compared to the friendly stages, adolescents with ASD maintained constant, and lower, levels of synchrony (Figure 1). Contrarily, groups did not differ on empathic behavior ratings. MEA revealed diminished movement synchrony in the ASD group compared to controls, as well as an interaction effect: while TD adolescents showed less synchrony in the distress stage compared to the friendly stages, no such difference was found in the ASD group (Figure 2).

**Conclusions:**

Adolescents with ASD displayed lower levels of synchrony with the social partner. Moreover, whereas TD adolescents displayed shifts in synchrony when facing the social partner's distress, among adolescents with ASD such shifts were not observed. These patterns were found both for behavioral coding and for MEA analysis. Contrarily to previous studies, empathic behavior did not differ between groups. It is possible that adolescents with ASD relied adequately on social knowledge regarding *what* to say to the distressed other, but struggled with *how* to say it, i.e., with timing and coordinating the response with non-verbal aspects of communication, of one's own and of the social partner.

**443.012 (Poster)** Biological Motion and Action Perception in Autism: A Systematic Review

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**Background:** Detecting and recognising the movements of other people is essential for understanding other's actions or intentions and giving appropriate reactions during social interaction. Biological Motion (BM) is Point-light displays (PLDs) are commonly used to test the BM which contained low-level form and kinematic information. Researchers found humans can easily recognise actions and emotions from these PLDs, and could easily recognise actions and the gender of actors from PLDs as well as emotions.

**Objectives:** Previous research suggests that autistic individuals have reduced biological motion perception compared to non-autistic individuals. The current review aimed to explore whether task and stimulus characteristics influence group differences in BM processing ability and whether BM processing ability in autistic individuals is related to non-biological motion processing ability.

**Methods:** This systematic review was conducted according to PRISMA guidance during June and July 2020 and searched five electronic databases. Following exclusion criteria, 33 articles that used behavioural methods to compare autistic and neurotypical individuals are included. Studies were separated into three categories ranging from least to most complex: detection of human motion, discrimination of action features, and recognition of human action. Within these categories, stimulus complexity was further considered according to the number of response choices, background distraction, and the number of target agents.

**Results:** For detection of human motion, Point Light Displays (PLDs) were widely used, and autistic children and adults reported less accuracy in BM detection than neurotypical individuals. Meanwhile, the performance is positive correlate with IQ score among autistic individuals. PLDs, pictures, and video clips were used in the discrimination and recognition task, and both groups performance equality in speed discrimination tasks. However, autistic individuals showed challenging to recognise actions in low context information stimuli and more than one actor's social interaction condition. For non-biological motion (non-BM), autistic individuals showed less accuracy in coherence motion compare with neurotypical individuals, and this may lead to the deficit for social interaction actions. Whereas, there is no group difference on the threshold for the non-BM task.

**Conclusions:** The children and adults showed more difficult on BM processing, and the performance highly depends on the IQ. Meanwhile, autistic individuals are more challenging to recognise low context information actions and difficult integrating local motion in non-BM. Further studies could more compare BM processing in a social environment with low or high context information.

**443.013 (Poster)** Camouflaging of Autistic Traits in Non-Autistic Adults Is Associated with Poorer Mental Health  
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Background:

Camouflaging refers to a range of coping strategies used by autistic people to minimise the visibility of traits or behaviours characteristic of autism. Camouflaging involves suppressing behaviours associated with autism, minimizing responses to sensory overstimulation, adopting a 'mask' or persona during social interactions, and developing explicit compensatory strategies to meet social and communication demands. Camouflaging is associated with poor mental health in autistic people. Camouflaging of autistic traits has also been reported in non-autistic people. A substantial body of research has demonstrated that elevated levels of autistic traits are associated with poorer mental health in non-autistic people, however the exact nature of this relationship remains unclear. Camouflaging may be an important variable in the relationship between mental health and autistic traits. Previous research has suggested that executive function resources may support camouflaging behaviours, however the relative importance of specific executive functions are unknown.

Objectives:

This study examined the manifestation of camouflaging in non-autistic adults. The primary objective was to examine the role of camouflaging in the known relationship between autistic traits and mental health problems in non-autistic people. The study also explored the association between different executive functions and camouflaging.

Methods:

Sixty-three non-autistic adults completed standardised self-report questionnaires which measured: autistic traits (Autism-Spectrum Quotient) , mental health symptoms (Depression, Anxiety, Stress Scales) (DASS), and camouflaging behaviours (Camouflaging Autistic Traits - Questionnaire). In addition, a subset (n=51) completed three tests of executive function measuring inhibition, working memory, and set-shifting. Multiple linear regression models were used to analyse data.

Results:

There was a significant positive relationship between autistic traits and a measure of mental health which incorporated anxiety, depressive and stress symptoms. However, when taking account of self-reported camouflaging in the regression model, the

relationship between autistic traits and mental health was no longer significant. Camouflaging instead emerged as a significant predictor of mental health, such that increased camouflaging was associated with increased symptoms of poor mental health when controlling for autistic traits. Closer analysis of the specific subscales of the DASS revealed a similar pattern of results across the three domains of anxiety, depression, and stress. Camouflaging did not correlate with any measure of executive function

Conclusions:

These findings have implications for understanding the relationship between autistic traits and mental health in non-autistic people and add to the growing development of theory and knowledge about the effects of camouflaging. The findings suggest that it is the camouflaging of autistic traits which is associated with poor mental health in non-autistic adults rather than autistic traits themselves. The role of autistic traits as an independent risk factor for poor mental health should be reconsidered in a framework incorporating the construct of camouflaging.

**443.014** (Poster) Can Autistic Children Discriminate Intentional from Incidental Pointing Gestures in a Word Learning Context?  
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Background: One early sign of Autism Spectrum Disorder (ASD) is a reduced response to joint attention characterized by, among other traits, a failure to follow someone's pointing (American Psychiatric Association, 2013). Studies have highlighted the fact that autistic children show impairments in using social cues to respond to joint attention (Dawson et al., 1998) and to acquire the meaning of words (e.g. Preissler & Carey, 2005). Nonetheless, the specific role of pointing following remains hard to isolate as it is often studied in combination with other cues such as eye gaze. One recent study has shown that autistic children are able to follow gaze and pointing cues, both combined or in isolation, to learn new words (Field, Lewis, & Allen, 2019). Interestingly, the authors reported that the children also mapped the new words to the new objects when the pointing cue was incidental (viz. speaker pointing at target while looking off into the distance towards the other direction).

Objectives: Using a stricter definition of incidental pointing, we seek to investigate if 3- to 5-year-old autistic (58) and typically-developing (61) children follow intentional pointing gestures and are able to differentiate them from incidental pointing gestures.

Methods: Stimuli were videos of a person sitting at a table while looking at the camera, displayed on a screen equipped with a mobile eye-tracker. During the first phase of the video, the actor uttered a pseudo-word while pointing intentionally with one finger towards one corner of the table and pointing incidentally towards the other corner of the table with his other arm (e.g. hand placed behind the neck and elbow pointing towards the corner of the table). The second phase consisted of a snapshot of the last frame of the video from the first phase. In both pointed corners of the table, a drawing of two different imaginary animals appeared in a cloud of smoke (see Figure 1).

Results: A Group x Time interaction on the relative distance between the children's fixations and the two pointed-at corners of the frame revealed that, upon hearing a novel word, TD children tend to be shifting their visual attention closer to the corner pointed intentionally, whereas no such trend is visible in the ASD group ( $\chi^2(1) = 24.26, p < .001$ ). Moreover, both verbal and nonverbal autistic children struggle with pointing gestures as no significant main effect of raw expressive vocabulary was found in the ASD group ( $p = .93$ ).

Conclusions: Unlike TD children, autistic children fail to discriminate between intentional and incidental pointing gestures in a word learning context when no other social cues are available. However, such difficulty doesn't seem to prevent some autistic children to acquire vocabulary as all of them, regardless of their level of language, attend to pointing gestures in the same manner.

**443.015** (Poster) Comparison of Social Skills Deficits and Strengths Profiles in Youth with Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder  
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Background: While impairments in social functioning are common for individuals with Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), these challenges present differently across populations. Recent literature suggests that ASD youth may exhibit more acquisition deficits (i.e., lack of knowledge of what to do) and fewer performance

deficits (i.e., enacting known behaviors) than ADHD youth, while both populations should demonstrate fewer social skill strengths than typically developing (TD) peers (Mikami et al., 2019). A method for assessing within-person distributions of social skills deficits and strengths (Gresham et al., 2010) — or a Social Skills Deficit and Strengths Profile (SSDSP) — has recently been developed, and can test this hypothesis by systematically examining ASD and ADHD youth SSDSPs. Indeed, one recent study has used the SSDSP in youth with ADHD, discovering greater social skill performance deficits, fewer strengths, and equivalent acquisition deficits compared to TD youth (Aduen et al., 2018).

**Objectives:** The present study tested the aforementioned ASD/ADHD hypothesis using the SSDSP in ASD, ADHD, and TD youth.

**Methods:** Parents of 254 youth with and without ADOS-2 confirmed ASD completed the Social Skills Improvement system (SSIS; Gresham et al., 2010), and the aforementioned method was applied to create an SSDSP for each population (See Table 1). Data from 47 youth with ADHD were extracted from Aduen et al., (2018). Independent *t*-tests compared SSDSPs across ASD and TD youth and the extracted ADHD data. Paired *t*-tests investigated within-group distributions (Figure 1).

**Results:** Analyses revealed that ASD youth exhibited significantly more acquisition deficits than ADHD youth ( $p < .05$ ), and significantly more deficits and fewer strengths than TD youth (all  $p < .001$ ; Table 1). ASD and ADHD youth did not significantly differ on performance deficits or social skill strengths. ADHD youth had comparable acquisition deficits and skills strengths, but significantly more performance deficits ( $p < .001$ ), than TD youth. Though ASD acquisition deficits were *more* prevalent relative to ADHD and TD youth, they were still less prevalent than strengths; performance deficits were the most prevalent aspect within ASD group SSDSPs (all  $p < .001$ ; Figure 1).

**Conclusions:** As expected, ASD youth exhibit significantly more acquisition deficits than ADHD youth. Though past work suggests ASD youth should display fewer performance deficits and skill strengths than ADHD youth (Mikami et al., 2019), rates were comparable in these samples. Importantly, ASD and ADHD groups showed high rates of performance deficits relative to TD youth, suggesting they share a profile of learned social skills that are not being enacted. Notably, though ASD youth obtained about twice as many acquisition deficits as ADHD and TD youth, acquisition deficits remained the least prevalent aspect of the within-ASD SSDSP. This highlights that, while uniquely pronounced, difficulties in acquiring social skills do not categorically define social challenges in ASD. Indeed, they appear to exhibit a similar prevalence of social strengths as youth with ADHD. Utilization of the SSDSP offers promising opportunities for more nuanced examination of social difficulties across youth populations.

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**443.016 (Poster) Concerns and Stress Among Autistic and Neurotypical Adolescents during the COVID-19 Pandemic**  
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**Background:** Autistic individuals typically find disturbance to routines as aversive and disruptive (Glass, 2001), and might therefore be especially affected by the Covid-19 pandemic. This may result in exacerbated symptoms of stress and anxiety, which are more prevalent in autistic individuals as compared to neurotypicals (Gillott, Furniss & Walter, 2001). Additionally, In typical development adolescence is a time of increased awareness and interest in peer relationships (Steinberg & Morris, 2001), which may become compromised due to social-distancing.

**Objectives:** The current study aimed to assess levels of experienced and observed stress of youths, and to examine how this is related to the specific concerns youths with and without ASD have regarding Covid-19.

**Methods:** 155 parents of 10-16-year-old adolescents (mean age 13.47 years, N=57 autistic) participated in the study. Data was collected July-September 2020, two months after the end of the first lockdown due to Covid-19 and right before a second lockdown, as cases began to rise. Parent- and self-report regarding adolescents' pandemic-related concerns were collected using the Covid-19 Adolescent Symptom and Psychological Experience Questionnaire (CASPE; Pfeifer et al., 2020). Exploratory factor analysis showed best fit for four factors: health concerns; instrumental concerns; concerns about family relationships; and concerns about social relationships. All of which were used as predictors of parent and child-reports regarding adolescent's stress and negative impact (NE) of the pandemic on daily-life.

**Results:** Two ANOVA analyses (IVs: diagnosis, sex, controlled for age) showed that autistic adolescents experienced higher levels of stress and NE, based on parent-report, but not self-report (see Table 1). Parent- and self-report stress significantly correlated overall ( $r(122) = .309, p < .01$ ) and in the neurotypical group ( $r(78) = .350, p < .01$ ). Although the correlation was not significant in the autism group, the difference between correlations was not significant  $z = -.48, p = 0.6312$ . Linear regression were used to examine the relationships between youths' concerns and stress or NE. Age was controlled for in all analyses but was not significant. See all models in Table 2. Parent-reported stress was predicted by female sex, autism diagnosis, and higher health

concerns. Whereas self-reported stress was positively predicted by concerns about family relationships and the interaction between diagnosis and concerns about social relationships. An examination of the interaction effect shows a positive relationship between concerns about social relationships and higher levels of stress for autistic, but not neurotypical youth ( $r=.306$   $p$ -value $=.044$  and  $r=.030$   $p$ -value $=.795$ , respectively). Higher parent-reported NE was predicted by female sex, autism diagnosis, higher health-concerns, and concerns about social relationships. Conversely, only concerns about family relationships positively predicted self-reported NE.

Conclusions: Parents and youths' judgments about their stress levels are correlated, but seem to relate to different aspects of youths' experiences, although the majority of these relate to the social aspects of the pandemic. Parents of autistic youths find them to be more stressed than they perceive themselves to be, which emphasizes the need to better understand the subjective experiences of parents and children during crises and the cause of the gaps between those views.

**443.017 (Poster)** Correlation between Face-to-Face and Digital Social Interaction and Suicidality in Autistic and Socially Anxious Individuals

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Background: Research has consistently shown that social support has an important role in predicting suicidal ideation, especially in non-autistic samples. However, few studies have investigated suicidal fluctuations driven by day-by-day social interaction. Even fewer have done this with autistic samples. Some that have done daily analysis have found an inverse relationship between perceived social support and same-day and next-day suicidal ideation. Differences in this correlation between autistic and non-autistic socially anxious individuals have yet to be fully investigated.

Objectives: To analyze the predictive relationship between face-to-face or digital interactions and suicidal ideation in autistic and in socially-anxious non-autistic participants.

Methods: Each participant was administered daily surveys through the MetricWire application on their phone. Part of these surveys asked the participants to rate their social interactions experienced during the day on a scale of 0-100. They were also asked to rank the frequency and severity of suicidal thoughts. These scores were combined to create a singular suicidal index score. The social interactions and suicidal index scores were then compared with a linear regression both individually and on a group level.

Results: During the tracking period just 11% of non-anxious controls ever experienced a suicidal thought during the day, while 92% of autistic participants and 84% of anxious, non-autistic participants reported at least some suicidal thinking. However, the mean number of days with some suicidal ideation, the mean intensity of suicidal ideation, and the frequency of suicidal thoughts within the hour immediately previous to nighttime reporting were all significantly greater in the socially anxious than the autistic group. Contrary to our hypothesis, a significant linear regression model showed daily social interactions, whether face-to-face or digital, did not predict daily suicidal thinking. Rather group membership was the strongest predictor, with socially-anxious but non-autistic participants showing greater intensity and frequency of suicidal ideation, with no difference in intentionality to act on suicidal impulses. The trait measure of LSAS total score was the driving force in predicting the intensity of daily suicidal thoughts. The strength of correlations between LSAS score and intensity of suicidality were stronger for the socially-anxious than autistic group.

Conclusions: While daily social interactions, either face-to-face or digital, did not predict suicidal thinking on a daily basis, the frequency and intensity of the suicidal ideation were significantly higher in the socially anxious group than in the autistic group. No difference between the groups was seen in the intention to act on suicidal impulses, but the socially anxious group presented stronger intensity and frequency of suicidality.

**443.018 (Poster)** Determining What Factors Contribute to Atypical Social Motivation in ASD

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**Background:** The social motivation theory posits that autism spectrum disorder (ASD) deficits emerge from the downstream consequences caused by reduced social motivation (Chevallier et al., 2012) (i.e., desire and valuation of engaging with others). For instance, without an intrinsic desire to engage with others during early development, children may not orient to the social world, demonstrate their enjoyment in social experiences, or subsequently, work to engage and maintain social connections.

Despite evidence that social motivation problems are elevated in males (Sedgewick et al., 2016), age (Clements et al., 2018), and linked to particular genetic etiologies of ASD (Beighley et al., 2019), there is a lack of clarity regarding what factors contribute to social motivation problems.

**Objectives:** We aimed to determine if core ASD features related to social motivation in children with ASD by examining what factors predict social motivation.

**Methods:** Data were obtained from three large cohorts of children with a confirmed ASD diagnosis (see Table): two cohorts ascertained for ASD ( $n=2809$  from Simons Simplex Collection, Fischbach & Lord, 2010;  $n=127$  from ZEBRA study) and one cohort ascertained for an ASD or intellectual disability associated genetic etiology ( $n=117$  from TIGER study). Social motivation was measured via the Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012) subdomain.

**Results:** Linear mixed effects models included ASD severity symptoms, sex, age, nonverbal cognition, and genetic etiology (i.e., the presence or absence of a pathogenic likely-gene disrupting mutation (LGDM)). Rather than inputting overall ASD severity via the overall calibrated severity score (CSS) on the ADOS-2 Rutter et al., 2012), separate scores for social affect and restricted and repetitive behavior to avoid collinearity. Increased social affect problem severity and age predicted increased social motivation problems,  $F(1,2288) > 40.53, p < .001$ , whereas lower nonverbal cognition and sex predicted decreased social motivation problems,  $F(1,2288) = 15.2, p < .001$ . Females were predicted to have fewer social motivation problems,  $F(1,2288) = 9.77, p = .002$ . Social motivation problems were not predicted by RRBs or the presence of an LGDM,  $F(1,2288) > 1.90, p = .17$  (see Figure).

**Conclusions:** Considering the association with social affect severity, our findings provide additional support for the social motivation hypothesis of ASD (Chevallier et al., 2012) and extend our understanding of the unique contributions across different factors. Importantly, both sex (significant predictor) and presence of LGDM (not a significant predictor) presented with large confidence intervals (2.7 & 2.6, respectively), suggesting areas of heterogeneity for future targeted analysis.

**443.019 (Poster)** Development of a Coding Scheme for Social Interactivity in ASD and Related Developmental Disorders  
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**Background:** Learning in individuals with autism spectrum disorder (ASD), particularly those with severe intellectual deficiencies, is often impaired. Among the factors responsible might be social deficits, as social interactions are known to be vital for learning in typically developing individuals. Therefore, fostering social interactions might potentiate their learning. Necessary first steps for quantitatively testing this possibility are to create situations where social interactions and learning can occur for these individuals and to measure the interactions and the learning that may result. However, measuring such interactions can be a considerable challenge, as they are likely to be infrequent, transient, fragmentary, and, perhaps, atypical. Using classes developed specifically for such individuals and others with related developmental disorders, we developed a reliable measurement system we feel meets these challenges.

**Objectives:** We used video recordings of adults with ASD and other related disorders who took part in recreational and adaptive skills classes to develop a coding scheme to describe and measure their social behaviors and interactions.

**Methods:** Twelve adults were selected via purposive sampling, in part to achieve as wide a variation as possible in diagnoses (ASD level 3,  $n=4$ ; level 2,  $n=3$ ; level 1,  $n=2$ ; other diagnoses,  $n=3$ ) and in levels of adaptive functioning. Six classes were designed to foster recreational and adaptive skills (e.g., cooking, office skills, fitness), led by experienced instructors. Classes were held weekly for ten weeks; each class consisted of at least two participants. Sessions were video-recorded. Written informed consent was obtained in accordance with procedures approved by Hopkins' IRB.

A modified grounded theory approach (Strauss & Corbin, 1998) was used to develop the coding scheme based upon the recordings from all six classes. After initial open coding, the constant comparative method and iterative thematic analysis (Glaser, 1965) were used to combine initial codes and organize them into themes. This coding scheme was reviewed with the instructors and researchers to help establish construct validity (Leung, 2015). A negative case analysis was conducted to ensure that all situations could be coded by the scheme. As an initial test, reliability and validity of the resulting scheme were measured using a dataset from one class: fitness class.

**Results:** This process resulted in a coding scheme of 13 codes within four themes: (1) patterns of engagement (i.e. collaboration among participants, non-engagement, division of labor), (2) task format (i.e. community of learners, participant-led, instructor-

led), (3) participant behavior toward instructor (i.e. obeys, ignores, resists, reminds instructor of need for support), and (4) task performance (i.e. successful without support, successful with support, unsuccessful). For the fitness class, we assigned 4,979 codes to 769 minutes of video with strong inter-coder reliability ( $Kappa=0.8$ ).

Conclusions: It seems possible to develop a reliable and plausibly valid coding scheme for social interactions of individuals across the ASD spectrum based upon video recordings in relatively naturalistic settings (classes). This is a necessary first step to better determine whether such interactions contribute to learning, and if so, how they might be optimized.

**443.020** (Poster) Developmental Effects in Physiological Stress Response to Social Threat in Adolescents with and without Autism

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Background: Humans place high value on how they are socially evaluated by others. The Trier Social Stress Test (TSST) is a well-established measure of social evaluative threat that promotes activation of the hypothalamic pituitary adrenal (HPA) axis and release of cortisol. Higher cortisol responses in typically developing (TD) adolescents are influenced by age and pubertal development especially in later stages. Children with ASD have been shown to exhibit blunted cortisol in response to the TSST although adults with ASD show a more prototypical response. The current study examined physiological stress in early adolescents with ASD and TD. It was hypothesized that TD youth would show elevated cortisol in response to the TSST influenced by age and pubertal stage. In contrast, youth with ASD would show a more diminished stress response yet still show effects for age and pubertal development.

Objectives: The objective of the current study was to examine the developmental effects of age and puberty on physiological stress to social evaluative threat in youth with and without ASD.

Methods: The sample included a large, well-characterized sample of 241 early adolescents between 10 to 13 years of age, 138 with ASD (median age = 11.25) and 103 TD (median age=11.67). Standardized diagnostic assessments and gold-standard pubertal development (genital/breast (GB), and pubic hair (PH) stage) physical exams were performed. Salivary cortisol was collected at multiple timepoints before and after the TSST. Linear mixed effects models examined the effects of baseline cortisol, time, age, sex, pubertal stage, and diagnosis.

Results: We did not find an effect of early pubertal development stage (GB or PH) on cortisol response (all  $p>0.05$ ). There was an interaction between age and TSST timepoint, showing stronger effects for older children across the timeline especially during the stressor ( $p=0.0396$ ). Finally, there was a significant diagnosis by TSST timepoint interaction characterized by a blunted cortisol stress response in youth with ASD compared to TD participants who showed higher cortisol ( $p<0.0001$ ).

Conclusions: We found evidence that age contributes to an increase in cortisol in response to being socially evaluated by others during early adolescence. TD youth exhibit an adaptive elevated stress response to psychosocial threat whereas youth with ASD do not. The current study replicated and extended research showing increased stress sensitivity arising during adolescence for TD and ASD youth which is driven by age rather than puberty at least in early adolescents. The impact of pubertal effects on physiological stress as measured by cortisol may increase as the sample advances through stages of sexual maturation. The current findings suggest that there may be a developmental lag in the perception of and stress response to social evaluation which may emerge in older adolescents with ASD.

**443.023** (Poster) Effects of Creative Movement Interventions on Praxis, Imitation, and Interpersonal Synchrony Skills of Children with ASD

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Background:

Children with Autism Spectrum Disorder (ASD) present with impairments in social communication skills including imitation and interpersonal synchrony (IPS). We have previously reported greater improvements in imitation and IPS in children with ASD after receiving face to face (F2F) rhythm and yoga-based interventions compared to a sedentary play (SP), standard of care intervention (Kaur & Bhat, 2019; Srinivasan et al., 2015; Srinivasan & Bhat, 2013). In the current study, we combined various

musical activities including instrument play, dance, and yoga to develop a multimodal Creative Movement (CM) intervention and compared its effects to that of a SP intervention. A subset of children with ASD received F2F training; however, after the outbreak of the COVID-19 pandemic, we are offering the intervention remotely through videoconferencing.

#### Objectives:

The current study investigates the effects of CM and SP interventions on the imitation and IPS skills of children with ASD. We will also compare the effects of F2F and telehealth-based intervention delivery in both groups.

#### Methods:

Twenty-four children with ASD between 5 and 14 years will be recruited for the study. Children with ASD will be matched on age, gender, and level of functioning before being randomly assigned to the CM or SP group. Both groups will receive 16 training sessions (2 sessions/week) over 8 weeks. The CM group will engage in whole-body movements using music, dance, and yoga to promote IPS, imitation, coordination, and balance. The SP group will engage in tabletop activities such as reading, building, and art-craft to promote social interactions and fine-motor skills. Two tests will be administered before and after the intervention: a) The postural praxis and bilateral motor coordination subtests of the Sensory Integration and Praxis Tests (SIPT-PP and SIPT-BMC) (Ayres, 1989) and b) an IPS test to assess synchrony performance during whole-body swaying. We will also assess their training-specific IPS performance during an early and a late training session.

#### Results:

Our preliminary data from 7 children with ASD suggest positive results following CM training. From pretest to posttest, children reduced the number of spatial errors on the SIPT-PP subtest (mean error  $\pm$  SE pretest score:  $7.43 \pm 1.73$ ; posttest score:  $2.57 \pm 0.53$ ,  $p < 0.05$ ) and the number of temporal errors during the SIPT-BMC subtest (CM group's mean error  $\pm$  SE pretest score:  $17.57 \pm 4.00$ ; posttest score:  $4.90 \pm 1.85$ ,  $p < 0.05$ ). While results from the generalized test of sway synchrony did not significantly change with training, training-specific IPS with the social partner increased during a late training session compared to an early training session (mean in-synchrony duration in minutes  $\pm$  SE early session:  $10.15 \pm 3.60$ ; late session:  $23.53 \pm 5.48$ ,  $p < 0.05$ ).

#### Conclusions:

CM intervention has positive effects on generalized imitation skills and training-specific IPS and could be used to promote socially-embedded motor skills in children with ASD. This study will also shed light on the pros and cons of telehealth-based interventions compared to F2F interventions.

#### **443.024** (Poster) Effects of Creative Movement Interventions on Social Communication & Behavioral Skills of Children with ASD

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#### Background:

Children with Autism Spectrum Disorder (ASD) demonstrate social communication impairments and engage in restricted and repetitive behaviors (American Psychiatric Association, 2013). Our past work demonstrated the positive effects of whole-body movement experiences including rhythm and yoga interventions on social communication and affective skills of children with ASD (Kaur & Bhat, 2019; Srinivasan et al., 2016a, 2026b).

#### Objectives:

In the present study we compare the effects of a Creative Movement (CM) intervention that combines music, dance, and yoga activities to a standard-of-care, Sedentary Play (SP) intervention on social communication and affective skills of children with ASD. In light of COVID-19, we have been using face-to-face and telehealth-based intervention methods and also plan to compare the two methods within each group.

#### Methods:

24 children with ASD between 6 and 14 years will participate over 10 weeks with pretests and post-tests conducted during the first and tenth weeks. Children will be matched on age, gender, and level of functioning and then randomly assigned to either CM or SP groups. Each child will receive 8 weeks of training @2 sessions/week conducted with an expert trainer and an adult model. The CM group will engage in music, dance, and yoga-based activities promoting interpersonal synchrony, imitation, and gross-motor skills. The SP group will engage in tabletop activities such as reading, building, and arts-crafts to promote academic and fine-motor skills. The standardized Joint Attention Test (JTAT, Bean & Eigsti, 2012), administered at pretest and post-test, will assess changes in responsive joint attention with training. We will also code training-specific changes in duration of verbalization and positive affect across an early, mid, and late training session.

Results:

Preliminary data from 7 children with ASD suggest that 5 out of 7 children showed a trend for improvement in standardized JTAT scores from pretest to posttest. From an early to a late training session, 6 out of 7 children increased verbalization towards their trainers and reduced self-directed verbalization. CM interventions promoted greater spontaneous speech initiations compared to responsive verbalization in all children. Five out of 7 children also showed a reduction in negative affect and an increase in task-appropriate, interested affect from an early to a late training session. We hypothesize that the CM group, irrespective of mode of intervention delivery (face-to-face or online), will demonstrate greater improvements in target skills on standardized and training-specific outcomes compared to the SP group.

Conclusions:

This study will add to the mounting evidence on the value of socially-embedded CM therapies in alleviating the core impairments of ASD. Moreover, we will also assess the effectiveness of delivering CM training using telehealth platforms and provide best practice guidelines based on our experiences. ASD clinicians could use CM interventions to improve motor, social communication, and behavioral skills in children with ASD. This work will offer evidence for the inclusion of whole-body movement experiences in the standard-of-care for children with ASD.

**443.025 (Poster)** Effects of Sex, Condition, and Phenotype on Visual Attention to Social Interactive Scenes in Children: Autism Biomarkers Consortium for Clinical Trials

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**Background:** The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) was designed to identify and validate promising eye-tracking (ET) biomarker candidates for ASD. One task examined by the ABC-CT was the Social Interactive Task (1). Previous work has shown greater differences between children with ASD and typically developing (TD) controls in attention to faces of child actors engaged in cooperative versus parallel play (1) as well as 3-way-interactions between group, play conditions, and sex (2).

**Objectives:** To replicate results of (1) and (2) in a large, well-powered sample while extending these results by controlling for and examining relationships with participant behavioral and experimental characteristics.

**Methods:** Participants were 6-to-11-year-old children with ASD (n females=65, male=215) and TD (n females=36, male=83) who were eye tracked while viewing social interactive paradigms drawn from (1) (including both cooperative (social) and parallel play ("non-social") conditions). The primary outcome variable was percentage of time looking at faces (%Faces), with factorial ANOVA of sex \* group \* condition to predict %Faces. Analyses were conducted without controls as well as controlling for IQ, Age, NEPSY memory for faces, and percentage of Valid ET Data.

**Results:** ANOVA without controls revealed interactions of group\*sex (p=.039) and group\*condition (p=.045), as well as main effects of group, condition, and sex (all ps<.01). Not other effects were identified.

%Faces in ASD was 28.0% (cooperative) and 20.5% (parallel), and in TD, 36.3% and 27.2%, respectively. Cooperative-parallel condition differences in %Faces in ASD were  $\Delta=7.5\%$  compared to  $\Delta=9.2\%$  in TD (both ps<0.0001). ASD-TD group differences

in %Faces were  $\Delta=8.3\%$  for cooperative and  $\Delta=6.7\%$  for parallel (both  $ps<0.0001$ ). Group differences in the cooperative condition were greater than the parallel condition ( $p=.045$ ).

Females (combining groups) had higher %Faces (29.8%) than males (26.2%) ( $\Delta=3.6\%$ ,  $p=0.004$ ). %Faces was 24.7% in ASD females and 23.7% in ASD males. %Faces in TD females was 34.9% compared to 28.6% in TD males. There was no significant female-male sex difference in %Faces observed in ASD participants ( $\Delta=1.0\%$ ,  $p=0.4911$ ), but there was in TD participants ( $\Delta=6.3\%$ ,  $p=0.0024$ ).

Inclusion of control variables revealed positive associations between %Faces and NEPSY memory for faces ( $t=6.47$ ,  $p<.001$ ) and Age ( $t=2.17$ ,  $p=.031$ ), and negative associations with IQ ( $t=-3.05$ ,  $p=.002$ ) and %Valid Data Acquired ( $t=-5.4$ ,  $p<.001$ ) but did not otherwise change the identified pattern of results.

**Conclusions:** Analyses replicated (1), with stronger group differences in cooperative versus parallel play, and sensitivity to condition present in both ASD and TD groups. Contrary to results from (2), which showed 3-way-interactions among group, condition, and sex, our results suggest interactions between sex and group (highlighting greater sex differences in TD) and condition and group (highlighting greater condition effects in TD) may be sufficient to describe interactions. New findings include identification of strong dependence of face looking with clinical characteristics including memory for faces, IQ, and broader experiment attention. These results will be discussed in terms of the methodological, sampling, and participant characteristics differences between current and prior work.

(1) Chevalier et al. *Autism Research*. 2015.

(2) Harrop et al. *Molecular Autism*. 2019

#### 443.026 (Poster) Empathic Disequilibrium in Autism

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#### Background:

Empathy is a core ability for effective and efficient social communication (Decety et al., 2016), and atypicalities in empathy are considered a hallmark of autism (Smith, 2009). Specifically, some studies suggest that autism is characterized by intact emotional empathy (EE; the ability to respond to another's mental states with appropriate emotion) and diminished cognitive empathy (CE; the ability to recognize what another person is feeling) (Baron-Cohen & Wheelwright, 2004). Yet mixed findings in this domain (e.g. Lombardo et al., 2016) led us to examine a novel conceptualization of empathy to autistic traits focusing on the gap between EE and CE, termed Empathic Disequilibrium (ED), as a more informative measure of autism.

#### Objectives:

ED was found to be predictive of autistic traits in a large neurotypical population even when controlling for total empathy scores (Shalev & Uzefovsky, 2020). We now extend these findings to examine ED in autism. Based on the previous findings and the theoretical framework of empathy in autism (Smith, 2009), we hypothesized that EE-dominance (EE higher than CE) will be related to autism diagnosis.

#### Methods:

Participants (1,905 with autism; 3,009 control) were recruited via the Cambridge Autism Research Database. Autistic traits were measured using the Autism Quotient (AQ; Baron-Cohen et al., 2001). EE and CE were measured using the Empathy Quotient (Baron-Cohen & Wheelwright, 2004). ED was calculated as the difference between CE and EE standardized scores. ANCOVA was conducted to predict ED by diagnosis (autism/control) and sex, controlling for total empathy. ED scores were used to classify participants to CE-dominant, EE-dominant, and balanced-empathy groups based on 1-SD from the mean. Chi-square tests were conducted to compare expected and observed proportions of autism diagnosis in each group. Finally, ANCOVA was conducted to examine autistic traits (using the AQ subscales) in each empathy group, controlling for overall empathy.

#### Results:

ED was predicted by diagnosis (autism/control) ( $p = 2 \times 10^{-47}$ ) and sex ( $p = 4 \times 10^{-7}$ ) (**Figure 1**). Higher rates of autism diagnoses were characteristic of individuals in the EE-dominant group (observed 51.4%; expected 39%;  $p = 5 \times 10^{-17}$ ). Importantly, autistic females showed higher rates of EE-dominance than autistic males (observed, 61%; expected 54%,  $p = 0.001$ ). Elevated autistic traits were found in the EE-dominant group for all AQ subscales (**Table 1**). Specifically, autistic individuals in the EE-dominance ED group showed elevated deficits in social skill ( $p = 0.0089$ ), communication ( $p = 6 \times 10^{-9}$ ) and attention-switching ( $p = 6 \times 10^{-9}$ ).

Conclusions:

Our findings suggest that the intra-personal imbalance between the emotional and cognitive might be informative for characterizing and understanding social deficits in autism and the broad autism phenotype. These findings imply the possibility of novel subgroup classification of autism based on the imbalance between EE and CE, rather by CE or EE separately, and that this is particularly informative for females. This promise to explain some of the mixed findings in the field.

**443.027 (Poster)** Examining Sex Differences in Social Responsiveness and Concurrent Verbal Intelligence Abilities of Young Individuals in Autism Spectrum Disorders

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**Background:** Social and communication deficits are core behavioral symptoms of autism spectrum disorders (ASD), however these symptoms present in unique and sometimes conflicting patterns for males and females resulting in differential diagnosis and intervention trajectories and females are often diagnosed later in life or not diagnosed at all; this trend is exacerbated when females do not present with comorbid cognitive impairments (Dean et al., 2017; Shattuck et al., 2009). Recent studies challenge gender invariance assumptions (Frazier et al., 2014; Hiller et al., 2014). Other studies continue to indicate social communication deficits are roughly universal for both genders (Dean et al., 2014; Holtmann et al., 2007). Gender differences in ASD are also observed for IQ (Rivet et al., 2011; Banach et al., 2009), yet salient subsections of IQ assessments, have not been examined for the same effects. Moreover, research evaluating verbal IQ and social communication deficits in children with ASD support a strong negative relationship between the two (Wetherby, 2006). Since gender differences specific to this relationship have yet to be examined, we aim to explore the conditional effects of gender differences on patterns of association between IQ and core behavioral symptoms of ASD.

**Objectives:** In the current study, we will compare associations between specific dimensions of social responsiveness and concurrent verbal intellectual abilities in youth with ASD when controlling for age and gender.

**Methods:** This study utilized a subset of secondary data from the Autism Brain Imaging Data Exchange (ABIDE) I ( $n = 37$ , 8 females,  $M_{age} = 14.4$  yrs,  $SD_{age} = 1.6$ ). Dimensions of social responsiveness were measured with the *Social Responsiveness Scale* (SRS; Constantino & Gruber, 2007). Performance on the *Wechsler Intelligence Scale for Children* (WISC-III; Woogler, 2001) Verbal Intelligence Quotient (VIQ) yielded an index of verbal intellectual abilities. We utilized nested linear multiple regression models to compare the strength of the association between the SRS subscale scores as predictors (Table 1) and VIQ scores as the outcome variable, first in Model 1 controlling for age, then in Model 2 controlling for both age and sex.

**Results:** Results of Model 1 revealed a significant negative relationship between VIQ scores and SRS subscale scores when controlling for age, indicating higher ASD symptom severity is associated with lower verbal IQ performance (see Table 2). Further, SRS subscale scores explained 52.5% of the variance in VIQ scores, suggesting the model serves as a predictor of verbal IQ ( $p < .001$ ). Model 2 accounted for an additional 7.9% of variance ( $p < .001$ ).

**Conclusions:** The current study findings indicate a moderate, negative association between VIQ performance and social responsiveness deficits. Further, these findings highlight variability in this association specific to gender differences and emphasize the importance of making this distinction across core behavioral symptomology. These findings support further investigation of gender variance in verbal intelligence ability and social communication impairments to better understand unique gender profiles for diagnostic and intervention best practices. Future studies should expand evaluation of this relationship to include Full Scale IQ and additional social skills measures with a larger sample size.

**443.029 (Poster)** Exploring Behavioral Biomarkers of Children with ASD Based on Physiological Data in Practice of Conversation Initiation with a Social Robot

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**Background:** Children with autism spectrum disorder (ASD) experience challenges with social conversation, a core impairment in ASD. This impairment limits these children in initiating and contributing to group conversations. Social robots with verbal conversation capabilities have great potential to provide therapeutic interventions of social conversation skills for children with ASD. The use of social robots for practices of conversation initiation could be highly beneficial for these children, to improve social conversation skills. Physiological cues can provide powerful tools in understanding responses and affective states of a child with ASD during conversations with a social robot. Therefore, exploring behavioral biomarkers based on physiological data may provide significant recommendations for further design of social robot-based intervention.

**Objectives:** This study aims to 1) explore physiological variation of children with ASD in response to different moments of scripted interactions with a social robot in order to understand their affective states and 2) provide recommendations for further design of social robot-based intervention that can adapt to the affective states of participants with autism.

**Methods:** Six children with autism (aged 8-12 years) participated in a social skills group. The group ran for 12 weeks, meeting once per week. During the last 10 group meetings, participants practiced conversation initiation with a social robot. As two small groups of three, participants entered a room with a humanoid NAO robot from SoftBank Robotics. Using two robots and two rooms, the participants completed the practice at the same time. One participant from each group wore an Empatica E4 wristband, measuring electrodermal activity and blood volume pulse. Each participant takes turns to initiate three trials of robot interaction. A complete trial consists of: 1) participant initiates interaction using one of five predefined questions; 2) robot animates, responds, and repeats the question; 3) participant responds; and 4) robot acknowledges. We analyzed physiological data from baseline recordings during quiet sitting in comparison to the robot interactions. We explored physiological variation to key moments in the participant's turn and others' turns.

**Results:** We have finished collecting data from 6 of 10 sessions of robot interaction. The preliminary analysis of the physiological data showed significant changes of physiological signals in response to the robot's questions, the latency in the robot's responses, and the performance of the robot in understanding the participants' questions.

**Conclusions:** Participants responded implicitly, with emotional behaviors, to different moments of social interactions with a social robot. Behavioral biomarkers have the potential to be used to design further social robot-based intervention that can adapt to the affective states of participants with autism. For example, the robot could monitor a participant's physiological signals to decide when to continue the intervention practice (e.g., when a participant's signals are within a margin close to baseline), or as feedback for how (e.g., introducing new questions based on the response to the robot's questions) the robot should adjust the intervention. In the future, the intervention could be further refined to adapt to subtle changes in behavioral biomarkers during interactions with a social robot.

#### 443.030 (Poster) Exploring the Role of Camouflaging Motivations and Consequences

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**Background:** Camouflaging (i.e., compensating for or masking autistic traits) is associated with poorer mental health and wellbeing in autistic and nonautistic individuals (Beck et al., 2020; Cassidy et al., 2020; Hull et al., 2017). However, camouflaging may also lead to some benefits, such as improved connections with others, increased ability to maintain employment, and avoidance of experiences of discrimination (Botha & Frost, 2019; Hull et al., 2017). It is important to understand why camouflaging may lead to poorer outcomes for individuals. This could allow researchers and clinicians to move toward supporting autistic individuals in maximizing the benefits of camouflaging while minimizing negative impacts on mental health and wellbeing.

**Objectives:** To examine the association between perceived positive and negative motivations and consequences of camouflaging (see example items below) and symptoms of anxiety and depression. This pilot study was conducted with a nonautistic sample to test whether the constructs may be related.

**Methods:** 283 undergraduate students (61% female; 84% Caucasian; *M* age = 19.28 years) completed measures of anxiety symptoms (GAD-7; Spitzer, 2006), depression symptoms (PHQ-9; Kroenke, 2001), levels of camouflaging (CAT-Q; Hull et al., 2019), and perceived camouflaging motivations and consequences. The items pertaining to perceived camouflaging motivations and consequences were developed based on qualitative research with autistic individuals (manuscript under review). Example items include "to gain positive perceptions" (positive motivation); "to avoid negative experiences" (negative motivation); "you fit in with others" (positive consequence); and "you feel inauthentic or like others don't you know the 'real you'" (negative

consequence). Hierarchical linear regression models were used to predict depression and anxiety starting with *gender* in step 1 and adding the *CAT-Q* and *positive and negative motivations* in subsequent steps. Post hoc analyses compared models predicting anxiety and depression using *gender* and *CAT-Q* to models predicting anxiety and depression using *gender* and *negative motivations and consequences*.

**Results:** Tables 1 and 2 include results for all steps of the hierarchical linear regression analyses for anxiety and depression, respectively. Negative camouflaging motivations ( $B = .19, t(272) = 3.43, p < .001$ ) and negative camouflaging consequences ( $B = .20, t(273) = 4.17, p < .001$ ) significantly predicted anxiety. Negative camouflaging motivations ( $B = .21, t(270) = 3.50, p < .001$ ) and negative camouflaging consequences ( $B = .25, t(273) = 4.36, p < .001$ ) also significantly predicted depression. Post hoc regression analyses indicated that combined, the nine items for negative camouflaging motivations and consequences explained more variance than the 24 items on the CAT-Q for both anxiety ( $R^2 = .10$  for *gender + CAT-Q*;  $R^2 = .16$  for *gender + negative motivations and consequences*) and depression ( $R^2 = .08$  for *gender + CAT-Q*;  $R^2 = .14$  for *gender + negative motivations and consequences*).

**Conclusions:** Results suggest that perceived camouflaging motivations and consequences may better predict anxiety and depression symptoms than camouflaging levels. However, these findings must be interpreted with caution, as this sample did not include autistic individuals. A crucial next step will be to replicate these analyses in an autistic sample.

#### 443.031 (Poster) Eye Will Remember You: Individual Differences in Face Fixation Patterns and Recognition Accuracy Amongst Autistic and Neurotypical Adults

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**Background:** Face recognition is a crucial building block for establishing and maintaining effective social relationships: we interact differently with people we know than with people we do not know. Many autistic adults experience difficulties attending to the eyes and recognizing others in their daily lives. These reports are substantiated by empirical investigations revealing face recognition impairments and reduced reliance on the eyes amongst autistic individuals, although intact recognition abilities and visual strategies have also been reported, signifying the heterogeneity of social abilities across the spectrum. The eye avoidance theory posits that atypical attention to the eyes in autism may limit the quality and quantity of social information that is processed, thereby leading to difficulties in higher-order social cognitive processes (e.g., face recognition). A link between the eyes and face recognition is emerging within the neurotypical literature, although a direct association has yet to be established in autism.

**Objectives:** The current study presents the first empirical investigation directly evaluating the eye avoidance theory of face recognition in autistic and neurotypical adults through a neurodiversity lens and an individual differences approach.

**Methods:** Adults with an autism spectrum disorder ( $n = 24$ ; 12 female, 9 male, 2 non-binary, 1 transgender) and age-, gender-, ethnicity-, and IQ-matched neurotypical adults ( $n = 21$ ; 11 female, 9 male, 2 non-binary) completed incidental and intentional measures of old/new face recognition while eye movements were recorded. Area-normalized fixation metrics were calculated for six facial regions (left eye, right eye, nasion, nose, mouth, and non-core features) during face encoding and  $d'$  measures of recognition accuracy were computed for each task.

**Results:** During encoding, the eyes and nasion were looked at significantly more often than other facial features, a pattern that was upheld for autistic and neurotypical adults alike, although individual differences were abundant for both groups. Manual inspection of individual heat maps revealed that the classic T-shaped pattern observed at the group level was a byproduct of averaging a variety of fixation patterns, rather than execution of a homogenous strategy across all participants. Autistic and neurotypical adults did not differ in face recognition accuracy, nor did performance vary across task demands, although intentional  $d'$  was negatively associated with autism symptomology, such that autistic adults with higher ADOS-2 scores performed more poorly than their autistic counterparts with better social adaptation skills. Fixation to the left eye also showed trending associations with face recognition accuracy, albeit on different tasks across groups, and was weakly related to ADOS-2 scores amongst autistic adults.

**Conclusions:** Autistic adults implement typical fixation patterns to internal facial features during face encoding and display face recognition abilities within range of their neurotypical peers. Individual-level analyses reveal the left eye may play a role in autistic and neurotypical face recognition, partially supporting the eye avoidance theory and highlighting the importance of adapting a neurodiversity perspective when evaluating autistic face recognition. This research advances our understanding of the neurocognitive mechanisms underlying face recognition, highlights the heterogeneity of autistic social behaviours, and has clinical implications for social skill programs in adulthood.

**443.032** (Poster) Gender Differences in Friendship Experiences, Peer Conflict, and Perceived Loneliness in Children with ASD  
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**Background:** The social deficits associated with Autism Spectrum Disorder (ASD) impair children's ability to successfully interact with peers and develop friendships. Boys with ASD have difficulty playing with others and tend to isolate themselves from their peers, whereas girls attempt to fit in with their neurotypical peers by imitating their social behaviors. However, girls with ASD are often victims of relational aggression (Dean et al., 2017). The isolation experienced by boys with ASD is associated with social-cognitive loneliness (feeling alone and isolated), while the relational aggression experienced by girls with ASD is associated with emotional loneliness (not making close, emotional connections with others). Children with ASD have difficulty understanding the emotional, but not social-cognitive, dimension of loneliness (Bauminger & Kasari, 2000). Therefore, boys, but not girls, may perceive themselves as lonely. Furthermore, school-aged children with ASD report lower levels of loneliness compared to preadolescents and adolescents (Chamberlain et al., 2007). Therefore, perceptions of loneliness may vary across both gender and developmental status.

**Objectives:** Qualitatively analyze interviews from the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2012) to explore how friendship experiences, peer conflict, and perceived loneliness differ across gender and developmental status in children with ASD.

**Methods:** The current study was a secondary data analysis of 22 children (11 girls) with ASD who participated in five different studies conducted at the UCLA Center for Autism Research. Eight children (four girls) were school-aged (ages 7-9), 10 (five girls) were preadolescents (ages 10-13), and four (two girls) were adolescents (ages 14-15). Boys and girls were matched on age, IQ, and ADOS severity score. Participants had been administered Module 3 of the ADOS. A thematic analysis was conducted on the ADOS interviews addressing friends, social difficulties/annoyance, and loneliness.

**Results:** Boys and girls with ASD were equally likely to have friends and engage with their peers. However, the majority of boys reported being bullied or having trouble getting along with others at school. Several boys experienced conflict due to difficulties in playing and interacting with peers. Girls were less likely than boys to experience peer conflict, and none of the girls experienced difficulties in playing or interacting with peers. When boys and girls reported feeling lonely, both alluded to social-cognitive loneliness – however, boys reported feeling lonely more frequently than girls. Finally, the majority of school-aged children reported not feeling lonely, whereas the majority of preadolescents and adolescents reported feeling lonely.

**Conclusions:** Both girls and boys with ASD had positive relationships with their friends, yet girls were less likely than boys to experience peer conflict and to report feeling lonely. Although few girls reported instances of relational aggression, this may have been due to difficulty recognizing rejection from peers (Sedgewick et al., 2016). Perceptions of loneliness also varied across age, indicating that school-aged children with ASD may have trouble understanding loneliness. Our next steps will be to increase the sample size and compare friendship experiences, peer conflict, and perceived loneliness in boys and girls with and without ASD.

**443.033** (Poster) Global and Fine Social Perception in Children and Adults with ASD: An Eye-Tracking Study  
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**Background:**

Social perception abnormalities in ASD have been largely objectified with eye-tracking. Mainly two different types of stimuli have been used. Dynamic audio-visual stimuli presenting complex social scenes, which can evaluate fine social perception, has been widely applied. Nevertheless, the complexity of these stimuli prevent its use across languages or among non-verbal individuals. More recently, studies have investigated global aspects of social perception using less complex stimuli based on visual preference paradigms. However, the sensitivity of these stimuli and its congruence with more subtle aspects of social perception has not yet been established.

**Objectives:**

Here, we aimed to investigate a putative correlation between global social perception and fine social perception in a large cohort of individuals with ASD and with TD, across a wide age range.

## Methods:

We included 123 individuals, 46 with ASD (age 2-26 years) and 77 with TD (age 2-30 years). Eye tracking recordings were obtained using two types of stimuli: 1) a visual preference stimuli, inspired by the original GeoPref test from Pierce et al. 2011, simultaneously showing videos of children in motion and videos with geometric figures in motion, 2) stimuli with videos containing complex social scenes from the film "Le petit Nicolas", a paradigm developed in our lab (Saitovitch et al., 2016). The main data used were: 1) for the visual preference stimuli: the number of fixations in the video with the children in motion and the number of fixations in the video with geometric movement and 2) for the videos of social scenes: the number of fixations in the eye area, face and non-social regions (excluding faces).

## Results:

In the social scenes paradigm, a significant reduction in fixations to the face ( $F(1,119) = 19.1, p = 2.7e-05$ ) and to the eyes ( $F(1,119) = 14.4, p = 0.00023$ ) was observed in ASD group compared to TD group whereas a significant increase in fixation to non social background were found ( $F(1,119) = 24.5, p = 2.4e-06$ ). In the preferential viewing paradigm, significant reduced fixations in dynamic biological movements were observed in ASD group compared to TD group ( $F(1,119) = 24.2, p = 2.8e-06$ ). In the ASD group, as in the TD group, a significant positive correlation between number of fixations to faces of characters and number of fixations in the video with the children in motion was observed ( $F(1,118) = 30.2; p = 2.3e-07$ ). In addition, a significant positive correlation between number of fixations to the eyes and number of fixations in the video with the children in motion was observed ( $F(1,118) = 11.7; p = 0.0008$ ).

## Conclusions:

To the best of our knowledge, this is the first study investigating a correlation of two levels within social perception using eye-tracking. Our results indicate a significant correlation between the global social perception (tested by the visual preference stimulus) and the fine social perception (tested by the social video clip stimulus) in participants with ASD and with TD. Importantly, our results showed that this correlation exists in participants with ASD and with TD, suggesting a universal mechanism of social perception.

### 443.034 (Poster) Imagined Contact with Individuals with Autism Improves Typically Developing University Students' Attitudes Towards Autism

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#### Background:

More young adults diagnosed with autism are attending university than in the last decades. Attending university for individuals with autism is associated with increases in self-esteem, employment, and personal skills. However, students with autism may face challenges at university with making and maintaining friendships, despite a desire to do so. One reason for this is that college students with autism experience social exclusion more so than their typically developing (TD) peers who tend to evaluate individuals with autism negatively. While exposure to individuals with autism can improve TD individuals' attitudes towards autism, this contact is not always possible. Investigating ways to improve TD university students' attitudes using simulated interactions may be effective.

#### Objectives:

We sought to 1) examine the relationship between TD university students' contact with individuals with autism and their attitudes towards autism and 2) examine whether simulating contact with individuals with autism would improve attitudes towards this group. Labeling people engaging in atypical behavior associated with autism can lead to more positive perceptions as perceivers have an explanation for these behaviors. Therefore, we examined whether imagining an interaction with someone displaying behavior stereotypically associated with autism and labeled as having autism would affect subsequent attitudes.

#### Methods:

TD university students ( $n = 130$ ) read vignettes in which they imagined interacting with another university student who depicted behaviors associated with ASD (i.e., perseveration) or not and with a label of autism or not. This yielded a 2 (label) x 2

(perseveration) design. Participants then completed a Feelings Thermometer which measured their attitudes towards individuals with autism.

#### Results:

Participants with greater contact with individuals with ASD had more positive attitudes towards people with autism,  $r = .32, p = .001$ . In addition, a 2 (Label: ASD vs. non-ASD) x 2 (Behavior: Perseveration vs. No Perseveration) analysis of covariance (ANCOVA) with prior contact as a covariate revealed a significant Label x Behavior interaction,  $F(1, 111) = 4.53, p = .036, \eta_p^2 = .039$ . Planned comparisons demonstrated that, for the non-ASD condition, there was not a significant effect of Behavior,  $F(1, 60) = 0.70, p = .407, \eta_p^2 = .012$ . However, for the ASD condition, attitudes towards individuals with ASD were higher in those in the Perseveration condition than the No Perseveration condition,  $F(1, 50) = 4.77, p = .034, \eta_p^2 = .087$ .

#### Conclusions:

These findings are consistent with other evidence showing that having knowledge that a person is diagnosed with ASD may be helpful in allowing somebody to understand some of the behaviors associated with ASD that may otherwise be considered unusual. With this knowledge, attitudes toward individuals with ASD in general may become more positive. This finding suggests that the imagined contact procedure may be useful for improving attitudes toward individuals who display some behaviors of ASD that may otherwise be viewed in a more negative manner. Apart from vignettes, alternative methods of simulating imagined contact can be explored in the future to further understand how imagined contact changes attitudes.

#### **443.035** (Poster) Impact of COVID-19 on Implementation of Live Eye-Tracking Research Procedures and Social Attention in Toddlers

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#### Background:

Screen-based eye tracking is a well-established method of investigating visual social attention in children with ASD (Guillon et al., 2014). Studies utilizing eye tracking methods in live, more ecologically valid contexts may provide more information regarding dynamics of social attention in ASD, but they are still limited (Thorup et al., 2018). Moreover, feasibility of live eye tracking in very young and disabled children has yet to be fully established. Finally, adopting COVID-19 safety measures may significantly impact feasibility and accuracy of live eye-tracking tasks.

#### Objectives:

**1)** Assess the preliminary feasibility of a live eye-tracking paradigm measuring social attention in toddlers with ASD, developmental delays, and typical development. **2)** Examine whether COVID-19 safety protocols alter calibration accuracy, participant affect, or amount of attention to the eye-tracking scene and to the experimenter.

#### Methods:

Eighteen toddlers (eleven pre-, seven during-COVID-19) interacted with an experimenter and toys in a live eye-tracking setting. During the pandemic, a plexiglass divider separated the child from the scene and experimenters wore masks. We examined calibration accuracy (degrees), participant affect (rated -1=negative, 0=neutral, 1=positive), proportion of valid looking at the scene (%Valid: duration looking at scene/total time), and proportion of looking at the examiner (%Examiner: duration looking at experimenter/duration looking at scene).

Two children from the pre-COVID-19 group were excluded because of low %Valid (<30%). Two additional participants, one pre- and one during-COVID-19, were excluded from the analysis of calibration accuracy only, due to unsuccessful calibrations. The final pre- and during-COVID groups did not differ in age ( $p=0.27$ ), Mullen Verbal DQ ( $p=0.76$ ), or ADOS-total scores ( $p=1.00$ ). Mean age for the entire sample was 27.82mo (SD=6.77).

#### Results:

For the combined sample, mean calibration accuracy was  $.42^\circ$  ( $SD=.95$ ), mean affect was  $-0.02$  ( $SD=0.26$ ), and mean %Valid was 61.81% ( $SD=14.08$ ).

A series of Wilcoxon rank sum tests, Bonferroni-adjusted, compared calibration accuracy, participant affect, %Valid, and %Experimenter pre- vs. during-COVID-19. Effect sizes were calculated via  $r=Z/\sqrt{N}$ . Calibration accuracy ( $Z=24.5$ ,  $p=1.00$ ,  $r=0.02$ ), participant affect ( $Z=32.0$ ,  $p=1.00$ ,  $r=0.01$ ) and %Valid ( $Z=29.0$ ,  $p=1.00$ ,  $r=0.07$ ) were not significantly different pre- vs. during-COVID-19. However, the group assessed during-COVID-19 had higher %Experimenter than the group assessed before the pandemic ( $Z=63.0$ ,  $p<.001$ ,  $r=0.83$ ).

Conclusions:

COVID-19 safety measures did not alter feasibility of data collection in toddlers with and without neurodevelopmental disabilities. Participant loss was comparable to published live eye-tracking studies of high and low-risk infants (Thorup et al., 2018). Calibration accuracy surpassed the field standard of  $.5^\circ$  (Nyström et al., 2013) and %Valid was well-above the upper cut-off (50%) used in the literature (Nyström et al., 2019). Introduction of safety measures also did not lead to greater negative affectivity in the toddlers. However, COVID-19 safety measures resulted in increased attention to social partners during a live eye-tracking scenario. It is not clear if toddlers were responding to the masks' novelty, or whether they were working to decode communicative and affective cues from a perceptually impoverished input. Accurate live-eye tracking data with minimal data loss from inattention can be collected under pre- and pandemic conditions in neurodevelopmentally diverse toddlers.

**443.036** (Poster) Meet Me in the Middle: The Link between Common Ground and Coordinated Joint Action in ASD and TD  
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Background:

Common ground (CG) is generated when two interlocutors build shared knowledge and concepts during a reciprocal conversation. Coordinated joint action (CJA) is created when two confederates accomplish a shared goal by coordinating their social-motoric movement in time and space. Both processes rely on the ability to interpret beliefs and actions in others, which is considered a core deficit in cognitively able ( $IQ>70$ ) youngsters with autism spectrum disorder (CAASD). Nonetheless, the developmental trajectory of CG ability as well as its link with CJA have been under-investigated for children and adolescents with CAASD.

Objectives:

This study examined group and age differences in CG for children and adolescents with CAASD compared to age-matched controls with typical development (TD), as well as CG's links with CJA. Findings regarding this link may offer a unique viewpoint for understanding social-communicational deficits in CAASD.

Methods:

Participants:

Children and adolescents ages 6–16yrs included 80 with CAASD ( $M = 11.11$ yrs,  $IQ = 103.88$ ) and 64 with TD ( $M = 10.73$ yrs,  $IQ = 114.53$ ) in three age-groups: early-childhood (6–8), pre-adolescence (8–12), and early-adolescence (12–16). Group differences on age and IQ were non-significant.

Measures:

Background measures included the Autism Diagnostic Observation Schedule (ADOS) and the Wechsler Intelligence Scale for Children—Fifth Edition (WISC-IV). A linguistic CG task was executed in peer dyads paired by IQ and chronological age. Children described 10 different tangram shapes to each other, six times (changing roles as follower and leader). Shapes were placed behind a screen, unseen to followers. Time duration and number of words were computed for each turn. However, to reflect the efficiency of the dyadic CG generation process, the current abstract presents duration and word count results only for the final turn (#6) while controlling for duration and word count at baseline (turn #1). Shorter time duration and lower word count

reflect more efficient CG performance. In addition, participants performed four dyadic CJA tasks: two imitation tasks (side-by-side walking, face-to-face movement-mirroring) and two completion tasks (virtual-football kick-and-catch, corridor completion during virtual football). CJA performance was coded via *Interact* micro-analyses coding system, providing four major coordinated movement scores for each task.

#### Results:

Group and age differences were examined for CG's time duration and word count in turn #6 (controlling for turn #1) using ANCOVA. Significant main effects emerged for group (CAASD > TD) and for age (early-childhood > pre-adolescence and early-adolescence) on duration and word count (see Table 1). For both groups, significant negative correlations emerged between time duration for CG (in turn #6 controlling for turn #1) and the CJA imitation and completion scores. Similarly, word count for CG (in turn #6 controlling for turn #1) correlated negatively with the CJA completion score in both groups but only correlated with the CJA imitation score in the CAASD group (see Table 2). Overall, better CG performance was linked with higher social-motor coordination.

#### Conclusions:

Interventionists should consider the action-language link in treating ASD.

**443.037 (Poster)** Peer Match Rather Than Autistic Diagnosis Predicts Social Network Density and Strength in Real-World Peer Interaction Among Autistic and Non-Autistic Adolescents  
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#### Background:

Social connections are crucial to mental health and well-being. Research on the social relationships of autistic students in inclusive education has used social network analysis to quantify their social connections, suggesting that they have fewer peer connections and are often peripheral or isolated in their classroom social networks. However, previous studies primarily focused on group comparisons between autistic and non-autistic students' social network measures in isolation of the peer context. Given the bidirectionality of social connections, as well as recent findings on the role of interpersonal similarity on positive social outcomes, it is necessary to investigate autistic student's social networks in the context of peers' group affiliation.

#### Objectives:

To compare characteristics of same-group and cross-group peer connections among autistic and non-autistic adolescents in a real-world, longitudinal social networks of peer interactions in inclusive education, by examining (1) whether affiliation in the same group (autistic or non-autistic), besides autism diagnosis, predicts social network measures; (2) whether reciprocity of connections differs between autistic-to-autistic, non-autistic-to-non-autistic, and mixed-group social networks; and (2) whether the school club social networks demonstrates homophily based on group affiliation or social centrality.

#### Methods:

We plotted the longitudinal social network in an inclusive school club (Maker Club) across four months at a public middle school in a large, urban area, based on the rates of observed social behaviors among the autistic and non-autistic adolescents ( $N=12$ , 6 were autistic, between grade 6 to 8) enrolled in the club. For a total of eight observation sessions, we calculated social network measures (degree centrality, strengths, and reciprocity) for same-group and cross-group social networks, as well as the assortativity coefficients (level of homophily) of the club networks based on group affiliation and degree centrality.

#### Results:

Figure 1 illustrates the mean networks of high social interaction rates among students in the club. Mixed-methods modeling suggested that students' degree centrality, either the number of connections they made with peers or received, was not predicted by their groups (autistic or non-autistic) but the type of social network (same-group or cross-group). Social network strengths showed similar results, although total network strengths (total rates of social interaction with peers) were predicted by both student groups and network types. One-way ANOVA comparing the reciprocity of social initiations in autistic-to-autistic ( $M=0.65$ ,  $SD=0.20$ ), non-autistic-to-non-autistic ( $M=0.85$ ,  $SD=0.17$ ), and mixed-group social networks ( $M=0.51$ ,  $SD=0.26$ )

revealed significant differences between network types ( $F=4.90, p=.01$ , Figure 2), while no significant differences were found between reciprocity in social responses across the three network types. The average assortativity coefficient of the club social network over time showed that students tend to connect to peers within the same group ( $r=.23$  and  $.29$  for social initiation and response networks), but not those with similar social activity or popularity ( $r_s=.04$ ).

Conclusions:

This preliminary study explored the role of interpersonal similarity on autistic adolescents' social networks in natural peer interactions. The results showed that the numbers and strengths of connections were predicted by matches between student and peer groups but autism diagnosis, and the students tended to connect with their same-group peers.

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**443.038** (Poster) Perceived Social Support By Typically Developing Children and Children with Autism Spectrum Disorder  
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Background: Social support is defined as, 'a multidimensional concept that includes the support actually received (informative, emotional and instrumental) and the sources of the support (friends, family, strangers). Social support from peers and teachers provide an index of social inclusion at school. Furthermore, social support has been demonstrated to be an important factor in the lives of those with ASD, yet very little research has investigated the extent of perceived social support available for children with ASD. Although it is common for teachers of children to provide information on child social support, adult perceptions of child social support do not always align with child perceptions. Gender differences in social support are not always discussed in the literature, but existing studies suggest that adolescent girls perceive more social support than adolescent boys. We compare self-reported perceptions of social support by children with ASD versus TD children, as well as investigate gender differences in perceptions of social support.

Objectives: The first aim of the study is to compare self-reported perceptions of social support by children with autism spectrum disorder (ASD) versus typically developing (TD) students. The second aim of the study is to investigate gender differences in perceptions of social support in children with typical development (TD).

Methods: Twenty-five children with ASD ( $n=12$ ) and TD children ( $n=13$ ) aged 8 to 12 years were recruited via a music intervention program (before the program) in an elementary school, in Gatineau, Quebec. The participants completed the Social Support Appraisal Scale with an examiner.

Results: An independent-samples t-test revealed that children with ASD reported having less social support from their peers compared to TD children ( $p<.05$ ). There was no significant group difference in self-reported teacher support ( $p>.05$ ). TD boys tended to report more peer support than TD girls, but there was no gender difference in self-reported teacher support ( $p>.05$ ).

Conclusions: The results of this study suggest that children with ASD self-report having less social support than their TD peers. We found that pre-adolescent boys tend to report higher peer support than girls, which contrasts research studies that have found the opposite trend in older children. Moreover, children with ASD are more likely to be excluded from social activities at school compared to TD children. Peer and teacher support systems are recognized as important resources that children use to bolster their ability to cope in stressful situations. Interventions that aim to facilitate the social inclusion of children with ASD should incorporate direct outcome measures of peer and teacher support. Given these points, findings support the need for interventions, targeted school activities, and research to ameliorate social support of students with ASD and TD girls, and to recognize the different social support needs of distinct populations.

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**443.039** (Poster) Perspective-Taking, Mentalizing, and Attending to Others in Narratives from Roleplaying Games  
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Background: Role-playing games (RPGs), in which a player interacts with an in-game world as character or avatar (Hitchens & Drachen, 2009), may be a useful tool for services for persons with autism spectrum disorder (ASD). These games may provide a fun way to practice a wide variety of skills, such as perspective-taking and "mentalizing" tasks such as assuming mental states, emotions and goals (Allen, 2003; Frith, 2001; Langdon & Coltheart, 2001). As these games tend to be played socially, gaming with players without ASD diagnoses may offer players with ASD a good way of meeting new acquaintances and practicing social skills while working on goals during and surrounding gameplay.

**Objectives:** As RPGs tend to be story-based, these games naturally produce narratives surrounding the player's experiences. We aimed to examine these narratives in order to gain insight into the narrator's experiences, comparing these experiences between those with ASD and an age matched group without an ASD diagnosis. Specifically, we looked at four "axes" of analysis: in-game perspective (whether or not the narrator told the story as their character would see it), references to individuals (such as references to oneself, others, a group including oneself, etc.), the use of words implying mental traits or activity, and the number of goals explicitly introduced.

**Methods:** We recruited five participants with ASD (2 female, 2 male, 1 gender nonbinary) and 12 participants without ASD (4 female, 8 male), all of whom had played an RPG within the past year. Sessions were conducted virtually, using Zoom, Skype, or Discord to interview participants. After participants arrived and informed consent was collected, a sample narration was offered to orient the participants to the task. After this sample, participants were asked to tell a story from an RPG they had played within the past year which we audio-recorded. Following the narrative participants completed a demographic form and the Autism Quotient Questionnaire, a 50-item questionnaire which assesses autism traits. Narratives were scored using a stanza, as well as sentence and word count of key words (such as "think" for the mental trait axis).

**Results:** Stanza analysis revealed that across participants, a relatively common four-part pattern emerged; an "introduction to the world" section, an in-game section, an in-game climax section, and an in-game and out-of-game conclusion and summary. Participants with ASD tended to produce shorter narratives (average of 241 words to 437 from non-ASD participants) and sometimes produced rambling or exceptionally short conclusions. However, comparisons based on ASD diagnosis as well as gender did not produce significant differences between the groups in narration or Questionnaire scores.

**Conclusions:** Current findings suggest that persons with ASD who play RPGs offer narratives which are largely similar to persons without an autism diagnosis. This suggests that RPGs may offer an environment where those with ASD are able to practice both social-communication and other skills while having fun. This work will be further examined with a larger participant group where the potential use of these games for mentalizing and perspective-taking practice will be specifically investigated.

**443.041 (Poster) Sex Differences in Social Competence from 6 to 36 Months in a Sample at High Familial Risk for Autism Spectrum Disorder**

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**Background:**

While symptoms autism spectrum disorder (ASD) unfold over the first 2-3 years of life, the average age of diagnosis remains close to 5 years, missing a critical window for early intervention. Assessments of symptoms of ASD, particularly of social communication (SC), vary with child's language, motor and cognitive development, which has posed challenges for capturing variability in SC symptoms over time. Child sex may be an important predictor of SC symptoms, as females generally show more advanced SC skills than boys regardless of ASD diagnosis. Precise quantification of sex-specific SC symptoms and trajectories may inform early identification of ASD. Here, we use moderated nonlinear factor analysis (MNLFA; Bauer, 2017) to establish measurement invariance, a psychometric property crucial to determining whether a latent variable (e.g., SC) functions similarly across sex and diagnostic groups over time. We then test for differences in SC symptoms by sex and diagnostic group.

**Objectives:**

1. To evaluate measurement invariance on SC and derive an estimate of SC symptoms in infant-siblings of children with ASD from 6 to 36 months.
2. To evaluate sex and diagnostic group differences in SC, as well as their interaction, from 6 to 36 months.

## Methods:

This study prospectively examined infants at high-familial-risk (HR) for ASD at 6, 12, 24, and 36 months of age (total  $N_{\text{observations}}=1220$ ). Clinical best estimate diagnosis of ASD (HR-ASD;  $N=88$ , 20 females) or no-ASD (HR-negative;  $N=297$ , 142 females) was made at 24 months. Participants were assessed with the AOSI at 6 and 12 months, and the ADOS at 24 and 36 months, which are both clinician-administered behavioral observations of SC and other ASD-relevant behaviors. Features harmonized across assessments included Response to Name, Social Interest, Social Referencing and Eye Contact. MNLFA was applied to obtain an assessment of SC symptoms (where higher scores indicate higher symptoms), accounting for measurement invariance by age. ANOVA was then employed to examine differences in sex, diagnostic outcome (HR-ASD vs. HR-negative) and sex-by-diagnosis interaction over time.

## Results:

MNLFA results indicated measurement non-invariance (i.e., differential item functioning) by age on Response to Name, Social Interest, and Social Referencing items ( $p's < .0001$ ), suggesting that these items do *not* function similarly over development. All items functioned similarly by sex. In the ANOVA model, there were significant main effects of sex ( $p=.018$ ) and diagnosis ( $p < .001$ ). There was no significant interaction of sex and diagnosis ( $p > .05$ ) (Figure 1).

## Conclusions:

We used a novel method to precisely model SC from 6 to 36 months in a sample at high familial risk for ASD. Consistent with previous literature, we found a robust underlying factor of SC, with measurement differences by age and mean-level differences emerging in diagnostic and sex groups. Sex differences in SC were consistent across HR-ASD and HR-negative groups, providing evidence that sex differences in SC are not ASD-specific. Diagnostic group differences were present across development, suggesting that when assessing SC, employing methods that correct for measurement invariance could improve detection of early ASD-relevant behaviors.

### **443.042 (Poster)** Social Attention of Children with ASD during Live Interactions Around a High-Interest Object

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## Background:

Previous research has demonstrated that social attention is reduced in school-aged children with Autism Spectrum Disorder (ASD) when compared with typical developing (TD) children. However, the majority of studies on this topic focused on computer-based stimuli. How school-aged children with ASD attend to social stimuli during real life interactions is not well understood.

## Objectives:

This study specifically investigated how social attention unfolds in the presence of objects that are of high interest to children with ASD, as previous studies suggest that these objects may compete for attention (Sasson & Touchstone 2014), but that high interest topics of conversation may improve social attention (Nadig et al 2010).

## Methods:

This study included 20 ASD and 30 TD school-aged children, matched on age (ASD  $M = 10.01$  years; TD  $M = 9.50$  years) and IQ (ASD  $M = 104.00$ ; TD  $M = 107.33$ ). Participants were asked to select their favourite object from a display of 5 objects that are commonly associated with circumscribed interests for individuals with ASD (Pokémon, dinosaur, train, spaceship, car), and 4 low-interest objects (yarn, flower, plastic cup, doll). After selecting a preferred object, participants engaged in a conversation with the experimenter about the object that they had chosen while their interactions were captured through a point of view head camera. Social attention was behaviorally coded from the video footage into 3 categories: 1) *Full face* consisted of video frames that contained all of the experimenter's major facial features (eyes, nose, and mouth); 2) *face out-of-view* captured frames in which the experimenter's face was not visible, because the participant was looking elsewhere; 3) *partial face* contained frames in which some but not all of the experimenter's facial features were visible. Coding was conducted on the first 60 seconds of the interaction and was further divided into three 20s segments to see if social attention behaviour changed over time as the interaction unfolded.

## Results:

Nonparametric analysis after Bonferroni correction revealed that the ASD group spent significantly less time viewing the experimenter's full face than the TD group, and this was true throughout the 60s second interaction (Mann-Whitney's U tests for 0-20s, 20-40s, 40-60s, ps all < .016). The ASD group also spent significantly less time in the partial face category than the TD group interaction (Mann-Whitney's U tests for 20-40s, 40-60s, ps all < .016). In contrast, the ASD group spent significantly more time than the TD group looking away from the experimenter's face (face out-of-view: Mann-Whitney's U test for 20-40s, 40-60s, ps all < .016). The TD group increased their social attention over time (Friedman's test for face full and out-of-view, ps < .016), but the ASD group did not (ps > .016).

## Conclusions:

Compared with the TD group, children with ASD showed less social attention in a real-life social interaction. While TD children increased their social attention over time, the social attention of children with ASD remained low. Our findings extend the literature on social attention in school-aged children with ASD to face-to-face interactions.

### **443.043** (Poster) Social Connectedness and Stress in Autistic Compared to Socially Anxious Adults

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## Background:

Autistic individuals often find social interactions to be stressful, in part due to a communication gap between autistic and neurotypical (NT) peers (Morrison et al., 2019). Feelings of everyday stress likely contribute to significantly elevated levels of anxiety in autism. Understanding how social interactions affect stress and anxiety is important when considering the well-being of autistic adults. Studies using ecological momentary assessment methods (EMA) are useful for tracking such relationships on a daily level more than one-time lab visits.

## Objectives:

The present study used EMA to measure daily social connections and stress. We hypothesized that the amount of tension associated with social interactions for autistic participants may lead to a positive association between these two. However, feelings of social connectedness, separate from the number of daily interactions, could correlate with better stress management.

## Methods:

Participants included adults participating in a longitudinal study of mental health in social anxiety and autism. Participants consisted of 100 adults in non-clinical (NOCLIN n =30), autistic (AUT n =35), and socially anxious (SOCANX n =35) groups. Daily phone surveys were delivered over the course of 6 months via MetricWire. Correlations were analyzed through the R studio package corrplot.

## Results:

Preliminary analysis of the correlations between the number of daily social interactions and reported daily stress varied across the three groups: the NOCLIN group showed significant positive correlation, there was no significant correlation in the SOCANX group, while the AUT group showed a *positive* correlation between social interactions and stress levels. Similar patterns were found for a question on negative affect. The NOCLIN and AUT groups also showed positive correlations between social connectedness and their perceived ability to manage their stress. All three groups showed strong correlations between social connectedness and a question on positive affect.

## Conclusions:

Data supported our hypothesis that increased numbers of social interactions may be associated with feelings of stress and negative affect in the autism group. Nonetheless feeling socially connected contributed to perceived ability to manage stress

across all groups. We are continuing our EMA research to better elucidate what aspects of social contact, compared to feelings of social connectedness, best predict stress and anxiety in autistic adults.

**443.044** (Poster) Social Functioning and the Presentation of Anxiety in Children with Autism and Co-Occurring Anxiety Disorders

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**Background:** Co-occurring anxiety in children with autism spectrum disorder (ASD) is associated with greater social impairment, including deficits in social ability (Duvekot et al., 2018; Lei & Ventola, 2018; McVey et al., 2018) and poorer peer relationship quality (Chou et al., 2020; Mazurek & Kanne, 2010; Wright & Wachs, 2019). Social difficulties may influence the presentation and impact of anxiety symptoms among children with autism, particularly social anxiety. Most research to date has investigated this topic using only single-informant, broad measures of social functioning, limiting our understanding of how different aspects of social functioning relate to one another and to anxiety in this population.

**Objectives:** The current study sought to extend prior work by using a novel Bayesian network analytic approach (Williams & Mulder, 2019) to examine how different facets of social ability (e.g., social communication ability, social motivation) and peer relationships (e.g., friendships, bullying) relate to one another and to anxiety severity and comorbidity in a large treatment-seeking sample of autistic children with co-occurring anxiety disorders. Additionally, this study sought to clarify the role of social functioning in the presentation of social and non-social anxiety symptoms in children with ASD.

**Methods:** Data were collected from 191 autistic children ages 7-13 and their caregivers who participated in intake interviews for the *Treatment of Anxiety in Autism Spectrum Disorder* trial. Interviews included the Anxiety Diagnostic Interview Schedule-Autism Addendum (ADIS/ASA), Social Responsiveness Scale-2 (SRS-2), Autism Diagnostic Observation Schedule (ADOS-2) and Child Behavior Checklist (CBCL).

**Results:** The network analysis demonstrated strong connections among the core social deficits of ASD (i.e., social motivation, social communication), and among measures of social integration (i.e., conflict with peers, bullying), though there was little overlap between these two clusters of social difficulties. Compared with other facets of social functioning, social motivation (i.e., level of interest and desire to engage in social interactions and relationships) demonstrated the strongest connections with nearly every facet of social ability as well as with peer relationship quality (posterior probabilities = 0.93 -1.00), suggesting that this domain of social functioning may play a central role in the social well-being of children with autism and comorbid anxiety. Logistic binary regressions indicated that ToM appeared to play a role in the presentation of anxiety symptoms, whereby marked impairment in ToM was most strongly associated with a distinct presentation of social anxiety (i.e., social fears without fear of negative evaluation) compared with social anxiety disorder (i.e., social fears with fear of negative evaluation) ( $\beta = 1.00, p = .041, OR = 2.71 [1.04, 7.05]$ ).

**Conclusions:** Findings suggest that difficulties in one area of social functioning are likely associated with difficulties in other, related areas—particularly social motivation, which may represent an optimal target for psychosocial intervention for children with autism and anxiety disorders. Further, ToM seemed to be a unique indicator of a distinct presentation of social fears in autistic children, suggesting that these children may particularly benefit from intervention strategies that target this social-cognitive skill.

**443.045** (Poster) Social Skills Interventions for Young Adults: Fitting into a Neurotypical World?

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**Background:**

Social skills instruction is often cited as necessary for autistic individuals to be successful in higher education or employment. However, literature reviews of social skills curricula have shown mixed results of effectiveness and focus largely on younger populations. In recent years the autistic community has made clear that their involvement in the creation and evaluation of interventions is critical (Gowen et al., 2019). In the most recent literature review, the authors reported on autistic satisfaction, but did not address the level of autistic input used to inform the interventions. It is important to understand what researchers believe is the goal of social skill interventions, which requires a critical examination of the outcome variables used in studies. Thus, we conducted a systematic literature review to critically examine studies on social skills interventions for autistic young adults.

Objectives:

To understand:

- The literature base for social skills interventions for young autistic adults
- To what extent the interventions are formed by autistic input, researchers are collecting information about social validity, or acceptance of the intervention and how the success of interventions is measured

Methods: The ERIC and PSYCInfo databases were systematically searched for articles that examined the effectiveness of social skills interventions for young adults, were published in 1990 or later, written in English, and domestic. Two members of the research team then coded 505 abstracts for eligibility, 26 of which were included in the analysis.

Results:

Of the 26 interventions identified in this literature review, participants were mostly male (77.6%) and of the studies that reported on race, 75% of participants were white. While studies that examined participant satisfaction found high levels of satisfaction and positive experiences with the interventions, only three asked for autistic input when designing the intervention or determining which social skills to teach. The outcome variables measured varied by study and within randomized controlled trials (RCT) and single subject studies, there were a mix of measures completed by participants and parents or caregivers. In the RCTs the only measures that showed an improvement of social skills knowledge were those that were created specifically for the intervention. Most studies found no improvement in mental health variables, with mixed results for one intervention and its impact on loneliness. Single subject studies reported a functional relationship between the intervention and the targeted social skill for all or the majority of their participants.

Conclusions: The studies in the literature review found mixed results of effectiveness of group interventions. Only three of the studies asked autistic individuals to contribute to the intervention itself, which is a significant gap in the literature base. Opportunities for improvement appear important for social skills interventions for young adults on the spectrum, as the studies found very little change in mental health variables. Researchers should work with the autistic community in building interventions and focus on building inclusivity through interventions for non-autistic populations to better understand the communication differences of autistic peers.

**443.046** (Poster) The Factors Affecting Social Cognition in Children with ASD

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Background: Problems on measures of theory of mind (ToM), or the ability to ascribe mental states to others, have been consistently reported for younger children with ASD with or without intellectual disabilities and for older children with intellectual disabilities. However, it is less clear whether older children without intellectual disabilities display problems on ToM measures (Scheeren et al., 2013), and whether these problems singularly reflect social cognitive processes or more general cognitive processes such as working memory, inferential thinking, or verbal IQ (VIQ) (Joseph & Tager-Flusberg, 2004).

Objectives: To address this issue, this study examined the performance of a large sample of verbal children and adolescents with ASD on both verbal and nonverbal measures of ToM compared to age and VIQ matched controls in order to test whether diagnostic groups differences on ToM could be explained in terms of variance on measures of working memory, inferential thinking, or VIQ.

Methods: The participants included 125 children between the ages of 8-15. 81 met diagnostic criteria (ADOS-2) for ASD but were not affected by intellectual disability (ASD-WoID group; M = 11.29 years, SD = 2.13) and 44 were in the Typical Development (TD) group (M = 11.59 years, SD = 2.25). IQ scores were obtained from the WASI-2 (Weschler, 2011). Working memory was assessed using the Story Memory subtest from the WRAML2 (Sheslow & Adams, 2003), inferential thinking using the QRI (Leslie & Caldwell, 2011), and ToM using the average of individual scores received on Strange Stories Task (Happé, 1994) and the Silent Films Task (Devine & Hughes, 2013). The ASD and TD samples were also matched on “higher VIQ” and “lower VIQ” subgroups based on a median VIQ split at 101.5 (see Table1).

Results: MANOVA revealed that the ASD group significantly differed from the TD group on the ToM, inferential thinking, and working memory measures ( $p < .001$ ), but there was no interaction of diagnostic group and VIQ group. Working memory and inferential thinking correlated with ToM in the ASD sample only. A stepwise logistic regression analysis indicated that performance on ToM measures correctly identified 82% of the ASD sample but only 49% of the TD sample ( $p < .001$ ). The

addition of Story Memory improved the identification of ASD slightly to 83.6%, but improved TD identification to 69.2% ( $p < .001$ ). The QRI did not contribute significantly on the 3<sup>rd</sup> step of regression ( $p < .20$ ). Thus, ToM performance significantly and independently differentiated many but not all ASD and TD participants above and beyond the effects of working memory and inferential thinking. Neither working memory nor inferential thinking measures impacted ASD identification, but the former also differentiated the diagnostic samples.

**Conclusions:** The findings were consistent with the hypothesis that ToM performance is associated with domain general cognitive abilities such as working memory and inferential thinking in ASD. However, the findings also support the idea that ToM deficits in ASD are not explained by impairments in more general cognitive abilities.

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**443.047 (Poster)** The Influence of Autism Label on Face Recognition By Non-Autistic Adults

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**Background:** Labeling an individual can influence the inferences others make about them. For example, using a face-inversion paradigm, Civile et al. (2018) found the difference between memory for upright vs. inverted faces was larger for faces labeled "regular people" than those labeled "diagnosed with autism." Civile et al. suggested this could mean participants treated faces labeled as "diagnosed with autism" in a more objectified manner than faces labeled as "regular people."

**Objectives:** In two pre-registered studies, we attempted to replicate and extend Civile et al.'s (2018) findings. Study 1 was a close replication using the face inversion paradigm. Study 2 was a conceptual replication using an in-group vs. out-group recognition memory paradigm (Bernstein et al., 2006).

**Methods:** In Study 1, we recruited a sample of 140 adults via MTurk (Mage = 37.53 years, SD = 8.77; NMale = 62). Participants saw 64 faces at encoding: Half were upright and half were inverted. As in Civile et al.'s study, half of participants were informed the faces they would see were of "regular people" and half were informed the faces were of "people diagnosed with autism." At test, participants saw the 64 old faces (in the same orientation at encoding) and 64 new faces (half upright and half inverted), and made old/new judgments.

In Study 2, 147 undergraduates (Mage = 18.52 years, SD = 0.85; NMale = 40) in one of three conditions saw 40 faces at encoding. In "identity-first" and "person-first" conditions, half of the faces appeared on blue backgrounds and were labeled either "autistic person" or "person with autism," and half appeared on orange backgrounds and were labeled either "non-autistic person" or "person without autism." In a control condition, faces appeared on blue and orange backgrounds, but were not given a label. At test, all participants saw the 40 old faces on the same color backgrounds as at encoding and 40 new faces (half on blue and half on orange). No faces were labeled at test.

**Results:** Study 1: Figure 1 shows upright faces were remembered better than inverted faces  $F(1,276) = 56.04, p < .001$ , and faces labeled as "regular people" were remembered better than those labeled "people diagnosed with autism"  $F(1,276) = 4.48, p = .035$ . The interaction was not significant, indicating magnitude of the inversion effect was the same regardless of label.

Study 2: Figure 2 shows faces on blue backgrounds were remembered better than those on orange backgrounds,  $F(1,144) = 6.74, p = .01$ . Neither effect of condition nor interaction were significant, suggesting face recognition did not depend on presence or type of autism label provided at encoding.

**Conclusions:** Results from Study 1 suggested that faces with an autism label were less likely to be recognized than those without (though no difference of inversion effect magnitude, contrary to Civile et al., 2018). However, results from Study 2 suggested autism labels had no effect on recognition memory. It is possible that explicit measures of bias may reveal differences these implicit measures did not.

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**443.048 (Poster)** The Role of Distractibility and Emotional Engagement in Imitation in Children with Autism

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**Background:**

It is critical to understand which circumstances facilitate imitation in children with ASD, so that targeted intervention can be informed accordingly. Critical factors modulating imitation performance in children without ASD include distractibility and

emotional engagement with the model (Micheletti et al., 2020; Vivanti et al., 2016). One plausible yet untested scenario is that children with ASD imitate more in response to a model who is socially engaging when there are no distractions in the environment.

Objectives:

The present study examines whether toddlers with ASD imitate more accurately in response to the following conditions:

A) whether the demonstrator is showing positive or neutral facial expression

B) whether the demonstration takes place in a distraction-free versus “busy” environment that includes distractors (e.g., posters on the wall).

Additionally, we used eye-tracking to examine the link between imitation and attention to the demonstration in response to these different scenarios.

Methods:

We examined video recorded sessions of 27 children with ASD (20–35 months) participating in an imitation task. Participants were shown videos of an unfamiliar adult performing object-directed actions with either a playful or neutral facial expression and with or without visual distractors. Distractors included posters on the wall, as well as plants and other objects designed to resemble the real-life scenario of a busy environment (e.g., classroom). During observation of the demonstration, gaze patterns in responses to the video-stimuli were recorded using a Tobii-Pro eye-tracking device. After watching the model, participants were given the same materials shown in the videos and were encouraged to interact with them. Their responses were rated on a scale from 0–3, with zero indicating no interaction and three indicating a full imitation of the action. The rater was blind to research hypotheses and achieved reliability and percentage agreement above 80% with a master rater.

Results:

Imitation performance was (a) not modulated by facial expression ( $p = .698$ ) and (b) more accurate when distractors were present ( $p = .004$ ). Eye-tracking data showed that children did not look longer at the demonstration when accompanied by playful affect compared to neutral affect ( $p = .196$ ). Conversely, they looked longer at the demonstration in the “busy” compared to the “distraction free” environment ( $p < .001$ ). Additionally, children looked longer at the action to imitate in stimuli with distractors in the background compared to stimuli without distractors ( $p = .001$ ).

Conclusions:

Attention and imitation of children with ASD were modulated by the presence or absence of distractions, but not by the affect (positive or neutral) shown by the demonstrator. Counter to predictions, children with ASD in this study imitated more accurately when the environment *was not* distraction-free, potentially because the presence of objects increased engagement with the task. Additionally, unlike children without ASD in previous studies (Micheletti et al., 2020) children with ASD in this study imitated actions to the same degree regardless of whether the model displayed playful or neutral affect. These results suggest that a more naturalistic versus distraction-free environment may facilitate imitation in young children with ASD.

**443.049** (Poster) To be Good or to be Right: Effects of Social Problem Solving Competence and Congruency on Social Functioning in ASD

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Background: Children with autism spectrum disorder (ASD) demonstrate variable difficulty with social problem solving (SPS; Russo-Ponsaran, 2015). SPS challenges include generating effective, competent solutions (Ziv, 2014) and selecting prosocial responses (Bottema-Beutal, 2019) to social problems. Some ASD children generate competent, prosocial goals (e.g., make friends) and effective solutions to social problems (competent congruent [CC] SPS); others may have non-competent goals (e.g., hostile, retributive) but still generate effective solutions to achieve them (non-competent congruent [NCC] SPS). Although social skills and ASD symptoms relate to SPS abilities in ASD (Mazza, 2017), it is unknown whether it is the *competence* or *congruence* of SPS responses that is most responsible for these relationships.

**Objectives:** Evaluate the relationship between social skills, ASD symptomatology, and congruence of socially competent, or non-competent, SPS goals and solutions.

**Methods:** 58 children (44 male) ages 5-11 years ( $M=8.53$ ,  $SD=1.33$ ) with ADOS-2-confirmed ASD and  $IQ \geq 80$  ( $M=103.72$ ,  $SD=14.33$ ) completed SPS and affect recognition (AR) tasks within SELweb, a computerized, self-administered social cognition battery (Figure 1; McKown, 2015; Russo-Ponsaran, 2019); CC and NCC SPS response rates were calculated for each participant (Table 1; Figure 1). Social skills were assessed using the parent-report Social Skills Improvement System (SSIS; Gresham & Elliott, 2008), and ASD symptomatology was evaluated via ADOS-2 Comparison Score (CS; Lord, 2012), Social Responsiveness Scale, 2nd Edition (SRS-2; Constantino & Gruber, 2012), and Social Communication Questionnaire (SCQ; Rutter, 2003). Bivariate correlations were conducted to examine relationships between CC or NCC SPS and AR, social skills, and ASD symptomatology. Variables with significant correlations were entered in commonality analyses (Nimon, 2008) to specify the unique and common variance each contributes to CC or NCC SPS (Table 2).

**Results:** Greater SSIS ( $r(58)=.355$ ,  $p<.01$ ), lower SRS-2 ( $r(58)=-.355$ ,  $p<.01$ ), and lower ADOS-2 CS ( $r(58)=-.261$ ,  $p<.05$ ) were associated with CC SPS. Conversely, lower SSIS ( $r(58)=-.355$ ,  $p<.01$ ), greater SRS-2 ( $r(58)=.367$ ,  $p<.01$ ), higher SCQ ( $r(58)=.276$ ,  $p<.05$ ), and poorer AR ( $r(58)=-.262$ ,  $p<.05$ ) were associated with greater NCC SPS. Commonality analyses revealed variance common to SSIS and SRS-2 accounted for the greatest overall variance in CC SPS, while ADOS-2 CS contributed the greatest unique variance. Variance common to SSIS, SRS-2, and SCQ accounted for the greatest overall variance in NCC SPS, and AR contributed the greatest unique variance.

**Conclusions:** Most youth with ASD exhibited CC SPS responses and did not exhibit NCC, though considerable variation was evident. While social skills and ASD symptoms were related to SPS responses, these results suggest that competence, rather than congruence, of SPS related to greater skills and fewer symptoms. Results also revealed common rater variance of parent report to be most related to SPS, while unique variance of clinician-rated symptoms of ASD and AR each predicted CC and NCC SPS, respectively. More finely parsing the shared and unique contributions of social symptoms to SPS provides a more nuanced means of understanding social cognitive profiles in ASD (Keifer et al., 2020). Future work should further disentangle the role of specific elements of SPS in impacting social functioning in ASD, to provide more precise social cognition intervention targets.

#### **443.050 (Poster)** Use of the Children's Communication Checklist-2 in School-Aged Students with ASD: A Psychometric Analysis

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#### **Background:**

Measurement of social-pragmatic communication skills is essential for clinicians and researchers working with school-aged autistic children. Many measures of these skills require time-intensive training and coding and are impractical for clinical assessment settings. In this poster session, we will examine the psychometric properties of the Children's Communication Checklist-2 (CCC-2; Bishop, 2006) as applied to children with ASD and completed by teachers, providing an updated report of the utility of this measure for clinicians and researchers.

#### **Objectives:**

- (1) To examine the reliability of the CCC-2 as a measure of social-pragmatic communication skills in children with ASD.
- (2) To explore the convergent and divergent validity of the CCC-2 as a measure of social-pragmatic communication skills in children with ASD.
- (3) To determine the factor structure of the CCC-2 for this sample of students with ASD and if the factor structure results differ by child biological sex, nonverbal IQ, ethnicity, or race.

#### **Methods:**

Using a sample of 299 school-aged autistic children ( $M=8.6$  years,  $sd=1.7$ , 27% female, 51% non-White) whose teachers completed the CCC-2, we evaluated the psychometric properties of the measure.

## Results:

Internal Consistency. Cronbach's alpha was .94 for the whole measure. Subscale alphas ranged from: .62-.86.

Convergent Validity. The CCC-2 GCC was highly correlated with the VABS Communication ( $r=.67, p<.01$ ) and Socialization ( $r=.61, p<.01$ ) domain standard scores. It was moderately correlated with the SSiS Social Skills Standard Score ( $r=.42, p<.01$ ).

Divergent Validity. The CCC-2 GCC did not show divergent validity with the VABS Daily Living Skills Domain ( $r=.61, p<.01$ ). It demonstrated divergent validity with the SSiS Problem Behavior Standard Score ( $r=-.31, p<.01$ ) and the SCQ restricted and repetitive behavior subscale ( $r=-.08, p<.28$ ).

Factor Structure. We conducted a series of CFAs and EFAs (See Table 1 for fit statistics) to determine the most parsimonious model fit. The final model was a 3-factor CFA on 38-items that met acceptable goodness of fit-criteria (RMSEA = 0.050, CFI = 0.896, TLI= 0.889, SRMR=.101). The factors were interpreted as (1) structural language (2) pragmatic communication and (3) pragmatic social. Nonverbal IQ was significantly associated with Structural Language ( $B= -.02, p < .001$ ) and Pragmatic Socialization ( $B= -.01, p < .001$ ), but not Pragmatic Communication. Individuals with higher nonverbal IQ scores had less difficulties with structural language and pragmatic social skills. Race and Ethnicity was associated with Structural Language ( $B = -.40, p < .001$ ), but not Pragmatic Socialization or Pragmatic Communication. Students who identified as White and Non-Hispanic/Non-Latino had fewer difficulties with structural language than students who identified as White, Hispanic/Latino, or multiracial in this sample.

## Conclusions:

Our results indicate strong psychometric properties for the CCC-2 with this population and a 3-factor model fit: Structural Language, Pragmatic Communication, and Pragmatic Social. Evidence of racial/ethnic bias was found for the structural language factor. Based on the results of this analysis, we will report several recommendations for use of these CCC-2 with school-aged autistic students as well as further interpretation of the factor analytic results.

### **443.051 (Poster)** Using Video Stimuli to Quantify Robust and Reliable Difficulties in Social Comprehension in Adults with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by impairments in social cognition that are especially apparent in complex social situations (Heavey et al., 2000). While some individuals with autism can accurately characterize simple emotions (e.g., happiness), they may stumble at deciphering complex emotions (e.g., playful) (Happé, 1994) or when making more advanced mental state judgments (Baron-Cohen et al., 1985), especially when those judgments are embedded in complex, dynamic situations (Dzoiibek et al., 2006). Real-world difficulties in social processing could arise from altered attention to faces, higher-order social cognitive differences, or a host of other domain specific and domain general processes. This underscores the importance of measuring and capturing these difficulties in the lab by using increasingly more complex, naturalistic stimuli.

Objectives: The current study investigated social cognition in autism with the use of complex audio-visual stimuli (a television show) together with a broad set of social cognition questions. Our aims here were to extend previous findings (Byrge et al., 2015) to a large sample comprised of data from two independent sites, with future plans to link these social cognition findings to eye-tracking and neuroimaging measures.

Methods: This multi-site study was comprised of ASD participants (Site 1  $n = 54$ ; Site 2  $n = 20$ ) and sex-, age-, and IQ-matched controls ( $n = 82$ ;  $n = 35$ ). Participants watched an episode of *The Office* while undergoing screen-based eye-tracking and answering 39 open-ended questions assessing their comprehension of the preceding segment of this video. One subset of these questions assessed characters' thoughts and feelings (13/39), while another subset assessed characters' motivations and intentions (18/39). Each question was answered aloud and recorded for later offline blind coding using a 0, 1, or 2 coding scheme, with high scores indicating better comprehension.

Results: For all categories across both sites, the autism group exhibited lower performance than the control group (see Figure 1 and Table 1). Although full-scale IQ was correlated to performance (ASD,  $r = 0.53$ ,  $p < 0.001$ ; Control,  $r = 0.27$ ,  $p < 0.01$ ) in each group, group differences persisted when IQ was included as a covariate ( $\beta = 0.11$ ,  $SE = 0.02$ ,  $p < 0.001$ ).

Conclusions: Overall, these results indicate that the stimuli used in this study are sensitive enough to pick up differences between groups in social judgments of videos, with differences replicated across two samples. Individuals with ASD were impaired overall, with the largest differences found for judgments of motivations/intentions. This is consistent with previous findings (Heavey et al., 2000; Byrge et al., 2015) indicating that people with ASD may have difficulty understanding behaviors motivated by complex mental states (i.e., intentions). Future analyses will link performance on this measure to eye movements on the same stimuli. Combining gaze and behavior may allow us to better understand the relationship between visual input and social comprehension in autism.

**443.052** (Poster) Video Game Use, Aggression, and Social Impairment in Adolescents with Autism Spectrum Disorder  
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Background:

Adolescents with autism spectrum disorder (ASD) play video games more often and for longer periods of time than their typically developing (TD) peers (Mazurek & Wenstrup, 2013), and also exhibit increased rates of aggression (Mays et al., 2011; Kim et al., 2000). However, increased video game use is not associated with increased aggression in ASD (Alkhatat & Ibrahim, 2020), although research in this area has been limited (Mazurek & Engelhardt, 2013). Video games, however, may increase social functioning by offering social interaction that avoids nonverbal cues, reading facial expressions, and interpreting gestures (Walther, 2007). The relationship between video games and social functioning has not been fully examined yet within the ASD community.

Objectives:

1. Compare the frequency and amount of video game playing in adolescents with ASD and TD (in a FSIQ matched sample).
2. Examine the association between video game playing and aggression in adolescents with ASD.
3. Examine the association between video game playing and social impairment in adolescents with ASD.

Methods:

Participants included 89 adolescents with ASD (Mean age=12.69 years (SD=2.03)) and 89 with TD (Mean age=13.09 years (SD=1.99)) enrolled in two longitudinal studies. All individuals were diagnosed using the Autism Diagnostic Observation Schedule (ADOS) and Social Communication Questionnaire (SCQ). The ASD and TD groups were case-matched for FSIQ and age (tolerance factors 11 & 0, groups did not differ significantly ( $p > .05$ ), resulting in mean FSIQ=105.66 (SD=13.38)) within ASD and 108.99 (SD=11.97) in TD. Parents completed the Child Behavior Checklist (CBCL), which includes reports of favorite hobbies and time spent on them compared to others of the similar age, as well as assessments of aggressive behavior. Participants were first categorized into video game players and non-players based on their responses to the hobbies questions, and then into 4 groupings based on their frequency of game play (don't play, play less than average, play an average amount, or play more than average). Social functioning was assessed using the Social Responsiveness Scale, Second Edition (SRS-2; parent report questionnaire).

Results:

Results indicated a significant group (ASD/TD) by video game playing status interaction ( $\chi^2(1, n=178) = 8.91$ ,  $p = .003$ ) with the ASD group playing more games. No significant differences were found in CBCL Aggression T-scores or SRS Total T-scores between players and non-players with ASD.

Similarly, significant diagnostic group differences, based on playing frequency, were found (Mantel-Haenszel  $\chi^2(1, n=173) = 20.40$ ,  $p < .0001$ ) (Figure 1). CBCL Aggression T-scores were significantly higher for ASD participants who played "more than

average” compared to those who played video games an “average” amount of time (Figure 2a). In ASD, amount of time spent playing video games was not associated with social impairment/satisfaction measures as measured by the SRS-2 (Figure 2b).

Conclusions:

While adolescents with ASD play more video games than their TD peers, in ASD, overall, video game playing is not associated with increased aggression or social functioning. However, those who play more than average compared to peers of a similar age have a higher Aggression T-score than those who play only an average amount.

**443.053 (Poster)** Visual Scanning Patterns Predicting Theory of Mind Performance

*J. M. Moriuchi<sup>1</sup>, S. Licon<sup>2</sup>, M. Printen<sup>3</sup>, H. Lechniak<sup>4</sup>, E. V. Ocampo<sup>1</sup> and L. Soorya<sup>1</sup>, (1)Department of Psychiatry, Rush University Medical Center, Chicago, IL, (2)Rush University Medical Center, Chicago, IL, (3)Child and Adolescent Psychiatry; Autism Assessment Research and Treatment Center, Rush University Medical Center, Chicago, IL, (4)Child and adolescent psychiatry, Rush University Medical Center, Chicago, IL*

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**Background:** Impairments in mentalizing represent a key deficit in social cognition for children with autism spectrum disorder (ASD). Explicit mentalizing tasks, such as the Reading the Mind in the Eyes Test, have shown promise as an outcome measure in social intervention studies. However, performance on explicit mentalizing tasks can be variable, even as individuals with ASD continue to struggle with applying mentalizing skills within everyday contexts. One hypothesis is that overall accuracy measures on explicit mentalizing tasks may not fully capture underlying social cognition; children with ASD may be utilizing alternate, compensatory strategies and may be solving mentalizing problems in a different way than typically-developing peers.

**Objectives:** To help clarify the underlying mechanisms of children’s mentalizing performance, we developed a computerized battery of social-cognitive measures co-registered with eye-tracking. By examining visual scanning patterns as participants completed mentalizing tasks, we aimed to measure not just whether children were accurate in their social attributions, but also how they were attempting to make social attributions on a moment-by-moment basis. Because mentalizing impairments tend to be most apparent in everyday contexts, we compared visual scanning patterns predictive of mentalizing performance and social disability across tasks using increasingly naturalistic stimuli, including still images and dynamic facial expressions and gestures.

**Methods:** Participants included 20 verbally-fluent children with ASD (16 male, 4 female) between the ages of 8 and 11 years old who represented a broad range of severity in ASD symptomatology (ADOS-2 Calibrated Severity Score: mean=8.4 [3.4]). Participants were enrolled in a randomized clinical trial of a combination behavioral-pharmacological treatment targeting social cognition and social behavior; the current study focused only on data at baseline, pre-treatment.

Eye-tracking data were collected while participants completed a battery of computerized social cognitive measures, including an adapted version of the child Reading the Mind in the Eyes Test (RMET; Figure 1A-B) and a dynamic emotion recognition test developed from the Geneva Multimodal Emotion Portrayals (GEMEP; Figure 1C-D) database.

**Results:** Accuracy on mentalizing tasks ranged from 25 to 89% correct responses. Visual attention to nonsocial regions was positively correlated across still images and dynamic stimuli ( $r=0.60$ ,  $p<0.05$ ) and higher than attention to social regions ( $t=2.00$ ,  $p=0.05$ ). Children who exhibited higher visual attention to the eyes region of faces tended to have less severe ASD symptomatology ( $r=-0.50$ ,  $p=0.03$ ) and higher mentalizing accuracy ( $r=0.52$ ,  $p=0.02$ ). Ongoing analyses are utilizing more temporally-sensitive measures to identify visual scanning patterns that may mediate the relationship between attention to eyes and mentalizing performance.

**Conclusions:** The computerized social-cognitive battery yielded a broad range of mentalizing performance in our pilot sample of school-age children with ASD and identified consistent visual scanning patterns contributing to mentalizing accuracy. This new approach holds promise as a tool sensitive to change both in mentalizing performance and in underlying social-cognitive processes.

**443.054** (Poster) Watch Your Step! the Link between Coordinated Joint Action and Peer Social Engagement in ASD and TD  
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**Background:**

Coordinated joint action (CJA) occurs when two confederates accomplish a shared goal by coordinating their social-motoric movement in time and space. Abilities to mirror, complement, and predict the other's actions during CJA requires successful operation of social-motor capabilities. Though social deficits in cognitively able (IQ > 70) youngsters with autism spectrum disorder (CAASD) have been relatively explored, the contribution of CJA to social engagement along development in children and adolescents with CAASD remains underexplored.

**Objectives:**

This study examined group and age differences in CJA for children and adolescents with CAASD compared to age-matched controls with typical development (TD), as well as CJA's links with social engagement. Findings regarding motor coordination's role for social functioning during development may open new future intervention paths focusing on social-motor coordination in youngsters with CAASD.

**Methods:**

Participants: Children and adolescents ages 6–16yrs included 80 with CAASD ( $M = 11.1$  yrs,  $IQ = 103.88$ ) and 64 with TD ( $M = 10.73$  yrs,  $IQ = 114.53$ ) in three age-groups: early-childhood (6–8), pre-adolescence (8–12), and early-adolescence (12–16). Group differences on age and IQ were non-significant.

Measures: Four dyadic CJA tasks were executed in peer dyads paired by IQ and chronological age: two imitation or mirroring tasks (side-by-side walking, face-to-face movement) and two completion tasks (virtual-football kick-and-catch, corridor completion during virtual football). CJA performance was coded via *Interact* micro-analyses coding system, providing four major coordinated movement scores for each task. In addition, dyadic construction game performance was observed (using Dyadic Relationships Q-Set) to assess social engagement, yielding total social engagement score (ranging between: 1–7) that was based on the following dyadic peer engagement qualities: positive social orientation, cohesiveness, harmony, responsiveness and coordinated play.

**Results:**

A series of Group X Age ANOVAs yielded significant group differences (CAASD < TD) for all four CJA tasks and significant age differences (early-adolescence and pre-adolescence > early-childhood) for three CJA tasks, beyond group. For CJA–mirroring, early-adolescence surpassed early-childhood. The Group X Age interaction was significant only for CJA–walking (early-adolescence and pre-adolescence > early-childhood), only in the TD group (see Table 1). All CJA tasks significantly and positively correlated with social engagement (total Q-set), only in the CAASD group. Controlling for age group yielded the same results (see Table 2).

**Conclusions:**

Findings regarding CJA's developmental trajectory indicated growing CJA competence with age for both groups. The differences in CJA performance found between the CAASD and TD groups, as well as CJA's significant link with social engagement in the CAASD group, provide a novel viewpoint on dyadic motor coordination's contribution to social engagement and on the possible role of joint body movements for understanding the social deficit in ASD. The current results suggest a promising new avenue for approaching the social deficit in ASD via a different, complementary channel – motor functioning and coordination – which may encourage the design of future socio-motoric interventions and further empirical investigations of the links between social and physical communication for this population.

**443.055 (Poster)** What Are the Obstacles Encountered By Autistic Children and Adolescents during the Pandemic in Quebec?  
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Background: COVID-19 hit all the society, bringing changes on a global scale (Courtenay & Perera, 2020). For about two months in Quebec, schools were closed and the entire province of Quebec was lock downed, depriving most people of social contact. During this period, few opportunities for community support were available (Montreuil et al., 2020). Adaptation was needed to cope with this situation, particularly for children and adolescents with special needs and their families (Eshraghi et al., 2020). Isolation for children in the general population had many consequences (Montreuil et al., 2020), but what about the impact on autistic children and adolescents?

Objectives: To document the obstacles reported by autistic children and adolescents as well as by their parents during the lockdown period in Quebec.

Methods: Through *LimeSurvey*, 109 parents of autistic children completed the new *French Questionnaire on the Needs of Children and Adolescents with Autism and their Families During the COVID-19 Pandemic*. Then, 56 of their autistic children aged 4 to 18 years completed a sub-section of the same questionnaire. Multiple-choice and open-ended questions were included. For each question, descriptive analyses were performed using SPSS software, and barriers were identified through thematic and qualitative analyses of the open-ended answers.

Results: Three main obstacles were reported by the autistic children. The greatest difficulty they encountered was related to not seeing their friends (57% of children), followed by fear of catching the virus (48%) and changes in routines (36%). The parents also emphasized that one of the most harmful factors in their child's adjustment was in the social sphere, more particularly linked to the isolation from their relatives (55%). When asked in open-ended questions what other factors were harmful to their autistic child's adjustment, isolation and lack of socialization were named by 36% of the parents, which is twice the proportion of those who mentioned the lack or difficulty of access to services (18%). In addition, 61% of the parents mentioned that spending time with their family was a facilitating factor in their child's adjustment. Finally, when the children were asked what they would recommend to a stressed friend during the pandemic, 29% of the recommendations were related to the social sphere, which represents the main theme of this qualitative analysis. More precisely, 70% of these recommendations pertained to communication and closeness with their parents, whereas the rest concerned visiting family and talking to trusted adults.

Conclusions: These results highlight a paradoxical aspect of autism: whereas this condition is marked by significant social deficits, the lack of social contact represents the main obstacle reported by autistic children/adolescents as well as by their parents during the lockdown period. It would be relevant to consider the social interactions in autistic children's lives as they seem to play a major role in their well-being and quality of life.

**443.056 (Poster)** With Whom Would You Prefer to Interact?: Investigating Context Dependent Effects of Social Behavior and Special Interests  
**K. M. Stockwell<sup>1</sup>, J. M. Gillis<sup>2</sup> and V. K. Jaswal<sup>1</sup>,** (1)University of Virginia, Charlottesville, VA, (2)Binghamton University, Binghamton, NY

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Background: Autistic people often differ from non-autistic people in their style of interaction, which can lead non-autistic people to be reluctant to interact with them (Sasson et al., 2017). This manifestation of stigma can negatively impact mental health and reduce opportunities to form relationships (Slavich et al., 2009). Approximately 44% of autistic young adults enroll in college within eight years of completing high school (Newman et al., 2011), making college an important setting in which to understand the stigmatization of autistic students (e.g., Gillespie-Lynch et al., 2020; Stockwell et al., 2020). A better understanding of which kinds of social activities are most likely to result in stigmatization may be helpful in the development of interventions to reduce the stigmatizing beliefs and behaviors of non-autistic people.

Objectives: This study investigated how non-autistic college students' preferences for interacting with autistic and non-autistic peers differed depending on the hypothetical social activity.

Methods: On each of 225 trials, undergraduates ( $N = 324$ ; 70.37% female;  $Mage = 19.09$  years,  $SD = 1.01$ ) selected which of two characters they would prefer to engage in a particular activity with (see Figure 1 for a list of the activities). The characters were described in vignettes as college students who behaved in ways characteristic of autism (or not) and additionally described as having a special interest (SI; or not). Participants also reported their knowledge of autism and relationships with autistic people.

Results: Participants chose to interact with vignette characters differently overall, Friedman test  $\chi^2(5) = 1187, p < 0.001$ , Kendall's  $W = 0.733$ . Participants selected non-autistic characters more than they selected autistic characters. They also chose to interact with vignette characters differently depending on the activity proposed, Friedman test  $\chi^2(77) = 16430, p < 0.001$ , Kendall's  $W = 0.659$ . For example, as Figure 2 shows, when the activity was working on a class project together, participants selected an autistic character with an SI about as often as one without (22.5% vs. 25.2%). But when the activity was going on a date, participants selected an autistic character with an SI significantly less often than one without (17.1% vs. 31.4%). Depending on the activity, participant character preferences were differentially impacted by social behavior and by SI.

Conclusions: While overall measures of stigma can give insight into how a group may be viewed, focusing on the individual items may enhance this insight. Examining how responses to individual level traits (social behavior, presence of an SI) differ depending on which activity participants are presented with can offer insight into areas that may need to be specifically targeted in anti-stigma interventions. Understanding how autistic social behavior and the presence of SIs influence interaction choices in non-autistic people may also assist in the development of these interventions.

## POSTER SESSION — SOCIAL NEUROSCIENCE

### Poster 444 - Social Neuroscience Posters

**444.001** (Poster) A Diminished Neural Response to One's Own Face in Autism, As Shown Using Fast Periodic Visual Stimulation

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#### Background:

Research suggests that self-related processing is altered in individuals with autism. Several recent studies report that individuals with autism show a diminished neural response for their own name and own face (Nijhof & Bird, 2019), making the neural processing of self-related stimuli a promising avenue for further study. Currently however, neuroimaging research, especially in clinical groups, is limited by the fact that data are generally quite noisy. Therefore, stimuli have to be repeated many times, making experiments long and demanding. The use of an EEG approach called Fast Periodic Visual Stimulation (FPVS), makes it possible to obtain a great amount of meaningful data with a high signal-to-noise ratio, in a relatively short time.

#### Objectives:

In this study, we wanted to use FPVS to test the discrimination of one's own face (as compared to a close other's face and a stranger's face) among other faces, in adults with and without autism. The aim was to further test the hypothesis that self-processing, as compared to other-related processing, is diminished at the neural level in autism.

#### Methods:

Neural activity of 20 adults with autism and 24 typically developed adults was recorded using a 64-electrode EEG-system, while they were watching rapidly alternating naturalistic images of faces on a screen. Strangers' faces were presented at a base frequency of 5.77 Hz, in three runs of 82 seconds with order counterbalanced. On each run, every fifth image (oddball frequency: 1.154 Hz) had the same identity. Per run, this was either one of ten photos of the participant, of someone close to the participant, or of a specific stranger.

#### Results:

A collapsed localizer approach indicated the signal-to-noise ratio at the oddball frequency to be highest in a left and right parieto-occipital cluster, as well as a midfrontal cluster. Within each cluster, the same pattern of results was found: the control group showed a significantly greater response to one's own face than for both the close other's and stranger's face, and a greater response for the close other's face than for the stranger's face. In contrast, in the autism group, the own and close other's face showed stronger responses than the stranger's face, but the difference between own and close other's face was not significant. See Figure 1 for the difference topography between own face and close other's face for the two groups.

#### Conclusions:

In a recording of under five minutes, we managed to extend previous findings of a diminished response to seeing one's own face in adults with autism, as compared to adults without autism. These findings provide further evidence for decreased self-other distinction in autism, despite intact familiarity processing. More generally, we want to emphasize that the use of FPVS is promising for studying face recognition in clinical groups.

**444.002 (Poster)** Attention to Novelty Vs. Habituation in Preschoolers with Autism Spectrum Disorders (ASD): An Eye-Tracking Study

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**Background:** Our prior knowledge on the world is constantly used to predict the incoming information. The incoherence between the two (i.e. prediction error, surprise) is thought to be estimated inflexibly and with high precision in individuals with autism (Lawson et al., 2014; Van de Cruys et al., 2014). Thus the rich inputs from the ever changing world might appear constantly novel and lacking regularity. In coherence with this framework previous studies in ASD reported prolonged habituation to repeated visual stimuli (Vivanti et al., 2018) and decreased attention to novel visual stimuli (Keehn, 2008).

**Objectives:** The goal of the present study was to compare visual habituation and novelty detection patterns between preschoolers with ASD and their age-matched typically developing peers and with regards to two stimuli types (social vs. non-social).

**Methods:**

A custom-designed habituation task with two conditions (social and non-social) was implemented on the Tobii eye-tracking device. In both conditions, two dynamic stimuli were displayed on each trial (videos of human faces vs. shape animations). One of the stimuli remained constant over trials (habituation stimulus) while the other one changed on each of the seven trials (novelty stimulus). Taking into account the findings of diminished attention to social stimuli in ASD (Chita-Tegmark, 2016; Pierce et al., 2011), all videos were framed with a static band containing geometric shapes, to ensure that the attention is captured on the screen. The task was shown to 100 (18F) preschoolers with ASD (aged 3.5±1.1) and 35 (11F) typically developing (TD) preschoolers (aged 3.9±1.7).

**Results:**

In social condition, preschoolers with ASD failed to habituate while the TD group showed less attention to the repeated stimulus over trials ( $p = 0.01$ ). However, both groups presented a similar pattern of habituation in the non-social condition ( $p = 0.99$ ). On the novelty side, the ASD group did not show preference for the novel social stimuli over trials as the TD ( $p > 0.001$ ). In social condition (solely), the ASD group looked more at the static frame containing geometric shapes compared to the TD group ( $p = 0.006$ ). Among children with ASD, we identified a subgroup of children who showed sensitivity to social novelty. These children had less severe (social) symptoms of autism ( $p = 0.13$ ) and better cognitive and adaptive functioning ( $p < 0.001$ ) compared to “novelty insensitive” subgroup. On the other hand, children with ASD who attended a static frame during the social condition presented more severe symptoms of autism ( $p = 0.11$ ), lower cognitive ( $p < 0.001$ ) and adaptive functioning ( $p = 0.002$ ).

**Conclusions:** The preserved pattern of habituation and novelty in geometric condition, as opposed to social condition in the ASD group, can be linked to the higher predictability of this type of stimuli compared to social condition. This finding is coherent with the predictive encoding deficit framework where the supposed high predictive error precision does not necessarily hinder the learning of new contingencies in the context of higher regularity but appears more problematic in less precise contexts such as social exchanges.

**444.003 (Poster)** Combined Frequency-Tagging EEG and Eye-Tracking Measures Provide No Support for the Excess Mouth/Diminished Eye Attention Hypothesis in Autism

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**Background:**

Scanning faces is important for social interactions. Difficulty with the social use of eye contact constitutes one of the clinical symptoms of autism spectrum disorder (ASD). It has been suggested that individuals with ASD look less at the eyes and more at

the mouth than typically developing (TD) individuals, possibly due to gaze aversion or gaze indifference. However, eye tracking evidence for this hypothesis is mixed. While gaze patterns convey information about overt orienting processes, it is unclear how this is manifested at the neural level and how relative covert attention to the eyes and mouth of faces might be affected in ASD.

**Objectives:** We used frequency-tagging EEG in combination with eye tracking to assess the "excess mouth/diminished eye attention" hypothesis in ASD. We modeled temporal scan paths to understand face exploration dynamics in ASD.

**Methods:**

We used frequency-tagging EEG in combination with eye tracking, while participants watched fast flickering faces for 1-minute stimulation sequences. The upper and lower halves of the faces were presented at 6 Hz and 7.5 Hz or vice versa in different stimulation sequences, allowing to objectively disentangle the neural saliency of the eyes versus mouth region of a perceived face. We tested 21 boys with ASD (8-12 years old) and 21 typically developing (TD) control boys, matched for age and IQ.

**Results:**

Both groups looked longer at the eyes than the mouth, without any group difference in relative fixation duration to these features. TD boys looked significantly more to the nose while the ASD boys looked more outside the face. EEG neural saliency data partly followed this pattern: neural responses to the upper or lower face half were not different between groups, but in the TD group, neural responses to the lower face halves were larger than responses to the upper part. Face exploration dynamics showed that TD individuals mostly maintained fixations within the same facial region, whereas individuals with ASD switched more often between the face parts.

**Conclusions:**

Combined eye-tracking and frequency-tagged neural responses show no support for the excess mouth/diminished eye gaze hypothesis in ASD. The more exploratory face scanning style observed in ASD might be related to their increased feature-based face processing style.

**444.004 (Poster)** Comparing fNIRS-Based Cortical Activation during a Dyadic Versus a Triadic Non-Verbal Communication Task in Children with and without Autism Spectrum Disorder

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**Background:**

Children with ASD have difficulties interpreting and communicating various hand and body gestures within a social interaction. Our previous work compared cortical activation patterns of children with and without ASD performing/observing simple dyadic communicative gestures such as waving bye, etc. (Bhat et al., 2019). However, cortical activation associated with simple dyadic communication did not clearly differentiate the two groups. In contrast, children with ASD had lower cortical activation over the Observation-Execution Matching System (OEMS) regions of inferior frontal gyrus (IFG) and superior temporal sulcus (STS) along with increased inferior parietal lobule (IPL) activation when observing and synchronizing triadic (object-related) reaching movements with an adult partner compared to children without ASD (Su et al., 2020).

**Objectives:**

In the present study, we compare triadic and dyadic non-verbal communicative gestures/actions and associated cortical activation between children with and without ASD as they observed partner's actions, performed solo, or copied a partner's reach-clean up actions during a reach-cleanup task or symbolic gestures during an engaging charades game task.

**Methods:**

Sixteen children with ASD and 15 typically developing school-aged children (TD) participated in the study. An fNIRS cap embedded with a 3x11 probe set covering middle frontal gyrus (MFG), IFG, STS, pre- and postcentral gyrus (PCG) and IPL was placed on the children's head to collect cortical activation data. Each child was seated across from an adult partner. In the reach-

cleanup task, children with ASD either observed or performed reach-cleanup actions (solo or in synchrony) based on the picture cards showing the order of cleanup or by following an adult partner's actions. In the charades game task, the child either observed gestures performed by the adult partner, performed gestures shown in a picture card or copied the adult's performed gestures. The reaching/gestural errors and synchrony errors during the solo and synchrony conditions were coded. The fNIRS-related oxy-hemoglobin response (i.e., regional cortical activation) was analyzed to study differences between groups, conditions, hemispheres, and regions.

#### Results:

Our preliminary analysis suggests that even the relatively complex and engaging dyadic task showed no group differences, the triadic task clearly showed lower cortical activation in the children with ASD compared to the children without ASD across all three conditions of Watch, Do, and Together (see representative figure for the synchrony condition). In terms of task-related differences, cortical activation was lower in the dyadic task compared to the triadic task across both groups. We are in the process of scoring video data assessing children's motor and synchrony behaviors and standardized tests and questionnaires to relate brain activation to synchrony errors and ASD-related behaviors.

#### Conclusions:

Our findings elucidate the various synchrony errors in children with ASD and how that might be mediated by poor cortical activation in the various OEMS regions important for motor planning, anticipation, and visuo-motor correspondence during certain synchrony tasks. We will identify multiple fNIRS-based neurobiomarkers that could be used to assess objective neural changes following a prolonged bout of synchrony-based interventions.

#### **444.006 (Poster)** Fixation-Related fMRI: Coregistering Eye-Tracking and MR Scanning to Identify the Neural Correlates of Engagement in ASD

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#### Background:

The social world is complex and dynamic, yet the study of social interaction/cognition typically uses static and artificial stimuli. Such methods can particularly limit ecological validity in ASD research, in which atypical engagement with the social world is a defining feature of the condition. Recent studies have utilized naturalistic approaches to fMRI work (e.g. movie viewing) to capture the complexity of the real world and examine underlying neural signatures of social perception. However, such naturalistic paradigms present challenges with regard to segregating neural activity in relation to specific onscreen events-of-interest, and thus often require complicated manipulations and/or analytic approaches to isolate and model stimulus properties (such as presence or absence of faces, motion changes etc.).

#### Objectives:

In our study, we explore fixation-related (FIRE) fMRI (Henderson et al., 2015)—a novel method for examining neural correlates during real-world scene viewing—to quantify what is engaging to children with and without ASD and to identify the neural mechanisms that underlie such engagement.

#### Methods:

Simultaneous eye-tracking and fMRI data were obtained while 8- to 12-year-old TD (n = 8) and ASD (n = 12) children viewed videos of naturalistic social scenes. Children were trained in a mock scanner until movement was <3mm for 3 8-minute periods. fMRI data were collected using a T2-weighted EPI sequence (TE=25s, TR=2.15s, flip angle=90°, voxel size=3.5mm x 3.5mm x 3.5mm, 37 axial slices without gap). Blink patterns (Shultz et al., 2011) and visual fixations were used to identify events-of-interest that *viewers themselves* perceived as 'highly engaging' or 'less engaging', and where viewers were looking during those events (e.g. at a face, body, or object), respectively. Nearly 50 events were identified per condition (highly engaging and less engaging), per group, yielding almost twice the number of trials sufficient (from a statistical standpoint) for eliciting an interpretable hemodynamic response. An inter-stimulus-interval of at least 2 seconds was used as the criterion for defining events, thereby maximizing the statistical efficiency of the design.

## Results:

TD and ASD participants had similar numbers of 'events-of-interest' ( $p > .05$ ), indicating that ASD participants are engaged by naturalistic stimuli as often as TD participants. The number of events identified was also comparable between conditions (highly engaging vs. less engaging,  $p > .05$ ), thereby suggesting that viewers are not always highly engaged with what they are looking at, even while looking at socially-relevant stimuli. However, there was only a small amount of overlap (12%) in which events were perceived as engaging by both groups.

## Conclusions:

Our preliminary analyses suggest that TD and ASD participants are differentially engaged while watching the same naturalistic stimuli. Immediate next steps include characterizing the content of participant-defined events-of-interest for each group to examine what stimulus properties are engaging to them, and analyses of fMRI data using such events-of-interest to identify the neural mechanisms underlying engagement in TD and ASD participants. The observed statistical efficiency of this novel methodology indicates a promising potential of this paradigm for gaining insight into the subjective experiences and perspectives of individuals with ASD.

### 444.007 (Poster) Neural Mechanisms of Imitation As a Social Signal in Autism

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## Background:

Some people imitate prolifically, even when it is not strictly necessary to do so but children with autism do this less than typically developing children. This might be explained by the social signalling hypothesis: that neurotypicals use imitation as a signal to boost affiliation but autistic people do not. Previous research has found that neurotypical imitation increases when their partner can see them, in line with the social-signalling hypothesis of imitation. Neuroimaging of this task using functional near-infrared spectroscopy (fNIRS) in typical adults found changes in right temporal-parietal junction and the right inferior parietal lobule in relation to viewing unusual actions and being watched.

## Objectives:

We aimed to evaluate spontaneous imitation of irrational actions and the neural correlates of this behaviour in participants with and without autism spectrum condition, using a naturalistic block-moving paradigm.

## Methods:

22 adults with autism and 22 neurotypical adults performed a simple block-moving task. Participants (Followers) were paired with a trained confederate (Leader), and in each trial the Leader demonstrated the order in which three blocks were to be moved from one board to another. Unbeknownst to the Follower, the Leader would move the blocks with either a rational (low) or irrational (high) trajectory (Fig1A). During the Follower's turn, the Leader would either watch them make their move or not. The 16 experimental trials thus followed a 2 x 2 factorial design where the trajectory demonstrated was rational or irrational, and the Follower was Watched or Unwatched. fNIRS signals were obtained from 44 channels over the right and left temporal-parietal junctions.

## Results:

When watching irrational actions, NT participants suppressed activity in the left TPJ relative to both baseline and ASC participants. In contrast, ASD participants showed significant activation in frontal lobe when watching irrational actions. When being watched, NT participants showed suppression in the left inferior parietal lobule (IPL), while ASD participants showed suppression in the right IPL. ASD participants also showed significant activation in the left TPJ where there were also group differences.

Following a trial where the Leader demonstrated an irrational trajectory, there is an implicit demand for irrational action. Here, the behavioural results showed that both NT and ASD participants imitated to the same extent. Despite the similar behavioural pattern, there were group differences in neural activations between NT and ASD participants: NT participants showed

suppression of neural activity in the left TPJ and left IPL while ASD participants showed activations in these regions, but showed a suppression of activity in the primary somatosensory cortex (Fig 1B).

### Conclusions:

Overall, the behavioural patterns of both NT and ASD participants were similar but there were differences in how irrational actions and the feeling of being watched were processed in the brain. In particular, left STS and TPJ were engaged in autistic but not typical adults. This implies that different neural mechanisms may be engaged when autistic participants imitate actions in order to achieve the same behavioural performance as typical participants.

**444.008 (Poster)** Temporal Binding of Body Postures into Movements in Individual Scoring High Versus Low on Autism Symptomatology: An Ssvpe Study

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**Background:** Perception of biological motion (BM) is an important social cognitive ability and impairments in this ability may severely impact social functioning. Two processes contribute to BM perception: spatial binding of motion patterns and temporal binding of body postures. So far, most research on BM perception in ASD has focused on the first process, which yielded inconsistent findings. A recent meta-analysis highlights the importance of the temporal dynamics of stimuli in determining BM processing anomalies in ASD (Federici et al. 2020), stressing the importance of investigating temporal binding of body postures in ASD. Recently, a new EEG paradigm was developed in which an apparent motion task was combined with steady-state visually evoked potentials (SSVEPs) to dissociate between the representation of individual body postures and their temporal integration into movements (Cracco et al., 2020).

**Objectives:** To further our understanding of ASD-related social perception difficulties, we investigated whether anomalies of BM perception could be explained by altered integration of body postures into movements in individuals scoring high (versus low) on ASD symptomatology.

**Methods:** Using EEG, we analyzed SSVEPs to fluent and non-fluent body posture sequences (See Figure 1) in adults scoring high versus low on ASD symptomatology ( $m_{low} = 34$ ,  $m_{high} = 35$ ), based on AQ scores. Sequences were symmetrical around the midpoint, leading to 3 SSVEPs: 1 coupled to image presentation (base rate), 1 coupled to the turning point in the sequence (half cycle), and 1 coupled to the repetition of the full body posture sequence (full cycle). Crucially, in fluent sequences, the primary percept is a series of movements, whereas in non-fluent sequences, it is a series of body postures. As movements repeat at half cycle rate and body posture sequences at full cycle rate, half cycle responses capture movement processing and full cycle responses capture body processing.

**Results:** Repeated measures ANOVAs showed that full cycle SSVEPs were stronger for non-fluent sequences, whereas half cycle SSVEPs were stronger for fluent sequences, replicating Cracco et al. (2020). The full cycle fluency effect was greater in the high-scoring group, suggesting enhanced body posture processing. However, contrary to the idea that ASD is associated with diminished integration of body postures into movements, a greater fluency effect in the high-scoring group was also found for half cycle responses.

**Conclusions:** Contrary to our prediction, individuals that scored high on ASD did not show diminished temporal integration of body postures into movements. On the contrary, integration of body postures into movements was enhanced in individuals that scored high, as was body processing. In other words, they showed a stronger response to the salient – more predictable – information of the stimulus (i.e. repeating movements in the fluent condition, repeating bodies in the non-fluent condition), which may reflect a preference for predictable information, in line with predictive coding theories, warranting further investigation.

**444.009 (Poster)** The Neurobiology of Face Processing in ASD: Evidence from a Combined fMRI and Eye-Tracking Study

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**Background:** Facial information processing differences are typically viewed as central to understanding difficulties experienced by autistic individuals during social interaction. Neurobiological studies of face processing in autism spectrum disorder (ASD) have yielded mixed results: some studies find differences in activity within facial information processing regions (particularly the

“fusiform face area” (FFA), within fusiform gyrus), while others find no differences. Many studies reporting null FFA differences in ASD interpret studies showing decreased FFA activity in terms visual attention – that autistic individuals do not have difficulty with face processing per se, but rather, they attend less to relevant facial information. Implicit in the face processing literature is previously untested assumption that the FFA functions equivalently in autistic and neurotypical (NT) individuals during face processing tasks; here we tested this assumption in one of the largest single fMRI studies on face processing in ASD.

**Objectives:** To test the hypothesis that FFA in ASD is less sensitive to traditional patterns of visual attention towards faces – namely, visual attention toward eyes.

**Methods:** Participants included 48 NT children (ages 6.08 to 18.00,  $M=12.01$ ) and 47 ASD children (ages 7.75 to 18.17,  $M=11.67$ ). Participants completed an identity discrimination task wherein they indicated whether two images (of faces or houses) were the same or different while fMRI and eye-tracking data were collected. For region of interest analyses, parameter estimates were derived from participants’ activation peak within pre-defined anatomical masks of bilateral FFA.

**Results:** As predicted, the faces > houses contrast yielded increased activity in bilateral FFA, in both ASD and NT groups. A RM-ANOVA revealed no significant main effects of group ( $F_{1, 93}=2.25, p=0.14, h^2_G=0.02$ ) nor hemisphere ( $F_{1, 93}=0.19, p=.67, h^2_G<0.01$ ), nor a group\*hemisphere interaction ( $F_{1, 93}=0.57, p=0.45, h^2_G<0.01$ ) in FFA activation. ASD and NT groups also did not differ in time spent looking at the eyes of face stimuli,  $t(91.46)=-1.00, p=0.32, d=0.21$ . Despite comparable group-level results in FFA activation, Pearson correlations revealed a significant relationship between right FFA activation and time spent looking at the eyes of face stimuli for the NT group,  $r=0.32, p=0.03$ , but not for the ASD group,  $r=0.09, p=0.54$ ; however, these group correlations did not differ significantly,  $z=1.11, p=0.27$ .

**Conclusions:** These findings provide novel evidence supporting the selectivity of right FFA for eye-selective visual attention in NT individuals and raise the possibility that this neurobiological relationship is diminished in autistic individuals. Our results did not confirm the hypothesis that time spent fixating on eyes or peak FFA activity was different between the NT and ASD groups. Other measures of visual attention to faces and fusiform activation measurements may reveal different results. Future large-scale studies that afford more statistical power may elucidate the specificity of the FFA in autism; such research has significant implications for how we understand the role of the FFA in contributing to face processing differences in ASD. This finding also has treatment implications, in that it suggests that increasing visual attention to the eyes may not be sufficient to enhance facial information processing in ASD.

## Technological Approaches

### POSTER SESSION — TECHNOLOGICAL APPROACHES

#### Poster 446 - Technological approaches Posters

**446.001** (Poster) A Computational Approach for Analyzing Gait Synchrony and Balance in Neurodevelopmental Disorders  
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**Background:** Gait is receiving increased attention as a quantifiable phenotype for children with neurodevelopmental disorders (NDD) including autism spectrum disorder (ASD). However, these assessments (a) are often conducted in laboratory settings using costly and cumbersome experiments, and (b) use locomotion parameters (e.g., cadence, stride length) rather than whole-body measures. While studies have used marker-based motion tracking systems to fill this gap, such systems may not be conducive to overcoming sensory hypersensitivities and social anxiety of some children with NDDs. With the advent of computational methods for pose estimation and complex data analysis, it is crucial to assess the applicability and validity of these techniques in order to develop ecological and less biased data collection and analysis methods to study gait in ASD.

**Objectives:** (1) Investigate the feasibility of a computational pipeline using accessible hardware and modern software to quantify whole-body *gait synchrony* (defined as the variance of the dominant oscillation frequencies of arms and legs) and *balance* (defined as the variance of spinal tilt angle) in children with 16p11.2 gene mutation (proband), a NDD with a high ASD prevalence, while increasing ecological relevance and reducing experimental constraints; (2) Apply our computational pipeline to compare gait synchrony and balance measures between children with 16p11.2 mutation and their typically developing (TD) siblings; and (3) Introduce a novel whole-body gait synchrony measure.

**Methods:** Video recordings of 15 probands (mean age: 9.90 years, 7 girls) and 12 TD siblings (mean age: 9.67 years, 4 girls) performing a preferred-pace walking task were analyzed using pose estimation software to track points of interest (POIs) on their bodies over time. The POI coordinates were then cleaned and converted into timeseries which were robust to camera angle and distance to subjects. Finally, these timeseries were transformed into separate gait synchrony and balance measures and compared between groups.

**Results:** Our computational pipeline successfully extracted movement information from video recordings with high accuracy. Analyses revealed that children with NDD had significantly less whole-body gait synchrony and poorer balance compared to their TD siblings (Goldman et al., 2019). Small and/or non-significant correlations between gait synchrony and balance measures with age indicate that group differences were not attributed to delayed motor development. We also reviewed the video recordings of potential outliers, which confirmed that two proband children with higher synchrony scores had near-perfect gait, and two TD children with relatively lower synchrony scores were walking with their arms held stiffly by their sides. No overall group differences in our gait synchrony measure were found across sex, whereas group differences in balance were significant across sex.

**Conclusions:** The quantification of movements during locomotion in children with NDDs poses unique ecological challenges. Our study reports the results using a novel method that offers a cost-effective solution while preserving the validity of its results. This remote approach also allows for easier and broader enrollment of research participants from commonly under-represented communities, further enriching our understanding of motor outcomes across a wider variety of cohorts.

**446.002** (Poster) A Computational Tool for Automatic Analysis of Parent-Child Interaction in Autism Spectrum Disorder  
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Background:

Lab-based, parent-child play interactions (PCI) are a common method of observing behaviors such as joint engagement in young children with autism spectrum disorder (ASD) (Adamson et al., 2009, 2010, 2012). Such tasks traditionally require manual coding of recorded videos to quantify behaviors that can help to characterize and distinguish children with ASD from other developmental disorders and typical development. Additionally, such coding can be used to quantify behaviors before, during, and after behavioral interventions that seek to improve social communication skills. However, manual coding is a time- and labor-intensive process, requiring raters to learn complex coding systems and to be trained to maintain consistency. Manual coding is therefore a challenging approach to measuring behavior across time and in response to treatment, particularly in large-scale trials. Automated analyses of PCI offers the opportunity to measure behavior in a non-intrusive, objective, and scalable manner.

#### Objectives:

To develop a tool for objective measurements of parent-child interaction from video recordings. We aim to provide an assessment of feasibility of this tool based on percentage of valid frames and continuous segments of recordings, as well as exploration of basic behavioral features such as participants' proximity and orientation.

#### Methods:

We developed a tool for visualization and computational analysis of behavior during PCI. The tool is based on the automatic detection of body landmarks for analysis of the videotaped interaction of PCI synchronously recorded from two RGB cameras. The analysis provides time-dependent computational features such as participant's proximity and orientation, which are key features of human interaction. The system also provides a measure of confidence, allowing to perform data quality checks for subsequent automatic analysis (Figure 1). The developed tool consists of a data processing pipeline, which integrates existing tools for body landmarks detection in 2D and reconstruction of 3D body pose from 2D videos, and a web-based visualization tool, allowing for the synchronous inspection of the recorded video together with the extracted features and manual annotations if available.

#### Results:

A subset of 6-minute recordings of 20 children, 56-67 months of age, five from each of the following diagnostic categories, based on gold standard diagnostic methods: Autism spectrum disorder (ASD) only, Attention deficit hyperactivity disorder (ADHD) only, ASD and comorbid ADHD, and typical development (TD) were included in the analysis. We defined 'valid frame' as a frame where both child and parent are detected, and the upper body is detected with high confidence. We computed the total amount of valid frames per participant, and statistics on continuous segments of valid frames (Figure 2). We did not find any differences in the amount of valid data between groups (Figure 2A). We also provide examples of automatically computed proximity and orientation (Figure 1).

#### Conclusions:

We have developed a visualization and computational tool that appears to be feasible for the automatic analysis of some key features of parent-child interaction, namely, proximity and orientation toward the partner. The modular structure will allow for the addition of new features for better objective characterization of interactive behavior.

#### **446.003** (Poster) AI-Based Classification of Autism from Early Ecological Interactions

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**Background:** Early detection is a pivotal factor for limiting the impacts of Autism Spectrum Disorder (ASD). Recognizing this condition in the first year of development allows treatment to start when brain plasticity is more pronounced, thus activating a more comprehensive effect of the intervention (Vivanti et al., 2019). Smiling is one of the primary tools that infants exploit to interact with the social environment. Although behaviors are challenging to investigate within the first months of life (Piven et al., 2017), smiling has been suggested as a possible early marker of ASD. Artificial Intelligence (AI) offers novel solutions for systematic analysis and classification of atypical behaviors (Tariq et al., 2018; Bangerter et al., 2020).

**Objectives:** This exploratory study aims to test whether AI-based models are effective in classifying infants with ASD using smile features in early ecological interactions with caregivers.

**Methods:** Home Videos (HV) of early interactions between caregivers and the toddler aged between 6 and 12 months were collected. The sample includes 18 infants with ASD and 15 typically developing infants (TD). Smiling features in HV dataset were analyzed using Openface: an AI-based software able to encode facial micro-movements and estimate Ekman's Action Units (AUs) activation (Baltrusaitis et al., 2018; Ekman & Friesen, 1979). Thus, a vector of intensities was generated for each AU in any frame of the HV sequence. The software output was processed using pyphysio python library (Bizzego et al., 2019) to filter smiling AUs and extract features such as intensity, frequency and duration. A Machine Learning algorithm (Random Forest) was applied to verify the validity of smiling features for ASD classification. In addition, for dimensionality reduction, Principal Component Analysis (PCA) was employed. We randomly split five times the dataset into training and testing, reserving 40% for the test. Cross-validation on the training set was applied to select hyperparameters with a grid search method, based on the resulting Area Under the Curve (AUC). Finally, a Random Forest (RF) classifier was trained on training and validated for the discrimination of ASD and TD, averaging over the five splits.

**Results:** All dependent variables were controlled for IQ and gender in the ASD group. PCA allowed the number of features to be reduced from 7 to 4 (AU12 *non*-social smile intensity, AU12/AU06 social smile intensities, social smile frequency) explaining more than 95% of the variance (Figure 1). On the five splits, the RF classifier performed on test with an average accuracy of 90%(10) and average AUC of 95%(10) in distinguishing infants with ASD and TD (Figure 2).

**Conclusions:** Even accounting for limitations due to the small sample size, the model achieved promising results in discriminating ASD in infants already within the first year of development. Our findings suggest that smiling features may be a relevant signature for the clinical assessment of early ASD symptoms. The implementation of AI-based models offers novel opportunities for the study of atypical behaviors. Future work includes designing AI-tools for supporting clinicians and families in early detection and monitoring of ASD.

**446.004 (Poster)** Assessing Affect and Physiological Responses in a Psychiatric Inpatient Sample of Individuals with Autism Spectrum Disorder (ASD)

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**Background:** More than a third of individuals with autism spectrum disorder (ASD) have an intellectual disability or are minimally verbal. Severe ASD symptomatology is associated with a higher prevalence of comorbid psychiatric disorders and emotion dysregulation problems. However, individuals with severe ASD symptoms are often excluded from research.

**Objectives:** This work systematically assesses the relationship between perceived affect ratings and electrodermal activity (EDA) in a sample of psychiatrically hospitalized youth with ASD who participated in a series of standardized, negative affect-inducing tasks. We evaluated three aims: (1) changes in rated affect; (2) differences in physiological responses; and (3) concordance between rated affect and physiological responses.

**Methods:** Sixty-two participants (mean = 12.5yrs, range 6-20yrs; 80.6% male; 7.02% racial or ethnic minority) from the Autism Inpatient Collection were administered a subset of tasks taken from the Laboratory Temperament Assessment Battery (Lab-TAB) designed to elicit negative affect (Tower, Locked Box, End of the Line) that began with and interspersed baseline rest conditions. The wireless wrist-worn Q Sensor (Affectiva, Inc.) was used to record EDA. Resulting data was parameterized within each segment as normalized *mean* skin conductance level, linear *trend* change, and phasic skin conductance response measured by the *coefficient of variation (CV)* and *non-specific skin conductance responses (NSSCRs)*. Valence and intensity of affective reactions were coded in 10-second intervals on a scale of -3 (highly negative) to +3 (highly positive) (12% of randomly selected videos were double coded, ICC = .751). Three multilevel longitudinal models were constructed to assess differences in rated affected/physiology from (1) initial baseline to consecutive baselines; (2) initial baseline to tasks; and (3) tasks to subsequent baselines. Age, sex, severity, and verbal ability were evaluated as covariates in the models. Correlation was used to assess the concordance of affect and physiology.

**Results:** No significant changes in rated affect from initial baseline to subsequent ones were observed; however, there was significantly more negative and positive affect and less neutral affect during tasks than both initial and subsequent baselines (see Fig 1). Significant increases in mean EDA and NSSCRs from initial baseline to subsequent tasks and baselines, and higher CV during tasks compared to initial baseline and subsequent ones, were observed (see Fig 2). Covariate analyses suggested that younger children showed more negative affect, and younger children and minimally verbal individuals had higher physiological reactivity, particularly towards the end of the protocol. Correlations between affect scores and EDA were reasonably low.

Conclusions: This is the first study we are aware of to simultaneously measure rated affect and physiological reactivity during standardized tasks in a psychiatric inpatient sample of individuals with ASD. Despite similar CV and rated affect in Aims 1 and 2, there was no direct association found in Aim 3, suggesting that EDA and rated affect explain differential variance. Evidence for individual differences based on age, sex, and verbal ability indicates the importance of more tailored interventions and the need for a more direct and sensitive assessment of emotion regulation in individuals with ASD who present with more severe symptomatology.

**446.005** (Poster) Autism Navigator® Jumpstart to Coaching in Everyday Activities: An Innovative Method for Training Non-Profit Staff in South Africa and Ghana

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**Background:** Autism Navigator® web-based training and virtual support strategies have powerful potential to address the research-to-practice gap in evidence-based services for young children with autism. The Autism Navigator JumpStart to Coaching in Everyday Activities (JCEA) distills the evidence-based Early Social Interaction intervention model into an interactive web-based course designed to equip specialist and non-specialist intervention providers to implement caregiver coaching for young children showing early signs of autism. In the first phase of an ongoing study, we explored whether this web-based training could be implemented by providers in real-world low-resource service settings in South Africa and Ghana, specifically, the autism-specific non-profit sector, when supported by implementation strategies focused on developing stakeholder relationships and training.

**Objectives:** The objective of this study was to determine the feasibility, acceptability, and appropriateness of the Autism Navigator JCEA course with virtual support for training non-profit providers in an evidence-based early intervention for children with autism.

**Methods:** Supported by implementation strategies from two ERIC clusters (Develop stakeholder interrelationships, Train and educate stakeholders), providers in autism-specific non-profit organisations in South Africa and Ghana were invited to complete the JCEA with bi-monthly virtual support from a regional trainer. Staff completed the Evidence-based Practice Attitude Scale (EBPAS-36) prior to completing the training, and Weiner et al.'s (2017) Feasibility, Acceptability, and Appropriateness measures following the training. Aspects of course utilization were examined.

**Results:** Between September 2019 and September 2020, 23 staff from 5 non-profits consented to complete the course. The sample included a substantial minority (44%) who did not speak English as a first language, and nearly half were non-specialists with no university education. Within the year, 11 staff (48%) completed the course in an average of 3.64 months (SD=2.29), 9 providers are still completing the course, and 3 have left the study. Providers generally had positive attitudes about implementing a new evidence-based intervention (EBPAS-36 mean total of 2.82; SD=.76). The Divergence subscale correlated with educational level ( $\rho = .53$ ;  $p < .017$ ), while the Feedback subscale correlated with time taken to complete the course ( $\rho = .63$ ;  $p < .007$ ). Ratings of course appropriateness, acceptability, and feasibility were generally high (means of 3.98, 4.15, and 3.85, respectively). The most rapid course progress took place during hard lockdown conditions in South Africa and Ghana between April and July, 2020. Non-profit leadership identified three implementation strategies as critical to uptake of the training in their organisations: local consensus discussions, ongoing training, and organisational support for the training in the lockdown period.

To date, 9 of the 11 providers who completed the course have recruited eligible families to participate in the second supervised-implementation phase of the study, suggesting buy-in to the intervention approach.

**Conclusions:** The Autism Navigator JCEA course shows promise as being feasible, acceptable, and appropriate for training specialist and non-specialist staff at non-profit organisations in South Africa and Ghana. Thoughtful use of implementation strategies related to stakeholder engagement and training enhanced implementation success. Lockdown conditions due to the COVID-19 pandemic may have contributed to engagement with and completion of the course.

**446.006** (Poster) Community Research during a Pandemic: Pivoting Community-Based Trial of Parent-Mediated Intervention for ASD to a Telehealth Format

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#### Background:

Health and safety restrictions due to the COVID-19 pandemic have pushed researchers to think about study design more creatively and flexibly. Project ImPACT for Toddlers (*PI for T*) is a parent-mediated intervention developed to meet the growing need for effective treatment for toddlers with or at high likelihood of having autism spectrum disorder (ASD; Stahmer et al., 2019). In response to the COVID-19 pandemic, and subsequent publicly-funded early intervention service system shift, a current community-based trial of *PI for T* pivoted from an in-person model to a fully telehealth format.

#### Objectives:

This study examines the transition of the *PI for T* community-based trial to a telehealth format. Telehealth adaptations made to child and family assessment, training of community providers in *PI for T*, intervention delivery, and data collection are described. Survey data on the feasibility and acceptability of the telehealth adaptations to provider training are reported.

#### Methods:

The community-based trial utilizes a randomized waitlist control design to examine provider fidelity of implementation (FI) of *PI for T* parent coaching strategies, parent FI of *PI for T* intervention strategies, and child outcomes. It involves training community providers in parent coaching strategies and tracking their use of *PI for T* with families within their clinical services. The initial plan (v. 1.0) for provider training involved weekly in-person workshops over six weeks, while the assessment protocol for child participants involved standardized, direct assessments (see Table 1) conducted in the home or clinic. Following the onset of COVID-19 and subsequent service system shift to telehealth for intervention, the research team removed all in-person contact in an alternative research plan. Telehealth child assessments and community provider training were piloted to examine feasibility and acceptability. Eight providers participated in the pilot telehealth workshop and completed surveys at midpoint (3 weeks) and training completion (6 weeks). Qualitative feedback from assessors informed the final (v. 2.0) assessment battery.

#### Results:

For the v. 2.0 assessment protocol, telehealth delivery of observational and interview measures provided assessors with adequate information to characterize child participants and determine study eligibility. Telehealth administration of direct behavioral assessments, (e.g., Preschool Language Scales, 5<sup>th</sup> edition), proved to be too complicated and burdensome for parents to deliver for the age-range targeted. Direct behavioral measures were replaced with standardized parent report assessments in similar domains. For the v. 2.0 training protocol, mid-point feedback indicated that providers found the telehealth format to be successful, with the majority of participants rating the following aspects as “extremely useful”: breakout room activities, virtual coaching practice with volunteer families, and observing the trainer model with a family (M=3.6 out of 5 each, respectively). Following completion of the workshop, the majority of providers rated their readiness to deliver *PI for T* highly (M=4.1 out of 5).

#### Conclusions:

Preliminary data indicate that training in a parent-mediated intervention can be successfully delivered through a telehealth format. Additionally, suitable telehealth alternatives were identified for the child assessment battery. Further data on the telehealth format, including long-term provider FI, is being collected and will be reported.

#### **446.007 (Poster) Desensitizing Hospitalized Children with Autism to a Wearable Biosensor Device**

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#### Background:

Wearable biosensors may provide information regarding the internal states of severely affected children with autism spectrum disorder (ASD) (i.e., those who are minimally verbal, have intellectual disability, or who have co-morbid psychiatric disorders). However, research utilizing wearable biosensors often excludes the most severely affected children with ASD, potentially due to heightened sensory sensitivities and/or unsafe behaviors that make wearable technology challenging to use. Paradoxically,

severely affected children with ASD are also the population most likely to benefit from wearable biosensor research, as they often experience difficulties communicating emotional dysregulation and physical discomfort.

#### Objectives:

In service of increasing the representation of severely affected youth with ASD in wearable biosensor research, we developed and assessed a desensitization protocol to prepare severely affected and psychiatrically hospitalized children with ASD for wearable device data collection.

#### Methods:

Seventy-seven participants were recruited through the Autism Inpatient Collection (AIC), a multisite study of specialized psychiatric inpatient units. Three sites from the larger AIC study used the desensitization protocol to acclimate severely affected youth with ASD to a wrist-worn biosensor. All participants had a diagnosis of ASD, verified through a research reliable administration of the Autism Diagnostic Observation Schedule (2<sup>nd</sup> Edition) and clinical diagnosis. The protocol involved four categories of support: 1) staff and research assistant (RA) support, 2) wearable accessories to cover the biosensor, 3) behavioral reinforcement, and 4) visual communication supports. Desensitization success was determined subjectively (i.e., the RA reported that the participant was ready for real data collection) and objectively (i.e., the child did not tinker with or remove the device for at least 75% of their real data collection sessions). The utility of each category of support was determined by RAs.

#### Results:

Participants were 89.6% male with a mean age of 12.0 (SD=3.5). Of the 77 participants, 62 (80.5%) were deemed desensitized by an RA after one session, and 6 (7.8%) were deemed desensitized after a second session. The remaining 9 (11.7%) participants could not tolerate the device, despite up to 5 further attempts at desensitization and did not move on to real data collection sessions. Of the 68 participants who did move on to data collection, 11 (16%) continued to experience difficulty with the biosensor, as indicated by tinkering or removing the device for  $\geq 25\%$  of their data collection sessions. As such, the desensitization protocol was successful for 88.3% and 74.0% of participants based on subjective and objective indicators, respectively. Wearable accessories to cover the device were viewed as most helpful during the desensitization process. Neither subjective nor objective indicators of desensitization success differed by age or sex.

#### Conclusions:

The desensitization protocol was successful in helping children with ASD adjust to a wrist-worn wearable biosensor device. However, additional research is needed to better understand how to increase tolerability in the sub-population of children who did not desensitize.

**446.008** (Poster) Differences in Outcomes between in-Person and Distance Coaching in Classroom Pivotal Response Teaching  
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**Background:** Classroom Pivotal Response Teaching (CPRT) is one research-supported strategy for autistic students. Teachers can learn to implement CPRT with fidelity, leading to more positive student outcomes (Stahmer, et al., 2016; Suhrheinrich, et al., 2019). However, training has been limited by district proximity to a training site. Video-conferencing technology is a well-established treatment delivery model for teaching evidence-based practices to providers in sites with minimal access to training (Fischer et al., 2018). Research directly comparing distance to in-person coaching for autism practices in classrooms is needed to understand how to best scale up evidence-based practices in schools.

**Objectives:** This study examines the effectiveness of CPRT distance coaching in public schools by comparing training outcomes, provider-reported feasibility and acceptability of CPRT, and perceptions of coaching support for in-person and distance training conditions. Teachers in the distance condition also identified barriers to using distance technology.

**Methods:** 191 providers serving autistic students in public schools participated. Based on district proximity to a training site (over a 1-hour drive), 62 providers received distance training and 129 received in-person training. Both groups participated in (1) a seven hour in-person CPRT workshop that included didactics, video examples and group activities; (2) four one-hour group

consultations; and (3) six individual coaching sessions involving a coach observing a CPRT lesson and providing feedback. Teachers in the distance group completed all coaching and consultation via using Zoom, a secure video conferencing technology. Outcome measures include training outcomes (i.e., coach-rated CPRT fidelity, training completion, CPRT certification) and provider report of CPRT feasibility and acceptability, Coach-Teacher Alliance (Johnson et al, 2016), and identified barriers to distance coaching. Multi-level modeling will be used to compare outcomes between training methods (multilevel logistic regression for dichotomous outcomes and hierarchical linear modeling for continuous outcomes) to account for providers nested within districts. These analyses plus analysis of CPRT feasibility and acceptability and Coach-Teacher Alliance will be completed prior to the conference.

Results: Preliminary chi-square analyses for 191 providers (62 distance, 129 in person) indicated that in-person trained providers had better training outcomes than distance-trained providers. A significantly larger percentage of providers trained in person were certified (79.8%) than those that received distance training (54.8%),  $\chi^2(1, N = 129) = 12.9, p < .001$ . A significantly larger percentage of providers trained in person completed training (87.6%) than those that received distance training (61.3%)  $\chi^2(1, N = 129) = 17.5, p < .0001$ . When comparing top scores for coach rated fidelity, teachers trained in person had significantly higher fidelity ( $M = 88.96, SD = 12.04$ ) than those trained using distance training ( $M = 83.57, SD = 17.72$ ),  $F(1, 129) = 5.07, p = .026$ . Provider-reported challenges with technology included uncertainty with using apps, district technology restrictions, and slow or inconsistent Wi-Fi connections.

Conclusions: Preliminary data suggest that fewer providers complete training and reach CPRT certification through coaching via distance technology than in-person. Results indicate a need to understand and address the barriers to distance training to maximize positive outcomes.

**446.009 (Poster)** Effectiveness of Applying Virtual Reality in Job Interview Training for Young Adults with Autism Spectrum Disorder

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Background: Job interview is a major obstacle for adults with autism spectrum disorder (ASD) when seeking for a job. Thanks to the development of virtual reality (VR) technique, studies have applied such technique in training young adults with ASD to get a job. However, the effectiveness of VR job interview training program waits to be examined.

Objectives: This study aims to investigate the effectiveness of VR job interview training in Taiwanese young adults with ASD.

Methods: We recruited 15 young adults (all males) with ASD in the training program. The participants received 6 sessions, focused on three topics including job interview, public presentation, and handling disagreement. After role play practice on the VR platform, feedbacks were provided by the trainer. The participants then practiced the second time after the feedbacks and discussion. During the role play practice on the VR platform, heart rate and Galvanic skin response (GSR) were monitored. We also used Role Play Interview Scale to compare the interview performance before and after the training.

Results: Overall, the participants showed high motivation to learn on the VR platform and were well-tolerated using the head mounted display. The effectiveness of the training was observed on several aspects. After the training, fewer pause, better eye contact, lower anxiety were noted during interview. Speech volume, amount and content were more appropriate. The content became more positive, more solid and relevant, and more organized.

Conclusions: Our findings suggested that VR technique may be a promising method for job interview training in young adults with ASD. More clinical application can be considered in the future.

**446.010 (Poster)** Evaluating Autism Likelihood in the First Year of Life: A Telehealth-Based Approach

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Background: Maximizing the benefits of early intervention for supporting the development of individuals on the autism spectrum (ASD) requires widespread and efficacious early screening and identification practices. Despite decades of effort to identify early behavioral markers of ASD, there remain significant gaps throughout the identification-to-services pipeline. This is in part due to variable and protracted onset, with some infants' behavioral markers emerging between 6 and 12 months, and others not meeting

criteria for a diagnosis until 36 months or later (Ozonoff et al., 2010, 2015; Zwaigenbaum et al., 2015). Parent concerns as early as 6 months have been associated with subsequent ASD diagnoses (Sacrey et al., 2016, 2015). However, families with early concerns typically face long waitlists and often must travel long distances to centers with appropriate expertise. Initial feasibility data suggest telehealth is a promising avenue to addressing this gap (Talbot *et al.*, 2019).

**Objectives:** Expand our initial findings using the Telehealth Evaluation of Development for Infants (TEDI) in a larger group of infants to determine whether infants with significant early ASD behavioral markers can be identified via telehealth.

**Methods:** Infants aged 6-12 months whose parents had concerns about social communication development or ASD were recruited nationally across two cohorts. Infants were assessed using the TEDI protocol, wherein parents are coached through a series of semi-structured interactions via synchronous telehealth. Examiner-coded measures included the Autism Observation Scale for Infants (AOSI; Bryson *et al.*, 2008) and examiners' clinical best estimate of ASD risk. Coders naïve to parent concerns scored the Early Communication Index (ECI; Greenwood et al., 2010). Parents completed Ages and Stages Questionnaires (3<sup>rd</sup> Edition and Social-Emotional 2<sup>nd</sup> Edition), and satisfaction questionnaires.

**Results:** 25 infants ( $n_{\text{cohort 1}} = 11$ ;  $n_{\text{cohort 2}} = 14$ ) enrolled and were evaluated (Mean age = 9.68 months,  $SD=2.32$ ). Most infants' scores fell into the "Refer for Assessment" range on at least one domain of the ASQ-3 (18 infants, 72% of the sample) and the ASQ-SE2 (14/15 infants, 93%). AOSI Total Scores were elevated ( $M = 13.52$ ,  $SD = 6.30$ ) compared to the suggested cut-off risk score of 7. A one-sample Wilcoxon signed rank test comparing mean AOSI Total Score to the cut-off indicates observed scores were significantly higher ( $Z = 304$   $p < .001$ ). Overall CBE ratings indicated significant concern for ASD 20/25 infants. A one-sample Wilcoxon signed rank test comparing Mean Parent Overall Satisfaction Ratings to a neutral rating indicates significant parent satisfaction with the TEDI (Cohort 1:  $Z = 66$ ,  $p = .003$ ; Cohort 2:  $Z = 105$ ,  $p = .001$ ).

**Conclusions:** These findings support the feasibility of conducting an informative developmental assessment via telehealth to detect infants with a high likelihood of ASD in the first year of life. Recruitment and additional behavioral coding of ASD-relevant behaviors (e.g. communication, play) is ongoing, and infants will be followed prospectively until toddlerhood to determine diagnostic and developmental outcomes. Further demonstration of the validity and clinical utility of this telehealth tool has the potential to increase services for underserved infants and their families.

**446.011 (Poster) Feasibility of a Low-Cost Motion Capture and Virtual Reality-Based Motor Intervention for Improving Gross Motor Skills in Youth with Autism Spectrum Disorder**

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**Background:** Motor impairment is widely acknowledged as a core feature in children with autism spectrum disorder (ASD), which can affect adaptive behavior and increase severity of symptoms. Low-cost, markerless motion capture and virtual reality (VR) game technologies hold a great deal of promise for informing personalized approaches to motor assessment and intervention in ASD.

**Objectives:** (1) Examine feasibility of using the GaitWayXR™ VR-based intervention to improve motor skills in children and adolescents with ASD, by examining compliance, tolerability, and acceptability with parent and child questionnaires and structured feedback; (2) Demonstrate a proof-of-concept for a method of quantifying dynamic whole-body movement from low-cost motion capture in children and adolescents with ASD, by developing a novel framework for objectively assessing motor skill and spatiotemporal features from motion tracking data during VR gameplay.

**Methods:** Ten children and adolescents (10-17 years) completed six, 20-minute VR-based motor training sessions over two weeks while whole-body movement was tracked with a low-cost motion capture system. We developed a methodology to quantify whole-body movement in skill and spatiotemporal categories (synchrony and symmetry) from motion tracking data, and explored associations with standardized measures of motor skill, cognitive flexibility and autism symptom severity.

**Results:** Our results confirmed that the VR intervention is safe and feasible, and parents and children reported high levels of engagement, enjoyment and acceptability. Our quantitative approach to whole-body movement during VR gameplay represented stable measures and corresponded with clinical features of ASD, although there was little evidence of any benefits of the GaitWayXR™ intervention on improving gross motor skills.

Conclusions: The use of custom-designed VR games that personalize the challenge during motor skills training combined with low-cost motion capture appears to be a feasible approach in youth with ASD. This is specially important for keeping this population engaged in physical activities which has been shown to help improving their daily living skills. Our quantification methodology shows promise in exploiting the VR technology to assess, track and potentially improve motor skills in children and adolescents with ASD.

**446.012** (Poster) Novel Digital Outcome Measures: Community Involvement in Research Development

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Background: Primary objectives of the AIMS-2-TRIALS research programme are advancing understanding of the rich inter- and intra-individual variation that characterises autistic people, and developing appropriate intervention for challenges commonly faced by this population. Both these goals depend on measurement that is reliable, valid, precise, and has well-understood association with meaningful outcomes. Innovation in digital technology, e.g. wearable sensors and smartphone applications enabling remote monitoring, provides a new set of tools with which to complement conventional measures that rely on human judgments, e.g. informant or clinical ratings. However, development of such novel instruments requires careful consideration and consultation with the autism community in order to address potential practical and ethical issues.

Objectives: We aimed to open discussion with autism community representatives to jointly explore key barriers and enablers for using digital technologies to measure autism characteristics and commonly co-occurring difficulties (e.g. mood, attention and sleep dysregulation). This work informs an AIMS-2-TRIALS project investigating the acceptability, feasibility, and validity of these candidate measures.

Methods: We approached community representatives through several autism research organisations (AIMS-2-TRIALS A-reps, Autistica's Insight Group, and the Cambridge Autism Research Database) to participate in discussions. We also invited adolescents attending the Service for Complex Autism & Associated Neurodevelopmental Disorders at the Maudsley Hospital. Eleven autistic adults, six parents/carers of autistic individuals and four autistic adolescents were involved. All discussions took place remotely due to the ongoing pandemic, and primarily comprised small focus groups (3-4 community representatives and 1-2 researchers), conducted via Zoom Meetings. Additionally, several advisors preferred a one-to-one discussion and one corresponded via email. Discussions were guided via a document sent prior to the meetings, outlining several candidate technologies and anticipated themes, such as device comfort and data security. Conversations were documented via notetaking and (where all parties agreed) Zoom's recording function.

Results: Discussions revealed positive interest in efforts to broaden the repertoire of measures for autism and related characteristics beyond those based on human judgement. However, preliminary analysis has also identified a number of key concerns relating to ethics, practical implementation, and validity. Given potential intrusiveness of certain remote data collection modalities, ethical concerns included the need for provision of appropriate information during the consent process and demonstrably secure data management systems. Future uses for the technology supporting the measurement methods were highlighted as having potential for benefit, but also misuse. Practical considerations included comfort, accessibility, and usability of the measurement devices. Concerns about validity included the ability of these measures to accurately reflect the experiences of autistic people, and residual potential for subjectivity in ostensibly objective measures.

Conclusions: Representatives recommended that researchers proceed with a sense of responsibility, and that community involvement continue throughout the research project. Therefore, involvement activities continue to guide our research in an iterative manner. For example, advisers' input on comfort and appearance has already informed choice of wearable devices, and next steps will include re-consulting advisers to obtain feedback on proposed remote monitoring procedures.

**446.013** (Poster) Novel Scalable Computational Method Reveals Distinctive Patterns of Eye Gaze in Toddlers with Autism Spectrum Disorder

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Background:

Feasible, reliable quantification of eye gaze has been a goal of behavioral research. Autism spectrum disorder (ASD) is characterized by reduced attention to social information, a feature that emerges during infancy.

Objectives:

Use low-cost, scalable devices to display brief naturalistic movies designed with social stimuli primarily on one side and nonsocial stimuli on the opposite side of the screen, record eye gaze responses, and use computer vision analysis to quantify gaze information relevant to ASD.

Methods:

In a sample of 993 children 17 – 37 months of age, 40 of whom diagnosed with ASD, brief movies were displayed on either an iPad or iPhone. Gaze information was extracted from the video of the child captured with the device's frontal camera while he/she was watching the movies. Features were derived from this gaze information; specifically, percent of frames during which the toddler gaze was on the right versus left side of the screen (percent right) and the time correlation of the gaze with the stimulus events. Side of social stimuli was counterbalanced across movies.

Results:

Figure 1 displays the distributions of the percent right (percent of frames during the movie when the child was gazing at the right side of the screen) for the 'Spinning Pinwheel' (iPhone) and 'Blowing Bubbles' (iPad) movies. Also shown are the results of silhouette analyses, which measured the extent to which the gaze patterns form distinct right versus left clusters (left versus right side of the screen). Analyses of both the percent right and silhouette scores revealed significant differences between the TD and ASD groups, with toddlers with ASD showing reduced attentional preference to the social stimuli ('Spinning pinwheel':  $P < 0.0001$  and effect size=0.51 for percent right,  $P < 0.00005$  and effect size=0.52 for silhouette score; 'Blowing bubbles':  $P < 0.000005$  and effect size=0.47 for percent right,  $P < 0.000001$  and effect size=0.51 for silhouette score).

We analyzed children's attention to speech patterns while watching the 'Fun at the park' movie in which two speakers located on opposite sides of the screen engaged in a conversation, evaluating the degree to which shifts in gaze occurred in conjunction with which person was speaking. We observed significant differences between the ASD and TD groups for the gaze-speech time correlation ( $P < 0.0001$ , effect size=0.42) and left-right clusters silhouette score ( $P < 0.00005$ , effect size=0.45). Figure 2 illustrates the feature distributions for the ASD and TD groups, and shows an example of the temporal gaze pattern for individuals with TD and ASD. Whereas children with TD show a tight correlation between their gaze and the alternating speech of the two adults in conversation, the children with ASD show a more variable pattern, less coordinated with speech.

Conclusions:

We demonstrated that ubiquitous, relatively low-cost, scalable devices can be used to collect and quantify gaze information relevant to ASD. This is a first step toward developing tools for advancing methods for early detection and reducing disparities in access to screening and diagnosis, which open the door to early intervention and improve the outcomes of individuals with ASD.

**446.014** (Poster) Predicting the ADOS-2 Calibrated Severity Score from Video and Audio Analysis

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Background:

Identifying granular behavioral attributes remains central to autism diagnosis, with the ongoing advances in robust non-intrusive methods paving the way for the application of computational behavioral assessments in clinical/research settings. This study presents an automated, multi-modal approach to extracting key social features of autism: gaze, facial movements, and prosody.

#### Objectives:

Our objective is threefold: (1) to utilize a state-of-the-art behavioral analysis pipeline that characterize observed behavior during autism diagnostic evaluations; (2) to filter the measured variables and retain the ones that have predictive power; and (3), to test regression model of biometric data predictive of Autism Diagnostic Observation Schedule-2 (ADOS-2) Calibrated Severity Score (CSS).

#### Methods:

Forty-seven participants with neurodevelopmental disorders, including ASD (mean=±8.7 years, SD=±2.4, F=20, M=27) were recruited. ADOS-2 footage was collected using off-the-shelf 2D cameras and Tobii Pro Glasses 2 worn by the examiner. The footage was then analyzed with the Argus Medical Decision Support (MDS) System, using state-of-the-art machine learning components, which automatically identified patients, analyzed their vocalizations, eye movements, facial expressions, and body pose. The system estimated 143 variables (Table 1). Research-reliable ADOS-2 raters selected 32 of these metrics based on discriminative power between NDD and controls, and/or correlations with clinical measures (Table 1). To ensure models were not overfit to test data with this feature selection (Smialowski et al. 2010), identified variables were verified to show robust correlations across the cross-validation folds used in later steps. To reduce the risk of multicollinearity and spurious correlations even further, we applied an iterative approach to narrow down the set of variables for each regression type (random forest, support vector regressor, k-NN, linear regression), a hill climbing algorithm combined with cross-validation and regression analysis. This step was necessary because due to the limited sample size, the risk of overfitting the training data was higher with more variables. Analyses included analyzing the predictive value of the selected features compared to the participants' IQ, age, and gender data and the model's predictive performance using root mean squared error (RMSE) and mean absolute error (MAE) with leave-one-out cross-validation. Four baseline results were utilized for each regressor type to put our results into perspective: (1) a model that predicts CSS scores randomly, (2) a model that predicts median CSS score (5) in all cases, (3) a regression model that uses just age and gender as independent variables, and (4) a regression model including age, gender, and IQ.

#### Results:

Table 2 shows the predictive performance of the trained models, including the baseline methods, yielded from leave-one-out cross-validation.

#### Conclusions:

The automated Argus MDS System yielded key social behavior metrics: gaze related features, emotional valence, vocal communicative abilities, and linked gaze and emotion metrics. Results suggest introducing biometric social markers increases predictive power and reduces the error rate for estimating ADOS-2 CSS. Further evaluations analyze social behavior metrics with social scores on standardized scales and include biometric data of repetitive behaviors (e.g. sensory, mannerisms) to advance understanding of the role of nonintrusive computer-vision-based behavior analysis in clinical settings.

#### **446.015 (Poster) Quantifying Social Approach in Preschoolers with ASD in Inclusion Classrooms**

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#### Background:

Children's movement supports the initiation, maintenance, and termination of social interactions, and allows for physical exploration of the environment (Adolph & Franchak, 2016). Children with Autism Spectrum Disorder (ASD), a developmental disorder characterized by atypical social communication and repetitive behaviors, exhibit a range of movement abnormalities, although their centrality to the disorder is unclear (Hilton et al., 2011). Atypicalities in social approach are thought to be characteristic of children with ASD, but few studies have quantified the social movement of children with ASD using objective measures.

#### Objectives:

In the current study, we introduce a new method—computational modeling of radio frequency identification (RFID) child tracking—for studying children with ASD in naturalistic settings. We present the use of RFID measurements to investigate the velocity and social approach of children with ASD and typically developing (TD) children interacting together in preschool inclusion classrooms during repeated multi-hour observations. We examine children's individual movement (i.e., angular and Euclidean velocity) and social approach (social movement to peers and teachers) in the classroom.

#### Methods:

Observations of 30 preschoolers (14 with ASD and 16 TD) in two inclusion classrooms on a total of 10 days yielded approximately 10 hours of data per child. Objective measurements of position and orientation were collected using four corner-mounted radio frequency identification (Ubisense) sensors, which tracked a right and left tag worn by each child (in a vest) and teacher in the classroom. We calculate angular velocity, Euclidean velocity (speed of movement), and social approach, and compare ASD and TD children on these parameters using multilevel statistical models.

#### Results:

Children with ASD did not differ from TD children in angular velocity or velocity of movement in the classroom. Rather, differences were apparent in social movement between peers and teachers. With respect to peer approach, a significant interaction term revealed that pairs of TD children moved toward ( $p_{\text{POS}}=0.001$ ) and away ( $p_{\text{NEG}}=0.001$ ) from each other at higher velocities than pairs of children in which one or both partners had ASD. By contrast, children with ASD approached their teachers ( $p_{\text{POS}} = 0.02$ ,  $p_{\text{NEG}} = 0.009$ ) – and were approached by their teachers ( $p_{\text{POS}} = 0.012$ ,  $p_{\text{NEG}} = 0.027$ ) – more quickly than TD children.

#### Conclusions:

Multi-hour, objective measurements indicated that children with ASD did not move through space or turn at higher velocities than other children. Instead, ASD differences were evident in social approach. Children with ASD were slower in approaching peers but quicker in approaching teachers than were TD children, shedding objective light on the patterning of interaction in preschool inclusion classrooms. More generally, the results suggest the potential of modeling RFID measurements to produce a quantitative understanding of the ASD phenotype in naturalistic social contexts.

**446.016** (Poster) Quantitative Evaluation of Imitation Performance for ASD Subjects Using Social Robot Zeno  
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**Background:** The diagnosis of Autism Spectrum Disorder (ASD) in affected children is usually based on social, communication, restricted, and repetitive patterns of behavior and provided by a physician or psychologist. Recent studies show that both motion kinematics and reaction time to visual stimuli in autistic children is quantitatively different in comparison with non-autistic children. While the diagnosis of ASD is based on human observations, robotic technology can assist in quantitatively measuring them and use them as a future tool for autism diagnosis and intervention with robots.

**Objectives:** We developed an algorithm called Online Dynamic Time Warping (ODTW) to measure human reaction time as well as the similarity cost in robot-human gesture imitation in real-time. In this poster, we discuss the implementation of this algorithm on social robot Zeno, and testing results of Zeno's imitation interaction with human subjects.

**Methods:** In our method, socially appropriate motion trajectories of human upper limb gestures such as waving, hand shaking, pointing, etc., are recorded from a physician and sent to the robot as reference trajectories to its motor joints. The subject is then asked to imitate the motion of the robot and their upper limb motion trajectories are recorded using a Kinect® sensor. The OTDW algorithm calculates the similarity between the pre-recorded robot motions and real-time subject motion responses. Furthermore, a measured time index to where the most similar human motion starts is proposed to indicate the subject's reaction time. A metric combining the similarity cost and reaction time was then proposed to estimate the overall imitation performance of the subject.

Results: The metric was validated using off-line interaction data collected from a cohort of 55 subjects interacting with Zeno. It was then used to provide on-line feedback during interaction and to design adaptive human-robot imitation sessions that encourage a subject to perform upper limb imitation motions with higher precision and speed. This second set of experiments was conducted with 13 human subjects. In order to simulate performance impairments during interaction, we asked subjects to follow the robot's arm movements with and without carrying a 15-pound weight. Results show that the algorithm can correctly reveal important features of human movement including the quality of motion and human reaction time to robot stimuli.

Conclusions: Based on our experiments, we validated the ODTW metric to assess imitation performance with social robot Zeno. In the future, this technology will be used to diagnose ASD conditions, or as a basis for evaluating the effect of robotic interventions on children with ASD.

**446.017 (Poster)** Remote Assessment of ASD in Clinical Trials: Automated Analysis of Natural Conversation  
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Background: Outcome measures currently used in clinical trials for ASD have limitations in terms of reliability, validity, burden and ecological validity (Anagnostou et al., 2014). To address this unmet measurement need we have developed novel digital tools for the remote measurement of ASD signs and symptoms and deployed these into an observational study. By measuring symptoms objectively in the home environment, digital health technology tools could reduce participant burden, improve ecological relevance and be administered more frequently which may increase sensitivity to change.

Expressive communication impairment is one of the core symptoms of ASD. This can manifest through differences with typically developing individuals in conversational, acoustic, prosodic, phonetic or lexical features of speech which may be more pronounced in individuals with lower IQs (Fusaroli, 2016). These differences can be quantified by recording natural conversations in the home environment of a participant and deriving conversational features. To do so audio recordings must be segmented according to the speaker. Whilst segmentation can be done manually, manual labelling is labor intensive when recordings are captured on a weekly basis from a large sample of participants in a clinical trial. Instead one can use an algorithm for automated segmentation, however this is challenging when recordings are captured in the home environment due to the presence of background noise.

Objectives: To investigate the feasibility of segmentation of conversation recordings captured in a natural environment using manual and automatic segmentation, based on known-groups analysis.

Methods: 90 individuals with ASD and 45 typically developing (TD) controls (5-45yrs) were asked to record a conversation with a study partner once per week during the 12-week observational period of a non-drug observational study. Task adherence was observed to be between 40-50% throughout the study leading to conversation recordings every 2-3 weeks on average. Individuals with ASD were categorized as low-functioning ( $IQ \leq 70$ ) or high-functioning ( $IQ > 70$ ). For automated segmentation, a deep-learning based human voice activity detection plus speech diarization pipeline was applied to the conversation recordings. To assess the performance of automated segmentation, one recording per participant from a representative subset of 8 low-functioning and 8 high-functioning participants diagnosed with ASD was manually labeled. Talk Duration (average duration that a participant speaks for within their turn) was then estimated based on both manual labeling and automated segmentation of the recordings.

Results: When using manual labels to estimate Talk Duration, there was a significant difference between low- and high-functioning participants (unpaired left-tailed t-test,  $p = 0.03$ ). When using the predicted labels from the speaker segmentation algorithm, this conversation measure showed a trend towards a significant difference ( $p = 0.08$ ).

Conclusions: Our results show that the expressive communication of individuals with ASD can be assessed in the home environment using natural conversation recordings. Analysis of conversational features can demonstrate known-group differences based on either manual labeling of recordings or through automated segmentation. Automated segmentation would be a key enabler to allow the use of this approach in large clinical trials.

**446.018 (Poster)** Role of Implementation Climate and Training in Predicting Telehealth Implementation of Applied Behavior Analysis Services during the COVID-19 Pandemic

**Background:** Following social distancing guidelines, Telehealth has been utilized to provide Applied Behavior Analysis (ABA) to children with Autism Spectrum Disorder. Telehealth implementation of ABA services (e.g., parent training), has shown to yield positive outcomes and reduce service disparities (Ferguson, 2019). However, previous research has shown that providers underutilize services due to limited training and resources (Ingersoll, Straiton, & Rivera Caquias, 2019). Additionally, telehealth users' attitudes and beliefs play a significant role in service uptake (Tsai et al., 2019). Understanding ABA providers' resources and beliefs will help support successful telehealth implementation during and after the COVID-19 pandemic.

**Objectives:** The present study examined implementation climate and telehealth training as predictors of Board-Certified Behavior Analysts' telehealth usability, acceptability, and future use.

**Methods:** To date, 311 Board-Certified Behavior Analysts working with children with Autism Spectrum Disorder have completed a Qualtrics online survey. Clinicians provided ratings for the Acceptability of Intervention Measure, Telehealth Usability Questionnaire, and Implementation Climate Scale. Acceptability is defined as clinicians' agreeableness or satisfaction with Telehealth, usability as perceptions of ease-of-use, effectiveness, and efficiency, and implementation climate as perceptions of policies and practices that are rewarded by their agency or clinic. A 5-point Likert scale was used to measure clinicians' intentions to use telehealth after COVID-19 restrictions (i.e., future use). Additionally, clinicians reported previous Telehealth training experiences (i.e., workshop, observation, self-guided webinar, and supervision or feedback on the job). Simple linear regressions were used to predict acceptability, usability, and future use from implementation climate and training experiences.

**Results:** Simple linear regressions indicated that implementation climate significantly predicted clinicians' perceptions of telehealth acceptability, usability, and intentions for future use (Table 1). In terms of training, not receiving training for Telehealth significantly predicted lower perceptions of telehealth usability, acceptability, and future use (Table 2). Participating in a Telehealth workshop significantly predicted higher perceptions of acceptability and intentions for future use (Table 2). Receiving feedback and supervision during a practicum or on the job significantly predicted higher perceptions of Telehealth usability (Table 2).

**Conclusions:** Findings suggest that implementation climate predicts clinicians' perceptions about telehealth usability, acceptability, and intentions to use in the future. Clinicians who did not receive any training on Telehealth were less likely to rate it as usable or acceptable, as well as less likely to want to use it in the future. Taken together, these findings highlight the importance of the implementation climate and educational support on clinicians' perceptions of Telehealth to deliver Applied Behavior Analysis. Increasing an agency's focus on Telehealth and Evidence Based Practices in general can help support clinicians' Telehealth use. Findings also suggest that practical feedback and supervision supports clinicians' understanding of Telehealth's usability, as it provides direct and personalized guidance on how to utilize Telehealth services. Additionally, structured and practical education about Telehealth (i.e., workshops) are helpful for increasing clinician's acceptability and usability of telehealth, as workshops provide both practical guidance and overall education about Telehealth use.

**446.019 (Poster)** Scalable Computation of Facial Movement Complexity in Young Children with Autism Spectrum Disorder  
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**Background:** Advances in computation and computer vision technologies open avenues towards the development of scalable behavioral analysis tools that can capture biomarkers related to Autism Spectrum Disorder (ASD). Among the early emerging symptoms of ASD are differences in facial expressions and movements, including differences in facial expression type, range, and complexity.

**Objectives:** Design and deploy scalable computational phenotyping tools for eliciting, recording, and measuring ASD-related behavioral biomarkers using a combination of strategically-designed stimuli consisting of social and non-social components that can potentially evoke variations in facial landmark features, differentiating ASD and typically developing (TD) individuals.

**Methods:** This study is a part of a broad effort to design a scalable, robust, and portable tools for computational behavioral phenotyping. Toddlers in the age of 17-37 months were recruited at four pediatric primary care clinics during the child's well-child visit (ASD: N=33, TD: N=366). While sitting on the caregiver's lap, the participants were shown stimuli that consisted of several short movies, presented on an iPad or iPhone. Stimuli included both social and non-social components (illustrative snapshots are presented in Figure 1). The toddler's face was recorded using the front-facing camera of the device. Computer vision algorithms were used to track and detect the facial landmarks (e.g., the periphery of the mouth and eyebrows). Landmarks' dynamics and affect were analyzed. In this work, we focused on how complex (or predictable) the facial dynamics are; to this end, we exploited multiscale entropy (MSE) ideas.

**Results:** Complexity on the landmarks related to the eyebrows and the mouth regions were explored (Figure 1). The results indicated that 1) the TD group often tend to elicit higher complexity in landmark movements while exposed to the social stimuli ( $p < 0.05$ ); 2) the ASD group demonstrated higher complexity for most of the non-social stimuli ( $p < 0.05$ ); 3) the TD group showed higher complexity ( $p < 0.05$ ) in the eyebrows compared to mouth region for social stimuli, unlike the ASD group. In agreement with existing literature, we observed that the complexity in landmark movements can serve as a biomarker to distinguish ASD and TD groups. A novelty of this work is that this biomarker can be retrieved using ubiquitous devices in a standard clinical setting. Lastly, analysis of the relationship between the complexity and the participants' affective state was non-significant, indicating that the landmarks' movement was not limited to the participants' affective state and it carries information beyond it.

**Conclusions:** We designed and deployed a scalable and portable computational behavioral phenotyping tool usable in pediatric clinics that displayed visual and interactive social and non-social stimuli while recording the participants' evoked responses. The complexity in facial landmark movements were explored, showing its potential for an ASD biomarker with value beyond differences in affective expression.

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#### **446.020 (Poster)** Searches for Web Tools to Screen for Autism Produce Few Results

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**Background:** What happens when a parent is worried about a child's risk for Autism Spectrum Disorder (ASD) and he/she searches online for help?

**Objectives:** To simulate and characterize the results of a web search by a parent who is concerned about their child's risk of ASD.

**Methods:** ASD screening tools were defined as a) existing on the internet; b) user inputs data; c) assigning a risk category to a child; d) intended for parental use; e) screening for ASD; f) can stand alone; g) designed for children < 9 years. A set of 42 relevant search terms was developed iteratively from Google Search auto-fill responses. An 18-member parent panel suggested their own terms and then chose their preferred terms out of the set of 42. For a 10-term search set, similar terms among top-ranked parent choices were combined and age-specific terms were added in order to represent all major themes from parent suggestions. Predominant browsers & search engines were identified based on market statistics. Country-specific search results for the United States, United Kingdom, India, Australia, and Canada were accessed using VPN (Virtual Private Network) software. Each of the 5 countries was searched using Google with all 10 terms to total 50 searches. The 3 most productive search terms were used to validate comparability of Bing with an additional 15 searches. The first page of each set of search results were recorded and sites meeting criteria for ASD screening tools were identified.

**Results:** Sixty-five searches yielded 1,475 results (mean 23 per search), 275 (19%) of which were sponsored links. 147 (10%) of search results were websites with content that met criteria for an ASD screening tool. Thirty-six of 65 searches (55%) contained a result with a tool. Sixty-six (45%) of these required more than one click to arrive at the tool from the search result. Sixteen (1%) unique websites containing tools were ultimately identified, three of which were labeled M-CHAT (Modified Checklist for Autism in Toddlers) or M-CHAT-R (M-CHAT Revised). Four terms were most likely to identify any tools (listed with mean tools per search): "autism quiz" (7.8), "autism screening tool" (4.0), "does my child have autism" (3.6), and "autism toddler"

(2.6). Study searches yielded no new tools after these four terms were used in the United States and the United Kingdom. Bing searches were comparable to Google.

Conclusions: This simulated search for ASD screening tools revealed few screening tool websites. Low yield rates illustrate the challenge for parents in finding useful tools online to help them assess their child's risk for an ASD. To help parents connect to needed resources more efficiently, advocates may consider creating curated resources that are optimized for common online search engines.

**446.022** (Poster) Study of Predictive Abilities of ASD Subjects with AI Based Assistive Methods

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Background: Autism Spectrum Disorder (ASD) encompasses a broad range of behavioral and functional deficiencies, often displaying wide divergence in presentation. Repeated attempts have been made to understand if there is any common underlying causality that can explain this wide presentation. It has been hypothesized that ASD could be a result of disorder in prediction capabilities in human brain. However, it's unclear as to what extent both spatial and temporal predictive abilities are impaired.

Objectives: To determine if basic prediction abilities in simple temporal and spatial domains are impaired in ASD using Machine-Learning based interactive video games. Is it possible to improve the ability through machine learning based AI tools?

Methods: Participants were 11 ASD and 12 age-matched Neurotypical (NT) controls in the age range of 7-15 years. All were healthy individuals with CARS score in mild-moderate ASD range.

Reinforcement-Learning based interactive video games were developed that measure and analyze the responses of the player to determine their prediction abilities. These games analyzed both the temporal and spatial predictions. For example, how long (temporal estimations involved) they need to keep the screen touched in order to achieve a certain length of a stick (spatial estimation involved) to cross a given computed barrier which is dynamically updated using ML-techniques based on prior responses. They were presented to the participants on Android-based Lenovo Tab with 8" screens for clear visibility and had sound effects to increase immersion.

For each participant, there was a 20-minute priming exercise to get comfortable and understand the game. During this priming exercise, their parents and a team of psychologists additionally supported them. Following the familiarization process, they were comfortably seated in a distraction-free room and played the games. Their performance was recorded on remote servers. Based on the subject's response, the next task was dynamically presented on Reinforcement Learning frame work to improve their prediction abilities.

Results: From the results, we observed a definite trend that ability to predict seems to be severely compromised in all subjects, compared to neurotypical subjects.

On average, the mean prediction success rate was just around 20%, whereas NT consistently demonstrated significantly higher success in the ranges of 80% and above. Performance did not correlate with the CARS scores. It seemed that CARS score does not capture the prediction abilities, even though prediction abilities seemed to be markedly impacted in ASD. However, ASD subjects with better eye-contact seemed to fare better in predictive tasks. Current state of Affect (emotions) in-relation to their loved ones such as parents seemed to significantly impact their predictive abilities. The follow up data demonstrated that the proposed AI based reinforcement based learning model helps in improving their spatial and temporal predictive abilities on successive trials.

Conclusions:

This pilot study show presence of a strong correlation between ASD and impairment of prediction abilities. Further studies are needed to better characterize both spatial and temporal predictive abilities, so that the AI based tool can be developed to enable improvement of the predictive abilities.

**446.023** (Poster) Supporting Transition Planning to Prepare Individuals with Autism Find Opportunities for Employment: Technological Design Challenges and Recommendations  
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Background:

Transition planning is a process to help individuals develop the necessary skills to successfully transition into adulthood. Despite the mandate of transition planning in public schools in the United States, individuals with autism have the lowest employment rate even compared to individuals with other types of disabilities. There are technological interventions proposed to better support transition planning for people with autism. However, most research has focused on using technology to train specific vocational or interview skills. To improve post-school outcomes, people with autism need more comprehensive and organized support especially from their transition planning team for identifying long-term career goals and developing skills that are tailored to the goals. To investigate more effective technological interventions for transition planning, we need a better understanding on how people with autism and their transition team collaborate to develop and achieve long-term employment goals for people with autism.

Objectives:

This work investigates the challenges that people with autism and their transition team face in preparing for employment through transition planning and opportunities of socio-technical systems to support the challenges.

Methods:

We conducted in-depth semi-structured interviews with 21 participants, including three people with autism, ten parents, and eight professionals (e.g., transition coordinator, special education teacher) who have participated in transition planning within the last three years. Semi-structured interviews took between 45 minutes and 1.5 hours through either phone or video conference. Two researchers used open-coding to independently code the transcribed interview data. They met and compared the codes, and developed the code-book with definitions of each code. Using the agreed-upon definitions, the data were re-coded and organized into categories.

Results:

We found the challenges in engaging people with autism and facilitating team collaboration in three major phases of transition planning---identifying interests, goal setting, and progress monitoring (see Figure 1). First, to better understand the interests and preferences of individuals with autism, we found the needs of visual and experience-based communication methods as well as the needs for hearing from team members who know various aspects of the individual. Second, to set realistic goals, it was important to support for collaborative goal setting and also show gaps between reality and dream goals. Finally, we needed effective ways to engage both people with autism and team members in progress monitoring toward the goals.

Conclusions:

We suggest several different technological design recommendations to address the difficulties that people with autism and their transition team face in transition planning. First, we suggest a visual and experience-based communication technology that can help people with autism effectively experience each occupation and discuss their preferences with their team. To help setting realistic goals, we recommend developing the online employment portfolio repository that leverages crowd experience to create both feasible and challenging employment goals and plans. Finally, we suggest collaborative monitoring technology to support progress tracking toward employment goals with the transition team.

**446.025 (Poster)** Using Virtual Reality to Investigate the Effect of Autistic and ADHD Traits on Visual Processing and Executive Function Patterns

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**Background:**

Autism Spectrum Disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD) are neurodevelopmental conditions often characterised by a local bias in visual processing and difficulties with executive functions, such as planning and working memory. These difficulties have previously been experimentally assessed using the Rey-Osterrieth Complex Figure (ROCF) task, an extensively used neuropsychological tool in which drawings of a complex figure (first copied and then re-drawn from memory) are analysed. Several theories have been proposed to explain and challenge the local visual bias in ASD, including, but not limited to, Weak Central Coherence (WCC) and Enhanced Perceptual Function (EPF). Building on our previous pilot work (INSAR, 2020) we investigated visual processing and executive function patterns in a novel Virtual Reality (VR) version of the ROCF task.

**Objectives:**

The aim of this study was to analyse drawing performance in a VR environment using a combination of personality questionnaires and screen captures of participants' viewpoints.

**Methods:**

92 (39 male, 53 female) neurotypical participants (average age 22.5) filled in AQ (Baron-Cohen et al, 2001), ASRS (Kessler et al, 2005) and SQ (Baron-Cohen et al, 2003) questionnaires and then a standard ROCF task (i.e. Copy, Immediate Recall and Delayed Recall) was completed in Virtual Reality. Organisational (Hamby et al, 1993) and perceptual (Booth, 2006) scoring systems were used to quantify emerging visual processing and executive function patterns. These patterns were quantitatively compared to "ideal" stereotypical sequences by calculating the inner product. The order in which elements of the ROCF were completed was visualised and compared to these ideal sequences (Figure 1).

**Results:**

Although significant differences were not found in the drawing tendencies of participants with differing levels of autistic and ADHD traits, drawings scoring higher on the organisational scale were systematically linked with higher performance rates. Higher ROCF organisation predicted better performance for both recall conditions. Matrices illustrating the order of figure completion were compared between the experimental conditions (Figure 2).

**Conclusions:**

Our study offered several innovative ways of visualising and evaluating VR data: matrix plots of drawing sequences and data-driven pattern identification approaches. This new approach supported other empirical findings that organisation is a predictor of performance in the ROCF task. The organisational level is thought to correlate with executive function abilities, but, surprisingly, we did not identify significant performance differences in neurotypical participants with differing levels of autistic ADHD and Systemizing traits. Consequently we have no evidence to confirm that visual processing and executive functioning biases vary with these personality trait levels. However, modification of the task to suit VR better, and recruitment of diagnosed autistic participants are the next steps in identifying what the visual processing and executive function patterns we have identified really mean.

## Technology Demonstration / Devices

### POSTER SESSION — TECHNOLOGY DEMONSTRATION / DEVICES

#### Poster 447 - Technology Demonstration / Devices Posters

**447.002** (Poster) Innervoice: Smart Communication for Autism  
*L. J. Brady, iTherapy, LLC, Martinez, CA*

Background: Autism Spectrum Disorder (ASD) is a leading causes of communication disorders. Acquiring functional language abilities can be difficult depending on the severity of the disorder. Those who are minimally to non-verbal face great challenges when participating in daily communication. Effective communication relies not only on words but on tone of voice and facial expressions. The ability to express emotion through one's tone of voice, or prosody, clarifies the communicative intent behind a spoken message. While there are augmentative and assistive communication (AAC) systems that allow a person to communicate using digitally synthesized speech, these voices are monotone and can be readily identified as computer generated. To be more effective, AAC products must convey emotions through prosody and have the ability to video-model a user's facial expressions to convey happiness, sadness, or anger.

Objectives: As a solution to the current limitations in AAC technology, *InnerVoice*, a therapeutic communication platform that utilizes VSM to express emotional content through an intuitive interface and which incorporates contemporary user experience (UX) elements that help individuals quickly find content and begin to communicate. *InnerVoice* will be the only communication technology on the market to use the highly effective, evidence-based technique of video self-modeling, which can not only speak for nonverbal individuals but also show them how to speak for themselves by demonstrating how the face and mouth move to form words within a conversation. In addition to speech, *InnerVoice* will feature synthesized emotional content that will convey users' feelings, making their messages much clearer and thereby minimizing miscommunication and frustration.

The core of *InnerVoice* is a 3D animated picture of an avatar; a representation of the user, the 3D avatar can be a picture of the user or any other person/character that motivates the user. The avatar displays facial expressions to convey emotional content which is combined with a synthesized voice that incorporates tone of voice. This ability to provide a fuller range of communication using a computer-mediated system will provide three distinct communication outcomes for people with communication disorders:

Methods: Provide the visual designs and the technical specifications for the facial expressions, speech animations, and user interface. Content will be created using core vocabulary and high frequency words that are meant to increase versatility in conversations.

Results: Upon completion of the R&D, we expect to demonstrate that *InnerVoice* will successfully model emotional communication and that usage will teach ASD individuals to learn how to communicate more effectively compared to other leading AAC devices. This application will stimulate interest and engagement, both of which positively impact attention and comprehension, two important foundations of learning.

Conclusions: *InnerVoice* teaches communication using a unique process called Multi-Sensory Semiotics: which pairs sensory stimuli -- anything from movements, touch, or sound -- with auditory symbols (words), visual symbols (text), or gestural symbols (sign language).

Additionally, potential for *InnerVoice* emotional response features and speech animation technology to become part of emerging fields such as virtual reality and gaming, particularly as they apply to the healthcare, education, and science fields.

**447.003 (Poster)** Interactive Elearning Modules to Support Paraprofessionals in Using Evidence-Based Practices with Students with Autism

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**Background:**

Paraprofessionals are often the primary providers of instruction to students with autism in schools. Yet, the literature suggests that minimal training is provided to paraprofessionals for implementing evidence-based practices (EBPs) with students with autism. When this training does occur, it is usually in the form of a workshop with very little follow-up from researchers (Walker & Smith, 2015).

The AFIRM team developed a set of interactive, e-learning modules designed specifically for paraprofessionals including an introduction to autism and six modules on specific evidence-based practices (reinforcement, prompting, time delay, visual cues, visual schedules, supporting peer interactions). Four of the modules are currently publicly available and free on the AFIRM website (<https://afirm.fpg.unc.edu/>), with the additional three modules to be released in Winter 2020.

**Objectives:**

1. Examine the change of knowledge gain from pre to post knowledge assessments for each module.
2. Examine the usability, relevance, and quality of the modules through collected survey data.

**Methods:** Users complete the same 10-item knowledge assessment about the content of the modules before and after each module. Additionally, users complete a survey with Likert-type questions on a 4-point scale with 4 being the highest possible rating. The survey addresses the usability, relevance, and quality of each module. Descriptive statistics were used to examine the usability, relevance, and quality of the modules. Paired sample t-tests were used to determine knowledge gain.

**Results:**

Collection of data is ongoing as new modules are released and more users complete modules. Currently, four modules are publicly available. For the Introduction to ASD module (n = 36,026 users), users pre-assessment score was 77.48 out of 100 and post assessment was 84.55. There was a similar pattern of improvement for the reinforcement module (n = 11,094 users, pre-assessment score = 57.03, post assessment score = 66.41), prompting (n = 5,941 users, pre-assessment score = 64.61, post-assessment score = 76.42, and time delay (n=1,194, pre-assessment score = 45.49, post assessment score = 58.12). Significant change from pre-assessment to post-assessment occurred for all modules at the p<0.001 level. The mean effect size was 0.52 across modules and ranged from 0.45-0.60 for individual modules. The quality of the modules were rated highly ranging from a mean of 3.43 to 3.52. Users rated these modules as relevant to the work they do ranging from a mean of 3.42 to 3.54. Users found the modules useful ranging from a mean of 3.40 to 3.50. Data collected through March 2021 will be added to the findings.

**Conclusions:**

Initial findings indicate that AFIRM users find these new modules to be relevant to their work, useful, and the quality of the modules high. Users increased their knowledge on content presented from pre-assessment to post-assessment. The information available through these modules is part of a process for supporting practitioners' use of practices having evidence of efficacy with children and youth with autism. Additional support through coaching and on-the-job feedback may be necessary to move the practice into sustained use with fidelity when working with students with autism.

**447.004 (Poster)** Making Data Collection on Autism Programs Easier and More Motivating: Development of a Novel Data Collection App Incorporating User-Centered Design and Behavioral Economics Insights

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**Background:** Despite the importance of data collection on autism treatment programs for evidence-based programming, many one-to-one behavioral support workers (1:1s) do not systemically collect quantitative data on child behaviors. Two significant barriers limit current data collection practices: 1) use of labor-intensive paper-and-pen data collection methods that do not easily

allow for behavior tracking over time or sharing of data amongst team members, and 2) the solitary nature of one-to-one work, which limits opportunities for timely supervisor feedback. We incorporated principles from behavioral economics to address these two barriers, as well as several user-centered design approaches to ensure a match between the app and the environment through incorporating stakeholder feedback each stage of the design process.

**Objectives:** Our app addresses these barriers by: 1) making it easier to collect data with a server-based digital interface including a smartphone app and web portal, and graphing features for child behaviors, and 2) providing individualized in-session pop-up reminders and between-session tailored feedback via text messages on data collection performance, including comparison charts to agency averages and expectations.

**Methods:** First, we conducted a community-based innovation tournament involving 11 1:1s to gather ideas on solutions to make data collection easier and more motivating. Second, we conducted 7 observations and 9 interviews with 1:1s and 7 interviews with their supervisors to better understand the barriers and facilitators to data collection on autism programs. Third, we integrated behavioral economic principles with community feedback to develop a prototype that we are testing with 1:1s to iteratively improve it (2/4 testing cycles completed so far involving 10 1:1s). See Figure 1 for the app design and current prototype. We will test the app in an RCT in spring, 2021.

**Results:** Participants in the innovation tournament, observations, and interviews all cited the chaotic environment as a primary barrier to data collection and issues with team communication around treatment planning. Many spontaneously (i.e., without knowing about the novel data collection app idea) expressed enthusiasm for a digital data collection system. Our initial data suggest that 1:1s find the app: 1) usable, feasible, acceptable, and appropriate to support data collection, and 2) an improvement on current practices. 1:1s also provided 17 discrete suggestions for improvement; 11 were actionable suggestions, including three new app features (e.g., interval data collection form), seven feature modifications (e.g., numeric type-in option for behavior frequency), and one flow modification (deleting a redundant behavior form submission confirmation). Six other suggestions were not actionable (e.g., were in contrast with the core project's aims to incorporate motivational messages grounded in behavioral economic theory, or were outside the project scope to create an app for 1:1s and not youth).

**Conclusions:** Results support the continued development and testing of the novel app for data collection on autism treatment programs. The presentation will include a technology demonstration of the app whereby attendees will be able to "take data" on a videotaped session of a child with autism using the live app.

**447.005 (Poster) Mobile and VR Technology to Find and Support Individual Needs**

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### **Background:**

Since the 1970s research has found a preference for the use of technology by autistic individuals. However, individual presentation of autistic traits and support needs are also prevalent. Hence it is imperative to design different avenues for providing support whether they are based on technology or not.

### **Objectives:**

The objective is to provide alternative designs for supporting autistic individuals with 1) a mobile game called Spiral for self-evaluation of functional status and 2) virtual reality and 360-video production for relaxation, training and structuring environments.

Spiral game was originally developed as a "roll-a-dice-type" board game for group sessions. The idea is to encourage to self-evaluate own functional status and to identify areas of personal development. The game contains question cards covering different aspects of functioning and allow players to evaluate themselves. The question cards' answers are discussed with other players. The first player at the finish line wins.

Mobile Virtual reality (VR) technology has shown potential use in health and social care. VR can be used to provide realistic experiences in a safe environment. It is becoming inexpensive and easy to use. The content creation does not necessarily require programming skills. This creates an opportunity to develop personalized content for relaxation, training and structuring different everyday scenarios.

## Methods:

An iterative, multidisciplinary development process started by technology knowledge transfer. In both cases early-stage-prototypes targeted for other user groups were presented to care professionals to visualise the potential of the used technology. The production of the prototypes was also discussed to boost the ideation. Each development cycle contained demo testing by care professionals or end-users. The feedback was used in development of the next demo version.

## Results:

A single player mobile game was produced that mimics the original game. The forest theme was copied from the board game to keep the brand consistent. The player's avatar is navigated through forest while picking berries as in the original game. Fifteen questions were selected as mobile games are played for a shorter time. The professionals selected the questions to cover all important areas. A slider was used (worst to best options) to evaluate their own status. In the end, the player selects three most important development goals to be further processed with professionals.

For the VR, videos were filmed with 360-camera. The scenarios and video production were first made by the researchers, and in the later development cycle, by care professionals with the users. The scenarios were selected based on the individual need of autistic individuals for relaxation purposes as well as for training and structuring different scenarios.

## Conclusions:

Preliminary experiences are encouraging but the development is still on-going and larger group of users will be involved in testing and further development. Spiral game will be further gamified by leveling and other game features. Further VR-content will be developed with users and care professionals. Next steps also include development of services which utilize the developed technology demos.

**447.006** (Poster) Socialmind- a Digital Trainer for Parents of Children with Autism

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Background: In many countries, there is a substantial time gap between the time of autism diagnosis and the time of starting the intervention. This period is critical for development and has great potential for early intervention. Many studies have found that parents of children with autism can learn to implement interventions, and help their children develop. The parents, therefore, if given the tools, can serve as agents of change for their children in this critical gap period. However, there are many challenges in the process of effectively training parents, ranging from a shortage of professionals, high costs, and in these complicated times of COVID-19 also physical accessibility.

### Objectives:

The purpose of this study is to examine the effectiveness of a "digital trainer" in training family members of children with ASD to implement components of evidence-based interventions and promote their child's language and communication skills. The study will utilize a digital trainer developed as part of a project called "SocialMind", aiming to democratize evidence-based treatment and increase its accessibility in the community.

### Methods:

The study will involve a 10 children 12-week case-control study in which we examine the efficacy of evidence parent training through a digital trainer in targeting functional use of communication in young children with ASD.

### Primary Outcomes:

Children's progress will be assessed during a 10-minute structured observation at baseline and week 12. During the structured observation, parents are instructed to try to get the child to communicate as much as possible. Raters will tally the children's frequency of functional utterances, the average length of utterances, and types of utterances (ie, unintelligible, imitative, verbally prompted, nonverbally prompted, or spontaneous), and frequency of responsive and initiative shared attention. In addition, parental fidelity of implementation is assessed and coded.

### Results:

data were collect by a pilot of 11 children through digital training and tele-health

of participants	11
	<b>AVE SD</b>
Age	4 1.8
Length of interval (pre to post in weeks)	12 5.23

**Children's outcome measures**

	<b>Pre</b>		<b>Post</b>	
	<b>AVE</b>	<b>SD</b>	<b>AVE</b>	<b>SD</b>
<b>length of utterance</b>	<b>1</b>	0.48	<b>1.39</b>	0.61
<b>Frequency of Joint attention /10 min</b>	<b>10</b>	9.55	<b>19.22</b>	Number12.75
<b>Number of functional utterances /10 min</b>	<b>32</b>	2.16	<b>54.68</b>	33.85
<b>spontaneous functional Utterances/10 min</b>	<b>10</b>	8.53	<b>24.18</b>	16.65

**Parental outcome measures**

	<b>Pre</b>		<b>Post</b>	
	<b>AVE</b>	<b>SD</b>	<b>AVE</b>	<b>SD</b>
<b>Average fidelity of implementation</b>				
<b>General</b>	<b>5.41</b>	1.88	<b>7.90</b>	2.12
<b>Reinforcing attempts</b>	<b>3.74</b>	2.17	<b>6.95</b>	2.67
<b>Natural reinforcement</b>	<b>3.83</b>	2.11	<b>7.04</b>	2.69
<b>Contingent reinforcement</b>	<b>3.74</b>	2.07	<b>7.04</b>	2.69
<b>Shared control</b>	<b>5.25</b>	2.68	<b>7.85</b>	2.48
<b>Interspace and vary</b>	<b>6.90</b>	2.15	<b>8.61</b>	2.18
<b>Follow the child's lead</b>	<b>7.15</b>	2.25	<b>8.70</b>	1.93
<b>Attention</b>	<b>7.29</b>	2.25	<b>8.52</b>	2.44
<b>Number of opportunities/ 10 min</b>	<b>29.70</b>	12.54	<b>44.09</b>	28.42

The data of 10 children that their parents used digital training with no tele-health support will be published in January 2021.

Conclusions:

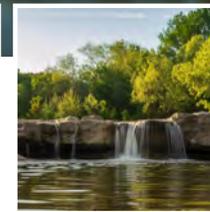
We should collect more data in a randomized control trial. The pilot study results suggest a promising direction for parent training and children's progress.



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## SAVE THE DATE



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Abstract submission for the 2022 meeting is  
scheduled to open in September 2021.

Watch our website for details.

[www.autism-insar.org](http://www.autism-insar.org)

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