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Psi Chi membership provides two major opportunities. The first of these is academic recognition to all inductees by the mere fact of membership. The second is the opportunity of each of the Society's local chapters to nourish and stimulate the professional growth of all members through fellowship and activities designed to augment and enhance the regular curriculum. In addition, the Organization provides programs to help achieve these goals including conventions, research awards and grants competitions, and publication opportunities.

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*Faculty mentor

Undergraduate Imposter Syndrome Rates Between Gender and Field of Study

Brianna A. Beesley, Nicholas G. Vece, and Zoe Johnson-Ulrich
Department of Psychology, Eastern Oregon University

ABSTRACT. Imposter syndrome is a psychological phenomenon in which an individual feels that their accomplishments or successes were not achieved by merit but instead achieved through chance or luck. This study investigated the relationship between imposter syndrome and field of study, focusing on differences between STEM and non-STEM undergraduate students, as well as differences in imposter syndrome prevalence among genders. One hundred eighty participants took part in this study via an online survey. Participants were asked to complete a demographic questionnaire and a 30-item questionnaire, which included the Clance IP Scale. We hypothesized that there would be higher levels of imposter syndrome among STEM majors compared to non-STEM majors, that undergraduate women would report higher levels of imposter syndrome compared to undergraduate men, and that women within STEM majors would report the highest overall level of imposter syndrome among the samples. As hypothesized, STEM majors reported significantly higher imposter syndrome than non-STEM, $F(1,180) = 6.13$, $p = .01$, $\eta^2 = .03$, and women reported significantly higher imposter syndrome levels than men, $F(1,180) = 4.51$, $p = .04$, $\eta^2 = .02$. Accordingly, female STEM majors had the highest levels of imposter syndrome ($M = 63.98$, 95% CI [60.89, 67.07]). This study is one of the first to investigate and find a significant difference between STEM and non-STEM participants and find a presence of imposter syndrome within the male non-STEM population, thus opening the door to a multitude of further research directions.

Keywords: imposter syndrome, STEM, non-STEM, undergraduate, gender differences



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Imposter syndrome (also referred to as the imposter phenomenon) was first studied in high-achieving women in both corporate and academic environments (Clance & Imes, 1978) and has since been studied across a wide range of social environments. The first article regarding imposter syndrome was written by Clance and Imes (1978) and included interviews from women regarding their experiences with imposter syndrome. Clance and Imes found that the most common feeling experienced by those with some form

of imposter syndrome was that they were undeserving of accomplishments and successes despite the proficiency they had shown within that given area. Individuals with imposter syndrome also feel that they have simply “fooled” everyone around them into believing they are as intelligent as their peers and attribute all their success to luck. These feelings are often unfounded, and the individual rationalizes additional instances of success as further proof of their deception. The feelings created by imposter syndrome are not often disclosed to others, as

the individual believes that just mentioning their feelings could cause others to see through their facade, and the secretive nature of the feelings can cause considerable lasting anxiety (Clance & Imes, 1978).

Despite the discomfort created by feelings of imposter syndrome, it is currently not recognized as a psychological disorder by the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders) or the ICD-11 (International Classification of Diseases), and thus, no official clinical interventions or standardized diagnostic tools currently exist. Despite the lack of official diagnosis, the work of Clance and Imes (1978) has inspired other studies regarding imposter syndrome to be conducted, and several scales have since been developed to measure it (Mak et al., 2019). Continued research on imposter syndrome may help others recognize imposter syndrome as a neglected disorder that impacts the lives of many people.

Since the original article published by Clance and Imes (1978), further research has been conducted to investigate the extent to which gender differences exist in the rates of imposter syndrome today. One such study reporting a significant gender effect was conducted by Cusack and colleagues (2013). In this study, 506 undergraduate students were recruited from various universities and asked to complete an online survey containing several questionnaires including the Clance IP (Imposter Phenomenon) Scale (Clance, 1985), the General Health Questionnaire (Goldberg, 1972), the Child and Adolescent Perfectionism Scale (Flett et al., 1997), the Rosenberg Self-Esteem Scale (Rosenberg, 1965), and finally the Test-Anxiety Scale (Taylor & Deane, 2002). The study showed that women reported significantly higher levels of imposter symptoms than men. Furthermore, higher rates of imposter syndrome were also positively correlated with perfectionism, test anxiety, and lower overall mental health (Cusack et al., 2013). Cusack et al. believed that this gender effect was due to the greater number of roles women have placed on them (e.g., mother, wife, employee) compared to men and the expectations of success that are placed on women within all of these roles. Overall, research has shown that imposter syndrome is more prevalent in women in high-achieving roles and academic environments (Clance & Imes, 1978; Cusack et al., 2013). However, it should be addressed that, although imposter syndrome levels in this study were higher in women, the actual scores for the men were not presented by Cusack et al. (2013), so it is unclear whether the men were also experiencing imposter syndrome to a measurable degree.

This study by Cusack et al. (2013) was one of several focused on studying imposter syndrome within a population prone to experiencing higher than average amounts of stress and anxiety: university students

(Gardner et al., 2019; Qureshi et al., 2017; Roets, 1991; Wang et al., 2019). Within university student populations, research has specifically focused on college STEM (science, technology, engineering, and math) students, or students of other traditionally educationally intensive programs such as law (Gardner et al., 2019; Qureshi et al., 2017; Wang et al., 2019). Although all subjects have their own individual stressors, especially at the collegiate level, STEM majors tend to be regarded as more difficult due to their academic demands. A high prevalence of imposter syndrome with STEM majors can be seen in a study by Qureshi et al. (2017). This study examined medical students during their last year of education. Participants completed an eight-question self-report assessment based on the Young Imposter Scale (Villwock et al., 2016). Results from the assessments found that, out of almost 150 students, nearly half (47.5%) were experiencing some level of imposter syndrome. One possible explanation presented by Qureshi et al. (2017) for the rate of imposter syndrome displayed was that the medical field is very demanding, as dealing with preserving the lives of others can be very challenging and has little margin for error.

Another study that focused on imposter syndrome within STEM and other traditionally difficult fields was conducted by Wang and colleagues (2019). The participants of Wang et al.'s research study were composed of students studying economics, program engineering, law, and other STEM fields. The participants of Wang et al. (2019) completed several questionnaires including the Clance IP Scale, the Short Almost Perfect Scale (Slaney et al., 2001), the Depression Anxiety Stress Scale-21 (Lovibond & Lovibond, 1995), and the Self-Concept Scale (Singelis, 1994). In addition to their results on the mediating link of imposter syndrome between anxiety and perfectionism, they also found that, on average, participants were experiencing at least moderate feelings of imposter syndrome regardless of their major, as assessed by the Clance IP Scale. Even though both studies highlight the prevalence of imposter syndrome among undergraduate students, a major limitation of this research is their focus on predominantly STEM fields only.

Although differences in imposter syndrome ratings between STEM and non-STEM majors have not yet been established, there have been measurable differences between the two fields in other areas regarding mental health. One such study by May and Casazza (2012) analyzed the differences in individuals' self-perceived stress between more loosely defined "hard sciences" (biology, mathematics, chemistry, nursing) and "soft sciences" (history, language, arts); with the traits of hard sciences similar to those associated with STEM

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fields, and the traits of soft sciences similar to non-STEM fields. Participants in this study took surveys containing the Perceived Stress Scale (Cohen et al., 1983) and the Personal Views Survey III-R (Maddi & Khoshaba, 2001), two questionnaires measuring an individual's perceived stress levels and psychological hardiness, respectively. The authors found that students of hard sciences experienced significantly more perceived stress than those studying soft sciences, even when other non-education-based stressors (e.g., finances, relationships) were controlled for within the data. In conjunction, the higher levels of stress and anxiety experienced by students of more difficult fields of study (May & Casazza, 2012) may be associated with higher rates of imposter syndrome (Cusack et al., 2013; Wang et al., 2019).

With the previous literature in mind, it is clear that there is more to investigate regarding imposter syndrome. In addition, there are limitations to the current literature that result in uncertainties regarding the generalizability of imposter syndrome research findings and implications. In general, research regarding imposter syndrome has been focused within higher education on specific majors or STEM fields (Qureshi et al., 2017; Roets, 1991; Wang et al., 2019). This means that, although the rates of student imposter syndrome within specific fields of upper education have been measured, the results cannot be generalized across all college students. As a result, overall differences between different student populations, such as various academic majors, have not been sufficiently measured. Therefore, it is currently impossible to tell whether imposter syndrome rates are higher amongst a specific population of students, or whether these imposter experiences are simply a normal part of modern culture. Building off current research and its limitations, our present study investigated the possible differences between gender and STEM and non-STEM students.

We explored three hypotheses within this study. We hypothesized that there would be a higher level of self-reported imposter syndrome among participants who are STEM majors compared to participants in non-STEM majors. Furthermore, as the experiences of women and the study of gender differences in imposter syndrome have been prevalent throughout the literature (Clance & Imes, 1978; Cusack et al., 2013), we also hypothesized that undergraduate women would report more pronounced levels of imposter syndrome compared to undergraduate men. Lastly, we hypothesized that, based on our previous hypotheses, women within STEM majors would report the highest overall level of imposter syndrome.

We administered a demographic questionnaire to undergraduate STEM and non-STEM majors followed by the Clance IP Scale (Clance, 1985). Through these questionnaires, imposter syndrome levels were assessed

in both areas of study (STEM and non-STEM), and comparisons between areas of study and gender were evaluated. In this study, the predictor variables are the major of the undergraduate participant (STEM or non-STEM) and their gender (male or female). Our outcome variable of this study is the severity of imposter syndrome experiences present in the participants as measured by the Clance IP Scale.

Method

Participants

Participants were undergraduate students enrolled during the 2022–2023 academic year. The study was advertised by professors via email, by the research team via in-class recruitment presentations, and through the University Infoline: a campus-wide weekly newsletter emailed to all students. As compensation for their participation, some professors provided extra credit to their participating students. Our sample consisted of 220 participants; however, due to either failed consistency or deception checks or double major status, only 180 were included in the analysis. The final sample used in analysis was made up of male non-STEM majors ($n = 20$), female non-STEM majors ($n = 44$), male STEM majors ($n = 34$), and female STEM majors ($n = 82$). Individuals who identified with a gender other than male or female ($n = 5$) or indicated that they were pursuing more than one major ($n = 15$) were not included in these analyses due to the extremely small size of those samples. Individuals who received a score under the lowest possible score from the personality portion of the study were also excluded from the analysis ($n = 20$) as this indicated that they did not complete the survey.

Although we were able to report the gender and major of participants, we are unable to report other demographic characteristics, like the participant's race/ethnicity, major, age, and year in school, due to lost data from a change in survey software. We recognize that this lack of information inhibits the generalizability of results; however, we believe that despite the missing characteristics, our research and its findings are advantageous for the field of psychology, educational systems, and counseling services, to have access to and be aware of.

Materials

For our imposter syndrome scale, we used the Clance IP Scale (Clance, 1985) due to its reliability and prevalence throughout the current literature (Cusack et al., 2013; Holmes et al., 2010; Mak et al., 2019; Wang et al., 2019). This scale includes 20 vignettes regarding feelings of imposter syndrome. Participants were asked to report how true they felt the vignettes related to their thoughts on a scale from 1 (*not at all*) to 5 (*very true*). Level of

imposter syndrome is calculated by summing a participant's responses, such that a high score indicates high levels of imposter syndrome, and a low score indicates low levels of imposter syndrome. Clance and Imes (1985) categorized scores into intensity and frequency categories, which include few (40 or less), moderate (41–60), frequent (61–80), and intense (80 or above). We chose this scale because it has been found the most favorable and widely utilized compared to the Harvey Imposter Scale, the Perceived Fraudulence Scale, and the Leary Imposter Scale (Mak et al., 2019) and found to be more sensitive, accurate, and consistent in detecting imposter syndrome when compared just to the Harvey Imposter Scale (Holmes et al., 2010).

To mask the focus on imposter syndrome and serve as a participant response quality check, we also utilized 10 questions from the International Personality Item Pool (Goldberg, 2022), which is commonly used to assess the Big Five Personality Markers. The questions chosen measured two specific personality traits: extraversion and agreeableness, with five questions dedicated to each trait. We decided to use the extraversion and agreeableness questions from the 10 International Personality Item Pool questions (Goldberg, 2022) because those questions' wording and content are similar to the Clance IP Scales' and they are both scored on 1 through 5 scales, allowing us to obscure the true objective of the study. These personality trait questions served as a consistency check as they easily flagged participants who answered unreliably and allowed us to remove participants from the data to ensure the quality of obtained responses. For example, an individual who indicates that they enjoy attention and also do not enjoy drawing attention themselves are likely not fully reading each question and thus their data would be removed.

A demographic assessment containing seven questions regarding age, gender, race, ethnicity, college major, and academic year was also administered to participants; we had no plan to analyze demographic variables other than gender but it may turn out that some are relevant to imposter syndrome and so the information was collected for potential future use. In addition, we wanted to obscure our true purpose such that participants would not guess that we were specifically interested in gender.

Design

This study utilized a 2 x 2 between-subjects design. The predictor variables of this research study were the difference in university majors of the undergraduate participants (STEM or non-STEM) and gender (male or female). The distinction between STEM and non-STEM majors was decided by the university's colleges and schools of study. The college of science, technology,

mathematics, and health sciences (STMHS) was considered STEM and non-STMHS colleges were considered non-STEM. For this study, biology, nursing, chemistry, biochemistry, psychology, computer science, cybersecurity, data analytics, health and human performance, mathematics, and sustainable rural systems were all considered STEM majors. Any other major outside of this list was considered non-STEM. The outcome variable was between subjects and was the severity of imposter syndrome experiences present in the participants assessed via the Clance IP Scale (Clance, 1985).

Procedure

The study was distributed to participants after it was approved by the institutional review board (protocol number 2022-03). Undergraduate participants completed this study remotely from January to February of 2023. The study was presented to participants through the online survey software Qualtrics, and participants accessed the study through a shareable link.

All participants read and signed an informed consent form online before they began the study. The consent form described the study as an assessment of personality differences between fields of study. Participants who did consent were presented with a URL link and asked to copy and paste the URL link into their web browser to complete the study. Due to this extra step, a small number of participants only completed the informed consent and did not continue with the study URL. However, this was a very small number and did not affect the collected data.

The first segment of the study asked participants to input their demographic information. After completing the demographic segment of the study, participants were then informed that they were going to begin the personality trait segment of the study (Beesley & Vece, 2023). Participants were then presented with a 30-item questionnaire composed of 20 vignettes from the Clance IP Scale (Clance, 1985) and 10 questions from the International Personality Item Pool (Goldberg, 2022), all of which were presented in a random order. After participants completed their responses to the vignettes, they were presented with a deception check. This check asked participants what they thought the purpose of the study was. Participants could either fill in a text box with their answer or select a box marked "I have no idea". This was to ensure that the true purpose of the study was obscured and participants were not acting due to any participant bias. Ultimately, no participants were removed based on their responses to the deception check.

After the deception check, the study ended, and participants were thanked for their participation and debriefed. The debriefing form informed participants

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that the true purpose of the study was to investigate imposter syndrome rates both between STEM and non-STEM majors and among genders. Participants were reminded that their responses were completely anonymous. After reading the debriefing, participants then received a prompt that included an extra credit code that they could send to the researchers.

Data Analysis

For this study, a 2 x 2 between-subjects analysis of variance (ANOVA) was performed to determine significant mean differences within our sample. The main effects of gender and major, as well as interaction effects, were measured.

Results

All assumptions of the ANOVA were met as assessed with a Levene's Test for Equality of Variances ($p = .43$), and a Shapiro-Wilk Test for Normalcy was used to test the STEM ($W = .96$, $p = .10$), non-STEM ($W = .98$, $p = .33$), female ($W = .97$, $p = .22$), and male ($W = .98$, $p = .47$) samples separately. The combined Clance IP Scale and personality scale was found to be very reliable when analyzed using Cronbach's Alpha ($\alpha = .86$). We found a significant main effect of college major, $F(1,180) = 6.13$, $p = .01$, $\eta^2 = .03$ (see Figure 1). As hypothesized, individuals in STEM majors ($M = 62.75$, $SD = 14.63$) experienced significantly higher rates of imposter syndrome when compared to non-STEM majors ($M = 56.56$, $SD = 13.15$). An additional significant main effect was also detected regarding gender, $F(1,180) = 4.51$, $p = .04$, $\eta^2 = .02$ (see Figure 1). In this case, participants who identified as female ($M = 62.25$, $SD = 14.29$) experienced significantly higher rates of imposter syndrome when compared to participants

who identified as male ($M = 56.98$, $SD = 14.44$), which confirmed our secondary hypothesis. No significant difference or interaction effects were identified between the gender and college major conditions, $F(3, 180) = 0.02$, $p = .747$, $\eta^2 = .00$. Imposter syndrome severity scores were also grouped into categories including few (40 or less), moderate (41–60), frequent (61–80), and intense (80 or above) as per the Clance IP Scale scoring rubric (Clance, 1985).

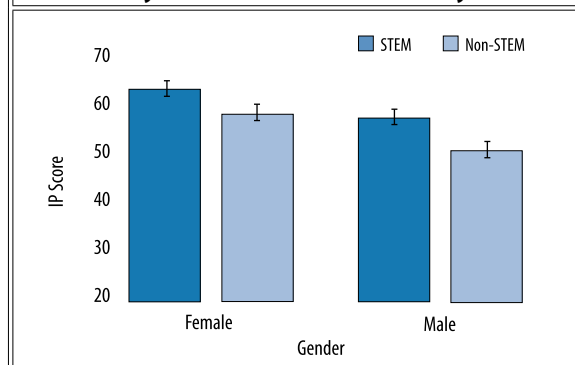
Discussion

Our first two hypotheses were confirmed; there was a significant difference in imposter syndrome rates between the majors, with STEM majors reporting significantly higher imposter syndrome than non-STEM. Additionally, there was a significant difference in imposter syndrome scores between men and women gender, with women reporting significantly higher imposter syndrome levels than men. Finally, we confirmed our third hypothesis, as female STEM majors had significantly higher levels of imposter syndrome when compared to all other conditions. Our study was the first, to our knowledge, to show that STEM majors not only have high levels of imposter syndrome, but that these levels are higher than non-STEM majors. Future efforts should aim at analyzing the majors separately, if possible, to determine whether there are specific STEM or non-STEM majors which are more prone to developing imposter syndrome.

These results also lend support to a positive relationship between high stress fields of study and imposter syndrome rates. More difficult fields of study are associated with greater levels of mental health disorders like anxiety (May & Casazza, 2012). This finding may indicate that the elevated academic anxieties of an individual in a STEM field may also lead to greater feelings of imposter syndrome. However, our results still demonstrated a moderate level of imposter syndrome feelings within non-STEM majors, something that has not been presented in the existing literature. One possible explanation for these results is that the non-STEM student sample was primarily made up of women, which is a population that has been previously associated with higher rates of imposter syndrome (Clance & Imes, 1978; Cusack et al., 2013). However, the male non-STEM participants still exhibited a moderate level of imposter syndrome. Another possible explanation for these elevated levels among non-STEM students is that the imposter syndrome may originate from general academic stressors, or even stressors outside of academics. During the interviews conducted by Gardener et al. (2019), some participants reported that their imposter feelings tend to appear in specific contexts where they believe they appear to be an imposter. This could be

FIGURE 1

Imposter Syndrome Severity Score by Gender and Field of Study



Note. Means scores are shown for the Imposter Syndrome Severity Scores between females and males in STEM and non-STEM fields of study. Error bars represent standard error.

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regarding their academic ability, race/ethnicity, or status as a first generation student (Bravata et al., 2020). Cusack et al. (2013) observed that individuals who experience more issues regarding anxiety and mental health also experience more imposter syndrome. This could account for some of the imposter syndrome frequency seen in non-STEM students, as both STEM and non-STEM students may undergo similar educational pressures and general life stressors.

The significantly higher rate of imposter syndrome in women compared to men within our results are consistent with the claims of Clance and Imes's (1978) original article on imposter syndrome, as well as the results of Cusack et al. (2013). As referenced by Clance and Imes (1978), women have various gender expectations and roles placed on them at a young age, encouraging imposter syndrome to develop. On top of that, women in STEM are less prevalent in STEM (NCSES, 2023) possibly due to factors such as gender stereotypes, a lack of female role models to encourage participation in STEM fields, and the fact that STEM fields and workplaces are typically male-dominated and exclusionary of women (Davis & Hill, 2018), which can play a role in a higher rate of imposter syndrome within women in STEM.

With considerations to the gender roles placed on girls at a young age, as well as the gender disparities seen within STEM fields and workplaces, our study's results corroborate Cusack et al. (2013) and Clance and Imes's (1978) explanations for how traditional gender expectations and workplace demographics influence imposter syndrome rates within women. However, it is important to note the age of these articles, and that gender roles have likely changed since the publishing of both Clance and Imes (1978) and Cusack et al. (2013). Although some do still exist regarding the roles of women and men, general understandings of gender roles have shifted considerably towards a more neutral outlook in the past few decades (Charlesworth & Banaji, 2021). This does indicate that gender stereotypes are not as strong now as they were before; however, Charlesworth and Banaji (2021) did note that they continue to exist and men are still seen as career-focused while women are seen as family-focused.

Additionally, our results did demonstrate that, on average, men reported a moderate level of imposter syndrome. In this aspect, our findings were consistent with that of Qureshi et al. (2017), because although it is true that men reported less imposter syndrome than women, the imposter syndrome that men experienced was still considerable. As most imposter syndrome research has focused on imposter syndrome prevalence among women, our results demonstrate that high imposter syndrome rates are not limited to the women and that

men suffer from this psychological phenomenon as well. Further research should explore possible relationships between childhood experiences, gender roles, and more in men who experience imposter syndrome.

Several limitations to the present study should be addressed. One major limitation is a lack of demographic data. Because this study's demographic data was not saved and reported, there is a large limitation on the generalizability of the results as other factors such as ethnicity or age could be mediating factors in the development or severity of imposter syndrome. Further research should explore some of these factors within college populations as any number of these factors may influence imposter syndrome presentation in a number of ways unaccounted for here. However, some general demographic information of the student population was made available through the university, indicating that the campus population at the time of data collection was predominantly made up of students identifying as White (67%) followed by students identifying as Hispanic (14%). Non-first-generation students were also a majority of the population, with first-generation students only accounting for 33% of the student population (Eastern Oregon University, 2023). Although these numbers might not be reflected in our sample, we believe they can provide a general idea of what our sample might have looked like.

There should also be considerations toward the university in which we conducted our study. Because our participant pool was composed of students from a small, rural, public university, our student population may display a different rate of imposter syndrome than other universities' student populations. Our participants were also mainly composed of women and STEM majors. This means that differences in imposter syndrome measured among genders and majors may have been more pronounced if we had obtained greater statistical power. Another demographic limitation of our study was the lack of participants who identified as nonbinary. Due to this exclusion, the results we obtained may not be fully generalizable across all college students.

One last limitation to be addressed regarding the design of this study was the choice of imposter syndrome scale used. We chose to use the Clance IP Scale (Clance, 1985) because it was both the most widely used tool for imposter syndrome measurement and the most validated (Holmes et al., 1993; Mak et al., 2015). However, because there is no current standard for imposter syndrome measurement, our data may be less valid should a more effective scale be created.

We believe that, based on the results obtained by this study, continued research in this area is warranted. This research should move its focus to other types of universities, such as private universities, universities

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in urban areas, and universities with larger student bodies. Additionally, this study was not able to include individuals pursuing multiple majors or those who self-identify as nonbinary, due to both samples not containing enough members to allow for any analysis. Further research should investigate these groups to determine whether any differences exist within them.

In addition to these demographics, there are others such as race/ethnicity and family history that further studies should look at as predictors of imposter syndrome. Bravata et al. (2020) briefly addressed this in a meta-analysis and found that marginalized groups experienced more imposter syndrome, but we believe that there is space in the current literature for this topic. Additionally, an individual's family background may play a role in imposter syndrome development, as first-generation college students may experience higher academic pressures than other students. Further research between STEM and non-STEM groups could address students' family backgrounds as a mediating factor between chosen major and imposter syndrome so that more meaningful direct comparisons can be made.

Lastly, as there was a prevalence of imposter syndrome among the men in our study, the field of imposter syndrome research should revise its scope to include both men and women in future analyses and investigations. More research could also move focus onto both the prevention and treatment of imposter syndrome within student bodies. As this is a condition that can significantly impair individuals both academically, mentally, and socially (Bravata et al, 2020; Clance & Imes, 1978; Cusack et al., 2013), further systems should be developed to aid these students and improve their academic and intrapersonal outcomes.

In sum, this study succeeded in administering the Clance IP Scale to a novel population within a rural university to assess imposter syndrome rates between genders and majors. Our results not only indicated that STEM majors and women experience more imposter syndrome on average in comparison to other students, but that all types of students tend to experience at least moderate imposter syndrome on average. Such prevalence results demonstrate a presence of imposter syndrome in the men that has not been widely researched before. With our findings in mind, further imposter syndrome research focusing on men and larger student populations is warranted. As imposter syndrome appears to be a phenomenon that impacts not only the women and STEM fields, but all other student demographics, it is important that further research be conducted regarding the treatment and prevention of imposter syndrome.

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Author Note.

Nicholas G. Vece  <https://orcid.org/0009-0001-9673-8207>

Zoe Johnson-Ulrich  <https://orcid.org/0000-0001-6000-5880>

We have no known conflicts of interest to disclose. All materials required to replicate this study can be accessed at <https://osf.io/tmcae/>.

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Any attempts to contact the research team should be sent to Nicholas Vece, Department of Psychology, Eastern Oregon University, One University Blvd., La Grande, OR, 97850-2807, United States. Email: nvece@eou.edu

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Demographics That Benefit the Most From a Growth Mindset of Intelligence Intervention

Gabriela N. Betanzos¹, Katherine L. Barrett^{2*}, and Cosette Fox^{1*}

¹Department of Psychology, Holy Cross College

²Department of Biology, Holy Cross College

ABSTRACT. Implicit theories pertain to one's beliefs about personal traits. According to the implicit theories of intelligence, a fixed mindset perceives intelligence as stagnant, whereas a growth mindset perceives intelligence as malleable and subject to growth. Interventions aimed at promoting a growth mindset have been successful in multiple realms among students of all ages, backgrounds, and demographics of interest. We investigated the effect of a growth mindset of intelligence intervention on implicit theories of intelligence, verbal language skills, perceived academic stress, grit, and term grade point average. We also measured various demographics to assess which ones benefit the most from such a treatment. The growth mindset intervention spanned over seven 30-minute sessions that took place in person over the span of four weeks. The control group received equivalent training on the various theories of intelligence. The data showed that the intervention was successful and was associated with an increase in implicit theories of intelligence specifically in the experimental group with a large effect size, $d = 1.80$, 95% CI [1.16, 2.42], $F(1,53) = 42.8$, $p < .001$. Certain demographic groups, such as athletes, first-generation students, traditional nontransfer intent students, non-Hispanics, students who play a musical instrument, and students with mental illness benefited the most from the intervention. Furthermore, the intervention increased perceived academic stress in students with mental illness, decreased academic stress in first-generation students, and increased grit in athletes. Understanding which student population is more receptive to such interventions is crucial to future efforts in tailoring growth mindset interventions on college campuses.

Keywords: growth mindset, implicit theories of intelligence, academic stress, first-generation students, grit



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For decades, research has been investigating what intrinsically motivates people in the face of setbacks and what affects their reactions to success or failure. The concept of implicit theories of intelligence proposed by Carol Dweck and colleagues in the late 80s and 90s (Dweck & Leggett, 1988; Dweck et al., 1995) has

helped supplement what the attribution theory had lacked in this research area (Hong et al., 1999). Implicit theories pertain to one's beliefs about personal traits or attributes. According to the implicit theories of intelligence, a person with a fixed mindset perceives intelligence as stagnant whereas a person with a growth mindset perceives

intelligence as malleable and subject to growth (Dweck & Leggett, 1988; Dweck, 2006). Individuals with a fixed mindset tend to avoid challenges and develop maladaptive tendencies that subliminally lead them to give up in the face of difficulties (Dweck, 2006; Haydel & Roeser, 2002). In contrast, individuals with a growth mindset perceive challenges and setbacks as opportunities for growth and tend to be process (effort, strategy, and progress) oriented (Dweck, 2006; Hong et al., 1999). In other words, one's mindset about intelligence can influence and guide one's initial reaction to challenges and obstacles, affecting overall outcomes in terms of motivation, effort, and persistence (for review, see Dweck & Yeager, 2019).

Benefits of Growth Mindset of Intelligence

Studies over the years have reiterated that a growth mindset of intelligence is associated with better academic performance in students of all ages ranging from elementary and junior high youth (Blackwell et al., 2007; Leondari & Gialamas, 2002), to high school students (Haydel & Roeser, 2002), and even college students (Fox et al., 2019; Fox & Barrera, 2020). Meta-analyses pertaining to various ages (Costa & Faria, 2018; Gál & Szamosközi, 2016) have also highlighted the academic and emotional benefits associated with a growth mindset of intelligence. The benefits of having a growth mindset of intelligence apply to a variety of academic measures, such as final exam course grades in mathematics and social sciences, mathematical ability, perceived academic performance and constructive coping mechanisms in a wide variety of student ages (Ahmavaara & Houston, 2007; Leondari & Gialamas, 2002; Shih, 2011; Shively & Ryan, 2013; Tempelaar et al., 2015). Most interesting is that cortisol levels were lower in high school students who displayed a growth mindset of intelligence when their grades were declining suggesting that a growth mindset leads to a relatively more positive perception of academic stressors (Lee et al., 2018). However, these apparent growth mindset-related academic benefits need to be considered carefully in light of recent evidence that the effect sizes associated with these findings are weak (Macnamara & Burgoyne, 2023; Sisk et al., 2018). A meta-analysis examining the effect of implicit theories and its related interventions on academic achievement in students of all ages argues that such a relationship is weak, and the benefits of growth mindset interventions are mainly limited to students with low socioeconomic status or students who are academically at risk (Sisk et al., 2018). A more recent meta-analysis by the same authors evaluated 63 studies, and reported a small nonsignificant effect size of growth mindset interventions on academic achievement after correcting for potential publication bias. These authors boldly conclude that the acclaimed fame of growth mindset interventions when it comes to academic

improvement could likely be attributable to inadequate study design, reporting flaws and even researcher and publication biases (Macnamara & Burgoyne, 2023).

Nonetheless, the benefits of a growth mindset of intelligence (or the detrimental effects of a fixed mindset of intelligence) extend beyond academics into the realm of emotional regulation and well-being. For example, a meta-analysis of 46 studies of students ranging from junior high to college age found that a growth mindset of intelligence was correlated with positive affective states whereas a fixed mindset of intelligence was correlated with negative affective states (Gál & Szamosközi, 2016). A growth mindset of intelligence was also correlated with effective coping strategies for anxiety in young adult students (Ruiselová & Prokopčáková, 2005).

Other Types of Mindsets and Their Benefits

The concept of implicit theories has been applied to personal traits and attributes other than intelligence. Researchers have investigated the benefits of a growth mindset or the detriments of a fixed mindset of thoughts, emotions, behavior (Schleider & Weisz, 2016a), and personality (Erdly & Dweck, 1993). For example, a fixed mindset of thoughts, emotions, and behavior was associated with mental health problems in teenage girls (Schleider & Weisz, 2016b). In fact, psychopathology predicted a fixed mindset in these domains (Schleider & Weisz, 2016a). A fixed mindset of emotions predicted higher distress and lower well-being (Howell, 2017). Those with a fixed mindset of emotions also had lower life satisfaction and less positive emotions (King & dela Rosa, 2019). A fixed mindset of emotions also led to less adaptive functioning (Howell, 2017). Those with a fixed mindset of emotions experienced difficulty developing coping strategies, but cognitive reappraisal eradicated some of these negative effects (King & dela Rosa, 2019). A multitude of studies led by pioneers such as Schleider and Yeager have shown that interventions promoting growth mindset of personality and related brain malleability result in improved mental health by increasing hope and agency and decreasing depression symptoms and self-hate (Miu & Yaeger, 2014; Schleider et al., 2022; Yeager et al., 2013). Pertaining to mindset domains other than thoughts, emotions, behavior, and personality, a growth mindset of well-being was correlated with prioritizing positivity, which translates into incorporating pleasurable activities into a daily routine (Passmore et al., 2018). Furthermore, those with a growth mindset about personal beliefs were less likely to experience negative emotions than those who possessed fixed beliefs (Howell, 2017).

Implicit Theories and Gender

Studies have also explored gender differences in implicit theories. Girls seem to have adopted relatively more fixed

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beliefs about their thoughts, emotions, (Jiang et al., 2022) and behavior (Schleider & Weisz, 2016b). Longitudinal assessment reveals that these fixed mindsets in girls were associated with worse mental health symptoms and increased over the span of a school year (Schleider & Weisz, 2016b). Furthermore, young men with a growth mindset of behavior show reduced peak in cortisol under social stress but young women did not show that same stress buffering benefit from having a growth mindset (Fischer et al., 2023). This tendency for girls to have relatively more of a fixed mindset is not limited to thoughts, emotions, and behavior. Girls were reported to have more of a fixed mindset of intelligence than boys and that fixed perception of their intelligence was associated with lower perception of efficacy in math (Todor, 2014). However, other studies reported that gender differences in implicit theories of intelligence were not significant (Macnamara & Rupani, 2017; Sigmundsson et al., 2021; Storek & Furnham, 2013). Further, implicit theories of intelligence were not a mediating factor in gender differences in intelligence in college age students or adults (Macnamara & Rupani, 2017; Storek & Furnham, 2013). This inconsistency in the relationship between mindset and gender is even more pronounced in unique types of mindsets. For example, engineering students that were men were more likely than women to have a fixed mindset about their making abilities (Galedin et al., 2016). Taken all together, the data up to date showed that the relationship between gender and implicit theories is still unclear and merits further investigation (Fischer et al., 2023).

Growth Mindset Interventions

As mentioned above, studies have shown that participants can be taught to have a growth mindset about various personal attributes such as intelligence and personality, a phenomenon referred to as growth mindset interventions. For example, these interventions led to an increase in growth mindset of intelligence in students of various ages, which then led to positive outcomes in the academic setting (Blackwell et al., 2007; Skipper, 2015; Spitzer & Aronson, 2015). Striking in the literature is the finding that these interventions are most beneficial to certain demographics. For example, these interventions and their related academic benefits have been particularly successful among minority students, such as African American college students and students at risk (Aronson et al., 2001; Sisk et al., 2018). Low-income students, women especially, have benefited from mindset interventions, which led to higher scores on standardized tests and mitigated disparities previously observed between men's and women's test scores (Good et al., 2003; Sisk et al., 2018). Specifically in adolescents who have generalized anxiety disorder, a growth mindset

of intelligence intervention was a useful tool to combat school-related stress and in some cases, improve scores on IQ tests (Da Fonseca et al., 2008a; Da Fonseca et al., 2008b). A growth mindset of intelligence intervention combined with a sense-of-purpose intervention was associated with improved grades for underperforming high school students (Paunesku et al., 2015). As mentioned earlier, the growth mindset of intelligence is focused on effort and progress rather than the outcome. Accordingly, a study conducted with Division I collegiate athletes concluded that those with competing-to-excel orientation mentalities had higher confidence in their own athletic ability and had increased goal-orientation, which is in stark contrast to athletes who developed competing-to-win orientation mindsets, scoring lower on levels of confidence (Ryska, 2001). Because college-athletes are typically considered competitive, leading them to a strong drive for personal and team success, the potential for changes in mindset, and how such findings can be applied to performance, are of interest. Similarly, grade school students who play a musical instrument were more likely to engage in incremental (growth) theory of learning, or overall success from the amplification of many smaller successes, than those who did not play an instrument; furthermore, playing an instrument proves that capabilities in music can be advanced through effort (O'Neil, 2011). These studies suggest that athletes and music instrument players might be primed to benefit greatly from a growth mindset intervention.

Mindset interventions have been applied to areas other than intelligence and their benefits extend beyond academics particularly among youth. A study conducted on undergraduate students by Schroder et al. (2017) showed that the association between the number of stressful life events a student had experienced, and mental illness symptoms (e.g., posttraumatic stress, depression), was weaker in students who had adapted a growth mindset of anxiety as a result of their intervention, compared to those with a fixed mindset. Additionally, maladaptive coping strategies, such as nonsuicidal self-injury, alcohol abuse, and drug use, were found to be lower in those students who acquired a growth mindset of anxiety due to the intervention (Schroder et al., 2017). Other researchers have also concluded that growth mindsets of both anxiety and emotions are related to improved emotional regulation practices (De Castella et al., 2013). Increasing mindset of personality in adolescents reduced aggression in response to victimization and exclusion (Yeager et al., 2013). Using the Growth Mindset Single Session Intervention (GM-SSI) in youth, Schleider and colleagues demonstrated that learning to adopt a growth mindset about traits, brain malleability, emotional and social setbacks, and personality led to

better mental health in this population that is vulnerable to depression and anxiety (Schleider et al., 2018; Schleider et al., 2019a; Schleider et al., 2019b; Schleider et al., 2020a; Schleider et al., 2020b). GM-SSIs have been found to reduce the internalized distress in adolescents with mental illnesses, particularly anxiety (Schleider & Weisz, 2018; Schleider et al., 2020). Teaching growth mindset to adolescents and their parents resulted in lower youth-reported depression and lower parental reporting of children's depression (Schleider & Weisz, 2017). In fact, the study showed that parents' beliefs about psychotherapy are also malleable and can be adjusted using growth mindset educational services (Schleider & Weisz, 2018). A 9-months postintervention assessment reported that these intervention outcomes are effective long-term (Schleider et al., 2019a) and are predictive of better mental health treatment response over time (Schleider et al., 2019a).

In light of this comprehensive review of research highlighting that growth mindset interventions are particularly helpful to students within certain demographics, those developing certain skills or those who suffer from mental illness, the present research aims at investigating the beneficial effects of a growth mindset of intelligence intervention with a focus to assess which demographics of college students would benefit the most. Specifically, the goal of the current study was to investigate the effectiveness of a growth mindset intervention promoting the malleability of intelligence and the brain in college students. We investigated the effect of a growth mindset of intelligence intervention on implicit theories of intelligence, verbal language skills assessment, perceived academic stress, grit and term grade point average (GPA). A second goal of the study was to assess which demographics benefitted the most from such a treatment. Gender, ethnicity, socioeconomic status, first-generation status, athleticism, musical experience, mental health and traditional vs. nontraditional college programs were the demographics considered in this study. We hypothesized that the intervention would result in an increase in growth mindset of intelligence, verbal language skills, grit, and term GPA and that the intervention will result in a decrease in perceived academic stress. We also hypothesized that the growth mindset intervention would relatively benefit women and disadvantaged students such as students from ethnic minorities, low socioeconomic status, and first-generation students (Aronson et al., 2001; Good et al., 2003). The growth mindset intervention spanned over seven 30-minute sessions that took place in person over four weeks teaching subjects about the concept of implicit theories, the malleability of the brain and providing practical advice on how to grow one's mindset

of intelligence. The control group received equivalent training on the various theories of intelligence.

Methods

Sample

The sample consisted of 65 first-year and sophomore students, with ages ranging from 18 to 24 years old. As shown in Table 1, the sample consisted of 60% women ($n = 39$) and 40% men ($n = 26$). Of the 65 students, 53.8% were traditional four-year students ($n = 35$), while 46.2% were nontraditional transfer intent students ($n = 30$). Additionally, 85% of students were nonathletes ($n = 52$), while 15% were involved in collegiate-level athletics ($n = 13$). As for ethnicity, 73.8% of students identified as non-Hispanic ($n = 50$), and 26.2% identified as Hispanic/Latino ($n = 15$). The socioeconomic status based on household income was diversified with 27.7% of households earning less than \$75,000 per year

TABLE 1		
Sociodemographic Characteristics of Subjects		
	<i>n</i>	%
Gender		
Male	26	40.0
Female	36	60.0
Program		
Traditional	35	53.8
Nontraditional	30	46.2
Student-Athletes		
Nonathletes	52	85.0
College Athletes	13	15.0
Ethnicity		
Non-Hispanics	50	73.8
Hispanics	15	26.2
Household Socioeconomic Status		
<\$75,000	18	27.7
>\$75,000	47	72.3
First-Generation		
Non-First-Generation	49	75.4
First-Generation	16	24.6
Musical Capabilities		
Noninstrument Players	47	72.3
Instrument Players	18	27.7
Mental Illness		
No Mental Illness	53	81.5
Mental Illness	12	18.5
Note. Nontraditional programs at Holy Cross College are made up of one-year or two-year transfer intent programs.		

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($n = 18$) and 72.3% ($n = 47$) earning \$75,000 or more per year. First-generation students are a population of interest in this study, as 24.6% ($n = 16$) indicated they were the first to attend college in their family, and 75.4% ($n = 49$) indicated that they were not. 27.7% of students played an instrument ($n = 18$), and 72.3% did not ($n = 47$). Concerning mental illness, 18.5% of the students reported suffering from at least one mental

illness during the semester when the study was conducted ($n = 12$) and 81.5% of students reported having no mental illness ($n = 53$). Table 2 shows how these demographic groups were distributed across the control and treatment groups.

With prior consent of participants, the end of the term GPA was collected for everyone.

Demographics

This form asked participants various demographic questions pertaining to age, gender, ethnicity, socioeconomic status, first generation status, athleticism, musical experience, mental health and traditional vs. nontraditional college programs.

Basic Achievement Skills Inventory

The Basic Achievement Skills Inventory (BASI) is a standardized achievement skills test for verbal language that measures vocabulary, spelling, language, and reading comprehension (Griffith, 2006). The test was timed for 25 minutes and contained 50 multiple choice questions. Subjects read the instructions and the questions from a booklet and recorded their answers on a scantron.

Theories of Intelligence Scale

The Theories of Intelligence Scale (TIS) is an 8-item questionnaire, with a 6-point scale, assessing implicit theories of intelligence or general beliefs about the fixedness or malleability of intelligence (Dweck, 2000). The growth mindset items were reversed scored and the average of all items was calculated. Higher scores are indicative of a higher growth mindset of intelligence. Internal consistency of TIS items was $\alpha = .92$ preintervention and $\alpha = .97$ postintervention.

Perception of Academic Stress Scale

The Perception of Academic Stress (PAS) is an 18-item, 5-point scale, measured three different aspects of perceived academic stress using three subscales (Bedewy & Gabriel, 2015). Subscale 1, items 6, 9, 13, and 14, measured stress related to students' academic expectations. Subscale 2, items 4, 5, 10, 11, 12, 15, 16, and 17, measured stress related to faculty expectations and examination. Lastly, Subscale 3, items 1, 2, 3, 7, 8 and 18, measured stress pertaining to students' academic perceptions. Total academic stress was calculated by adding up all three scales. Internal consistency of Subscale 1 items was $\alpha = .64$, that of Subscale 2 items was $\alpha = .62$, and of Subscale 3 items was $\alpha = .54$.

12-Item Grit Scale

This grit questionnaire uses a 5-point scale and was developed by Angela Duckworth (Duckworth et al.,

TABLE 2

Descriptive Statistics Across Demographics and Group

	Control Group		Experimental Group	
	<i>n</i>	%	<i>n</i>	%
Age (Years)				
18	21	63.6	14	43.8
19	11	33.3	14	43.8
22	0	0	1	3.1
24	1	3.0	1	3.1
N/A	0	0	2	6.3
Gender				
Men	13	39.3	13	40.6
Women	20	60.6	19	59.4
Enrollment				
Traditional	18	54.5	17	53.1
Nontraditional	15	45.5	15	46.9
Student Athletics				
Nonathletes	28	84.8	24	75.0
College Athlete	5	15.2	8	25.0
Ethnicity				
Non-Hispanic	29	87.8	21	65.6
Hispanic	4	12.2	11	34.4
Household Socioeconomic Status				
<\$75,000	8	24.2	10	31.3
>\$75,000	25	75.8	22	68.8
First-Generation				
Non-First-Generation	25	75.8	24	75.0
First-Generation	8	24.2	8	25.0
Musical Capabilities				
Noninstrument Player	24	72.7	23	72.0
Instrument Player	9	27.3	9	28.0
Mental Illness				
No Mental Illness	24	72.7	29	90.6
Mental Illness	9	27.3	3	9.4

Note. Traditional students are the ones committed to staying on campus for four years vs. nontraditional students who are part of programs that are designed for transfer to an R1 university.

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2007). Items 2, 3, 4, 7, 8, and 11 are reversed when scoring, and a higher average score indicates higher grit. The internal consistency of grit items was $\alpha = .70$.

Design

The research project was approved by the Institutional Review Board (IRB) of Holy Cross College. We used a mixed within and between research design with some outcomes measured pre-and postintervention and compared between control and experimental groups (implicit theories of intelligence and verbal language skills) and other outcomes only measured postintervention and compared between control and experimental groups (perception of academic stress, grit, and term GPA). Participants were randomly assigned to an experimental group learning about the growth mindset of intelligence and its benefits or a control group learning about various theories of intelligence. Each group met with the researchers in the mornings on average twice a week for a total of seven 30-minute sessions. At the beginning of session 1, all participants willing to participate signed an informed consent and completed a demographic questionnaire. We then collected baseline measures of verbal language skills and implicit theories of intelligence. The following five sessions consisted of presentations specific to each group. Participants in the experimental group were presented with slides that were modified versions of the materials available on the Project for Education Research that Scales (PERTS) website (PERTS, n.d.). Participants were taught the basic concepts of growth vs. fixed mindset of intelligence and their effects on people's thinking and behaviors. Then participants were introduced to the concept of neuroplasticity with basic neuroscience knowledge. The treatment concluded with practical applications of how participants can shape their mindsets exploring the power growth mindset has through language and feedback to the individual and from others. The control group presentation slides covered four intelligence theories (Spearman's general intelligence, Cattell's theory of intelligence, Sternberg triarchic theory and Gardner's theory of multiple intelligences). Presentations started with a quick survey regarding students' prior knowledge of the various theories, detailed slides explaining each theory and possible careers stemming from each type of intelligence when applicable. In both groups, participants took part in a writing activity at the end of each session that prompted them to reflect on what they learned and provided them with some opportunities for personal applications such as applying the knowledge to varying social scenarios or connecting it to their past experiences. Both groups watched short video clips pertaining to the content and were asked to

discuss with a partner what they learned and what was most interesting to them. Grit and perceived academic stress were measured on the last day of testing. Verbal language skills and implicit theories of intelligence tests were also readministered on the final day. The study concluded with the participants receiving a small gift to thank them for their time.

Statistical Analysis

All statistical analyses were conducted in the R programming language (R Core Team 2023). Prior to analysis, data were checked for normality and homogeneity of variances. All data and R code used for the present analysis are available at for review.¹

The first goal of the study pertaining to the effectiveness of the intervention (control vs. experimental groups) on the post-intervention dependent variables was evaluated by computing between-groups effect sizes using Cohen's *d* and 95% confidence intervals within the R package "psych." Cohen's *d* and 95% confidence intervals were used to estimate the effect of the intervention on multiple measures: postintervention implicit theories of intelligence scores, postintervention verbal language skills scores, term GPA, total academic stress, academic stress Subscales 1, 2 and 3, and grit. A MANOVA ($\alpha = .05$) was also conducted to identify statistically significant differences between the control and experimental groups on the various outcome measures post-intervention.

Principal components analysis (PCA) following the "princomp" method in the vegan R library was used to complement Cohen's *d* and MANOVA analyses and provide a visual illustration of how all the dependent variables interact across the demographic categorical variables. Although boxplots of the outcomes across control and experimental groups provide a visual of the differences in growth mindset according to the demographic characteristics, PCA is frequently used to explore trends in multidimensional data that may be overlooked in traditional graphical analyses. Thus, the purpose of PCA in this context was to discern relationships among term GPA, verbal language skills, all academic stress scales, grit, and implicit theories of intelligence according to control and experimental groups. Prior to conducting the PCA, we computed two derived variables: language skill score difference, the absolute difference between pre- and postintervention language skills scores, and implicit theories score difference, the absolute difference between pre- and postimplicit theories of intelligence scores. This was done to reduce redundancy and multicollinearity, and to show the magnitude of change in these variables between control and experimental groups.

¹<https://osf.io/286m4>

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To address the study's second goal, which was to evaluate which demographic groups benefited the most from the intervention, we again computed between-groups effect sizes using Cohen's d statistic and 95% confidence intervals within the R package "psych." We calculated the difference between the control and experimental groups using Cohen's d to assess the effect size of the change in specific postintervention outcomes (e.g., postimplicit theories of intelligence, grit) in each binary demographic category (e.g., gender, ethnicity, music experience).

Finally, we employed multiple linear regression ($\alpha = .05$) using the "lm" function in the R program to build a model that represents the most important and influential variables that contribute to an enhancement in growth mindset in our study population. We included in this model the postintervention implicit theories of intelligence as the response variable, and the preintervention implicit theories and all the dichotomous demographic variables such as gender and race predictor variables. All predictors were included in the initial model, and then we used backward stepping multiple regression and Akaike's Information Criterion (AIC) with the "step.AIC" function in the R program "MASS" library to arrive at the best fit model. Finally, we ran an ANOVA on the final model using the "anova()" function in R to calculate the percentage of the variance explained by each predictor on postintervention growth mindset. This was accomplished by dividing the F -statistic of each predictor variable over the sum of the F statistics for all predictor variables and multiplying by 100.

Results

Effect of the Intervention on Outcomes

Table 3 shows the difference between the control and experimental group in the postintervention implicit

theories of intelligence, which was significantly higher in the experimental group ($M = 5.25$, $SD = 0.73$) compared to the control group ($M = 3.60$, $SD = 1.12$) with a very large effect size ($d = 1.80$, 95% CI [1.16, 2.42]) that was corroborated with the MANOVA test, $F(1, 53) = 42.8$, $p < .001$, showing that the intervention was successful and is associated with a substantial increase in growth mindset specifically in the experimental group. This effect of the intervention on increasing implicit theories of intelligence did not translate to other outcomes that pertain to academics such as verbal language assessment, GPA or grit. The effect of the intervention on these outcomes is small with a Cohen's d around 0.2 or smaller (verbal assessment $d = -0.27$, 95% CI [-0.80, 0.27]; GPA $d = -0.04$, 95% CI [-0.57, 0.48]; grit $d = -0.22$, 95% CI [-0.75, 0.31]). In contrast, the effect of the intervention on the perceived academic stress pertaining to students' academic expectations (Subscale 1) shows that Cohen's d is small to medium in size ($d = 0.39$, 95% CI [-0.14, 0.92]). The experimental group ($M = 2.38$, $SD = 0.72$) appears to be slightly higher on that outcome than the control group ($M = 2.18$, $SD = 0.67$). However, MANOVA indicated that the observed difference in academic stress pertaining to students' academic expectations between control and experimental groups was not statistically significant, $F(1,53) = 2.03$, $p = .16$; For the remainder of the outcomes, the MANOVA results agreed with the small effect sizes revealed by Cohen's d analysis, as none of the measures differed significantly between the control and experimental groups.

To disentangle possible underlying relationships among response variables and demographic characteristics, we used PCA to provide a visual assessment of the effect of the intervention (control v. experimental groups) on the relationships among the dependent variables (see Figure 1). Subjects in the control and experimental groups formed two distinct clusters in multivariate space, which supports the findings reported above that the intervention is associated with an increase in growth mindset of intelligence in the experimental group. Within the experimental group, implicit theories score difference is greater, as indicated by the vector that is associated with this metric, which shows that individuals who learned about implicit theories of intelligence did exhibit greater growth mindset of intelligence. A few other interesting findings that emerged from the PCA are that Grit and BASI score differences are strongly correlated in the control group. All measures of perceived academic stress were strongly correlated with each other as expected. Importantly, the PCA results support these bivariate correlations that are presented in Table 4.

TABLE 3

Effect of the Intervention on Outcomes

Outcomes	Control Group: <i>M</i> (<i>SD</i>)	Experimental Group: <i>M</i> (<i>SD</i>)	Cohen's <i>d</i> (CI)
Postintervention TIS	3.54 (1.16)	5.25 (0.70)	1.80 [1.16, 2.42]
Postintervention BASI	37.00 (5.83)	36.00 (6.37)	-0.27 [-0.80, 0.27]
Grit	3.09 (0.75)	2.96 (0.66)	-0.22 [-0.75, 0.31]
Term GPA	3.48 (0.67)	3.43 (0.74)	-0.04 [-0.57, 0.49]
PAS Total	2.40 (0.55)	2.50 (0.51)	0.16 [-0.37, 0.69]
Stress Subscale 1	2.18 (0.67)	2.38 (0.72)	0.39 [-0.14, 0.92]
Stress Subscale 2	2.43 (0.66)	2.60 (0.61)	0.21 [-0.32, 0.74]
Stress Subscale 3	2.51 (0.51)	2.46 (0.50)	-0.21 [-0.74, 0.32]

Note. TIS represents implicit theories of intelligence, BASI measures verbal language skills and PAS stands for perceived academic stress. PAS subscale 1 measures students academic expectations, subscale 2 measures faculty expectations and examination and subscale 3 measures students academic perception. Notice the increase in implicit theories of intelligence in the experimental group relative to the control group post intervention as marked by a large Cohen's d .

Demographics That Benefited the Most From the Intervention

Table 5 presents the effect sizes and 95% confidence intervals of the difference between control and experimental groups on postintervention implicit theories of intelligence for each demographic grouping. For example, the effect of the treatment (control vs experimental group) was assessed across first-generation vs. non-first-generation participants, first-generation students seem to exhibit a greater increase in growth mindset of intelligence following the intervention ($d = 2.03$, 95% CI [0.55, 3.44]) relative to non-first-generation students ($d = 1.75$, 95% CI [1.03, 2.44]; see Figure 2). Traditional students appeared to

benefit more from the intervention ($d = 2.09$, 95% CI [1.18, 2.97]) compared to nontraditional students ($d = 1.50$, 95% CI [0.59, 2.38]) as illustrated in Figure 3. Athletes also showed a greater growth mindset of intelligence following the intervention ($d = 3.07$, 95% CI 0.79, 5.24) relative to nonathletes ($d = 1.65$, 95% CI [0.96, 2.32]). This differential effect of the intervention on athletes compared to nonathletes is captured in Figure 4. Comparably, students who play an instrument appear to express a greater increase in growth mindset of intelligence postintervention ($d = 2.66$, 95% CI [1.07, 4.20]) compared to those who do not play an instrument ($d = 1.66$, 95% CI [0.94, 2.35]) as well illustrated in the box plot in Figure

FIGURE 1

Relationships Between Outcomes Comparing Experimental to Control Group

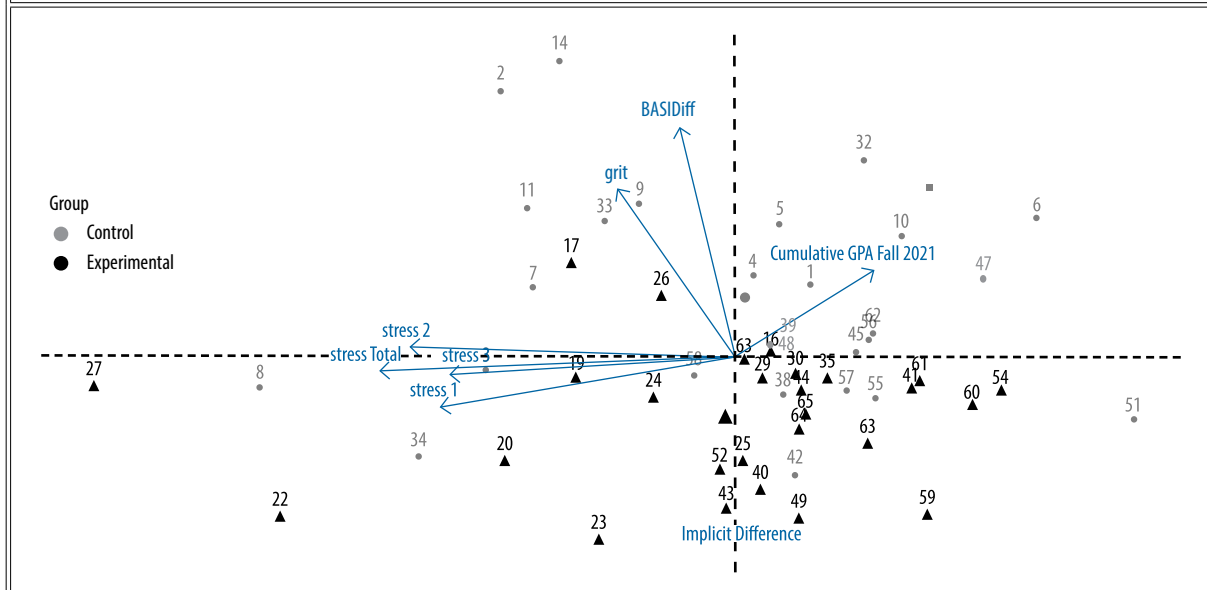


TABLE 4

Descriptive Statistics and Bivariate Correlations

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	1. BASI Pre	2. BASI Post	3. Grit	4. Post Implicit	5. Pre Implicit	6. Total Stress	7. Stress 1	8. Stress 2	9. Stress 3
1. BASI Pre	66	34.60	5.57	-								
2. BASI Post	63	36.50	6.02	0.74*	-							
3. Grit	63	4.11	0.89	-0.29*	-0.04	-						
4. Post Implicit	66	4.40	1.29	-0.06	-0.18	-0.01	-					
5. Pre Implicit	66	3.04	0.71	-0.16	-0.20	0.03	0.71*	-				
6. Total Stress	66	2.45	0.52	-0.36*	-0.28*	0.32*	0.15	0.14	-			
7. Stress 1	66	2.27	0.69	-0.17	-0.23	0.24	0.14	0.16	0.73*	-		
8. Stress 2	66	2.52	0.64	-0.36*	-0.23	0.36*	0.18	0.14	0.90*	0.57*	-	
9. Stress 3	66	2.47	0.50	-0.33*	-0.22	0.22	0.01	0.05	0.83*	0.47*	0.63*	-

Note. BASI = Basic Achievement Skills Inventory. * $p < .05$.

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TABLE 5

Effect of the Intervention on Implicit Theories of Intelligence (TIS) Across Demographic Groups

Outcomes	Preintervention TIS		Postintervention TIS		Cohen's <i>d</i>	95% CI
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Gender						
Male	4.18	0.91	4.50	1.35	1.87	[0.79, 2.92]
Female	4.06	0.88	4.31	1.26	1.79	[0.99, 2.57]
Program						
Traditional	4.14	0.97	4.36	1.41	2.09	[1.18, 2.97]
Nontraditional	4.06	0.79	4.40	1.15	1.50	[0.59, 2.38]
Student-Athletes						
Nonathletes	4.06	0.92	4.23	1.29	1.65	[0.96, 2.32]
College Athletes	4.42	0.59	5.34	0.75	3.07	[0.79, 5.24]
Ethnicity						
Non-Hispanics	4.70	0.59	5.25	0.58	1.91	[1.06, 2.75]
Hispanics	3.89	0.88	4.07	1.33	1.58	[0.56, 2.55]
Household Socioeconomic Status						
<\$75,000	4.40	0.79	4.70	1.30	1.75	[0.46, 2.99]
>\$75,000	3.99	0.90	4.26	1.27	1.77	[1.02, 2.51]
First-Generation						
Non-First-Generation	3.99	0.88	4.27	1.23	1.75	[1.03, 2.44]
First-Generation	4.48	0.84	4.75	1.44	2.03	[0.55, 3.44]
Musical Capabilities						
No-Instrument	4.17	0.88	4.42	1.28	1.66	[0.94, 2.35]
Instrument Player	3.91	0.91	4.28	1.33	2.66	[1.07, 4.20]
Mental Illness						
No Mental Illness	4.08	0.90	4.46	1.25	1.67	[0.98, 2.35]
Mental Illness	4.23	0.83	4.03	1.46	2.46	[0.62, 4.21]

Note. Cohen's *d* values comparing control to experimental groups on implicit theories of intelligence at postintervention show that first gen, non-Hispanics, athletes, traditional students, instrument players and subjects with mental illness benefited more from the intervention. These specific demographic groups were associated with relatively large Cohen's *d* values.

TABLE 6

Effect of the Intervention on Grit and Perceived Academic Stress (PAS) Across Demographic Groups

	Grit				PAS Subscale 1:			
	<i>M</i>	<i>SD</i>	Cohen's <i>d</i>	95% CI	<i>M</i>	<i>SD</i>	Cohen's <i>d</i>	95% CI
Student-Athletics								
Non-Athletes	2.98	(0.70)	-0.53	[-1.12, 0.07]	2.26	(0.70)	0.35	[-0.24, 0.93]
College Athletes	3.32	(0.72)	1.15	[-0.57, 2.79]	2.39	(0.65)	-0.09	[-1.66, 1.48]
Mental Illness								
No Mental Illness	3.10	(0.65)	-0.33	[-0.92, 0.26]	2.28	(0.70)	0.26	[-0.33, 0.85]
Mental Illness	2.71	(0.88)	-0.07	[-1.42, 1.29]	2.29	(0.71)	1.21	[-0.29, 2.66]

Note. Grit and perceived academic stress were only measured after the intervention. Perceived Academic Stress (PAS) subscale 1 pertains to students' academic expectations. When looking at Cohen's *d* values comparing the control to the experimental group within athletes and within non-athletes, note that the intervention is associated with an increase in grit only in athletes. The intervention also is associated with an increase in perceived stress in students stemming from their academic expectations only in subjects with mental illness.

5. Participants who reported a mental illness also appear to glean greater benefit from the intervention ($d = 2.46$, 95% CI [0.62, 4.21]) over those who reported no mental illness ($d = 1.70$, 95% CI [0.98, 2.35]; see Figure 6). Non-Hispanic students also showed greater but statistically insignificant gain in growth mindset of intelligence following the intervention ($d = 1.83$, 95% CI [1.06, 2.75]) compared to their Hispanic peers ($d = 1.50$, 95% CI [0.56, 2.55]) as illustrated in Figure 7. The intervention did not have a differential effect among gender groups (see Figure 8) nor among socioeconomic groups ($d = 1.83$, 95% CI [1.06, 2.75]; see Figure 9). Women showed a slightly lower gain in growth mindset ($d = 1.79$, 95% CI [0.99, 2.57]) compared to men ($d = 1.87$, 95% CI [0.79, 2.92]), as displayed in Figure 8. Similarly, students who identified as low socioeconomic status (reported annual income < \$75,000) had nearly identical responses to the growth mindset intervention ($d = 1.75$, 95% CI [0.46, 2.99]) to those of higher socioeconomic status (reported annual income > \$75,000; $d = 1.77$, 95% CI [1.02, 2.51]).

Table 6 presents effect sizes and 95% confidence intervals of the difference between control and experimental groups in some of the demographic subgroups on grit and perceived academic stress following the intervention. Interestingly, first-generation students in the control group had a higher level of stress (Subscale 1, stress due to students' academic expectations, and Subscale 3, stress pertaining to students' academic perceptions) compared to first-generation students in the experimental group whereas non-first-generation students in the control and experimental groups had similar levels of stress. The effect size results imply that the intervention decreased the two measures of academic stress specifically in first-generation students. Furthermore, grit and perceived academic stress Subscale 1 pertaining to students' academic expectations were two outcomes that showed a change that is associated with the intervention, specifically in athletes and subjects with mental illness. The intervention was associated with an increase in grit in athletes Cohen's d was large in athletes when comparing control to experimental groups, showing an increase in grit in athletes that is associated with the intervention ($d = 1.15$, 95% CI [-0.57, 2.79]) but that was not observed in nonathletes ($d = -0.53$, 95% CI [-1.12, 0.07]). Similarly, the intervention is associated with higher perceived academic stress due to students' academic expectations as reflected by a large effect size between the control and experimental groups in subjects with mental illness ($d = 1.21$, 95% CI [-0.29, 2.66]) but not in subjects with no mental illness ($d = 0.26$, 95% CI [-0.33, 0.85]).

Finally, stepwise multiple linear regression analysis was conducted to determine which variables most strongly predict postintervention implicit theories of intelligence.

The results from this analysis showed that preintervention implicit theories of intelligence, $t(4, 50) = 9.17, p < .001$, treatment group, $t(4, 50) = 6.26, p < .001$, gender, $t(4, 50) = 6.88, p < .001$, and Hispanic roots, $t(4, 50) = -6.48, p < .001$, explained 93% of the variance in postintervention implicit theories of intelligence, $F(4, 50) = 164.5, p < .001$. According to the ANOVA conducted on the regression model, the treatment (control v. experimental), preintervention implicit theories of intelligence, race, and gender accounted for 63%, 29%, 6%, and 2% of the variance in growth mindset, respectively.

Discussion

The present study investigated the effect of a growth mindset of intelligence intervention on multiple outcomes in college students while taking into consideration various demographics. The study found that the intervention resulted in an increase in growth mindset of intelligence showing that the intervention was successful. Furthermore, based on effect sizes analysis, certain demographic groups such as athletes, first-generation students, traditional nontransfer intent students, non-Hispanic students, music instrument players and participants with mental illness benefited the most from the intervention. The intervention resulted in an increase in perceived stress pertaining to students' academic expectations in participants with mental illness and resulted in a decrease in two measures of academic stress in first-generation students. The intervention also resulted in an increase in grit, particularly in athletes. Our hypothesis that the intervention would increase a growth mindset of intelligence and would benefit certain demographics including underprivileged students was confirmed with the exception that the intervention did not particularly benefit women or participants from low socioeconomic status. Furthermore, our hypothesis that the intervention would result in an increase in academic related measures such as verbal language skills, grit, and term GPA and a decrease in perceived academic stress was only partly confirmed as the intervention did decrease perceived academic stress only in first-generation students and did increase grit only in athletes.

The intervention was successful in increasing growth mindset of intelligence in the experimental group as shown in previous studies (Skipper, 2015; Spitzer & Aronson, 2015). This increase in growth mindset of intelligence provides benefits such as prioritizing learning goals that encourage strategies in overcoming difficulties despite any inherent abilities. When acquiring a growth mindset, participants learn that their personal traits such as intelligence can be improved upon by employing mastery-centered response strategies through effort (Henderson & Dweck, 1990; Hong et al., 1999). These benefits gleaned from a growth mindset of intelligence

were associated with improved academic performance (Blackwell et al., 2007; Fox et al., 2020), constructive coping mechanisms (Ahmavaara & Houston, 2007), and a more positive perception of academic stressors (Lee et al., 2018). However, in the current study, the intervention-induced increase in growth mindset of intelligence did not translate in a general improvement of academic related measures such as verbal skills, term GPA, grit, or perceived academic stress. This result agrees with recent meta-analysis studies (Macnamara & Burgoyne, 2023; Sisk et al., 2018) showing that the effect of growth mindset interventions on academic outcomes is, at its best, weak, and is affected by faulty research design, research and publication bias,

FIGURE 2

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across First Generation Status

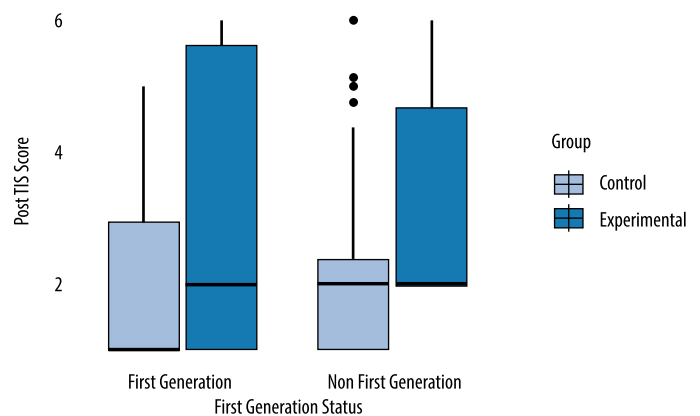
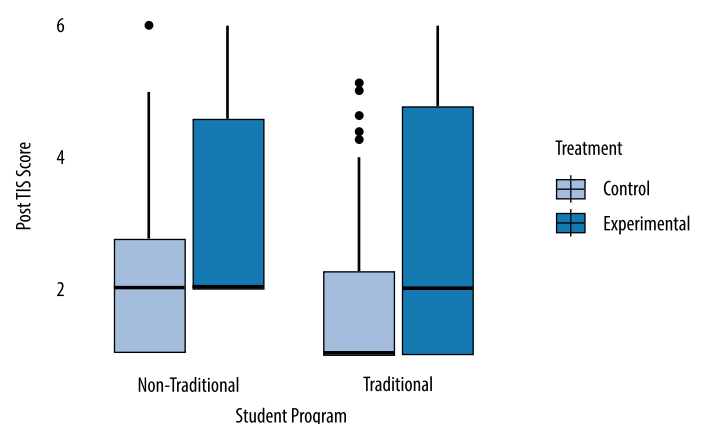


FIGURE 3

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Student Program



and even financial conflicts of interest. Keep in mind, however, that these meta-analyses assessed the effect of various types of growth mindset interventions on academic outcomes and did not focus solely on growth mindset of intelligence. Meta-analysis that focused on growth mindset of intelligence did report significant low to moderate association between having a growth mindset of intelligence and academic outcomes (Costa & Faria, 2018). Furthermore, when the investigation of the effect of growth mindset on academic outcomes was narrowed to certain demographics such as students with low socio-economic status or students at risk, the

meta-analysis did report that these specific populations did benefit academically from adopting a growth mindset of intelligence (Sisk et al., 2018).

An important goal of this study was to evaluate which demographics among college students benefit the most from a growth mindset of intelligence intervention. The intervention did benefit non-Hispanic students, first-generation students, athletes, music instrument players, traditional nontransfer intent students, and students with mental illness. However, socioeconomic status and gender did not interact with the effect of the intervention. In contrast with our findings, studies have shown that students with low socioeconomic status, women, and underperforming or academically at-risk students benefited the most from such interventions (Good et al., 2003; Paunesku et al., 2015; Sisk et al., 2018). This could be due to the small sample size in the current study especially in subjects with low socioeconomic status ($n = 18$) and to the fact that even at baseline our subjects portrayed implicit theories leaning towards a strong growth mindset with an average between the experimental and the control group of 4.11 on that measure. Therefore, this relatively high baseline of growth mindset combined with a relatively small sample size might have contributed to the lack of interaction between the intervention and gender and socioeconomic status. As to gender and growth mindset, some studies have reported that women tend to have relatively more of a fixed mindset of intelligence associated with lower perception of efficacy in math (Todor, 2014) and therefore may benefit more from a growth mindset intervention than men but that result has not been consistently found in the literature (Macnamara & Rupani, 2017; Sigmundsson et al., 2021; Storek & Furnham, 2013;). Therefore, both men and women, according to our results, may benefit equivalently from a growth mindset intervention. Also, in contrast with previous studies, our data shows that non-Hispanics benefited more from the intervention relative to Hispanic students. Hispanic students have been shown to display a greater growth mindset than non-Hispanic white students and non-Hispanic students with higher socioeconomic status were more likely to endorse a fixed mindset (Hwang et al., 2019). In accordance with our results, an intervention aiming at increasing growth mindset over a semester, even though it benefited both Hispanic and non-Hispanic students, the study did show that Hispanic students gained relatively a stronger growth mindset as the result of the intervention (Kwak et al., 2022).

Interestingly, our results show that an increase in growth mindset of intelligence is associated with a decrease in perceived academic stress in first-generation students and with an increase in academic related stress in students with mental illness. The former result is in

FIGURE 4

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Athlete Status

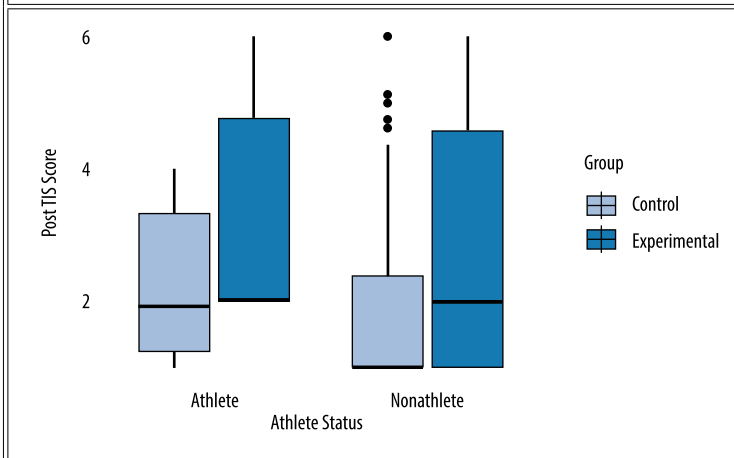
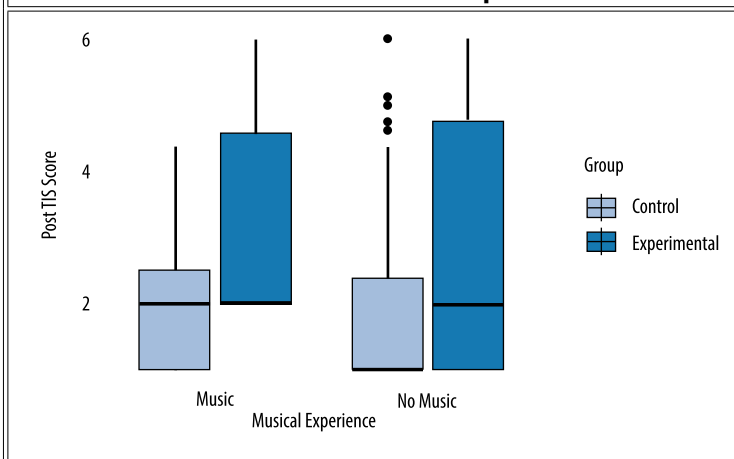


FIGURE 5

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Musical Experience



line with previous literature showing the stress mitigating effect of adopting a growth mindset of intelligence (Gal & Szamoskozi, 2016; Lee et al., 2018). On the other hand, the intervention-induced increase in perceived academic stress in students with mental illness might be intriguing. However, research has shown that stress is not always detrimental (Crum et al., 2017) and short-term academic stress, when accompanied by a sense of control and growth mindset can be beneficial. In fact, studies have shown that teaching subjects the 'stress-is-enhancing' mindset results in better cognitive performance and health and moderates the response in face of challenges (Crum et al., 2017; Jiang et al., 2019). It is noteworthy that the intervention-induced increase in academic expectations stress was pronounced in subjects with mental illness, a population vulnerable to the detrimental effect of stress. This leads to the idea that interventions promoting growth mindset of intelligence could be combined with interventions promoting a stress-is-enhancing mindset and tailored specifically to students suffering from mental illness to teach them how to manage the growth mindset-induced stress in a healthy way. Long-term assessment in college students of these benefits and drawbacks acquired through the adoption of a growth mindset of intelligence should be the focus of future investigations.

To our knowledge, no other studies have looked at the impact of growth mindset interventions on specifically first-generation students or on nontraditional transfer intent students. As mentioned above, we report that first-generation students benefited more from the intervention than non-first-generation students. Many studies showed that first-generation college students oftentimes have reduced campus engagement combined with difficulty in establishing firm social and professional networks and difficulty in directly seeking out support from faculty (Katrech & Aruguete, 2017; Pratt et al., 2017; Stebleton et al., 2014). Growth mindset of intelligence interventions resulting in greater emphasis on effort and persistence may be crucial to increasing success and retention of first-generation students in college. Accordingly, a study by Prat-Sala and Redford (2012) combined many growth mindset principles in relation to self-efficacy, writing and literary skills, concluded that increased confidence in writing likely leads to an increase in motivation and perseverance. Furthermore, qualitative research geared specifically towards first-generation students by Conefrey (2021) aimed at high-impact practices to enhance literacy and study skills found an increase in academic outcomes, persistence in academics, and self-efficacy. More specifically, metacognitive, and self-regulation skills help first-generation students in valuing perseverance regardless of the challenge (Conefrey, 2021) which is closely related to the growth mindset concept. As for our result showing that

traditional students benefited more from the intervention than nontraditional students, we speculate that this result is because traditional students who are invested in their current institution prioritize learning objectives and creative learning strategies. Contrastingly, the nontraditional students in this study are all part of a program designed for them to transfer to an elite university contingent on their maintaining of a high GPA. Such a contingency may have resulted in these transfer-intent students focusing on transfer requirements and acquiring the highest GPA possible rather than the learning process and the prospect of growing their intelligence.

Engagement in enriching activities such as athleticism

FIGURE 6

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Mental Illness

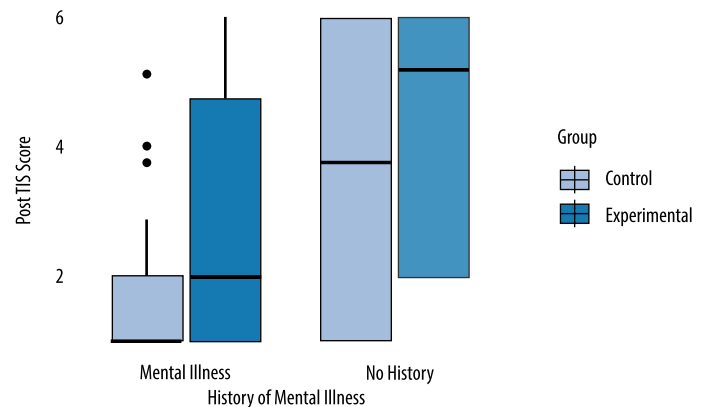
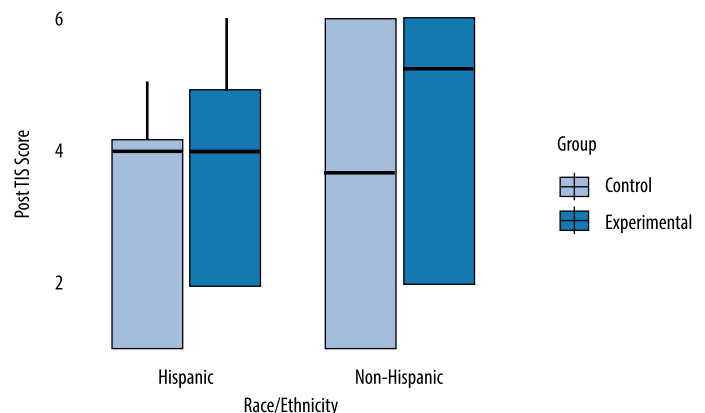


FIGURE 7

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Ethnicity



or music might provide a greater receptivity to growth mindset interventions. In accordance with our results showing that athletes benefited more from the intervention than nonathletes and that the intervention resulted in an increase in grit only in athletes, growth mindset interventions have been shown to be particularly beneficial to athletes by reducing negative emotional and physical states, increasing mental toughness, helping to create a better training environment, and thus resulting in better performance (Hardy et al., 1996; Sheard & Golby, 2006). An intervention aimed at increasing athletic performance by feedback modification to praising

effort, motivation, and persistence promoted growth mindset and the athletes developed a healthier attitude towards failure (Dweck 2009; Rattan et al., 2015). As for the relationship between growth mindset and music experience, children learning how to play an instrument have an increased likelihood to appreciate principles of incremental theories of learning or growth mindset than students who do not play an instrument (O'Neill, 2011). Furthermore, in support of our results, the practice of music itself demonstrates the ability to improve with effort, meaning children who play an instrument may have an advantage by being more receptive to the concept of growth mindset through their continuous practice and appreciation of the payoff of effort (Davis, 2016; O'Neill, 2011). Learning to play an instrument is among the best first-hand experiences to help individuals learn the importance of hard work (Davis, 2016). Therefore, students who play music instruments, due to the persistence and effort, might be primed to adopting the concept of growth mindset and hence that would explain our result that the intervention benefited more music instrument players than nonplayers.

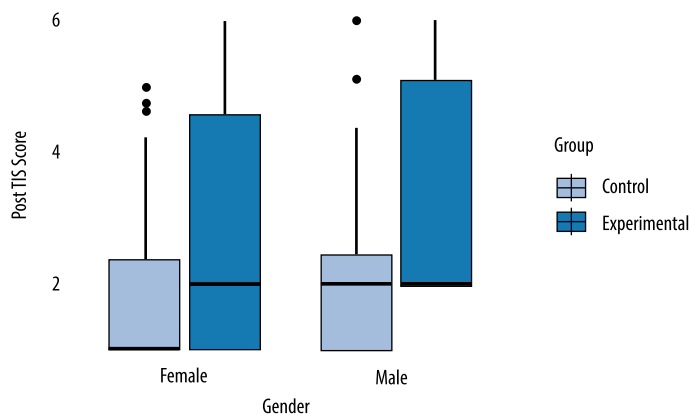
Students with mental illness reaped relatively greater benefits from the growth mindset of intelligence intervention used in this study. In accordance with our results, studies have shown that growth mindset interventions benefit adolescents with internalizing mental illness such as depression and anxiety (Schleider & Weisz, 2016a, b; Schleider et al., 2022). A meta-analysis exploring mental distress and growth mindset reported a negative correlation between these two variables but found a positive correlation between active coping strategies and growth mindset (Burnette et al., 2020). Individuals with growth mindset that employed active coping strategies and use of cognitive reappraisal were found to experience easier social adjustments and less depressive symptoms (De Castella et al., 2013). Therefore, as mentioned earlier, prioritizing growth mindset interventions combined with positive perception of stress and healthy coping strategies geared towards students with mental illness is essential.

The primary limitation of the current study lies within the small overall sample size, which consequently led to small sample sizes within each respective demographic group. This is the result of the potential subject pool size, as the study was conducted at a small liberal arts college with an enrolment of under 500 students. This may limit the generalizability of the results, and therefore replication of the study at a larger undergraduate institution would be very beneficial especially if the institution has a strong representation of all the demographic groups considered in this study.

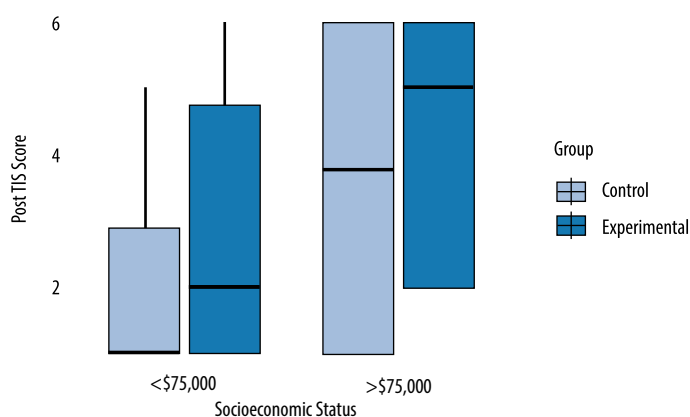
In conclusion, our study reports a successful growth mindset of intelligence intervention that increased growth mindset of intelligence particularly in certain demographic groups among college students such as athletes,

FIGURE 8

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Gender Groups

**FIGURE 9**

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Socioeconomic Status



students with music experience, first-generation students, non-Hispanics, traditional nontransfer intent students, and students with mental illness. The intervention was also associated with changes in grit and academic related perceived stress in specific demographic population of students. Understanding which student population is more receptive to such interventions is crucial in future efforts in tailoring such interventions on college campuses.

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Author Note. Cosette Fox  <https://orcid.org/0000-0003-0006-1033>
Katherine Barrett  <https://orcid.org/0000-0002-5981-133X>
Gabriela N. Betanzos is now at the Department of Neuroscience
and Behavior at the University of Notre Dame, Notre Dame, IN.
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Correspondence concerning this article should be addressed to Cosette Fox at 54515 S. R. 933 NORTH, P.O. BOX 308, NOTRE DAME, IN 46556-308. Email: cfox@hcc-nd.edu

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The Development of the Sexual Satisfaction and Frustration Inventory for Women

Tammy L. Zacchilli^{1*}, Lara K. Ault^{1*}, Richard C. Zamora^{2*}, Andree Garnier¹, and Alanna Marrero¹

¹ Department of Social Sciences, Saint Leo University

² Department of Psychology, Mount St. Mary's University

ABSTRACT. The only known measure of sexual frustration, to the researchers' knowledge, is a non-peer reviewed 4-item scale. Thus, the main purpose of the present studies was the construction of a more comprehensive sexual frustration measure that assesses both conditions producing sexual frustration and ways people cope with it. Our pilot study results were surprising. First, a sexual satisfaction scale was developed because the items reflected satisfaction rather than frustration. Second, men's data were unusable due to impression management. In the subsequent studies, items were developed to measure sexual frustration using all female participants. Based on the results of these studies, the Sexual Satisfaction and Frustration Inventory for Women was created. Four factors of frustration emerged: Expectations, Insecurity, Infidelity, and Self-Pleasure. These 4 factors were subjected to a confirmatory factor analysis that resulted in a good fit for the 4-factor model compared to the 1- and 2-factor models. The same 4 factors emerged from the CFA. Expectations and Insecurity emerged from the prompt "I am sexually frustrated when," and appear to produce sexual frustration. The other factors, Self-Pleasure and Infidelity, emerged from the prompt "When I am sexually frustrated, I..." and appear to be strategies for coping with sexual frustration. Sexual frustration predictor and coping mechanism factors showed evidence of convergent and discriminant validity. Only Expectations and Insecurity correlated with sexual satisfaction, both negatively. This suggests that satisfaction is not necessarily the inverse of frustration, despite that our sexual satisfaction scale was meant to be a sexual frustration scale. Implications and directions for future research will be discussed.

Keywords: sexual frustration, satisfaction, needs frustration, self-determination theory



Diversity badge earned for conducting research focusing on aspects of diversity.

Shifting economic and social experiences have been related to decreased sexual activity over the last two decades, and a recent meta-analysis (Delcea et al., 2021) suggested that this trend may be multinational. Although reasons for decreased sexual activity are uncertain, a reasonable conclusion is that sexual frustration is likely to result if, as has been hypothesized, external variables such as extended work hours and lack of

access to suitable partners are driving this decrease. Sexual frustration results in dissonance between the desire for sex and the lack of sex, and frustration has been long linked to aggression. Both dissonance and frustration are unpleasant emotional experiences with likely negative psychological consequences; we therefore created this scale to examine sexual frustration as an important psychological construct with important implications for relationships.

Few studies have examined sexual frustration. According to Stuger (2012), sexual frustration is “triggered by multiple forms of dissonance between the absence or lack of sexual reward and the (un)conscious motivation to obtain these sexual rewards” (p. 168). Wright (2012) created the only sexual frustration scale to our knowledge, and the scale focuses narrowly on desired frequency and quality of sexual activity. Wright found that most participants in her study reported some degree of sexual frustration. Specifically, participants who reported less sex during the past week reported more sexual frustration. Seehuus and Rellini (2013) found that sexual satisfaction was negatively related to sexually permissive behaviors, and Davison et al. (2009) found that sexual satisfaction was related to general health in women. Thus, sexual satisfaction seems to be important to relationship quality, but little is known about the effects of and coping mechanisms for sexual frustration.

More recently, research has noted that economic and social experiences have influenced sexual activity (Gleason et al., 2021). Additionally, sexual behavior decreased among U.S. adults between 2000 and 2018, predominantly among younger U.S. men. Lack of cohabitation was implicated as a factor in the decrease. A seven-study meta-analysis (Delcea et al., 2021) included three studies from the United States, and one each from China, Turkey, Italy, and the United Kingdom. Studies were conducted between March and April 2020 ($n = 6,929$). Results showed a decrease in sexual activity during the period included in the analysis. Given these changes in sexual activity, we sought to measure sexual frustration in women and developed a scale in order to do so.

Sexual Satisfaction and Dissatisfaction

Extensive research has examined factors related to sexual satisfaction in women. For example, Jamali et al. (2018) found that sexual satisfaction was positively related to self-esteem and negatively related to stress. Additionally, Smith et al. (2011) stated that men and women who were dissatisfied with sexual frequency in their relationship also reported low relationship and sexual satisfaction. Partner initiation and communication are strong predictors of sexual satisfaction in women (Bridges et al., 2004). Research has also indicated that sexual satisfaction is predictive of well-being, mental health, and physical health in women in same-sex as well as heterosexual relationships (Holmberg et al., 2010). In a more recent study, Roels and Janssen (2020) found that both sexual communication and frequency were significantly related to sexual satisfaction in a group of young, heterosexual couples. Finally, Ebrahimkhani et al. (2019) found that sexual satisfaction, sexual esteem, and sexual consciousness (i.e., thinking about sexual

issues) were predictive of overall marital satisfaction.

Measures of sexual satisfaction vary from more complex to single-item scales (Mark et al., 2014). The Index of Sexual Satisfaction (ISS, Hudson et al., 1981) measures the extent of sexual dissatisfaction in a relationship, and it is scored so that high numbers reflect lower sexual satisfaction. This 25-item measure includes relationship satisfaction as well as sexual satisfaction due to its focus on treatment progress. Thus, although valuable for its treatment-assessment purpose, it intentionally confounds sexual and relationship satisfaction for its applied purposes. Another commonly used scale, the Global Measure of Sexual Satisfaction (GMSEX; Lawrance & Byers, 1995) is more recent than the ISS and attempts to capture both positive and negative aspects of an individual's sexual relationship through a subjective lens. It also includes an affective reaction to the participant's subjective evaluation of positive and negative aspects of sexuality in the relationship. The New Sexual Satisfaction Scale (NSSS-S; Slulhofer et al., 2010) is even more recent and is a short form of the original NSSS, which uniquely uses an individual, interpersonal, and behavioral lens through which participants evaluate their sexual relationships. The original included five broad dimensions that ultimately broke down to two subscales: an ego-focused and a partner- and activity-focused factor, still measuring a very broad construct. The NSSS-S is unidimensional and made up of 12 items that use a 1–5 Likert-type response scale, from 1 (*not at all satisfied*) to 5 (*extremely satisfied*). Psychometrically, the GMSEX appears to be the most reliable and valid and is especially appropriate for clinical settings and other settings that focus on treatment gains over time. Several good sexual satisfaction scales are in use, including both global and very specific single-item measures. Our measure of sexual satisfaction materialized in an attempt to measure frustration and provides a single-factor assessment of individuals' self-reflected overall positivity with the quality and frequency of sex, and similarity of partner's sexual attitude and preferences. Sexual dissatisfaction has largely been measured by these same (and similar) measures, which assess both satisfaction and dissatisfaction. Our sexual satisfaction scale is most appropriate for nonclinical populations, such as college students or cohabitating couples, and focuses on positivity.

Need Frustration and Self-Determination Theory

The need for intimacy, sex, and emotional involvement are all important aspects of an intimate relationship (Drigotas & Rusbult, 1992; Le & Farrell, 2009). Recent research has examined the relationship between need frustration, conflict, and dissatisfaction in romantic couples (Vanhee et al., 2018). Couples have needs that they desire to be

fulfilled, including sexual fulfillment, and failure to meet these needs can result in strains on the relationship. Lack of sexual fulfillment, as with other blocked goals, could lead to frustration in the relationship.

Self-determination theory is also applicable to understanding sexual frustration in romantic relationships. According to Deci and Ryan (2000), the three universal needs include the need for autonomy, the need for competence, and the need for relatedness. According to self-determination theory, partners can either support or frustrate each other's needs (Vanhee et al., 2018). Partners who are loving and caring to each other can satisfy their need for relatedness. However, the need for relatedness can be frustrated if partners are cold, rejecting, or distant to each other (Vanhee et al., 2018). Relational needs can be frustrated when partners feel rejected or abandoned by their partners (La Guardia & Patrick, 2008). Sexual frustration could result from the romantic relationships' inability to meet the partners' need for relatedness.

Sexual Excitation and Sexual Inhibition

According to Carpenter et al. (2008), sexual functioning and related behaviors can be significant health concerns; therefore, an understanding of sexual functioning is necessary for the improved treatment of sexual problems, as well as understanding "normative" sexuality in terms of trends in frequency or satisfaction. Sexual frustration is one potential sexual problem that couples and individuals may face. According to Bancroft and Janssen (2000), the dual control model of sexual response proposes two independent systems that influence sexual arousal: Sexual inhibition, or the inhibitory system, is viewed as avoiding threats related to sexual encounters, and excitation, or the excitatory system, includes factors related to sexual arousal (Carpenter et al., 2008). Bancroft et al. (2009) found that men score higher on excitation whereas women score higher on inhibition. The authors also noted that sexual excitation and inhibition are related to sexual aggression, infidelity, and sexual risk taking in both men and women. Both men and women demonstrate excitation and inhibition sexual systems, although sometimes for different functions (e.g., concern for consequences like pregnancy, measured by the Sexual Inhibition Scale-1 [SIS-1]; concern for performance failure, measured by Sexual Inhibition Scale-2 [SIS-2]). Literature has shown a considerable variability among individuals on these sexual dimensions, and that women and men are more similar than different (Carpenter et al., 2008). For the purposes of this study, we used the three-factor (i. e., Sexual Excitation Scale, Sexual Inhibition Scale-1, and Sexual Inhibition Scale-2) scale reflecting

overlapping factor structures for women (Carpenter et al., 2008) for validation purposes.

Purpose of Current Studies

An initial pilot survey study including 283 women and 176 men attempted to create a scale measuring sexual frustration, but instead ended up creating a scale of sexual satisfaction. The sexual satisfaction subscale included 11 items ($\alpha = .91$). Factor loadings ranged from .50 to .84, indicating that this was a reliable factor. Unfortunately, the scale for sexual frustration was unsatisfactory. Thus, new items were written, and Study 1 was launched.

Study 1

The purpose of Study 1 was to develop new items to measure sexual frustration following the unsuccessful pilot version. We predicted that two factors would measure sexual frustration, based on responses to prompts asking (a) "I am sexually frustrated when..." eliciting factors contributing to sexual frustration and (b) "When I am sexually frustrated, I..." eliciting responses to frustration. These factors were expected to positively correlate with Wright's (2012) measure of sexual frustration as well as with each other. The two predicted factors were "causes to sexual frustration" and "reactions to frustration." Additionally, we collected data in Study 2 to examine the confirmatory factor analysis for the sexual satisfaction scale developed in Study 1.

Method

Participants

Participants included 250 women and 76 men with the mean age of 28 ($SD = 9.61$). Participants were recruited through Facebook and in psychology courses at a small, private university in the southeast. Most (55.2%) of the sample self-identified as European American with 18% African American and 15.2% Hispanic. The remaining 12% reported other. Additionally, 71% of the sample was in a romantic relationship, and 81% of the sample was heterosexual, 10% were bisexual, 3.7% were gay or lesbian, and 4% were asexual. The rest of the sample (1.3%) chose not to disclose their sexual orientation.

Materials and Procedure

After receiving approval from the Institutional Review Board, participants responded to an online questionnaire through Qualtrics that included an implied consent form, a demographic measure, and Hendrick et al.'s (1998) Love and Relationship Biography, which assessed length of relationship, relationship status, and living arrangements. Janssen et al.'s (2002) Sexual Inhibition (SIS-1; $\alpha = .70$ and SIS-2; $\alpha = .73$), and Sexual

Excitation Scales ($\alpha = .82$). The SIS-1 measures inhibition due to performance failure (e.g., “When I have a distracting thought, I easily lose my erection”), whereas SIS-2 measures inhibition due to threat of performance consequences (e.g., “If there is a risk of an unwanted pregnancy, I am unlikely to get sexually aroused”). A sample item for the Sexual Excitation Scale is “When I think of an attractive person, I easily become sexually aroused.” Wright’s (2012) Sexual Frustration Scale ($\alpha = .84$) is a four-item scale that includes items such as “How sexually frustrated do you currently feel?” Finally, the Sexual Satisfaction Scale ($\alpha = .89$) that was developed in the pilot study was included. Sample items from this scale include “I initiate sexual activity with my partner” and “I am sexually satisfied.” The reported alphas were calculated in the current study.

To measure sexual frustration, we developed 15 items with the goal of measuring causes of frustration and 16 items to measure reactions to frustration. The

causes items began with “I am sexually frustrated when” whereas the reaction items began with “When I am sexually frustrated, I...” Sample items include “I expect too much from my partner sexually,” “I feel uncomfortable with my body,” and “I have the urge to cheat.”

Results

The data were subjected to an Exploratory Factor Analysis using oblimin rotation because the factors were expected to correlate and, desiring a simple structure (Thurstone, 1935), we did not wish to constrain the analysis (Cattell, 1978). The Exploratory Factor Analysis was run separately for men and women. For women, results indicated that four factors emerged (see Table 1). Sixteen items were removed due to their low factor loadings ($< .40$; Stevens, 1992) or their loading on more than one factor. Sample items that were excluded are “I am sexually frustrated when the children are always around,” “I am sexually frustrated when I have relational/

TABLE 1

Items and Factor Loadings for Sexual Frustration in Women in Study 1

	Factor 1 Expectations $\alpha = .90$	Factor 2 Insecurity $\alpha = .89$	Factor 2 Infidelity $\alpha = .87$	Factor 2 Self-Pleasure $\alpha = .79$
My partner is not as experienced as I would like.	.63	.19	.31	.37
My partner has sexual performance problems.	.74	.40	.22	.39
My partner does not meet my expectations.	.85	.24	.39	.40
I expect too much from my partner sexually.	.74	.43	.33	.43
I feel insecure.	.38	.86	.19	.30
I feel undesirable.	.37	.86	.09	.22
I feel uncomfortable with my body.	.33	.84	.01	.19
I blame myself for feeling frustrated.	.38	.68	.25	.26
I cheat on my spouse/partner.	.23	.13	.87	.28
I have the urge to cheat.	.34	.17	.87	.30
I enter into friends with benefits relationships.	.30	.21	.73	.42
I have hook-ups to feel better.	.34	.22	.68	.37
I masturbate to relieve my frustration.	.41	.21	.21	.84
I use toys/vibrators.	.34	.20	.30	.72
I use porn to relieve my frustration.	.26	.12	.35	.67

TABLE 2

Items and Factor Loadings for Men in Study 1

	Factor 1 $\alpha = .88$	Factor 2 $\alpha = .71$
I feel insecure.	.97	-.08
I feel undesirable.	.96	-.12
I feel uncomfortable with my body.	.93	-.14
I blame myself for feeling frustrated.	.53	.20
I feel sexually insecure.	.44	.26
When my partner does not meet my needs.	-.08	.75
When I expect too much from my partner sexually.	-.00	.70
When my partner has sexual performance problems.	-.07	.70
When my partner does not properly please me in bed.	-.13	.68
When my partner does not want to have sex.	-.12	.68
When I have not been intimate in awhile.	.03	.64
When I do not get alone time with my partner.	.08	.63
I have mood swings.	.19	.54
I have relationship/marital issues with my partner.	.04	.52
I masturbate to relieve my frustration.	.08	.48
I watch porn to relieve my frustration.	.03	.48
I take my frustration out on other people.	.16	.46
I am not satisfied with the relationship.	.02	.44
When my partner is not as experienced as I would like.	-.08	.42
I cheat on my spouses/partner.	-.00	-.04
I enter into friends with benefits relationships.	.12	-.06
I have hook-ups to feel better.	-.03	-.01
I have urge to cheat.	-.14	.27

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marital problems with my partner,” and “When I am sexually frustrated, I read erotic literature to relieve my frustration.” Cronbach’s alphas were calculated for each of the four factors. Factor loadings and reliabilities are in Table 1.

For men, the results were confusing and unreliable. Specifically, the Exploratory Factor Analysis revealed three noncohesive factors with weak loadings and appeared to reflect impression management. The results of the Exploratory Factor Analysis for men is located in Table 2. Given the unsuccessful analysis of men’s self-reported sexual frustration data, we decided that future work would need to focus on getting men comfortable with reporting on their sexual frustration. Therefore, the remainder of the analyses in Study 1 focused on women.

Correlations were also calculated between the variables and are displayed in Table 3. These correlations included the women’s data only. The four sexual frustration factors share small to moderate positive correlations with Wright’s (2012) sexual frustration scale. As expected, the four sexual frustration factors were also significantly related to each other. Contrary to prediction, sexual frustration was unrelated to sexual satisfaction. The cut-off for factor loadings was .40 or higher (Stevens, 1992).

Additionally, the sexual satisfaction items developed in Study 1 were examined through a confirmatory factor analysis using EQS 6.4 for Windows. The model showed an acceptable value for the Standardized Root Mean Square Residual (SRMR; .07), which should be less than .10 (Kline, 2005). According to Kline, the Comparative Fit Index (CFI) should be greater than .90. In this present study, the CFI was .86, which was below the cut-off. The Root Mean Square of Approximation (RMSEA) also did not show acceptable fit given the cut-off value proposed by Kline.

Discussion

The researchers predicted that a two-factor solution would emerge resulting in the factors of “causes of frustration” and “reactions to frustration.” Sixteen items were removed because of low factor loadings or due to loading on more than one factor, leaving a total of 15 items in the scale. The EFA revealed four factors for the all-female participants in the study. One factor seemed to measure causes of frustration related to expectations. The other three factors seemed to measure reactions to frustration (Insecurity, Infidelity, Self-Pleasure). Interestingly, none of the sexual frustration factors were negatively related to sexual satisfaction as one might predict. Although the CFA for relationship satisfaction was imperfect, it should be mentioned that we expected sexual satisfaction to correlate significantly (negatively) with sexual frustration. On the face of it, satisfaction seems the conceptual opposite of frustration. At this point, it is possible that the measurement problems with the sexual satisfaction scale ($CFI < .90$) explain the lack of correlation, and we address this surprising lack of relationship between sexual satisfaction and frustration in Study 2. The purpose of Study 2 was to conduct a confirmatory factor analysis on the sexual frustration items that remained in Study 1.

Study 2

Study 2 served two main purposes. First, we collected data on the Sexual Frustration Scale so that a confirmatory factor analysis (CFA) could be conducted. Second, we examined the relationships between the sexual frustration factors, Wright’s (2012) Sexual Frustration Scale, and sexual inhibition and excitation. We predicted that the four-factor solution would provide the best fit and that the four factors would be positively related to each other as well as positively related to Wright’s measure of sexual frustration. Finally, we predicted that the factors Expectations, Insecurity, and Infidelity would be negatively related to sexual satisfaction, whereas Self-Pleasure would be positively related to sexual excitation. We further predicted that sexual frustration would be higher among those with high excitation, as any interruptions or other obstacles might be particularly frustrating during easier/more frequent excitation. Inhibition 1 and 2, on the other hand, were expected to be uncorrelated with frustration, as inhibition generally serves to reduce sexual drive; thus, sexual frustration is less relevant. However, it is an empirical question whether inhibition from fears of performance failure (ISI-1) or inhibition from fears of consequences of sex (ISI-2) correlate differently with sexual frustration in women.

TABLE 3

Correlations Between Sexual Frustration, Sexual Satisfaction, Sexual Excitation, and Inhibition for Women in Study 1

Variable	1	2	3	4	5	6	7	8	9
1. Wright’s Sexual Frustration Scale	-								
2. Expectations	.45**	-							
3. Insecurity	.31**	.36**	-						
4. Infidelity	.24**	.41**	.24**	-					
5. Self-Pleasure	.40**	.45**	.22**	.39**	-				
6. Sexual Satisfaction	.05	.02	.08	.01	.10	-			
7. Sexual Inhibition 1	.34**	.37**	.32**	.21**	.30**	-.09	-		
8. Sexual Inhibition 2	.03	-.03	.14*	-.10	-.02	.05	.28**	-	
9. Sexual Excitation	.51**	.49**	.33**	.44**	.50**	.15*	.52**	-.05	-

Method

Participants

Participants were recruited through Facebook and in psychology courses at a small, private university in the southeast United States. Participants included 181 women with a mean age of 27.22 ($SD = 8.42$). Most of the sample was European American (70%) with 11.6% Hispanic, 7.7% African American, 4% Caribbean, and 4% Asian American. Additionally, 73% were currently involved in a romantic relationship, and 70% reported that this was a sexual relationship. Most of the sample was heterosexual (91%), and 5.5% of the sample was bisexual, 1.7% were gay or lesbian, and 0.9% were asexual.

Materials and Procedure

After receiving approval from the Institutional Review Board, participants responded to an online questionnaire through Qualtrics that included an implied consent form, a demographics measure, the Love and Relationship Biography (e.g., Hendrick et al., 1998), Janssen et al.'s (2002) Sexual Inhibition (SIS-1; $\alpha = .69$ and SIS-2; $\alpha = .70$) and Sexual Excitation Scales ($\alpha = .78$), Wright's (2012) Sexual Frustration Scale ($\alpha = .84$), and the Sexual Satisfaction Scale ($\alpha = .87$) that was developed in the pilot study and Study 1. The reported alphas were calculated in the current study. As previously mentioned, we developed 15 items with the goal of measuring causes of frustration and 16 items were developed to measure reactions to frustration. However, the exploratory factor analysis in the previous study revealed four factors with 14 items: Expectations, Insecurity, Infidelity, and Self-Pleasure. Thus, participants also responded to the 14 items measuring sexual frustration.

Results

A factor analysis using oblimin rotation was calculated to examine the factor loadings associated with the four factors. Additionally, Cronbach's alphas were calculated for each factor. All four factors showed acceptable reliability. The results are in Table 4.

Three models were tested using confirmatory factor analysis, performed using EQS-6.4 for Windows. The four-factor model showed acceptable values for SRMR, which should be less than .10 as well as the RMSEA, which should be between .05 and .08 for acceptable fit (Kline, 2005). Additionally, the CFI was greater than .90, which indicates good fit (Kline, 2005). The results of the CFA are in Table 5.

Correlations were calculated between the four sexual frustration factors, sexual satisfaction, Wright's (2012) measure of sexual frustration, and the measures of sexual excitation and inhibition. There were small correlations

between the new sexual frustration subscales and Wright's measure of sexual frustration. In line with predictions, sexual satisfaction was negatively and significantly correlated with all the sexual frustration factors except Infidelity unlike in Study 1. Also, as predicted, Self-Pleasure as a response to sexual frustration was positively related to sexual excitation. The results are in Table 6.

TABLE 4

Items and Factor Loadings for Sexual Frustration in Women in Study 2

	Factor 1 Expectations $\alpha = .71$	Factor 2 Insecurity $\alpha = .88$	Factor 2 Infidelity $\alpha = .70$	Factor 2 Self-Pleasure $\alpha = .76$
I am sexually frustrated when...				
My partner is not as experienced as I would like.	.53	.19	.07	.06
My partner has sexual performance problems.	.61	.26	-.08	.01
I expect too much from my partner sexually.	.70	.36	-.25	.11
I feel insecure.	-.08	.94	-.01	-.15
I feel undesirable.	.05	.82	-.12	-.14
I feel uncomfortable with my body.	-.15	.82	-.11	-.21
I blame myself for feeling frustrated.	-.10	.53	-.04	-.13
When I am sexually frustrated, I... I cheat on my spouse/partner.	.06	.21	.84	.07
I have the urge to cheat.	.25	.26	.59	.15
I enter into friends with benefits relationships.	.04	.24	.43	.27
I have hook-ups to feel better.	-.01	.24	.41	.12
I masturbate to relieve my frustration.	-.07	.20	-.08	.92
I use toys/vibrators.	-.07	.21	-.00	.56
I watch porn to relieve my frustration.	-.09	.27	-.01	.63

TABLE 5

Confirmatory Factor Analysis of the Sexual Frustration Inventory for Women in Study 2

	RMSEA	CFI	SRMR	χ^2 (df)
One Factor	.29	.50	.16	506.29 (77)
Two Factor	.18	.61	.15	409.06 (76)
Four Factor	.08	.91	.07	150.08 (71)

Note. RMSEA = Root Mean Square of Approximation; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual.

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General Discussion

The initial purpose of the present studies was to develop a current and more extensive measure of sexual frustration for both men and women than exists in the literature today. Sexual frustration is an important variable and requires a valid and reliable measure we can use to examine it. The final scale includes two sets of subscales that reflect two different aspects of sexual frustration, and demonstrates convergent and discriminant validity. The first two factors, Expectations and Insecurity, appear to explain the scenarios or personal perceptions that lead to sexual frustration, whereas the second two factors, Infidelity and Self-Pleasure, capture ways women respond to, or cope with, their sexual frustration. In this way, the scale differs importantly from Wright's (2012) scale, which focuses exclusively on the current or recent experience of sexual frustration, whereas this new measure evaluates scenarios leading up to sexual frustration as well as coping mechanisms for dealing with sexual frustration.

In the pilot study, the sexual satisfaction scale was developed and inspired the creation of items in Study 1 that focused on sexual frustration predictors and responses. Study 1 developed the sexual frustration scale for women using an exploratory factor analysis and tested correlations for validity purposes and also provided a CFA for the sexual satisfaction scale. Study 2 presented a confirmatory factor analysis of the items for sexual frustration that recreated the same four-factor structure as the EFA in Study 1 and demonstrated good fit. Like in Study 1, the same correlates were included to examine scale validity in Study 2.

Expectations materialized as a predictor or "cause" of sexual frustration in which women's sexual desires are not met by their partners. A second "casual" factor leading to sexual frustration was Insecurity. This factor

represents women's own self-criticism or discomfort with their bodies or sexuality as contributing to sexual frustration. Note that we are not making any causal claims by using the word "cause" but, rather, that it was a response to the reasons why women are frustrated. Self-Pleasure involved masturbation as a coping mechanism for sexual frustration, whereas Infidelity served as another form of reducing frustrating arousal. The results thus suggest that women who experience sexual frustration may choose behavioral coping to assuage their frustration by cheating on their partner (or at least considering it) or relying on self-pleasure. We feel that this new sexual frustration scale provides a more comprehensive measure of sexual frustration, incorporating both reasons for sexual frustration and ways women commonly deal with it.

Sexual Frustration's Relationships With Other Variables

In our pilot study, a measure of sexual frustration was attempted, but the remaining items did not result in a clear measure of sexual frustration and made more conceptual sense as sexual satisfaction. Because the sexual satisfaction scale emerged as a biproduct of conceptually reversed items from the attempted frustration scale, it may be that the very general sexual satisfaction measure was unrelated to the specific predictors and responses to sexual frustration in the frustration measure. Our single-factor multifaceted sexual satisfaction scale involves an individual's overall assessment of satisfaction with openness and compatibility sexually with one's partner, having a desired frequency of sex, and enjoying sex overall, but also specifically experiencing orgasm. Sexual satisfaction as measured by our scale, then, involves several broad "approach" facets, which may be somewhat independent of sexual frustration. There may be more to being sexually satisfied than the avoidance of sexual frustration. Satisfaction could mean fulfillment of one's desires, whereas frustration could be seen as the prevention of fulfillment. In this way, the two should be negatively correlated. If, however, the meaning of satisfaction differs based on individual levels of homeostatic excitation, sexual satisfaction may not have to be met if frustration is kept at bay. Perhaps those higher in excitation are more invested in most aspects of sexuality, reflected by sexual excitation's strong positive correlations with nearly all the variables in the study, including sexual frustration, although most weakly (but significantly) with sexual satisfaction. Sexual excitation may play an interesting role in the balancing act between sexual satisfaction and frustration.

Unlike Study 1, in Study 2 Sexual Inhibition-1 significantly and positively correlated with Wright's

TABLE 6

Correlations Between Sexual Frustration, Sexual Satisfaction, Sexual Excitation, and Inhibition for Women in Study 2

Variable	1	2	3	4	5	6	7	8	9
1. Wright's Sexual Frustration Scale	-								
2. Expectations	.28**	-							
3. Insecurity	.30**	.23*	-						
4. Infidelity	.13	.13	.19*	-					
5. Self-Pleasure	.30**	.11	.10	.24**	-				
6. Sexual Satisfaction	-.24**	-.24**	-.32**	-.14	-.02	-			
7. Sexual Inhibition 1	.04	.14	.18*	-.07	.05	.28**	-		
8. Sexual Inhibition 2	-.07	-.08	.03	-.17*	-.12	.11	.40**	-	
9. Sexual Excitation	.21*	.18*	.13	.19*	.43**	.15	.13	-.01	-

frustration scale, and with all four of the sexual frustration subscales. Sexual inhibition, although initially predicted to be unrelated to sexual frustration due to associated reduced drive, may play an important role in women's sexual frustration, especially as it pertains to concerns about consequences of sex. Concerns about pregnancy or STIs may be related to frustration through holding back or denying oneself sexual activity to avoid harm. This relationship was only found in one of the two studies measuring SI, so further data is needed before we draw conclusions.

Convergent and Discriminant Validity

Indicating convergent validity, the items predicting what leads to frustration, or "causes" negatively correlated with sexual satisfaction, as would be expected. However, the coping items are unrelated to sexual satisfaction, suggesting that, when women engage in infidelity and/or self-pleasure, they are less sexually frustrated, but not necessarily more satisfied. Wright's 4-item scale, focused primarily on frequency of sex and frequency of desired sex, negatively correlates with sexual frustration in the same direction and strength as the new scale, and is unidimensional. Therefore, the sexual frustration scale presented in this article is appropriate for more nuanced examinations into sexual frustration.

Surprisingly, only two of the sexual frustration subscales, Expectations and Insecurity, were significantly related to sexual satisfaction. Both were negatively related to sexual satisfaction as expected. These two factors were considered predictors of sexual frustration. Expectations as a "cause" of frustration should negatively correlate with sexual satisfaction, by definition, because women's expectations for satisfying sex are not being met. Further, Insecurity as a predictor for sexual frustration would also reflect lower sexual satisfaction. Negative feelings about oneself with respect to sexual frustration are likely quite inconsistent with a satisfying sex life. Thus, women who had higher expectations of their partner and/or who were insecure about their bodies or about sexuality, were more likely to be sexually dissatisfied. One might also assume that, with infidelity or self-pleasure, women are alleviating their frustration and therefore these reactions may serve as successful coping mechanisms for dealing with frustration. Nonsignificant or weak relationships with sexual excitement for infidelity and self-pleasure in Study 2 suggest that frustration alleviation is not related to how easily women are sexually excited. This set of findings suggests an intriguing relationship between precursors of sexual frustration, coping with frustration, and sexual satisfaction, which was also not reliably correlated with sexual excitement. Individual differences in excitability (excitation) appear

unrelated to sexual satisfaction, although they are related to sexual frustration. If women are getting their sexual needs met, perhaps it does not matter how easily (or with how much difficulty) they are sexually excited. Women high in sexual excitement, though, may be particularly vulnerable to becoming sexually frustrated.

Implications

Women appear to experience sexual frustration, at least in part, due to unmet expectations regarding their partner. This suggests that women either have very high standards, do not communicate what they want effectively to their partners, or have partners who are not pleasing them. Ironically, insecurity with one's body or discomfort with one's sexuality is another "cause" of sexual frustration that may be related to sexual inhibition. We could consider this a Self-Expectations factor, in which women's judgments of their sexual worthiness may hinder their ability to enjoy sex. Insecurity was the only sexual frustration factor significantly positively correlated with sexual inhibition (SIS-1 in Study 2, but also SIS-1 in Study 1). Women's own insecurity may prevent them from having the open sexual experiences they wish due to emotional discomfort.

Exploring ways women deal with unmet expectations is warranted, as it is unclear whether partner communication would improve the alignment of their expectations with the reality of their sexual experience with their partner. A valid and reliable measure of sexual frustration will allow researchers to investigate reasons for frustration external to individual cognition or couple-level satisfaction or communication issues. Recent trends in decreasing sexual activity across several countries over the last two decades suggest that cultural pressure (Gleason et al., 2021) or even post-COVID re-entrance into society may contribute to sexual frustration (Delcea et al., 2021). Measuring self-reflected sexual frustration allows researchers to investigate exterior stressors, such as excessive work hours or time apart, that may not have an easy solution, such as having a productive conversation about their sexual relationship.

Limitations

Although our sexual satisfaction and frustration scale demonstrates good psychometric properties, the scale is only appropriate for women. As a result of the pilot data, we realized societal pressures and expectations surrounding men's sexual activity and talent may inhibit their honesty about this issue. This is a fascinating point in its own right, but at present, we only have data for women's sexual frustration, which is a limitation of the studies. In addition, we relied on self-report in an online survey for these studies, and our studies are not

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exempt from the typical limitations associated with those methods, including careless and inattentive responding, or dishonesty. Our samples were also mostly White and heterosexual; a more diverse sample would be optimal and would allow us to generalize to other groups.

The nature of this study was correlational and, therefore it should be noted that our “cause” of sexual frustration is a way to describe the prompt; we did not test causal relationships in these studies, although doing so in the future may be appropriate. Finally, we did not ask participants where they encountered the survey, so we were unable to compare college versus social media samples on a number of interesting variables. Although we did not make predictions based on participant recruitment location, we will measure it in future research to allow for such examinations.

Future Research

Future directions with the women's sexual frustration scale include further examining the relationship between sexual frustration and relationship satisfaction, as well as the moderating role of relationship conflict styles (Zacchilli et al., 2009). Perhaps the more open partners are with their communication, and the more they use positive conflict strategies, the more satisfied they are, even in the face of sexual frustration. Sexual frustration is clearly a point of conflict in a relationship and, if unresolved, it could exaggerate existing problems that likely co-occur with frustration, such as not having enough time alone together. We also plan to continue examining sexual excitation and inhibition in relation to the four sexual frustration factors. Both excitation and inhibition may moderate the relationship between satisfaction and frustration sexually.

Studies are in progress to examine sexual frustration in men, as well. Initial studies have shown that the four factors in women do not hold up for men (Zacchilli et al., 2018). Thus, further studies have been launched to develop items to measure frustration in men. Given the societal pressures on men's virility (Peterson, 2015), it may be a considerably different set of items that explains men's sexual frustration. It may be that an implicit association test (Greenwald et al., 1998), rather than a self-report scale, would be most appropriate for men. Ironically, women have traditionally been discouraged from communicating openly about sex (Reiss, 1967), and now that women have more sexual freedom, it appears men might feel intimidated communicating honestly about sex, especially when they are admitting they are frustrated by a lack of sexual activity. As women have been more allowed by societal norms to be open sexually, social expectations for men's sexual promiscuity appear to have become so extreme as to be toxic in some social

circles (e. g., the manosphere; Ging, 2019). If women are frustrated by their unmet expectations for their male partners, men may have concern for insecurity when they are told they must have perfect bodies and be virtual sexual Olympians in order to attract women (Scaptura & Boyle, 2020). Further, men in particular have been found to be sensitive to how they respond to questions about sexual behavior (Fischer, 2007). For example, Fischer (2007) found that men increased their reported sexual prowess if a female (rather than male) researcher told them that, socially, women have become more promiscuous than men. Thus, men's responses to questions about sexuality may be fluid depending on the circumstances surrounding how they are asked about it, even in a completely anonymous survey. Examining sexual excitation and sexual satisfaction in men may also shed light on differences between men's and women's experience of sexual frustration. Unlike women, are men perhaps more sexually satisfied by the ways they cope with sexual frustration—which are yet to be determined—because there is a positive relationship for men between excitation and sexual satisfaction? Research should examine the relationship between sexual excitation and satisfaction for both men and women, and we will continue to work to develop a scale of men's sexual frustration.

Finally, additional validation for the scale is needed. Future research should include relationship satisfaction in addition to sexual satisfaction. Relationships between communication and conflict styles (Zacchilli et al., 2009), sexual satisfaction, sexual frustration, and overall relationship satisfaction will give us a better picture of the way these variables interact.

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Author Note. Lara K. Ault <https://orcid.org/0000-0003-2062-9140>

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Correspondence concerning this article should be addressed to Tammy Lowery Zacchilli, Department of Social Sciences, Saint Leo University, MC 2127, Box 6665, Saint Leo, FL 33574, United States. Email: tammy.zacchilli@saintleo.edu

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Revisiting the Birthday Number Effect, Subjective Preferences, and Self-Esteem in College Students

Courtney G. Nutt, Anna N. DiMassimo, and Ralph G. Hale*

Department of Psychological Science, University of North Georgia

ABSTRACT. People tend to prefer details related to themselves. For example, people often like numbers associated with their birth date more than other numbers. This is known as the birthday number effect (Pelham et al., 2002). Discovery of this effect stemmed from the name-letter effect, a similar phenomenon in which individuals are likely to prefer letters in their name over other letters (Nuttin, 1985). The heightened fondness for details connected to oneself has been shown to influence decisions including where one lives and with whom one falls in love (Pelham et al., 2005). The present study attempted to replicate the birthday number effect. A significant preference for birthday numbers was found, $F(1, 97) = 17.85, p < .001, \eta_p^2 = .16$. Previous research has suggested that this effect relates to self-esteem, but this association had not yet been tested. No correlation between self-esteem and birthday-related numbers was found in the present study, $r(99) = -.02, p = .88$. However, the study did find that women had significantly lower self-esteem than men, $t(99) = -3.62, p < .001, d = -0.78$. The knowledge gained from this study provides a deeper insight into implicit feelings regarding the components of self-identity and how they relate to self-esteem in a college student population.

Keywords: birthday number effect, mere exposure, mere ownership, implicit egotism, self-esteem, college students

Beliefs and attitudes often impact a variety of mental processes and behaviors, and research has demonstrated that humans express these feelings in many ways, often without intention or conscious realization (Tracy et al., 2015). The human mind is home to a broad range of subjective information that can manifest in many interesting ways. Kitayama and Karasawa (1997) sought to determine if individuals would express unconscious feelings when rating numbers. They found that participants were more likely to rate numbers related to their birthdays, including the numerical month, day, and year, more highly than other numbers. They described this phenomenon as the *birthday number effect* (BNE). In the present study, we aimed to investigate and discuss the probable mechanism behind the BNE and how it may correlate with self-esteem in a college student population.

The idea leading to the discovery of this effect stemmed from the *name-letter effect*, in which people show a preference for the letters in their names over

other letters (Nuttin, 1987). Interestingly, these subjective preference effects appear to be consistent across cultures (Nickell et al., 2003). Although the BNE has been shown to be replicable, the function or mechanism behind the effect is still contested. Several theories have attempted to explain why someone would show a stronger preference for the numbers related to their birthday compared to other numbers. Kitayama and Karasawa (1997) theorized a higher rating for a number connected personally to a participant was an indication the participant also had a higher self-image. In other words, the BNE was theorized to be associated with self-esteem. Implicit self-esteem is explained as an unconscious act of determining the value of self (Brown, 1993). This theory was supported by Dijksterhuis (2004) in which self-esteem levels were shifted higher or lower depending on the type of words shown after the letter "I." The letter "I" is perceived as an identification of oneself. Therefore, the participants implicitly linked the word following the letter "I" with how they felt

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about themselves, suggesting that self-esteem can be manipulated by shifting the context in which personally identifying details are presented. Research into self-esteem highlights differences between “state” and “trait” self-esteem. State self-esteem is the result of social evaluation and the influences of social comparison. However, trait self-esteem is more generally related to a sense of individual well-being (Wang et al., 2021). These differences are relevant to the study of mechanisms responsible for the BNE. Preference for numbers related to birthdays is likely associated with the more stable trait self-esteem rather than the more transient state self-esteem since it is likely related to personal identity.

The connection between the BNE and self-esteem will be discussed from three perspectives: implicit egotism, mere exposure, and mere ownership. First, implicit egotism is a theoretical basis for self-esteem in which individuals prefer information that relates to themselves (Pelham et al., 2002). Second, the mere exposure effect posits that repeated exposure to stimuli results in a stronger preference (Zajonc, 1968). Finally, the mere ownership effect suggests that a stronger preference for personal information relates to feelings of ownership (Beggan, 1992; Nuttin, 1985). Each of these perspectives may provide insight into the mechanism behind the BNE. Here, we will discuss each of these perspectives in more depth.

Implicit Egotism

Implicit self-esteem can also be explained in the theory of *implicit egotism* which states that humans actively seek out and prefer personally connected details (e.g., items, places, names) over nonconnected details (Pelham et al., 2002). People are unconsciously biased to prefer something linked to their positive, self-related, characteristics. For example, Pelham and colleagues (2005) found that people are more likely to move to a state related to their name over other states (e.g., individuals named Virginia or Georgia are more likely to move to those states, respectively). This effect was found for city and street name preferences as well. In the same study, participants would reliably rate someone as more attractive if they were wearing a shirt containing a number in which the specific digit had been conditioned to be linked to their name earlier in the study. This supports the notion that whom someone finds attractive could be based at least in part on implicit egotism and suggests that a large impact on the process of decision-making goes unnoticed in major life events. Studies attempting to extricate implicit egotism from implicit self-enhancement have shown that people will adhere to the BNE even when they are presented with a threat to their self-concept. This suggests a bridge

between the BNE and implicit egotism (Pelham et al., 2002). Research by Coulter and Grewal (2014) demonstrated that the BNE is present even in cases involving novel one-time circumstances, such as items selected for purchase at a store. Implicit egotism can be seen as a driving force in the motivations behind the BNE. Jones and colleagues (2002) found that the preference for the first letters of someone’s first or last name was greater when compared to their preference for the most common letters in the English alphabet, suggesting that implicit egotism remains a stronger influence compared to the Mere Exposure Effect.

Mere Exposure Effect

Another theory proposed as an explanation for the BNE is the *mere exposure effect*, in which repeated exposure can result in an increased fondness or preference (Zajonc, 1968). Johnson (1986) found that people are more likely to prefer certain items from a list if the letters in those items were previously presented more often. There are three main models for this effect: Zajonc’s Affective Model, the Two-Factor Model, and Processing Fluency (Montoya et al., 2017). Zajonc’s Affective Model states that previously conditioned fear responses to fear-inducing stimuli can be nullified after multiple exposures without any negative consequences, sometimes eventually going as far as to induce a positive feeling instead (Zajonc, 1968). The Two-Factor Model further elaborates on Zajonc’s concepts, suggesting that people ultimately become bored with certain stimuli, thereby decreasing item preference and creating an inverted-U shape preference distribution (Berlyne, 1970; Stang, 1973). A third theory potentially explaining the mere exposure effect is Processing Fluency, which states that information people have been exposed to over time is encoded and processed more quickly (Whittlesea et al., 1990). Based on this theory, if someone puts in less effort to recognize certain stimuli, like a number related to their birthday, a higher preference for these stimuli may result due to a sense of familiarity. Following this logic, individuals may believe they like these items more than others simply due to more efficient encoding and processing. With these theories in mind, someone being exposed often to numbers related to their birthday, typically in a positive way, could mean they are more likely to show a stronger preference for those numbers over others. There is also a possibility of a person experiencing negative feelings surrounding their birthday numbers based on past experiences even after repeated exposure. Williams and colleagues (2015) examined previous research on the occurrence of suicide on and around one’s birthday. They indicated that the association between increased suicide risk around

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birthdays may be due to multiple factors including the representation of numbers related to birthdays as more stressful (Williams et al., 2011). Historically, indications of older age, feelings of loneliness, and traumatic events may cultivate increased suicidal behaviors on birthdays (Alderson, 1975). Considering this information, it is logical to argue the Processing Fluency theory as the most likely and significant mechanism in use if the BNE is related to mere exposure. However, the question remains, is it possible for repeated exposure to create a sense of ownership over an item, and how much might the feeling of ownership change this preference?

Mere Ownership Effect

The mere exposure effect is similar to another effect that past research has suggested to be a contributing factor to the BNE, the *mere ownership effect*. This theory posits that individuals will show a higher preference for items for which they feel a sense of ownership compared with other items (Beggan, 1992; Nuttin, 1985). Belk (1988) demonstrated that individuals start seeing items they own as an extension of themselves and will often use them as tools to help define their identity. For example, the belief in zodiac symbols and astrology and their ability to determine someone's personality¹ implies that people can find an identity and a sense of ownership of their birthdate (Di Natale et al., 2022). Finding an identity through and feeling ownership of a birthdate can result in a shared sense of identity with others sharing the same birthday-related numbers. Cialdini and De Nicholas (1989) found that participants were less likely to admit they shared a birthday with someone who scored higher than them on a social personality test compared to someone who scored higher than them on an intelligence test. This suggests that people find the prospect of having poorer social skills than someone else more intimidating than feeling less intelligent. Without the knowledge of others' social skills, participants were more open to sharing their birthdays. Relatedly, Burger and colleagues (2004) demonstrated that participants were (a) more likely to do a favor for someone and (b) more likely to donate a larger amount of money to a charity if they believed they shared the same birthday as the person asking for the favor or money, respectively. These studies support the notion that numbers related to birthdays are often meaningful to people due to personal identity and social bonding.

Nickell and colleagues (2003) suggested that the mere-ownership effect is responsible for both the name-letter effect and the BNE, stating that people tend to prefer these letters and numbers because of their relationship to their sense of ownership. This is also

¹Also an example of the Barnum or Forer effect.

related to the endowment effect, in which the favorability of owned items broadens to include details of other individuals to whom one is close in addition to details of oneself (Zhao et al., 2014). Within the context of the BNE, this suggests that someone may feel similar ownership and preference to a family member, close friend, or spouse's birthday as they would their own. Because numbers related to birthdays are stimuli that people are exposed to often, and because people often feel that their birthday belongs to them personally (despite sharing the same birthday with others), a likely theory is that both mere exposure and mere ownership are contributors to the heightened preference for numbers related to birthdays.

Present Study

The BNE is a replicable effect likely produced due to some combination of implicit egotism, mere exposure, and mere ownership. In the present study, we sought to test preferences for numbers related to birthdays relative to other numbers. We tested preference for both birth month numbers and birth date numbers. Previous research found a preference for higher birth date numbers, (i.e., numbers over 12; see Kitayama & Karasawa, 1997). The reasoning behind this specific number preference is unclear. Higher birth date numbers do not include birth months (i.e., 1–12), so it may have to do with overlap between the use of these numbers for dates and months. We investigated whether participants found numbers greater than 12 to be preferable to numbers 12 or smaller, regardless of their own birthdays. Additionally, we looked for number preference differences based on gender. Previous research has demonstrated that gender differences are prominent for self-esteem (e.g., Zuckerman et al., 2016), but gender differences in the BNE are unknown.

Recent sociocultural events and history threats that could potentially impact self-esteem should be considered. One factor is how the type and duration of internet usage for college students could impact self-esteem. Wright and colleagues (2023) found college students to be more prone to an increased amount of time spent on electronic devices like smartphones, specifically using social media. The increased social media time combined with the effects of the COVID-19 pandemic have proven to be harmful to college student's mental health. Social media has been shown to decrease the amount of time college students will spend studying and/or sleeping. These factors have major impacts on college student's overall well-being (Kolar et al., 2021). In addition to the amount of time spent on social media, Wright and colleagues (2020) also found that the type of social media can impact someone's overall well-being and

self-esteem. Social media applications with a majority image-based platform (e.g., Snapchat) have a larger role in negatively affecting well-being than non-image-based platforms (e.g., Twitter). Due to the increase in the amount of average time spent on social media since the COVID-19 pandemic, the relationship between self-esteem and the BNE may not be as strong as was previously demonstrated. The effects of the COVID-19 pandemic are still being researched. However, lifestyle changes and habits developed during this period of isolation and instability likely negatively impacted adolescent mental health. Socialization is important for adolescents' development in order to learn how to participate in society as well as become accepted by their chosen social groups (Perez-Felkner, 2013). COVID-19 perpetuated an imminent threat to this social development period and might have impacted the emergence of certain psychopathologies (Mittal et al., 2020). Lu and colleagues (2020) importantly noted how the sedentary behavioral habits developed during the pandemic could be risk factors for the development of certain mood disorders. Self-esteem has been observed to mediate the relationship between predictors of anxiety and psychological consequences (Rossie et al., 2020). Considering this information, the way we measure and conceptualize self-esteem moving forward may need to be modified to consider the effects of the COVID-19 pandemic on college students' self-esteem. The retrospective ages of the participant pool reflect an important period of development, and these factors may have influenced self-esteem in the participant sample of the present study.

In previous research into the BNE, it was suggested (but never confirmed) that self-esteem or a similar mechanism may play a role in this effect. Rather than simply assume that any bias for birthday numbers might be due to self-esteem (Kitayama & Karasawa, 1997) or implicit egotism (Coulter and Grewal, 2014; Pelham et al., 2002) as was suggested previously, here we directly tested the association. This is the first study to directly investigate the claim of self-esteem potentially influencing the BNE. Based on the theories of implicit egotism, mere exposure, and mere ownership, it is logical to assume that self-esteem may play a role in the BNE. The likelihood that one attributes importance to details of one's life may be connected to the importance that one places on oneself generally. However, it is necessary to measure self-esteem directly to determine what effect, if any, self-esteem has on the BNE. We hypothesized that participants would have a preference for numbers related to their birthday, consistent with the BNE and that these preferences would be associated with self-esteem.

Method

Participants

One hundred one students (70 women, 31 men) from the University of North Georgia research participant pool volunteered to be part of this study. A power analysis was conducted to determine the required sample size for our bivariate correlation using the formula $r = \frac{\sqrt{t^2}}{t^2 + df}$ where t represents the critical t value to reach α of .05. Using a desired power level of .80 and aiming to detect a medium effect size ($r = .30$), the analysis indicated that a minimum of 70 participants would be needed to achieve the desired power level. Participants were all between 18 and 25 years old except for one 37-year-old participant. Demographic data other than age and gender (e.g., race and ethnicity) was not collected. Consistent with Roberts and colleagues (2020), we acknowledge that this is a limitation of this study and plan to collect demographic data in future research. Informed consent was provided prior to starting the study. Participants were granted partial course credit as compensation for their participation. This study adhered to all ethical guidelines and was approved by the University of North Georgia's Institutional Review Board.

Measures

This study used a questionnaire to collect preference responses for various categories and was designed on Qualtrics (www.qualtrics.com). Nine sets of items were created for participants to rate in terms of individual preference including the numbers 1–50 and other distractor topics (i.e., animals, days of the week, time of day, and the seasons). The rating scale was identical for all items. Participants were asked to indicate how much they liked each item using a 4-point scale of 1 (*I don't like at all*), 2 (*I don't like*), 3 (*I like*), and 4 (*I like a lot*). The rating options used in this study are similar in nature to the scales used by Kitayama and Karasawa (1997) in which they simply requested a preference rating for a variety of different items. All items in a set were rated individually. The first set of items was numbers 1–10. The second set of items presented were the four seasons (i.e., spring, summer, winter, and fall). The third set of items was numbers 11–20. The fourth set of items were animals (i.e., cat, dog, snake, bunny, tiger, octopus). The fifth set of items was numbers 21–30. The sixth set of items was the days of the week (i.e., Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday). The seventh set of items was numbers 31–40. The eighth set of items was time of day (i.e., morning, afternoon, and night). The ninth set of items was numbers 41–50. The distractor topics (e.g., seasons, days of the week) were included to prevent participant fatigue while rating numbers 1–50 and to keep the true nature of our study masked. We did not want participants to

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suspect that we were primarily interested in numbers related to their birthdays. Therefore, numbers 1–50 were used. Both “types” of birthday-related numbers of interest to this study fit within this range, followed by distractor numbers. Specifically, *birth month* numbers ranged from 1–12, whereas *birth date* numbers ranged from 1–31. The numbers 32–50 were distractors.

In addition to these measures, the Rosenberg Self-Esteem Scale was used. This measure consists of ten 4-point scale items, with response options ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). This scale was created by Rosenberg (1965) to measure characteristics of global self-worth, including positive and negative feelings about oneself. The Rosenberg Self-Esteem Scale is a reliable measurement tool for determining individual differences in self-esteem, having strong internal reliability ($\alpha = .77-.88$) and test-retest reliability ($\alpha = .82-.88$; see Blascovich & Tomaka, 1993; Silber & Tippet, 1965).

Other information was collected from participants in a demographics questionnaire. The items collected included date of birth (MM / DD / YYYY) and gender (i.e., man, woman, nonbinary/ third gender, or prefer not to say).

Procedure

Participants signed up for the study using the University of North Georgia’s research participant pool website (Sona/NERD). Informed consent was obtained electronically through Qualtrics. Then participants confirmed that they were at least 18 years old in order to participate. Following consent and eligibility confirmation, instructions were provided, in which participants were informed that they would have to rate a series of items using scales provided and complete a demographics questionnaire. Participants confirmed that they understood the instructions. Consistent with Kitayama and Karasawa (1997), the individual preference items were presented in the following set order: (a) numbers 1–10, (b) seasons, (c) numbers 11–20, (d) animals, (e) numbers 21–30, (f) days of the week, (g) numbers 31–40, (h) time of day, and (i) numbers 41–50. The Rosenberg Self-Esteem Scale was proctored in a counterbalanced order between participants to reduce order effects, with half completing the scale before the preference items and half completing the scale afterward. Once the preference items and self-esteem scale were completed (in either counterbalanced order), the participants completed the demographic questionnaire. Afterward, a debrief was displayed, followed by researcher contact information for participants to use if they had any questions.

Results

To test the hypothesis of birthday number preference and how it is influenced by gender, a 2 (Birthday vs. Nonbirthday Number) $\times$ 2 (Birthday Number Type) $\times$ 2 (Birthday Number Size) $\times$ 2 (Gender) mixed design ANOVA was conducted. The first two factors were within-subjects and the last two were between-subjects (see Table 1).

A significant main effect was found for Birthday Number, $F(1, 97) = 17.85, p < .001, \eta_p^2 = .16$; participants rated their combined birthday numbers (month and date) higher than other numbers. Additionally, there was a significant main effect of gender in ratings of all numbers, $F(1, 97) = 5.91, p = .017, \eta_p^2 = .06$; women consistently rated all numbers higher than men (see Figure 1). Both women and men showed a greater preference toward numbers relating to their birth month and birth day. However, women showed a higher preference for all numbers than men.

However, no significant main effect was found for birthday number type (date versus month), $F(1, 97) = 0.23, p = .64, \eta_p^2 = .00$. Participant preferences did not differ between birthday numbers related to month versus day. Finally, a main effect for birthday number size (small, 1–12, versus large, 13–31) neared significance, $F(1, 97) = 3.68, p = .06, \eta_p^2 = .04$. Participant preferences may subtly differ between small

TABLE 1

Number Preference Ratings by Condition

BD Month	Woman	Small	3.19
		Large	3.04
	Man	Small	3.00
		Large	2.87
BD Date	Woman	Small	3.16
		Large	3.18
	Man	Small	3.13
		Large	2.47
Non-BD Date	Woman	Small	2.77
		Large	2.76
	Man	Small	2.73
		Large	2.52
Non-BD Month	Woman	Small	2.76
		Large	2.77
	Man	Small	2.73
		Large	2.51

Note. Ratings for birthday (written here as “BD”) numbers and nonbirthday numbers are displayed, broken out by birth date (1–31) versus birth month (1–12), gender, and birth date size (i.e., small = 1–12; large = 13–31). Generally, there was a preference for birthday-related over nonbirthday-related numbers, and women tended to rate all numbers regardless of category higher than men.

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and large birthday-related numbers. There were no significant interactions between any of these four factors, $F_s < 2.66$, $p_s > .11$.

Together, these findings confirm the ubiquity and replicability of the BNE. Women rated all numbers higher than men regardless of birthday affiliation; however, the BNE was still found in both genders that we analyzed. Contrary to previous research finding birth dates to be more highly rated than birth months, participants showed similar ratings for both—perhaps even showing a slight preference toward smaller birthday numbers, suggesting the BNE may not be biased toward large numbers as previously reported (Kitayama & Karasawa, 1997). Previous research suggested a heightened BNE for higher rather than lower numbers. The slight preference for smaller versus larger numbers in the present study may be attributed to fatigue effects because the order of preference items was not counterbalanced between participants. However, this design is based on the original study by Kitayama and Karasawa (1997), suggesting that there may be additional factors such as generational changes or sample variability. Future studies should counterbalance all item preference sets to see which pattern of results (i.e., either Kitayama & Karasawa, 1997, or the present study) is replicated in a design without potentially confounding order effects.

These results demonstrated the replicability of the BNE and provided a nuanced understanding of how other factors, including gender, may impact the strength of this effect. However, it was of particular importance in this study to investigate whether self-esteem impacts the BNE as previously suggested. Despite previous suggestions of the BNE relating to self-esteem, no correlation between self-esteem and birthday-related numbers was found, $r(99) = -.02$, $p = .88$. When subgrouped by gender, no correlations between self-esteem and birthday-related numbers were found for men, $r(31) = .00$, $p > .99$, or women, $r(70) = .12$, $p = .31$.

Finally, an independent-samples t test comparing self-esteem and gender found that women ($M = 16.96$, $SD = 5.82$) had significantly lower self-esteem than men ($M = 21.35$, $SD = 5.12$), $t(99) = -3.62$, $p < .001$, $d = -0.78$, 95% CI $[-1.22, -0.34]$. Despite women rating all preference items (e.g., birthday numbers, nonbirthday numbers, and distractor items) higher than men, self-esteem was markedly lower for women. This highlights the ubiquity of the BNE. Women had a more prominent BNE than men despite having lower self-esteem (see Figure 2).

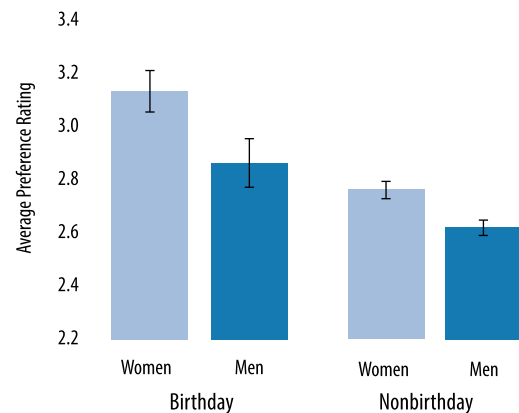
Discussion

In this study, we sought to test the BNE, an effect in which individuals prefer numbers associated with

their birthdays over other nonrelated numbers. We also wanted to test prior claims or suggestions of the BNE being a result of heightened self-esteem or similar factors. Participants in our study tended to exhibit the BNE, providing supporting evidence for the replicability of this cognitive effect. This effect was found to be stronger for women than men. In fact, women rated all preference items more strongly than men including birthday numbers, nonbirthday numbers, and distractor

FIGURE 1

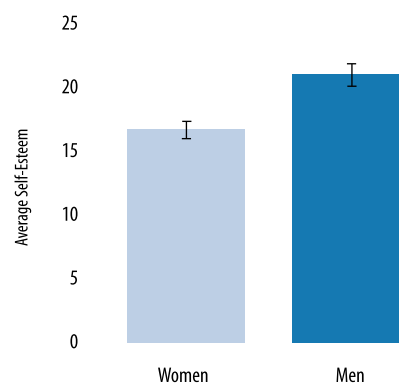
Number Preference Ratings for Birthdays and Nonbirthdays Between Genders



Note. Birthday number versus nonbirthday number ratings shown for female and male participants. Error bars represent standard error.

FIGURE 2

Self-Esteem Differences by Gender



Note. Average Rosenberg Self-Esteem Scale ratings shown for women and men. Women had significantly lower self-esteem than men. Error bars represent standard error.

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items. These findings are similar to those in related effects such as the name-letter effect (Hoorens & Nuttin, 1993). The establishment of this name-letter effect is the early relative to the BNE seeing as they both involve the unconscious, self-serving, preference for personal elements (Kitayama & Karasawa, 1997).

As for self-esteem, we failed to find a correlation between self-esteem and the BNE. The BNE, as described by Kitayama and Karasawa (1997), is believed to be motivated by implicit egotism. Also, Greenwald and Banaji (1995) suggested that one must have high self-esteem to implicitly favor items related to themselves. The present study does not support this conclusion. In fact, we found that women tended to have significantly lower self-esteem than men—despite having an equally strong BNE. We are not arguing the BNE is generated by lower self-esteem; we failed to find a correlation between self-esteem and the BNE. However, women had the highest ratings for item preferences and lowest ratings for self-esteem. These findings coincide with previous research on self-esteem and gender differences. Historically, women have faced many tribulations in which self-esteem and their self-concept have been threatened. A conglomeration of research has delved into the efforts of modern society and the long-term effects of the marginalization of women. For instance, Kling and colleagues (1999) provided evidence of men having higher self-esteem than women across measures, ages, and nationalities in their meta-analysis. More recently, Zuckerman and others (2016) analyzed this same gender difference across past studies and concluded that lower self-esteem in women in developed countries is thought to derive from a period of acceptance. Women now see themselves as part of the majority and are therefore subject to comparison to their male counterparts, which leads to dissonance. Women's awareness of discrimination is thought to be part of why lower self-esteem is seen in current research involving self-esteem and gender differences (Zuckerman et al., 2016).

It is also important to consider social media usage among college students of all genders. Social media usage can increase the diagnosis of depression and anxiety in college students. This has been credited to the lack of physical activity and sleep, resulting from an extended time on electronic devices (Hu et al., 2001). Vogel and colleagues (2014) found those who used social media applications were more likely to have lower self-esteem than those without social media. This may also be due to comparisons made to other social media users. Impacts on physical and mental health stemming from social media use, alongside problems of increased social comparison, could logically result in a decrease in overall self-esteem.

Considering the results of the current study, women

seem to associate themselves with their birthdays similarly to men, but is their self-esteem still low due to discrimination or comparison? We therefore conclude: (a) the BNE is a strong, replicable effect for men and women; (b) the BNE is not driven by self-esteem in college students; and (c) there are significant gender differences in self-esteem not impacting the BNE.

Limitations

This study has several limitations that are important to mention. One limitation here relates to the population from which the sample was pulled. We utilized the university's student participation pool, which is comprised primarily of college students of young adult age with a bias toward women over men. We understand that this is not a representative sample of the broader population. Despite having significantly more female than male participants, the gender differences found related to self-esteem are consistent with prior research. Therefore, we can cautiously surmise that other gender-related findings are generalizable to a larger, more representative population.

We also acknowledge the lack of demographic data that was collected. Any demographic data collected for this study related to specific hypotheses or study design. Future research should collect more complete demographic data including information regarding race/ethnicity and socioeconomic status in compliance with current APA standards. Participants should also be sampled from a more diverse population. This increases the generalizability of findings while also increasing equity of opportunity for participation.

Applications

There may be many potential applications of general knowledge around the BNE. For instance, more self-awareness around how people view items related to themselves could help make people more conscious consumers and less likely to be scammed. Newer marketing techniques known as mass-personalization programs involve tailoring prices and products to individual consumers to increase sales (Coulter & Grewal, 2014). As consumers, having more awareness of marketing practices will help to decrease the occurrences of falling victim to manipulation.

As demonstrated in the present study, women tend to have a somewhat stronger BNE than men despite inverse differences in self-esteem. Industries and businesses could benefit from this information pertaining to marketing and services tailored to each gender. Therefore, even more caution should be taken by women while participating in consumer practices. Algorithms creating custom entertainment and marketing online, through social media, and over the phone have become a growing topic of interest and concern. The BNE

and similar cognitive effects may prove to have myriad applications in the future in terms of the consumer understanding the power their unconscious biases may have in them becoming active participants in marketing games.

Future Directions

Future research into the BNE could improve upon the present study to expand upon these findings. In upcoming studies, fewer question categories and numbers for participants to rate would be beneficial, because possible fatigue effects impacted number and distractor ratings toward the end of the preference item lists. This might explain why previous research (Kitayama & Karasawa, 1997) found a preference for large numbers, whereas we neared a significant but inverse finding. Future research should also counterbalance all preference rating item lists between participants to eliminate possible order effects.

Additionally, participants may have pre-existing biases toward certain numbers, and this was not assessed in this study. For instance, the number 13 could have been rated lower because of the negative connotation associated with this number (e.g., “Friday the 13th”). Superstitions about the number 13 likely evolved from early Roman history into the modern-day fear capitalized on by entertainment and movie industries (Scanlon et al., 1993). As such, the birthday number effect might have had no impact on the ratings for this number. Another example could be the number 25, which might have been rated higher because of Christmas occurring on the 25th of December and the connection to biblical history (Nothaft, 2012). Gamblers may have particular feelings around the numbers seven or 21. These preferences would relate to the influence of mere exposure on preference rather than the impact of implicit egotism. Future research should directly probe the impact of these pre-existing number biases other than birthday numbers.

Finally, future research should aim to have a larger, more diverse sample to confirm that our findings related to self-esteem and the BNE were not generated solely by the homogeneity of our participant sample. In this study, our sample was 70% women with a vast majority of the individuals ranging in age from 18-25. Young adult women have been shown to have the lowest rate of self-esteem when compared to men of the same age and both genders of older age (Sprecher et al., 2013). Further research should also capitalize on cross-cultural designs. Collectivist and individualistic cultures value self-esteem in categorically different ways (Diener & Diener, 1995). The BNE study conducted by Kitayama and Karasawa (1997) sampled only Japanese participants, whereas our study only sampled Americans. This suggests, although perhaps not universally, that the BNE and similar cognitive effects are likely to generalize to a culturally and

globally large population of interest.

The gender differences in self-reported self-esteem may not be attributed to the BNE but are important to note. Self-esteem in women is still significantly lower than in men despite current movements supporting women's inclusivity and recognition. Current studies should take into account this reported difference in college-aged women. Studies such as Veldhuis and colleagues (2020) that apply modern behaviors such as “selfie” taking and social networking are pivotal to understanding the differences shown in the present study. Future research should focus on understanding what factors in modern-day society are lowering self-esteem, while cognitive effects hypothesized to demonstrate pieces of the self-concept, such as the BNE, are still represented.

Finally, future research should seek to dig deeper and directly test—as we did here—the various alternative potential explanations for the BNE. These include implicit egotism, mere exposure, processing fluency, and mere ownership. Our findings related to self-esteem suggest that implicit egotism is unlikely to be the driving factor for the BNE. However, research should explicitly test the others. Mere exposure and processing fluency are highly probable explanations and could be investigated directly to determine if those mechanisms better explain this cognitive effect. The present study is the first to directly test proposed causes of the BNE, and we found no reason to believe self-esteem to be a driving factor. Future research should aim to continue this effort to better understand the connections between our preferences, motivations, and underlying mechanisms.

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Author Note. Ralph G. Hale  <https://orcid.org/0000-0001-5026-8417>
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Correspondence concerning this article should be addressed to Ralph G. Hale, University of North Georgia, 3820 Mundy Mill Rd, Oakwood, GA 30566. Email: ralph.hale@ung.edu

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TikTok Too Long? Examining Time on TikTok, Psychological Distress, and the Moderation of TikTok Motivations Among College Students

Veronica von Fedak¹ and Michael R. Langlais^{2*}

¹Department of Psychology, Florida State University

²Department of Human Sciences and Design, Baylor University

ABSTRACT. Despite nearly 80% of adults using social media daily, studies have shown that social media use predicts psychological distress. However, few studies have focused on TikTok and its relationship with psychological distress, despite the growth this application has experienced over the past two years. It has also been suggested that the motivation to use TikTok would be associated with psychological distress (stress, anxiety, and depressive symptoms). Therefore, the goal of this study was to examine the relationship between TikTok use and psychological distress among college students and examine motivations for using TikTok (distraction or procrastination, keeping in touch, seeing what people are up to, being part of the information loop, communicating with romantic partner, flirting, meeting new friends, talking with friends, and entertainment) as moderators. This study was conducted via a survey that participants ($N = 199$) completed online. Increased time on TikTok was negatively associated with depressive symptoms ($\beta = .15, p = .04$), stress ($\beta = .18, p = .03$), and psychological distress ($\beta = .16, p = .04$). Additionally, regression results indicate that using TikTok in order to be part of the information loop significantly moderated the relationship between time on TikTok and psychological distress ($\beta_s = -.15$ to $-.17, p < .05$). More precisely, spending more time on TikTok to be part of the information loop predicted lower psychological distress compared to those without this motivation ($\beta_s = -.16$ to $-.17, p < .05$). Recommendations for using TikTok for college students and future research directions are discussed.

Keywords: TikTok, psychological well-being, social media motivations, college students

Excessive use of social media has been consistently linked with lower levels of mental health, including greater levels of anxiety and depression and lower self-esteem (Berryman et al., 2018; Primack et al., 2017; Sherlock & Wagstaff, 2019). Studies have explored how certain behaviors on Facebook (Langlais et al., 2018), Instagram (Sherlock & Wagstaff, 2019), Snapchat (Dunn & Langlais, 2020), and social media broadly (Marengo et al., 2018) can hinder well-being. However, few studies have examined the use of TikTok and psychological distress, despite the increased use of this platform. The average TikTok user opens the app eight times per day and spends an average of 95 minutes on TikTok per day (Statista, 2022). Given the literature on social media and psychological distress, it can be assumed that spending excessive time on TikTok could be

detrimental for psychological well-being. Therefore, the goal of this study was to empirically test this assumption in order to understand to what extent, if any, using TikTok could impact college students' psychological distress. Although recent studies have illustrated negative relationships between TikTok use and psychological constructs related to health (Nienstedt et al., 2023), our study advances this literature by examining whether the motivations to use TikTok may impact the relationship between TikTok behaviors and psychological distress. We also specifically focus on college students, who are heavy TikTok consumers (Statista, 2022). This study is imperative given not only the increased number of users on TikTok (Vogels et al., 2022), but also because of the high number of minutes spent on the app (Statista, 2022). Results from this study can be used to inform college

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students who use TikTok about the healthiest ways to use the platform.

This study has a number of advantages. First, we explore a variety of different behaviors on TikTok, not just time on the app, including the number of followers, number of people following, and number of likes. Additionally, this study explores the motivations of college students for using TikTok. Although what people do on TikTok could impact well-being, this effect may be more specifically impacted by why individuals use TikTok. Those who use it for entertainment, for example, may be less impacted than those who use TikTok to stay informed. The current study examines the following motivations for using TikTok: distraction or procrastination, keeping in touch, seeing what people are up to, being part of the information loop, communicating with a romantic partner, flirting, meeting new friends, talking with friends, and entertainment as moderators. This study will examine the direct effects of TikTok behaviors and motivations for college students' psychological distress, as well as how the motivations for using TikTok moderate the relationship between various TikTok behaviors and college students' stress, anxiety, and depressive symptoms.

Information on TikTok

TikTok is a relatively new social media platform that was initially released in 2016. It first aired as Musical.ly and was later bought by another company and upgraded to the application known today as TikTok (Tidy & Smith Galer, 2020). Unlike other social media platforms, TikTok users' main content is short-form videos that can be as short as 15 seconds or as long as 10 minutes on any topic (Stokel-Walker, 2022). When navigating the application, the home page is labeled as one's "For You" page, where the application tailors each user's "For You" page specifically to them by using an algorithm to constantly supply new content recommendations that might fit the individual's personalized likes and interests. Users can react to videos by liking, sharing, commenting, or saving them to their TikTok account. Once users begin following other content creators, the home page adds a "Following" page of the creators the individuals follow in order to see those specific videos without having TikTok recommendations interfere with the viewing experience. TikTok is one of the largest social media platforms today, and as of 2023, it has amassed over 1.8 billion monthly users globally (Aslam, 2023).

Though TikTok has become increasingly popular globally, the people using the application vary demographically. According to Pew Research Center (Vogels et al., 2022), TikTok use for American teenagers between

the ages of 13 to 17 has risen to 67% and Facebook use has dropped to 32%. Many college students use TikTok, with 51% report using TikTok as a resource for class assignments (Thiel, 2023). When looking at the data concerning the countries with the most users, the United States has the largest TikTok audience, with approximately 136.5 million users, followed by Indonesia, with 99 million users, and Brazil, with 74 million users (Statista, 2022). There are also gender differences regarding TikTok use, with 57% of TikTok users identifying as women and 43% identify as men (Statista, 2022). When it comes to TikTok content creators, 53.8% are women and 46.2% are men (Statista, 2022). This same difference was seen in previous research regarding individuals between the ages of 9 and 13, illustrating a higher prevalence among female TikTok users compared to male users during the COVID-19 pandemic and beyond (Jennings & Caplovitz, 2022). When looking at the global online audience of TikTok by age, most TikTok users are between the ages of 18 to 24, and the same distribution can be seen regarding TikTok creators (Statista, 2022). Based on this data, many people use TikTok, predominantly women and college students.

TikTok and Psychological Distress

Theoretically, there is support for using TikTok, as well as a rationale for why using TikTok could impact psychological distress. According to Baumeister and Leary (1995), humans have a need to belong. There are many ways individuals strive to have this need met, including social media (Seidman et al., 2019). For instance, Sharabati et al. (2022) found that continuous intent to use TikTok was related to meeting belongingness needs. Using TikTok to meet belongingness is also one of the precursors for TikTok addiction (Miranda et al., 2023). By connecting with others on TikTok, creating content with and for others on TikTok, or watching TikTok with others, college students can meet their belongingness need. If this need is not met, college students may experience higher levels of psychological distress.

Empirical data reveals a link between using social media, such as TikTok, and psychological distress. Although few articles have reviewed TikTok and psychological distress directly, several studies have examined the impact of other social media networks on psychological well-being. Spending time on social media has been shown to have notable negative impacts on well-being, particularly when people use social media passively, such as scrolling through and viewing content without interacting with others (Seidman et al., 2019). One study that looked at passive social media use, focusing particularly on cyberbullying, found that 59% of those observed chose to remain passive and take no

action, 45% volunteered to assist the victim, and 5% acknowledged siding with the bully. The act of remaining passive in the face of cyberbullying was linked to factors such as older age, decreased empathy, earlier experiences as a victim of traditional bullying, and moral disengagement. (Underwood & Ehrenreich, 2017).

Furthermore, recent research has shown that social media intensity, defined by extensive time on social media, had a negative indirect effect on well-being (Aalbers et al., 2019; Roberts & David, 2022). Another study on adolescent Facebook use indicated that daily stress significantly predicted social support seeking through Facebook, which was then positively associated with adolescents' low mood (Frison & Eggermont, 2015). These studies argue that by spending time on social media rather than with others, college students may not feel socially connected to others and instead feel left out of activities. Aalbers et al. (2019) found that social media use did not directly predict depressive symptoms, loneliness, or stress. Rather, previously feeling fatigued and lonely predicted passive social media use, meaning that experiencing these symptoms could lead someone to scroll through social media pages. This empirical evidence exemplifies that college students who are already experiencing higher levels of psychological distress might be prone to spending more time on social media in a passive manner, which can potentially have further negative impacts on well-being.

Studies on social media and well-being are not new. Early studies illustrated that spending time on Facebook was predictive of psychological distress. For example, one study found that spending too much time on Facebook predicted declines in young adults' life satisfaction (Kross et al., 2013). Langlais et al. (2018) found that individuals who spent time viewing current and potential romantic partners' Facebook content were more likely to experience declines in self-esteem. However, Wright et al. (2017) found that individuals who were not in a committed or married relationship and were single reported higher levels of loneliness, which decreased significantly once they were engaged (Wright et al., 2017). Another study examined the differences between users and nonusers of social media sites and found that more total daily social media time, regardless of the platform, was linked to poorer health, including loneliness and depressive symptoms (Wright et al., 2021). Furthermore, image-based social networking sites such as Snapchat had a more significant negative impact on well-being, whereas professional and video-based networks had certain positive health outcomes, attributed to a sense of social connection and perceived peer support (Wright et al., 2020). Huang (2020) found in their meta-analyses that the mean correlation between

problematic social media use and distress were positive, indicating a link between greater levels of problematic social media participation and increased feelings of despair and loneliness. Additionally, during the COVID-19 pandemic, TikTok use increased (Wright et al., 2023), potentially due to a need to relieve feelings of isolation. Overall, results from empirical data show that spending time on social media, particularly when scrolling through content can have a negative effect on one's psychological well-being. Because most individuals use TikTok to consume content rather than connect with others, and because the empirical and theoretical literature suggests that this type of consumption is not good for one's health, we propose the following hypothesis:

Hypothesis 1: The amount of time spent on TikTok will be positively associated with psychological distress.

Motivations for Using TikTok and Psychological Distress

Although social media use has been linked to lower levels of well-being, this relationship is likely to be influenced by the motivation for using social media. Utz et al. (2015) found that the most common motivations for using social media included distraction or procrastination, keeping in touch with others, seeing what people are up to, being part of the information loop, communicating with others, flirting, meeting new friends, and entertainment (Utz et al., 2015). However, research on the motivations for using TikTok is limited. One study of Chinese college students' motives for TikTok use found that entertainment was the most common motive, followed by information sharing, and socialization as the lowest motive (Yang & Ha, 2021). Another study on the motivations for using social media revealed a strong correlation between smartphone addiction and entertainment as a motive (Ewing et al., 2023). Compared to other social media platforms, TikTok content mainly comes from the home page, which are videos that are tailored to a users' interests through their computer-generated algorithm. This algorithmic approach is unique compared to other social media platforms where most of the content comes from the accounts a user follows. Past research on the motivations for using Facebook, Instagram, and Snapchat showed that users were mostly engaging with social media to maintain friendships, form connections, and seek information, and each of these were influenced by the desire for affiliation (Garibaldi et al., 2022). If individuals are using TikTok to maintain friendships and form connections, they are theoretically meeting their belongingness needs (Baumeister & Leary, 1995). However, refraining from connecting with others and instead focusing on scrolling through content could

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have implications for psychological well-being, because passive behaviors on social media may address belongingness needs. It is important to not only understand if existing social media motivations relate to TikTok, but also determine if these motivations explain any potential relationships with psychological distress.

Predominantly, studies have focused on friendship, connection, and information as primary motivations for using social media (Garibaldi et al., 2022). Another study found that the primary motivations for using Instagram were surveillance or knowledge about others, documentation, coolness, and creativity (Sun, 2022). These studies identify some similar and overlapping motivations for using social media, namely the need to be connected through information shared by one's network. These common motivations may impact social media use addiction, problematic use, and impulsivity. Although research has focused on the motivations for using social media, few studies have investigated how these motivations directly impact one's psychological well-being. However, some studies have found indirect relationships between motivations and well-being. A mixed-methods study with social connection motivations showed a negative direct effect on problematic social media use, with a positive indirect effect on problematic social media use through impulsive use (Arness & Ollis, 2022). This indirect effect suggests that people who use social media to feel connected may engage in impulsive behavior when they believe they are out of the loop or disconnected from the social media environment. This tendency could be motivated by a strong need to be up to date on the latest updates, news, and trends. Another study looked at the following motivations: social identity, subjective norm, maintaining interpersonal interconnectivity, social enhancement value, and entertainment value (Raza et al., 2020). This study found that when these motivations impacted social media usage for social benefit, there was a positive correlation with life satisfaction; but when these motivations impacted social media use for social overload there was a negative correlation with life satisfaction (Raza et al., 2020). Although studies have inconsistently measured motivations for using social media, researchers have regularly identified being part of the information loop (i.e., information-seeking) as a common motivation for using social media. This motivation is similar to the fear of missing out, which has been extensively investigated (Przybylski et al., 2013). If college students do not believe they are in the information loop, their belongingness needs are threatened, and their psychological distress may increase. Because this pressure to be part of the information loop can be stressful for college students, we propose the following hypotheses.

Hypothesis 2: The motivations for using TikTok to

meet belongingness needs (being part of the information loop, keeping in touch, meeting new friends, and talking with friends) will be associated with psychological distress.

Hypothesis 3: Being motivated by being part of the information loop will moderate the relationship between time on TikTok and psychological distress.

Method

Participants

Participants in this study were undergraduate students recruited from a large university in the Southeastern U.S. ($N = 199$). Participants were predominantly female (96.0%; the remaining 4.0% identified as male), and the average age of participants was 19.91 ($SD = 1.39$). Participants were predominantly heterosexual (83.9%) but also identified as bisexual (11.1%), gay or lesbian (3.5%), and other (1.5%). Most participants were White (66.8%), followed by Hispanic (15.6%), African American (8.5%), Asian/Pacific Islander (6.5%), and 2.5% indicated "other." Many students were second-year students (30.0%) and third-year students (34.7%), with the rest being fourth or higher-year students (19.6%) and first-year students (15.6%). For the current study, 44.7% of participants were romantically single, 41.2% were seriously dating, 1.0% were engaged, and 0.5% were married. The average length of those in relationships was 21.08 months ($SD = 17.91$).

Procedures

Participants were recruited through posts in courses in Human Development and Family Science. Interested instructors volunteered to share information about the study in the learning management software (Canvas) associated with their course. Interested participants selected the link to proceed to an online survey, which stated the eligibility criteria of the study (participants needed to be at least 18 years and older and have previously or currently used TikTok). Of the 340 participants who were solicited, 199 were eligible and completed the online survey. The online survey asked participants to answer questions about their activity on TikTok and why they use TikTok, and to complete measures of psychological distress and demographics, as well as other variables not associated with the current study. The 72-item online survey took approximately 15 minutes to complete, and participants received extra credit as compensation for their participation. All procedures for this study were approved by the appropriate institutional review board. Preliminary analyses revealed no significant differences between men and women on any independent, dependent, or moderating variable besides messaging on TikTok, which female participants engaged in more ($F = 8.61, p < .01$).

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Measures

TikTok Behaviors

Seven different items were included regarding behaviors on TikTok. Three items focused on how frequently participants used TikTok: “How much time do you spend on TikTok?” (1 = *no time at all*; 7 = *all the time*); “How many minutes each day do you spend on TikTok?” (open-ended); and “How many times a day do you check TikTok?” (open-ended). Four other questions were asked to learn more about how people used TikTok: “How many videos have you uploaded to TikTok?” (open-ended); “How many people do you follow on TikTok?” (open-ended); “How many people follow you on TikTok?” (open-ended); and “How many ‘likes’ do you have on TikTok?” (open-ended). Means and standard deviations for each of these items are presented in Table 1.

TikTok Motivations

The current study used an adaption of Roesner et al.’s (2014) checklist of Snapchat motivations, as used by Utz et al. (2015). This checklist was then modified to apply to TikTok. More specifically, one of the motivations listed in Utz et al.’s (2015) checklist was, “I mainly use Facebook/Snapchat to keep in touch with family and friends.” This item was changed to say, “I mainly use TikTok to keep in touch with family and friends.” In addition to the 7 motivations listed in this scale (for procrastination and distraction, to keep in touch with others, to see what people are up to, to be part of the information loop, to communicate with a romantic partner, to flirt with others, to meet new friends, to talk with friends) another motivation was added (for entertainment) to be consistent with studies on the motivation for using TikTok (Wright et al., 2022; Yang & Ha, 2021). Frequency data for each of these variables are presented in Table 1.

Psychological Distress

Psychological distress was measured using the Depression-Anxiety-Stress Scale (Lovibond & Lovibond, 1995). This 21-item scale includes seven items per measure of psychological distress: depressive symptoms, anxiety, and stress. Examples include “I felt down-hearted and blue” (depressive symptoms), “I felt I was close to panic” (anxiety), and “I tend to over-react to situations” (stress). Responses ranged from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The mean for psychological distress is 1.77 ($SD = 0.55$); for each of the subscales, the means are as follows: stress ($M = 1.97$, $SD = 0.61$, Range = 0–2.43), anxiety ($M = 1.70$, $SD = 0.63$; Range = 0–2.86), and depressive symptoms ($M = 1.65$; $SD = 0.58$; Range = 0–2.43). Reliability of this scale was acceptable for the full scale

(Cronbach’s alpha = .93), and for each subscale: stress (Cronbach’s alpha = .82), anxiety (Cronbach’s alpha = .85), and depressive symptoms (Cronbach’s alpha = .87). Higher scores on this scale indicate more psychological distress, which is represented by higher stress, more anxiety, and more depressive symptoms. Correlations for all study variables are presented in Table 2.

Data Analysis

Data was analyzed using regression analyses. First, all variables were mean-centered as recommended by Hayes (2022). For all analyses, psychological distress, including each of the subscales (anxiety, depressive symptoms, and stress), were the criterion variables. For all analyses, age was included as a control variable. For Hypothesis 1, age and the different TikTok behaviors were included as predictors in each of the regression models. For

TABLE 1

Descriptive Characteristics of Study Sample (N = 199)

	M	SD	Range	% Yes
TikTok Behaviors				
TikTok time	4.69	(1.36)	6	
TikTok check	8.24	(8.79)	50	
TikTok minutes	99.86	(66.28)	400	
TikTok upload	25.40	(54.00)	500	
TikTok followers	672.08	(3639.33)	49300	
TikTok following	232.60	(422.68)	5493	
TikTok likes	26884.02	(103349.69)	886100	
TikTok Motivations				
Procrastination and distraction	0.76	(0.43)	76.4	
Keeping in touch	0.22	(0.41)	21.6	
Seeing what people are up to	0.60	(0.49)	60.3	
Being part of the information loop	0.64	(0.48)	63.8	
Communicating with romantic partner	0.10	(0.30)	9.5	
Flirting	0.02	(0.14)	2.0	
Meeting new friends	0.06	(0.24)	6.0	
Entertainment	0.96	(0.19)	96.5	
Psychological Distress				
Anxiety	1.70	(0.63)	2.86	
Depressive symptoms	1.65	(0.58)	2.43	
Stress	1.97	(0.61)	2.43	
Psychological distress	1.77	(0.55)	2.48	

Note. TikTok behaviors were gathered through open-ended questions. TikTok motivations were measured using Yes (1) or No (0). The measures of psychological distress are on a scale of 0 to 3, with higher scores indicating more anxiety, stress, or depressive symptoms. The mean and standard deviation of psychological distress are measured using the entire Depression Anxiety Stress Scale (DASS).

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Hypothesis 2, age and the motivations for using TikTok were included as predictors in the regression models. For Hypothesis 3, age was included in Step 1 of the regression analyses, TikTok time and the motivation for being part of the information loop were included in Step 2, and the interaction between TikTok time and being part of the information loop were included in Step 3. Missing data was considered missing at random; data was only missing when a single item was missing. Participants who missed an item for TikTok behaviors were dropped from those analyses ($n = 3$). Missing data with the motivations (Hypothesis 2) were interpreted as not having those motivations, so all participants were included in these analyses. All participants provided information about TikTok time and the motivation for being part of the information loop (and age), so all participants were included in addressing the third Hypothesis.

Results

The first hypothesis of this study predicted that spending time on TikTok would be associated with college students' psychological distress. Results for this hypothesis are presented in Table 3. Separate models were conducted for anxiety, depressive symptoms, stress, and psychological well-being (total of all three subscales). Results

revealed that time on TikTok was positively associated with depressive symptoms, stress, and psychological distress, and not associated with anxiety. No other behaviors on TikTok were associated with psychological distress. Additionally, age was not significant in any of these models. The R^2 for these regressions were small (.03–.06), meaning that 3–6% of the variance of psychological distress was explained by TikTok behaviors. Therefore, our first hypothesis was partially supported.

The second hypothesis predicted that four motivations for using TikTok (being part of the information loop, keeping in touch, meeting new friends, and talking with friends) would be associated with psychological distress. Results for these analyses are presented in Table 4. Collectively, none of the motivations were associated with psychological distress, stress, anxiety, or depressive symptoms. Additionally, age was not significant. However, because the R^2 value was small (.02), separate models were conducted using each of the motivations as singular predictors at Step 2 as recommended by Hayes (2022). For these models, R^2 values ranged from .11–.30, supporting this approach and allowing the identification of significant motivations. Using this approach, procrastination and distraction was positively associated with anxiety ($\beta = .16$; $SE = .11$, $p = .02$) and being part of the information loop was positively associated

TABLE 2

Correlations of Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Stress	-																		
2. Anxiety	.76**	-																	
3. Depressive symptoms	.73**	.72**	-																
4. Time on TikTok	.21**	.15*	.11	-															
5. Checking TikTok	.09	.11	.00	.45**	-														
6. Minutes on TikTok	.12	.10	.04	.41**	.47**	-													
7. Uploads on TikTok	.07	.11	.02	.16*	.15*	.07	-												
8. Followers on TikTok	-.04	-.01	-.02	.14	.32**	.15*	.10	-											
9. Following on TikTok	-.03	.00	.02	.15*	.00	.22*	.11	-.01	-										
10. Likes on TikTok	.03	.07	.00	.17*	.05	.14*	.26**	.63**	-.01	-									
11. Distraction/Procrastination	.09	.17*	.10	.18*	.04	.15*	-.06	.02	.09	-.03	-								
12. Keeping in touch	.09	.02	.03	.04	.14	.11	.10	-.02	.18*	-.00	.09	-							
13. Seeing what people are up to	.12	.14	.13	.07	.31	.07	.15*	.08	.07	.16*	.01	.20**	-						
14. Being part of information loop	.16*	.16*	.14*	.17*	.05	.14*	.15*	.06	.13	.02	.15*	.14*	.33**	-					
15. Communicating with Partner	.02	.05	.00	.14	.65	.03	.07	-.03	-.04	-.02	.14*	.29**	.05	.10	-				
16. Flirting	.05	.13	.06	.11	.03	.15*	.03	.47**	.04	.21**	.08	.10	.12	.11	.08	-			
17. Meeting new friends	.02	.08	.08	.18*	.33	.07	.25**	.02	.07	.00	-.06	.18*	.12	-.03	.06	.11	-		
18. Talking with friends	.03	.07	.06	.04	.42	.06	.18*	-.02	.24**	.00	.09	.42**	.09	.20**	.22**	.13	.34**	-	
19. Entertainment	.02	.00	.03	.06	.11	.11	.05	.03	.04	.02	.15*	-.03	.12	.20**	-.03	.03	-.18*	-.21**	-

Note. ** $p < .01$. * $p < .05$.

with stress ($\beta = .16$; $SE = .09$, $p = .03$), anxiety ($\beta = .16$; $SE = .10$, $p = .03$), and psychological well-being ($\beta = .17$; $SE = .08$, $p = .02$). The other motivations were not statistically significant when predicting psychological distress.

The third hypothesis predicted that the motivations for using TikTok to be part of the information loop would moderate the relationship between TikTok time and psychological distress. Age was included at Step 1, the predictor variables (time on TikTok, the motivation to be part of the information loop) were included at Step 2, and the interaction between these variables were included at Step 3. Results are presented in Table 5. Results of these analyses found that time on TikTok was positively associated with anxiety ($\beta = .32$; $SE = .05$, $p = .01$), depressive symptoms ($\beta = .33$; $SE = .05$, $p = .01$), stress ($\beta = .40$; $SE = .05$, $p < .001$), and psychological distress ($\beta = .38$; $SE = .05$, $p < .001$). Being part of the information loop was also positively associated with depressive symptoms ($\beta = .74$; $SE = .31$, $p = .01$), stress ($\beta = .74$; $SE = .32$, $p = .004$), anxiety ($\beta = .67$; $SE = .34$, $p = .01$), and psychological distress ($\beta = .18$; $SE = .29$, $p = .002$). Additionally, the interaction between time on TikTok and being part of the information loop was negatively associated with anxiety ($\beta = -.60$; $SE = .07$, $p = .04$), depressive symptoms ($\beta = -.71$; $SE = .06$, $p = .01$), stress ($\beta = -.69$; $SE = .07$, $p = .02$), and psychological distress ($\beta = -.73$; $SE = .06$, $p = .01$). For all regressions, R^2 was not significant at Step 1. For Step 2, there was a significant change in R^2 for anxiety ($p = .04$), stress ($p = .003$), and psychological distress ($p = .01$). For all four regression analyses, there was a significant change in R^2 at Step 3 (ranging from .04 to .07; $p < .05$, range of $p = .01$ to .04).

These interactions showed similar yet unique results for psychological distress. Figure 1 shows the results for psychological distress; although we found significant interactions for the other three measures of psychological distress (anxiety, stress, and depressive symptoms), the moderation results showed the same pattern. First, psychological distress is higher for individuals who do not use TikTok to be part of the information loop compared to those who have that motivation. Second, participants report declining psychological distress the more time they spend on TikTok to be part of the information loop. Yet, psychological distress increases the more time participants spend on TikTok when they are not motivated to be part of the information loop. These trends are the same for all measures of psychological distress. Thus, the third hypothesis was supported.

Discussion

The goal of the study was to understand how behaviors and motivations on TikTok impacted college students'

stress, depressive symptoms, and anxiety. The study used moderation analysis to understand the interactions between TikTok behaviors and motivations for the psychological well-being of college students. The primary predictors that impacted psychological well-being were time spent on TikTok and being part of the information loop and procrastination or distraction as motivations for using TikTok. The current study consistently found that time on TikTok and using TikTok in order to stay part of the information loop was associated with college students' psychological distress. It is possible that constantly trying to keep up with the latest trends to maintain relevancy in social relationships can be unrealistic and damaging as it perpetuates

TABLE 3

Regression Results Examining TikTok Behaviors and Psychological Distress (N = 199)

	Anxiety		Depressive Symptoms		Stress		Psychological Distress	
Intercept	.68	(.69)	1.03	(.63)**	.92	(.65)**	.88	(.60)**
Age	-.03	(.03)	-.08	(.03)	-.05	(.03)	-.06	(.03)
TikTok time	.11	(.04)	.15	(.04)*	.18	(.04)*	.16	(.04)*
TikTok check	.05	(.01)	-.06	(.00)	-.01	(.00)	-.01	(.01)
TikTok minutes	.05	(.00)	.01	(.00)	.10	(.00)	.06	(.00)
TikTok upload	.08	(.00)	.01	(.00)	.05	(.00)	.06	(.00)
TikTok followers	-.11	(.00)	-.02	(.00)	-.12	(.00)	-.09	(.00)
TikTok following	-.03	(.00)	.01	(.00)	-.07	(.00)	-.03	(.00)
TikTok likes	.08	(.00)	.00	(.00)	.05	(.00)	.05	(.00)

Note. Data are presented as standardized beta coefficients with standard errors in parentheses.
* $p < .05$.

TABLE 4

Regression Results Testing the Motivations for Using TikTok and Psychological Distress (N = 199)

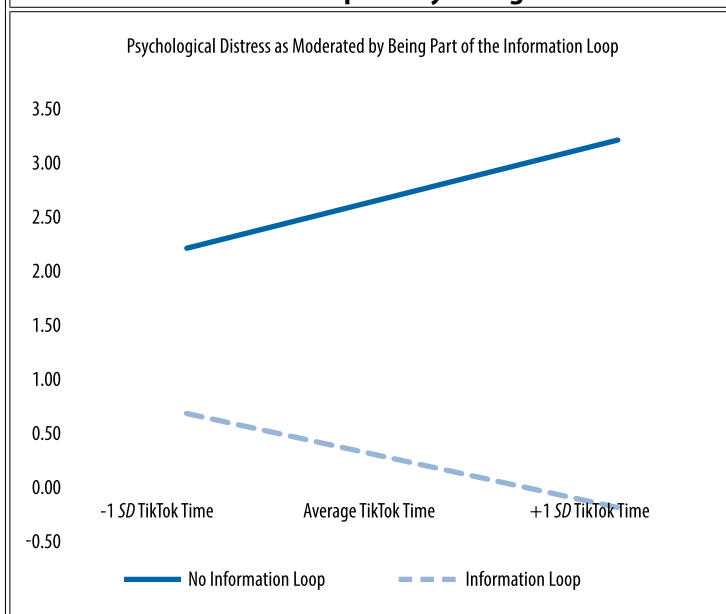
	Anxiety		Depressive Symptoms		Stress		Psychological Distress	
Intercept	.45	(.80)	.60	(.74)*	.80	(.79)*	.62	(.71)*
Age	.00	(.03)	-.01	(.03)	.00	(.03)	.00	(.03)
Procrastination and distraction	.23	(.11)*	.13	(.10)	.11	(.11)	.15	(.10)
Keeping in touch	-.08	(.12)	-.03	(.11)	.09	(.11)	-.01	(.10)
Seeing what people are up to	.12	(.10)	.10	(.09)	.09	(.10)	.10	(.09)
Being part of the information loop	.16	(.10)	.12	(.10)	.16	(.10)	.14	(.09)
Communicating with romantic partner	.04	(.16)	-.06	(.15)	-.05	(.16)	-.03	(.14)
Flirting	.42	(.32)	.11	(.30)	.08	(.32)	.20	(.28)
Meeting new friends	.19	(.19)	.20	(.18)	.03	(.19)	.14	(.17)
Entertainment	-.14	(.28)	.01	(.26)	-.06	(.27)	-.06	(.25)

Note. Data are presented as standardized beta coefficients with standard errors in parentheses.
* $p < .05$.

the endless cycle of catching up to the latest trends. It may also be a sign of social comparison or unhealthy expectations for oneself. However, when participants reported increased time on TikTok and the motivation

TABLE 5**Moderation Estimates**

Variable	Estimate	SE	95% Confidence Interval		<i>t</i>	<i>p</i>
			Lower	Upper		
Anxiety (intercept)	.94	.24	.47	1.41	3.91	<.001
TikTok Time	.31	.05	.04	.25	2.75	.01
Information Loop	.64	.32	.21	1.48	2.61	.01
TikTok Time x Information Loop	-.57	.07	-.27	-.01	-2.09	.04
Depressive Symptoms (intercept)	.98	.22	.55	1.42	4.46	<.001
TikTok Time	.30	.05	.03	.22	2.65	.01
Information Loop	.70	.30	.26	1.43	2.85	.01
TikTok Time x Information Loop	-.66	.06	-.27	-.03	-2.39	.02
Stress (intercept)	1.07	.23	.62	1.52	4.67	<.001
TikTok Time	.39	.05	.08	.27	3.56	<.001
Information Loop	.71	.31	.30	1.51	2.94	.01
TikTok Time x Information Loop	-.66	.06	-.28	-.03	-2.46	.02
Psychological Distress (intercept)	1.00	.21	.59	1.40	4.82	<.001
TikTok Time	.37	.05	.06	.24	3.32	<.001
Information Loop	.76	.28	.32	1.41	3.11	<.001
TikTok Time x Information Loop	-.69	.06	-.26	-.03	-2.57	.01

FIGURE 1**Interaction of Time on TikTok and Being Part of the Information Loop for Psychological Distress**

to be part of the information loop, psychological distress appeared to decline. Participants may feel less anxious and stressed because they feel that they are part of the information loop given how much time they spend on the application.

We found support for the first hypothesis as time spent on TikTok was positively associated with depressive symptoms, stress, and lower psychological well-being. Spending excessive amounts of time on TikTok can hinder academic success, the quality of personal relationships, time spent on physical activity, and college students' attention span, which is consistent with studies on other social media platforms (Aalbers et al., 2019; Roberts & David, 2022). For instance, Lorenz-Spreen et al. (2019) found that because of the large influx of information presented on social media, one's attention span decreases because individuals are trying to keep up with all the topics simultaneously, causing a decrease in collective attention. It seems that TikTok constantly provides content that is new, quick, easy to consume, and catered to one's preferences, and may be associated with decreased attention compared to other social media platforms. Losing track of time could be stressful to some college students if it inhibits their ability to complete a task. Due to the length of content on TikTok, which is usually short (Stokel-Walker, 2022), and because TikTok does not display the time log of the video content, it becomes easier to lose track of time. Additionally, college students may assume that consuming a few more videos while on TikTok will not detract from other tasks. This assumption could cause some college students to use TikTok longer than they originally intended. By doing so, college students may feel guilty for being on TikTok to begin with. Individuals could report stress when they believe their TikTok use spilled over into their responsibilities. In other words, college students may feel guilty if they feel like they wasted time on TikTok rather than maximizing their time. TikTok also portrays an idealized version of people's lives, which can cause feelings of inadequacy and low self-esteem. When people are constantly exposed to others' content on TikTok by spending more time on the app, they may be more prone to compare themselves to the individuals they view; this social comparison could prompt feelings of sadness and anxiety among college students (Spitzer et al., 2023). Interestingly, the other behaviors on TikTok (including number of followers, number of likes, and number of people following) were not associated with changes in well-being. These null findings may be explained by college students' motivation for using TikTok. For example, it is possible that college students use TikTok as a form of entertainment or a way to connect with others without considering the number of likes or followers they have.

This study also found that the motivations partially explained the relationship with using TikTok and psychological well-being. Trying to constantly keep up with TikTok's content and remain aware of the latest trends may cause a college student to develop an addiction to the application (Miranda et al., 2023), which can be associated with feeling stressed, anxious, and depressed. TikTok is constantly feeding its users' new content. With it, the latest trends are being created, making it almost impossible for an individual to keep track of the past and current trends that are regularly being exposed to users. It may be distressing for college students to keep up with TikTok's continuous influx of content, resulting in feelings of stress, anxiety, and depressive symptoms. Being part of the information loop may also result in unhealthy social comparison. When college students witness information that they want to be a part of, and aren't, could result in downward social comparison, which is linked to lower self-esteem and body image with other social media platforms (Tiggemann & Anderberg, 2020). It is also possible that college students may engage in unhealthy expectations for their own behavior, feeling like they need to be a part of the information that they are seeking and consuming. These behaviors have been shown to limit psychological well-being (O'Brien et al., 2022). Additionally, this study found that using TikTok for distraction and procrastination reasons may lead to various issues pertaining to well-being. Spending time on TikTok in ways that could reduce productivity means that college students are being taken away from other tasks or activities that they need to complete. Not getting to necessary tasks could lead to feelings of guilt and lower psychological well-being. Similar to studies on the fear of missing out and social media (O'Brien et al., 2022), TikTok may also promote fear of missing out. People may distract themselves by spending time on TikTok to deal with fears of missing out, which may result in feeling socially isolated and worse than they did before. Not feeling included or experiencing distress about keeping up with the modern trends, can invoke feelings of sadness and anxiety within college students.

The other motivations were not predictive of psychological well-being. These motivations were to keep in touch with others, see what people are up to, communicate with a romantic partner, flirt with others, meet new friends, talk to friends, and entertainment. Most of these motivations rely on communicating with others, and whether participants communicated with others was not directly examined in this study. It is also likely that the effects of these motivations had both positive and negative consequences for well-being, resulting in null findings. Some college students may be motivated

to connect with others in a positive way, and others may be motivated to communicate negatively. Also, these motivations are less intrapersonal than being connected and seeking distraction. For example, connecting with friends and family can be good and bad, resulting in null effects for psychological well-being. It is interesting to note that entertainment was not associated with psychological well-being, given that other studies have found that entertainment may help promote well-being, even in the context of TikTok (Utz et al., 2015; Yang & Ha, 2021). Conversely, a separate study found that the entertainment motivation correlated with depressive symptoms and negative mood (Ewing et al., 2023). Future studies should examine these motivations more closely to understand whether they influence psychological well-being.

The third hypothesis predicted that being part of the information loop moderated the relationship between TikTok time and psychological well-being. The participants who exhibited the lowest levels of psychological distress were those who spent more time on TikTok and were motivated to use the app as a source of information. Participants may feel as if they are up to date with important information as a result of spending significant amount of time on TikTok. Participants may be able to keep up with important content if they are spending more time on the application, and therefore, feel less anxious, stress, and sad. Those who do not have this motivation may be more susceptible to increases in psychological distress. This finding could be reflective of some of the other reasons why participants use TikTok, such as for entertainment, procrastination, or meeting others. If participants spend more time on TikTok, and they have motivations other than being part of the information loop, they may be susceptible to feeling like they did not accomplish what they wanted to or that they may be dealing with social comparison, a common experience that college students deal with the more time they spend on social media (Spitzer et al., 2023). More research is needed to better understand why individuals who are not motivated to use TikTok to be part of the information loop reported increased psychological distress.

Based on the relationship between some of these TikTok behaviors and motivations with psychological distress, there are some suggestions that can help minimize feelings of stress, anxiety, and depressive symptoms. First, it might help if college students limit how much time they are on TikTok. Spending excessive amounts of time on TikTok may contribute to feelings of stress, anxiety, and depressive symptoms. Setting limits on the amount of time spent on TikTok may be beneficial long-term when considering an individual's

well-being. In fact, some policies have been introduced in the United States that limit minors use of TikTok to no more than an hour without parental consent. College students may also benefit from curating their For You Page by following and interacting with content that promotes positivity, self-care, and self-improvement. By viewing and interacting with content on TikTok, college students can reinforce the algorithm for the For You Page. Studies have shown that consuming positive media can be beneficial for one's well-being (e.g., Djasasbi et al., 2010). Taking breaks from TikTok may also be necessary to focus and engage in other activities that may be important for college students, like exercising, reading, or spending time with loved ones (e.g., Chen et al., 2017). Future studies should seek to replicate these findings and test these recommendations.

Limitations and Conclusions

Although this study advances knowledge on TikTok and psychological distress, it is not without its limitations. First, data was cross-sectional in nature causing a potential bidirectional relationship, which suggests that people with poor mental health may participate more with social media platforms, including TikTok. The study design also relied on individual items to get a strong sense of whether TikTok related to psychological distress. Additionally, self-reporting on TikTok use is prone to self-serving biases. Also, because no identifying information was collected, it is possible that participants could have completed the survey multiple times. These issues raise concerns about data accuracy and reliability. The sample size is also a limitation when generalizing the findings to a larger population. The study's exclusive emphasis on college students with the financial means to attend college makes it difficult to generalize the findings to people with lower socioeconomic status (SES) throughout the country. The lack of statistical significance in the control variables may stem from limited variation in the sample characteristics and a relatively smaller sample size. Additionally, participants were primarily heterosexual female college students, which limits the generalizability of the study. Furthermore, the motivation scale only used one question per motive; a more effective approach would include an accurate and balanced motivation measure. The scale, though appropriate for other platforms, requires modification considering TikTok. The dichotomous nature of some of the variables, and lack of variability with psychological distress also explains the relatively small standard deviation present in some of the findings. Future studies should incorporate longitudinal designs with more nuanced measures of TikTok behaviors and motivations, and also include more diverse samples.

However, this study provides a preliminary glimpse into the role of TikTok and psychological well-being. It is also important to note that people who never or did not currently use TikTok did not participate in this study. It would be beneficial for future studies to compare TikTok users to nonusers.

The current study examined the relationship between TikTok use and psychological distress among college students and tested whether motivations to use TikTok moderated this relationship. The study found that more time spent on TikTok was associated with higher the levels of psychological distress, unless they were motivated to be part of the information loop. Yet, using TikTok for procrastinating and distractions predicted more psychological distress. The motive to staying in the information loop extends beyond simple time spent on TikTok and other social media sites like Facebook, Instagram, X (formerly Twitter), or even LinkedIn should not be ruled out. Although this study had some limitations, it provides some clarity of how TikTok contributes to psychological distress.

TikTok is a relatively new social media platform, and there is still much to discover about the relationship between TikTok and psychological distress. This study provides empirical evidence that may help future studies on TikTok and psychological distress. Future studies are encouraged to test the efficacy of the recommendations presented in this study to help provide further guidance with TikTok use as it relates to well-being. It is important for TikTok users (and other social media users) to understand the impact social media platforms can have on psychological distress. Not only is it important to understand that certain applications may impact psychological distress, but people should be more aware about how certain social media behaviors and motivations may hinder one's psychological well-being. Understanding the effects of TikTok can aid researchers in understanding and developing interventions to mitigate any negative effects.

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Author Note. Michael R. Langlais <https://orcid.org/0000-001-8892-2808>
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Correspondence concerning this article should be addressed to
Veronica von Fedak, Florida State University, Psychology, 1107 W.
Call St., Tallahassee, FL 32306. Email: veronica.vonfedak@gmail.com

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Understanding Family Dynamics in a Cross-Cultural Sample: A Multi-National Study

Mary Moussa Rogers¹, Kelly Cuccolo², Cliff McKinney³, John E. Edlund⁴, Jon E. Grahe⁵, Martha S. Zlokovich⁶, Lisa M. Bauer⁷, Tatyana El-Kour⁸, Tabea Hässler⁹, Fanli Jia¹⁰, Jill Norvilitis¹¹, Christina Shane-Simpson¹², R. Andrew Yockey¹³, Leslie D. Cramblet Alvarez¹⁴, Léila Eisner⁹, Thomas Rhys Evans¹⁵, Hojjatollah Farahani¹⁶, Sara Haden¹⁷, Gina Hawkins¹⁸, Yoshito Kawabata¹⁹, Tara Stoppa²⁰, Asil Ali Özdoğru^{21,22}, Handan Akkas^{23,24}, Olenka Dworakowski⁹, Amber Matteson⁵, Tifani Fletcher²⁵, Anamaries Garcia Marrero⁵, Stephanie Godleski⁴, Courtney L. Gosnell²⁶, Lynn Heydasch⁹, Amanda Jerge⁴, Arazais D. Oliveros³, Melahat Özge Şimşek²¹, Jessica J. Wegman⁴, Stephanie Wright^{27,28}, Sibo Zhao²⁹, Parvis Azadfallah¹⁶, Rhiannon Gibbs¹⁷, Christopher Koch³⁰, Israel Meth¹⁷, Kalu T. U. Ogba³¹, Irem Metin-Orta³², Christopher Redker³³, Casiana Reyes¹⁹, Lisa H. Rosen³⁴, Rhonda N. Balzarini^{35,36}, Zornitsa Kalibatseva³⁷

¹University of South Carolina Aiken, ²No Affiliation, ³Mississippi State University, ⁴Rochester Institute of Technology, ⁵Pacific Lutheran University, ⁶Psi Chi, the International Honor Society, ⁷University of Missouri – Columbia, ⁸Fielding Graduate University, ⁹University of Zurich, ¹⁰Seton Hall University, ¹¹State University of New York College at Buffalo, ¹²WebMD Health Services Group Inc., ¹³University of North Texas Health Science Center at Fort Worth, ¹⁴University of Denver, ¹⁵University of Greenwich, ¹⁶Tarbiat Modares University, ¹⁷Long Island University, ¹⁸Texas A&M University Corpus Christi, ¹⁹University of Guam, ²⁰Eastern University, ²¹Üsküdar University, ²²Marmara University, ²³Ankara Science University, ²⁴Tilburg University, ²⁵West Liberty University, ²⁶Pace University, ²⁷Georgia Highlands College, ²⁸Georgia Gwinnett College, ²⁹Central University of Finance and Economics, ³⁰George Fox University, ³¹University of Nigeria, ³²Atilim University, ³³Ferris State University, ³⁴Texas Woman's University, ³⁵Texas State University, ³⁶Kinsey Institute at Indiana University, ³⁷Stockton University

ABSTRACT. The Family Systems Circumplex Model posits that balanced levels of cohesion and adaptability are associated with positive familial outcomes, whereas extremely high or low levels of these factors are associated with deleterious outcomes. Despite the popularity and utility of this model in Western cultures, there is a dearth of empirical data supporting its use in more culturally diverse contexts. The current, preregistered study assessed the Family Circumplex Model, cultural factors, and emerging adult outcomes across 7 countries (i.e., China, Iran, Nigeria, Switzerland, Turkey, the United Kingdom, and the United States). Participants were $N = 3,593$ emerging adults, mostly self-identifying as women (71.3%).



Diversity badge earned for conducting research focusing on aspects of diversity. Open Data, Open Materials, and Preregistration badges earned for transparent research practices. Data and materials are available at <https://osf.io/xdyq7/>. The preregistration can be viewed at <https://osf.io/qba7v/>.

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Collaborators were participants in Psi Chi's Network for International Collaborative Exchange (NICE) and administered measures related to family dynamics and cultural orientation to participants in a random order. Results indicated that the Family Circumplex Model did not fit cross-culturally. As such, a new model was adapted, the Expanded Circumplex Model, which demonstrated invariance across samples and between women and men. The Expanded Circumplex Model retained 6 constructs with differences regarding the separation of disengagement into 2 variables and the combining of adaptive flexibility and cohesion. The current study suggests that the cultural context in which family dynamics occur should be taken into consideration when conceptualizing family dynamics theory and measurement. Future work should seek to replicate and further apply the Expanded Circumplex Model to familial outcomes.

Keywords: Family Circumplex Model, family dynamics, open science, cross-cultural psychology

Families look and function differently, and these differences must be considered across the lifespan. Some individuals come from single-parent family structures, from homes with high levels of communication and warmth, or homes with high levels of conflict and stress. Family structures and dynamics have been shown to influence behavioral outcomes among adults such as risky sexual behavior or substance use (Oliveira et al., 2020). Hence, it is not surprising that examination of family structures and dynamics is an important component in understanding psychopathology, behavioral etiology, and targets of intervention (Härkönen et al., 2017). What continues to need clarification, however, is how these structured interventions may vary between different cultures and contexts. Indeed, due to the high clinical relevance of family dynamics, it is desirable that empirical results be generalizable to other contexts within and across countries.

Despite years of research, however, there has been mixed success in validating models of family structure cross-culturally (e.g., Rada & Olson, 2016; Turkdogan et al., 2019; Pirutinsky & Kor, 2023). Although cross-cultural research on attachment has been conducted applying the widely used Circumplex Model of Family Dynamics (e.g., van Ijzendoorn & Sagi-Schwartz, 2008), which postulates that developmental outcomes are relevant to cohesion and adaptability within family structures, this body of work has found mixed results in cross-cultural samples (Pirutinsky & Kor, 2013; Yi, 2009). To illustrate, Pirutinsky and Kor (2013) observed that the Circumplex Model did not appropriately describe the family dynamics of Orthodox Jews in Israel. Ultimately, outcomes in this sample were better explained by a model including

cohesion-adaptability, enmeshment, chaos, and disengagement (a four-factor structure) than the original model structured around cohesion and adaptability (two factors).

Furthermore, research on parenting styles suggests different mental health outcomes by regions within the United States, as well as across different countries (Lansford, 2010; McKinney & Brown, 2017; Sorkhabi, 2005). This suggests that aspects of the parent-child relationship, including conflict, cohesion, discipline, communication, and warmth, vary by ecological context (Sorkhabi & Mandara, 2013; Szapocznik & Kurtines, 1993). A person's individual experience is likely influenced by their environment (e.g., norms, expectations, culture). Thus, children in different environments are likely to perceive family dynamics and parent behaviors differently, and therefore, may experience different psychological outcomes (Lerner & Kauffman, 1985; McKinney & Brown, 2017).

Another factor hindering the generalization of family research is bias in sample selection. Family interventions and policies have been potentially biased by an overreliance on research involving Western, Educated, Industrialized, Rich, and Democratic (WEIRD) populations, as well as a focus on White persons within WEIRD countries (Ards et al., 1998; Pelton, 2015; for more information on WEIRD populations see Henrich et al., 2010; Olson et al., 2019). Furthermore, recent research has indicated that the largest growing populations are in Africa and the Middle East, yet these populations are most often left out of research, thus indicating a greater need for research including participants from these areas (United Nations, 2019).

Family Circumplex Model

Developed in Western contexts, the Family Circumplex Model is a foundational model in family research that proposes that family systems, style of interaction, and structure affect the development and mental health of individuals within the system (Olson, 2000; Olson et al., 1979; Olson et al., 2019). The two major components of this model are cohesion and adaptability. The first component, cohesion, is defined by the level of closeness between family members, loyalty, and level of dependence on one another. Cohesion ranges from disengaged (e.g., family members spending little to no time together or actively avoiding one another) to enmeshed (e.g., family members spending the majority of their time together and depending on one another highly). The second component, adaptability, includes whether leadership is shared in the family (e.g., authoritarian leadership in rigid families), the types of discipline used (e.g., inconsistent discipline in chaotic families), role change (e.g., roles change as children age in adaptable families), and change to dynamics under external stress (e.g., structured families change when demanded). Significant research has found success validating the Circumplex Model in European contexts (e.g., Everri et al., 2020; Vegas et al., 2022) and, with necessary revision, in African or Middle Eastern contexts (Megersa & Tefera, 2022; Sarour & El Keshky, 2022; Turkdogan et al., 2019). Research regarding the Family Circumplex Model has generally supported that children have the most positive outcomes when families have high cohesion, characterized by strong bonds with some autonomy, and high adaptability, characterized by the ability to share roles and leadership and change dynamics somewhat when under duress (Gomes & Gouveia-Pereira, 2020; Kouneski, 2002). Further, balanced family systems are thought to have good communication (i.e., members actively listen to others and only speak for themselves) while unbalanced systems have poor communication (i.e., speaking for others, inappropriate self-disclosure, lack of active listening; Dunst, 2021; Kouneski, 2002).

Although an abundance of research has suggested that less optimal family dynamics are associated with negative outcomes, multiple studies demonstrated mixed findings regarding the measurement of family dynamics as well as outcomes across cultures (Olson et al., 2019). The Family Circumplex Model's foundation is grounded in Westernized values of individualism and autonomy, which might not promote optimal outcomes across all cultures or contexts (Kouneski, 2002; Pirutinsky & Kor, 2013). Pirutinsky and Kor (2013) suggested that assumptions made by the Family Circumplex Model may require adjustment in cross-cultural samples to better generalize to family functioning

in nonwesternized samples, and Olson (2000) also suggested that family outcomes would vary based on family member satisfaction within the dynamic. More specifically, Olson (2000) discussed the likelihood that ethnic and cultural considerations would change what was considered functional within a family system, and that interpretation by clinicians should be guided by this understanding (Gorall & Olson, 1995). Furthermore, the most recent version of the self-report questionnaire assessing this model also incorporates satisfaction, as Olson (2011) suggested that individual perception may impact relevant outcomes. Understanding that cultural context changes how family dynamics influence future behaviors is central to understanding how to measure and generalize the Circumplex Model across contexts.

Cross-Cultural Family Dynamics

Because the family unit is an important system for human development, it is imperative to consider the continuum of collectivist and individualistic values that affect the way individuals perceive themselves within family systems. Collectivism values group-oriented priorities over individual needs and highlights societal values, whereas individualism prioritizes individuality, autonomy, and agency over the values of their systems (Schwartz et al., 2012). Thus, family cohesion may be different in a collectivist society where individualism and autonomy may be less valued. Indeed, positive life outcomes may be promoted in collectivist societies through more rigid family dynamics and the presence of filial piety (Chen, 2014). Similarly, values of conservatism and authoritarianism in certain regions of the United States may promote respect for authority figures, such as family elders (McKinney & Brown, 2017). These societal factors and values may play important roles in understanding the family system and potential associated outcomes of children in these families.

An empirical study conducted in Turkey, mainly a collectivistic and relational culture (Kağıtçıbaşı, 2007), showed that parental overprotection and guilt induction are positively related to perceived parental warmth and not associated with attachment insecurity among Turkish school children (Sümer & Kağıtçıbaşı, 2010). Additionally, some emerging adult children may be satisfied with lower or higher frequency of supportive behaviors. Thus, the level of cohesion that children report may be impacted by how much and what type of support they receive from their parents (Furman & Buhrmester, 1992). The construct of cohesion may change based on cultural values and how those values impact children's perceptions of their parents' behaviors. Olson has also suggested renorming of cohesion when evaluating the validity of the model (Olson et al., 2019).

Moreover, research has suggested that families with different cultural backgrounds and unique circumstances (e.g., cancer diagnosis) may have cohesion, but still require intervention (Yi, 2009).

Current Study

The current study assessed the Family Circumplex Model to determine validity across samples with varying cultures and demographics. The current study used multigroup analysis to determine differences and similarities in family dynamics across regions within the United States, and between countries outside of the United States, and focused on culture, location, and gender. A preregistration template detailing all methods, measures, hypotheses, and planned analyses was completed prior to data collection.

Hypothesis 1 stated that the Circumplex Model would be validated in individual samples from more Westernized regions and cultures (e.g., Northeastern and Midwestern regions of the U.S., Switzerland, and the United Kingdom), but that it would have poorer model fit for less westernized samples (e.g., Iran, Nigeria). Given that this hypothesis was somewhat exploratory, and the few international studies to date, we anticipated that exploratory factor analysis would be required if the theoretical model fit was poor (e.g., Pirutinsky & Kor, 2013). Thus, Hypothesis 2 stated that exploratory factor analysis may reveal a model that better fits samples with poorer model fit from Hypothesis 1.

Method

Procedure

Collaborators were invited to collect online survey data of their institution's students through Psi Chi's Network for International Collaborative Exchange (NICE): Crowd, crowd-sourced project (Cuccolo et al., 2021; see also: <https://osf.io/4ct72/>). Collaborators voluntarily signed up if they were interested in the project and did so in exchange for shared crowd-sourced data upon completion, as well as authorship on the main publication. Collaborators at each site completed their own Institutional Review Board protocol housed under their own institution, with the indication that aggregate anonymous data would be shared upon completion of data collection. All data collections were conducted anonymously online with some completed through undergraduate psychology participant pools, some through voluntary participation, and others through paid participation. Qualtrics was used for almost all data collections, with several sites using Google Forms or Unipark when Qualtrics was not supported at the collaborator's institution. The study's seven measures assessed demographics (including an assessment of

TABLE 1

Demographics

	<i>N</i>	%
Current primary caregiver		
Biological Mother	2,538	78.0
Biological Father	558	17.0
Grandmother	53	1.6
Adoptive Mother	46	1.4
Adoptive Father	15	0.4
Parents deceased		
No	2,175	92.8
Yes	189	7.2
Hours spent with primary mother / caregiver figure		
0–1 hours daily	1,676	46.8
1–2 hours daily	1,026	28.7
2–5 hours daily	600	16.8
5–10 hours daily	190	5.3
>10 hours daily	88	2.5
Hours spent with primary father/caregiver figure		
0–1 hours daily	2,360	66.5
1–2 hours daily	712	20.1
2–5 hours daily	339	9.6
5–10 hours daily	98	2.8
>10 hours daily	38	1.1
Country Born		
United States of America	2,672	70.8
Turkey	241	6.4
China	195	5.3
United Kingdom of Great Britain and N Ireland	174	4.6
Nigeria	85	2.1
Switzerland	56	1.5
Another Country	330	9.1
State Born (U.S. Residents)		
New York	537	19.0
Texas	335	11.8
Mississippi	250	8.8
Georgia	158	5.6
Minnesota	132	4.7
Michigan	112	4.0
North Dakota	105	3.7
California	105	3.7
Washington	96	3.4
Pennsylvania	83	2.2
Another State	790	28.0

socioeconomic status, SES) as well as family dynamics, filial piety, cultural orientation, emerging adulthood adjustment, substance use, and risky sexual behaviors. Questionnaires were presented in randomized order to participants, who were asked to respond based on current perceptions of current family interactions. Measures were piloted in countries where English was not the first language to determine if translation was necessary. After piloting, it was only necessary to translate measures into German, Persian, and Turkish. Measures were translated and back-translated using standard practice (e.g., Chapman & Carter, 1979).

Participants

Each collaborator obtained at least 100 participants, resulting in data collection from emerging adults at 18 sites across the United States (see Table 1) and six sites outside the United States located in China, Nigeria, Switzerland, Iran, Turkey, and the United Kingdom ($N = 3593$). Participants ranged in age from 18 to 63 ($M = 20.31$, $SD = 4.14$) with the most indicating their gender as women (71.3%) and the remaining reporting men (27.9%) and nonbinary (0.4%). Participants in the United States reported racial backgrounds of White (59.1%), Black (12.3%), Hispanic (10.1%), Asian (11.9%), Native American (0.8%), Native Hawaiian (0.9%), and Other (4.2%). Participants reported that 11.6% of fathers and 10.4% of mothers completed education lower than a primary education degree or high school equivalent, 35.7% of fathers and 29.4% of mothers completed a primary education degree or high school equivalent, 12.3% of fathers and 15.3% of mothers completed a 2-year higher education degree, 24.6% of fathers and 27.9% of mothers completed a four-year degree, and 15.8% of fathers and 17.0% of mothers completed a graduate degree.

Measures

Family Circumplex Model

The Family Adaptability and Cohesion Scale (FACES-IV; Olson, 2011) is a 42-item measure that assesses adaptability and cohesion dimensions of family dynamics on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Six subscales include Balanced Cohesion (e.g., Family members are involved in each other's lives), Balanced Adaptability (e.g., Discipline is fair in our family), Disengaged (e.g., Our family seldom depend on each other), Enmeshed (e.g., We spend too much time together), Rigid (e.g., Our family is highly organized), and Chaotic (e.g., Things do not get done in our family). Published studies validating FACES included samples from North America and Europe and consistently demonstrated good internal reliability with Cronbach's

alpha scores ranging from .75 to .89 (Olson, 2011). The FACES has also been used in China ($\alpha = .74$; Ye et al., 2019) and Korea ($\alpha = .76-.89$; Lee et al., 2010), as well as with Asian Americans (Cheung & Park, 2010). Alphas for the current study ranged from .77 to .87.

Cultural Orientation

The Culture Orientation Scale (Triandis & Gelfand, 1998) is a 16-item measure that assesses four dimensions of cultural orientation on a 9-point scale ranging from 1 (*never or definitely no*) to 9 (*always or definitely yes*). Four subscales include Vertical Collectivism (e.g., Family members should stick together, no matter what sacrifices are required), Vertical Individualism (e.g., Winning is everything), Horizontal Collectivism (e.g., If a coworker gets a prize, I would feel proud), and Horizontal Individualism (e.g., I rely on myself most of the time; I rarely rely on others). Multiple studies have indicated good convergent and discriminant validity with similar measures with alphas ranging from .62 to .80 (Triandis & Gelfand, 1998). The current study created one Total Orientation scale for use in the prediction model by reverse coding the Vertical and Horizontal Individualism scales and summing them with the Collectivism scales, such that higher scores indicated higher levels of collectivism and lower scores indicated higher levels of individualism, which resulted in an alpha of .83 (Triandis & Gelfand, 1998). Furthermore, to differentiate cases by cultural orientation for use in confirmatory factor analysis model testing, cutoffs were used for scores > 72 as collectivistic and < 72 as individualistic (e.g., Cai & Fink, 2002).

Data Analytic Plan

Preliminary Analyses

A priori power analyses indicated that a sample size of 890 with a moderate correlation ($r = .30$) with $\beta = .20$ would power the analyses adequately (Byrne, 2016; Hulley et al., 2007; Kline, 2014). Cases missing greater than 5% of data were removed, resulting in a loss of $N = 40$ across variables. The 15 cases reporting non-binary gender identity were not incorporated in the metric invariance testing analyses due to the small sample size. All variables were analyzed for assumptions (i.e., linearity, normality, homoscedasticity, and multicollinearity; see Kline 2013, 2014; Tabachnik & Fidell, 2007). Stochastic regression imputation using maximum-likelihood estimates was then conducted in AMOS 26.0.

Results

Structure of Family Dynamics

Hypothesis 1a

To test Hypothesis 1a, confirmatory factor analysis was

conducted using six latent factors of the Circumplex Model (i.e., Cohesion, Disengaged, Enmeshment, Adaptability, Chaotic, and Rigid) indicated by loading the seven items from each subscale onto the latent variables as described across multiple studies validating the FACES-IV (Olson, 2011). Following recommendations (Hu & Bentler, 1999; Schreiber et al., 2006; Schumacker & Lomax, 2016), we used several model fit indices to examine the entire sample together. Fit indices evaluated included (a) the comparative fit index (CFI), (b) the Tucker-Lewis index (TLI), (c) the standardized root mean square residual (SRMR) with values less than .08 suggesting good fit and less than .06 better fit, and (d) the root mean square error of approximation (RMSEA) with values less than .05 indicative of excellent fit and between .08 and .05 considered good fit. To improve fit, modification indices were examined. Error terms were correlated when modification indices suggested at least a 20-point change in the chi-square parameter due to similarity of question wording. To maintain the same model used by Olson (2011), no items were deleted. Once the overall sample did not have good fit, individual samples were tested in a multilevel confirmatory factor analysis, and the same steps described above were conducted.

When the CFA failed to fit the overall and individual samples of data, in order to test Hypotheses 1b, a random half of the dataset was selected, and an exploratory factor analysis was conducted in SPSS 26.0. Maximum likelihood method of extraction was used, with a direct oblimin rotation (Costello & Osborne, 2005). The scree plot, eigenvalues, and pattern matrix were examined to determine the number of factors and items per factor (O'Connor, 2000). Items were selected for each factor if their loading was greater than .50 on the factor and less than .20 on any other factors. The other half of the dataset was then used to conduct a CFA on the new model. To achieve good model fit, modification indices were examined to delete items that cross-loaded inappropriately until the good model fit was achieved. To examine metric invariance of the new model, a multigroup analysis was then conducted with each sample as an individual group, and an additional analysis was conducted for gender. Fit indices were used to determine configural, metric, and scalar invariance across samples and gender (Putnick & Bornstein, 2016).

Hypothesis 1b

Descriptive statistics for all measures can be found in Table 2. Fit indices for each model's CFA can be found in Table 3. Confirmatory factor analysis of the Circumplex Model in the overall sample had a poor model fit before and after correlating error terms. Similarly, the Circumplex Model did not fit in any of the individual

samples, neither the individualistic sample, nor the geographically western sample. An exploratory factor analysis of a random half of the sample was conducted, and the scree plot suggested models with between four and eight factors. Examination of the pattern matrix and eigenvalues determined that items on the seventh

TABLE 2

Descriptive Statistics

	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>
Collectivism	16.00	134.00	85.76	11.73
Disengagement	7.00	35.00	17.91	5.18
Enmeshment	7.00	35.00	15.71	4.99
Rigid	7.00	35.00	19.73	5.27
Chaotic	7.00	35.00	16.43	5.44
Cohesion	7.00	35.00	27.10	5.49
Flexibility	7.00	35.00	24.28	5.42

TABLE 3

Model Fit Indices

Sample	χ^2	<i>df</i>	TLI ¹	CFI ¹	RMSEA ¹	SRMR ¹	Error Terms				
							Correlated	TLI ²	CFI ²	RMSEA ²	SRMR ²
Overall	143,124.50	804	.75	.78	.07	.07	63	.84	.86	.06	.06
USA	91,537.35	804	.75	.77	.07	.07	48	.83	.85	.06	.07
Individualistic	41,205.14	804	.72	.79	.08	.08	58	.79	.82	.07	.09
Collectivistic	41,041.27	804	.70	.69	.08	.09	57	.80	.83	.06	.08
North Dakota	20,188.39	804	.74	.72	.09	.09	40	.72	.75	.08	.08
Mississippi	27,400.59	804	.72	.73	.08	.09	28	.77	.80	.07	.08
Texas ¹	23,617.64	804	.67	.68	.10	.11	25	.74	.78	.07	.08
New York ¹	17,157.48	804	.64	.66	.08	.10	19	.70	.74	.08	.08
New York ²	20,905.57	804	.64	.66	.09	.10	25	.73	.76	.08	.08
Turkey	21,877.34	804	.61	.63	.10	.11					
Georgia	17,936.20	804	.60	.61	.11	.12					
UK	20,948.29	804	.60	.61	.10	.11					
China	15,558.10	804	.57	.58	.10	.11					
Michigan	15,036.15	804	.52	.54	.12	.14					
Pennsylvania	14,176.78	804	.51	.52	.12	.13					
Texas ²	14,465.37	804	.48	.10	.12	.13					
Wisconsin	15,161.95	804	.48	.50	.13	.15					
West Virginia	16,538.48	804	.48	.50	.12	.14					
New York ³	15,719.54	804	.46	.50	.12	.13					
Washington	16,984.26	804	.42	.44	.14	.16					
New York ⁴	16,599.92	804	.30	.34	.16	.18					
Nigeria	14,759.61	804	.30	.34	.16	.18					

Note. Subscript for fit indices indicates pre and post error terms correlated. Subscript for samples indicate separate universities within the same state of the United States

and eight factor cross-loaded and were not useful for model creation. Additionally, the fifth and sixth factors appeared to contribute a meaningful portion of the variance (i.e., > 3% each). Thus, a six-factor model was examined with items that loaded greater than .50 on one factor and less than .20 on other factors. A CFA of the six-factor model revealed that the fit was just below adequate (i.e., CFI = .91, TLI = .89, RMSEA = .05,

SRMR = .05); thus, removal of five items that had high regression weights and cross-loaded onto other items resulted in good model fit (i.e., CFI = .96, TLI = .95, RMSEA = .04, SRMR = .03). This resulted in a 19-item, six-factor measure (see Table 4).

Metric invariance was then tested using multigroup analysis for each individual sample collected. Multigroup analysis of all 18 samples (i.e., $n > 100$) revealed Δ CFI was less than .001, Δ RMSEA was less than .001, and Δ SRMR was less than .001, suggesting that metric invariance was achieved across all samples (see Table 5). Similarly, gender multigroup analysis resulted in Δ CFI less than .001, Δ RMSEA less than .001, and Δ SRMR less than .001, also suggesting metric invariance across gender of reporters (see Table 6). Thus, the constructs of the new model were similar across samples and genders reporting. The new model (i.e., Expanded Circumplex Model) consisted of six variables (see Table 4) including (a) *Cohesive Adaptability*, which is a mixture of items representing both the Olson model cohesion and adaptability constructs and suggesting overall adaptive family functioning; (b) *Chaotic Roles*, which include items from the chaotic construct that all focus on a lack of clarity of role within family; (c) *Consequences*, which includes items from Olson's rigid construct specifying clarity of consequences and strictness of consequences; (d) *Enmeshment*, which includes two of the original items from Olson's enmeshment construct; (e) *Avoidance of Family*, which includes items from Olson's disengaged construct regarding preference of spending time outside of the family; and (f) *Seldom Depend*, which also includes items from Olson's disengaged construct with items focusing more on family members seldom doing things together rather than preferring to spend time apart. Although *Avoidance of Family* and *Seldom Depend* are conceptually similar, factor loadings suggested that respondents did not vary their responses together if they indicated purposeful avoidance of family contrasting to family members not requiring one another to live their daily lives.

Discussion

The results of the current study suggest that the Circumplex Model did not achieve adequate fit across a global sample, thus supporting Hypothesis 1. Unexpectedly, the model also did not fit within the individual samples collected, including samples from similar regions collected for the validation of the FACES-IV (Olson, 2011). It must also be noted that in the validation study of the FACES-IV, no error terms were correlated in contrast to the current study where model fit was not achieved prior to or after correlating error terms (Olson, 2011). Furthermore, in the FACES-IV validation study,

TABLE 4

Final 6-Factor Solution With Factor Loadings

FACES-IV Item	Factor					
	1	2	3	4	5	6
Factor 1: Cohesive/Flexibility						
13. Family members are supportive of each other during difficult times	.78	-.02	.01	.02	-.03	.02
14. Discipline is fair in our family	.64	.02	.04	.02	.03	.01
19. Family members consult other family members on important decisions	.62	.07	.03	.01	.01	-.05
20. My family is able to adjust to change when necessary	.71	.10	-.05	.03	.20	.06
25. Family members like to spend some of their free time with each other	.70	.02	.03	.13	-.03	.05
31. Although family members have individual interests, they still participate in family activities	.68	.02	.01	-.05	.02	.13
37. Our family has a good balance of separateness and closeness	.69	.03	.01	.01	.02	.01
Factor 2: Chaotic Roles						
12. It is hard to know who the leader is in our family	-.06	.65	-.08	.01	.02	.02
24. It is unclear who is responsible for things (chores, activities) in our family	.05	.60	-.14	.03	.10	.03
30. There is no leadership in our family	.06	.83	-.05	.05	.10	.06
Factor 3: Consequences						
11. There are clear consequences when a family member does something wrong	.05	-.10	.73	.05	.06	.07
5. There are strict consequences for breaking the rules in our family	.03	-.02	.86	.03	.01	.01
Factor 4: Enmeshment						
4. We spend too much time together	.03	-.02	.02	.63	.01	.02
28. We feel too connected to each other	.09	.02	.03	.76	-.06	-.03
Factor 5: Avoid Family						
9. Family members seem to avoid contact with each other when at home	-.03	.01	.02	.02	.72	.10
3. We get along better with people outside our family than inside	.03	.05	.03	.19	.58	.12
39. Family members mainly operate independently	.01	.02	.01	-.20	.50	.13
Factor 6: Seldom Depend						
33. Family members seldom depend on each other	-.05	.03	.02	.01	.05	.67
27. Our family seldom does things together	.03	.01	.01	.02	.06	.75

participants were recruited through college attending university students who engaged in snowball recruitment, with the final sample ranging in age from 18 to 59 in comparison to the current samples range from 18 to 63. A new model was therefore created; however, it is important to note that replication is key to determining the robustness of the Expanded Circumplex Model. Although the constructs were relatively similar to the Circumplex Model, some notable differences exist.

Specifically, the Circumplex Model consists of six constructs on dimensions of adaptability (i.e., Adaptability, Chaotic, and Rigid) and cohesion (i.e., Cohesion, Disengaged, and Enmeshment). The Expanded Circumplex Model also consists of six constructs, starting with Cohesive Adaptability which reflects both cohesion and adaptability constructs, suggestive of an overall adaptive family functioning construct. Along the dimension of cohesion, Enmeshment remained the same with fewer items in the new construct; however, Disengagement appeared to be comprised of two separate constructs, one suggestive of preferring to spend time with others outside of the family (i.e., Avoidance of Family) and one suggestive of rarely spending time with family members (i.e., Seldom Depend on Family). Chaotic Adaptability became Chaotic Roles, with questions focusing on chaotic leadership in the family, whereas Rigid Adaptability became Consequences with questions focusing on strict, clear consequences for actions in the family. The final new model resulted in a 19-question survey that had good fit across the entire sample and was not significantly different within individual samples (i.e., metric invariance). Given that there is some consistency between the Expanded Circumplex Model and the Circumplex Model, global family dynamics may not be as different as expected and may not be as regionally or culturally discriminant as expected. Indeed, the newly identified model demonstrated invariance across samples of emerging adults regardless of region or culture.

Limitations

Although the sample was relatively large, diverse, and represented similar ages compared to samples used in previous validation studies (e.g., Olson, 2011), the use of a cross-sectional sample of mostly college-attending emerging adults has limitations. Furthermore, the distribution of participants from rural, urban, or suburban locations is unclear in the current study. Samples of similar age groups that are not in college may uncover family dynamics that differ from the current sample, which may influence the validation of the Circumplex Model or the new model. Furthermore, the use of samples with younger children or parent-report may further

change the validation outcome for either model. The use of the FACES-IV may be a limitation such that there may be facets of family dynamics that were not addressed in the measure for our global sample, particularly with regard to language barriers. Specifically, qualitative research on family dynamics with other cultures and languages may better assist in describing the family dynamics of other cultures than the use of an English-validated model and measure. Given that the Circumplex Model has multiple studies that support its validation, however, it is important that replication occurs to determine if the Expanded Circumplex Model continues to represent diverse samples of family dynamics. Furthermore, given that certain aspects of the previous validation studies' methodologies were not known to the current authors, it is difficult to determine if the same analysis procedure was followed, and thus difficult to say whether the current study was able to replicate the Circumplex Model adequately. Analytical variability has contributed to failures to replicate in other recent large-scale collaborations (Jones et al., 2018). Additionally, the samples collected in the current study may not reflect the samples collected in the FACES-IV validation study, which may have resulted in a cohort effect. Finally, the inclusion of Middle East/North African (MENA) and African populations were narrow and, while demonstrating the increasing need for those populations in foundational theory, require further broader inclusion.

Conclusions

Considering the widespread use of the Circumplex Model and the FACES-IV in clinical applications and

TABLE 5

**Multigroup Analysis Fit Indices
Across Individual Samples**

Model	CFI	RMSEA	SRMR	$\chi^2(df)$
Unconstrained	.95	.03	.05	3,650.40 (2,055)
Measurement Weights	.95	.03	.05	3,889.54 (2,237)
Structural Covariances	.94	.03	.10	4,946.58 (2,531)
Measurement Residuals	.94	.03	.10	5,785.55 (2,797)

TABLE 6

**Multigroup Analysis Fit Indices
Across Binary Gender**

Model	CFI	RMSEA	SRMR	$\chi^2(df)$
Unconstrained	.93	.01	.05	3,408.20 (2,055)
Measurement Weights	.92	.02	.05	3,765.23 (2,237)
Structural Covariances	.89	.02	.09	4,686.67 (2,531)
Measurement Residuals	.85	.02	.10	5,635.60 (2,797)

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practice, the current study may provide some insight into its utility and interpretation, particularly for diverse families. Regarding use of the FACES-IV, it is suggested that interpretation should shift based on cultural and ethnic norms (Gorall & Olson, 1995; Olson et al., 2019). In a world increasing in globalization and shifting cultural standards, the current study confirms the need to assess cultural factors relevant to families in psychodiagnostics and intervention targets. Some aspects of the current study results suggest unique needs for interpretation across international families, specifically, further examination of nuanced differences among disengagement regarding active avoidance rather than more passive separateness. Future directions regarding clinical outcomes and implications for different cultural or geographic backgrounds may be key to understanding the potential utility of a modified Circumplex Model. Replication is required before a shifted model, the Expanded Circumplex Model, is used to inform clinical practice. However, we are optimistic about the likelihood of replication given the creation of a global model with good fit. Refinement of The Expanded Circumplex Model may also be furthered by mixed methods (i.e., qualitative and quantitative) in global samples. Importantly, the current study demonstrated that cross-cultural research benefits the understanding of clinical models currently in use and further demonstrates the necessity of inclusion of MENA and African peoples in cross-cultural research.

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Correspondence concerning this article should be addressed to Mary Moussa Rogers, Department of Psychology, University of South Carolina Aiken, 471 University Parkway, Aiken, SC, 29801. Email: mary.rogers@usca.edu

Comparing Traditional and Modern Teaching Methods in Mathematics Education: Effects on Undergraduate Students' Achievement and Motivation

Benjamin J. Norton
Psychology Department, Lyon College

ABSTRACT. This study explored the influence of teaching methodology and education level on college students' mathematical achievement and motivation. We predicted the scores on respective measures to be higher for students in the modern teaching method as compared to the traditional teaching method, and that scores would increase with the level of mathematics education. Forty-three undergraduate students from a private liberal arts college participated in the experiment. A pretest-posttest design was used to examine mathematical achievement; the Mathematics Motivation Questionnaire was administered following the intervention to measure motivation. Interestingly, teaching method had little to no effect on student achievement, $F(1, 37) = 2.00, p = .17$, partial $\eta^2 = .05$, and motivation, Wilks' Lambda = .86, $F(1, 41) = 1.25, p = .30$, though the advanced and intermediate students scored significantly higher on the posttest, $F(2, 37) = 3.96, p = .03$, partial $\eta^2 = .18$, and the motivation subscores of self-regulation, self-efficacy, and utility value, Wilks' Lambda = .59, $F(2, 40) = 2.16, p = .03$, than the introductory students. Implications include instruction oriented toward motivating students on their mathematical abilities, encouraging connection and recall to previously learned concepts, and continued assessment of long-term influences of teaching methodology on success outcomes.

Keywords: mathematics education, teaching methods, college students, achievement, motivation

The effectiveness of teaching methods in education has long been a subject of inquiry, with educators continually exploring ways to enhance instructional efficiency and effectiveness. In mathematics education, the conventional approach often involves introducing topics with concrete examples and gradually progressing toward more abstract concepts as students develop their understanding through practice (McNeil et al., 2019). These teaching methods, whether traditional or modern, play a pivotal role in shaping the learning experience.

Traditional teaching methods are teacher-centered, emphasizing lectures and textbook-driven memorization through repetition and practice problems (Demirel, 2012, as cited in San & Kis, 2018; Hidalgo-Cabrillana & Mayan-Lopez, 2018; Tularam & Machisella, 2018). This approach relies on clear explanations, demonstrations, and guidance from the instructor to achieve skill mastery (Noreen & Rana, 2019; Umugiraneza et al., 2017;

Voskoglou, 2019). In contrast, modern teaching methods prioritize student engagement and comprehension through activities that foster critical thinking, problem-solving, and collaborative learning (Noreen & Rana, 2019; Tularam & Machisella, 2018). These methods promote active participation, discussion, and the development of higher-order thinking skills (Bonwell, 1991, as cited in Roop et al., 2018; Hidalgo-Cabrillana & Mayan-Lopez, 2018).

The preference of teaching method varies with the students' education level. Modern teaching methods tend to yield significant results in primary education by promoting deep conceptual understanding (Hidalgo-Cabrillana & Mayan-Lopez, 2018; McNeil et al., 2019) and demonstrate improved performance in secondary education (Akcakin, 2017; Damrongpanit, 2019; Noreen & Rana, 2019; Umugiraneza, 2017). However, instructors may default to using traditional approaches when faced with unfamiliar material, exacerbated even more when they know only a handful of alternative methods for

instruction and assessment (Umugiraneza et al., 2019). Conversely, traditional methods may be favored due to their relative simplicity and frequency of usage as a tried-and-true method (San & Kis, 2018). In postsecondary education, students often express a preference for modern methods when given a choice (Roop et al., 2018; Voskoglou, 2019). These methods adapt content to the developmental stage of students, addressing foundational concepts in lower-level courses and more complex ideas in upper-level courses, often yielding outcomes that match or exceed traditional approaches.

Mathematical achievement is commonly measured by assessing a student's mastery of mathematical concepts through problem-solving and performance on tests (McNeil et al., 2019; Noreen & Rana, 2019). This achievement can also involve setting goals, both external (e.g., awards and competitions) and internal (e.g., self-satisfaction; Akcakin, 2017). Some studies additionally break down mathematical achievement into components such as mathematical self-efficacy, achievement motivation, and attitude, which collectively influence overall achievement (see Damrongpanit, 2019). *Mathematical motivation* reflects a student's interest and desire to understand mathematical concepts (Damrongpanit, 2019). It encompasses intrinsic value, self-regulation, self-efficacy, utility value, and test anxiety (Fiorella et al., 2021). Motivation can also be assessed based on learning strategies, perceived value of learning, goal orientation, and the learning environment (Akcakin, 2017).

Roop et al. (2018) and Voskoglou (2019) previously investigated the two instructional methods on collegiate populations with results favoring the modern methods in terms of producing higher rates of achievement and preference, paralleling those conducted on primary and secondary school populations (Hidalgo-Cabrillana & Mayan-Lopez, 2018; McNeil et al., 2019; Noreen & Rana, 2019); however, both studies targeted a single, introductory-level course rather than surveying a more general student population. Mathematical motivation has been studied less frequently with this population, presenting a relative gap in the literature, especially when surveying students with various levels of mathematical backgrounds and experiences.

In the current study, we assessed the impact of both traditional and modern teaching methods on college students across various levels of math education. In alignment with prior findings, students who were exposed to modern teaching methods were expected to demonstrate higher scores in both achievement and motivation when compared to their counterparts in the traditional teaching group; similarly, we expected that students with advanced mathematical experience would outperform those at intermediate and introductory levels.

Method

Participants

Forty-three undergraduate students were recruited through convenience sampling from a small private liberal arts college in Arkansas: participants ranged

TABLE 1

Participant Demographic Characteristics by Condition and Education Level

Characteristic	Teaching Condition		Mathematics Education Level			
	Traditional	Modern	Introductory	Intermediate	Advanced	Total
Gender						
Men	13	17	13	7	10	30
Women	9	4	7	4	2	13
Race/Ethnicity						
African American	0	6	5	0	1	6
Asian	0	1	0	0	1	1
Asian American/ Pacific Islander	3	1	0	1	3	4
European American	15	10	10	9	6	25
Hispanic/Latin American	0	2	2	0	0	2
Multiracial	2	1	2	1	0	3
Other/Not Specified	2	0	1	0	1	2
Total	22	21	20	11	12	43

Note. Chi-squared tests were run to evaluate the similarity of groups based on the demographic variables recorded. The only pairing that showed significant difference was between race/ethnicity and teaching condition, $\chi^2(7) = 16.00, p = .03$, Cramer's $V = .61$, which is most likely due to the demographics of the population the sample was pulled from.

TABLE 2

Pretest and Posttest Exercises With Overall Average Scores

Exercise	M	SD
Pretest		
Evaluate 8^4 .	4.14	1.46
If you have 10 trophies, how many ways are there to arrange 8 of them on a shelf?	1.72	1.40
There are 13 jellybeans in a jar. How many ways are there to choose 4 of them if order does not matter?	1.65	1.45
Posttest		
Evaluate ${}_8C_3$.	3.91	1.66
How many total outfits can you create with 5 shirts, 4 pants, 8 pairs of socks, and 5 pairs of shoes?	4.70	1.01
How many unique ways are there to rearrange the letters in "NEW YORK"?	3.77	1.62
5 people are selected from a class made up of 7 juniors and 8 seniors to represent the college population in a study. How many ways are there to select 2 juniors and 3 seniors from the class?	2.54	1.45
Evaluate ${}_7P_3$.	3.63	1.96
How many possible 10-digit phone numbers are there: (XXX) XXX-XXXX?	3.58	1.68

Note. $N = 43$.

in age from 18–24 ($M = 19.95$, $SD = 1.57$); identified as women ($n = 13$) or men ($n = 30$); were African American ($n = 6$), Asian ($n = 1$), Asian American and/or Pacific Islander ($n = 4$), European American ($n = 25$), Hispanic and/or Latin American ($n = 2$), multiracial ($n = 3$), or other/not specified ($n = 2$); and were classified as either a first-year student ($n = 17$), sophomore ($n = 11$), junior ($n = 6$), or senior ($n = 9$). Participants were recruited from a variety of mathematics courses offered during the spring semester, as well as two introductory psychology courses. Based on their highest mathematics course previously or currently enrolled in, participants were characterized as either introductory ($n = 20$), intermediate ($n = 11$), or advanced ($n = 12$) regarding their mathematics education level (all psychology students recruited met the previously or currently enrolled criteria). Participation was incentivized through the awarding of bonus points toward a concurrent mathematics class of their choosing or research experience credits as part of a course requirement for those enrolled in the introductory psychology courses.

Procedure

Approval from the Institutional Review Board for this study was completed prior to the data collection phase. Participants self-selected into one of five masked instructional sessions based on their availability when they signed up (i.e., students were unaware of which condition they were in prior to their participation). Sessions were held at 7:00 p.m. for the span of a week to meet the scheduled availability of participants. The first, third, and fifth sessions were taught using the traditional method ($n_1 = 5$, $n_3 = 8$, $n_5 = 9$; total = 22), and the second and fourth sessions were taught using the modern method ($n_2 = 7$, $n_4 = 14$; total = 21). Table 1 contains a detailed breakdown of the sample's demographics by teaching condition and mathematics education level.

Participants were given five minutes to complete a content pretest at beginning of each instructional period. Following the pretest, participants were given a blank sheet of paper and a pencil and were asked to take notes as if they were in a typical math class during the 45-minute instructional period. Once the instruction concluded, participants were given ten minutes to complete a content posttest to assess their understanding of the material covered. Following the posttest, they completed various surveys and filled out demographic information. Once they completed the surveys, the participants turned in their study materials and received a debriefing form that explained the purpose of the study and a description of the experimental conditions. A brief description of the group sessions follows.

Traditional Group

The instructor was the primary speaker during the session, using a whiteboard or similar apparatus at the front of the classroom to write notes such as definitions and examples for the students to take notes on at their own pace. The instructor introduced new concepts, worked examples at the board, and had students work exercises on their own. During examples the instructor asked students to go step by step throughout the solution process while remaining at the board to record the steps. The instructor periodically asked questions to gauge the understanding of the material among the participants and to promote engagement with the material. The session ended with a short exercise for the students to complete on their own prior to the assessment to provide them a chance to work through the solution process on their own.

Modern Group

The instructor presented the students with a short exercise to complete in randomly assigned small groups; once completed, one student from each group showed their work on the whiteboard while another explained their solution process. Students from different groups were asked to check the work on the board and ask any questions for understanding. Following this discussion, the instructor formalized the solution process using formulas and had the students take notes on how similar or different it was from their process. This was repeated for each concept covered prior to the content assessment.

Materials

The pretest and posttest assessments covering the mathematical content used questions adapted from concepts addressed within the first week of a combinatorics (advanced counting) course, an infrequently taught math course at the institution where this study was conducted. This material was recommended by mathematics faculty members based on its ease of learning across mathematical experience and its relatively low explicit instruction throughout most college-level mathematics courses. Nine questions were used; an easy, medium, and hard question was constructed for each of the three concept groups: basic counting principle, permutations, and combinations (introductory-level, intermediate-level, and advanced-level, respectively). The question order for the assessment was randomly generated with the only criteria that one easy, medium, and hard question from the subsections be selected for the pretest. All participants took the same assessment with the same question order (see Table 2).

Each content assessment question was scored using a holistic rubric from the Berkeley Graduate Division

Teaching and Resource Center (n.d.) where the content was assessed and rated for common mistakes made throughout participant data to keep scores consistent across all sessions and conditions (see Table 3). The scoring process involved three raters – the author and two volunteers – who were familiar with the assessment rubric and objectives of the study. The raters jointly reviewed each assessment and engaged in discussions to reach a consensus on the scores, with any discrepancies in ratings ultimately decided by the author.

The Mathematics Motivation Questionnaire (MMQ; Fiorella et al., 2021) was used with a 5-point Likert scale to assess participant motivation levels regarding their mathematics experience (19 items, Cronbach's $\alpha = .85$). Subscales of the questionnaire include Intrinsic Value (3 items, $\alpha = .85$), Self-Regulation (4 items, $\alpha = .73$), Self-Efficacy (4 items, $\alpha = .87$), Utility Value (4 items, $\alpha = .89$), and Test Anxiety (4 items, $\alpha = .79$). The participants' degree type (whether they were a mathematics major, minor, or neither), their prior math courses taken, and other study-specific questions were recorded but not utilized in the following analyses.

Results

The following hypotheses were tested: (a) students in the modern group would score higher on both achievement and motivation assessments as opposed to the traditional group and (b) students with higher levels of educational experience within mathematics would score higher than those with less experience. Item-wise means and standard deviations for the content assessment are presented in Table 2.

Achievement

Paired-samples t tests were conducted to assess general improvement on the content assessment from pretest to posttest for both teaching methodology and education level. Table 4 presents the means, standard deviations, and effect sizes for teaching condition, education level, and overall performance. Improvement was significant overall ($p < .001$), for teaching condition (both $ps < .001$), and across education level (all $ps \leq .01$) with large effect sizes for teaching condition and medium effect sizes for education level (see Table 4).

Mirroring the analysis of Akcakin (2017) and Voskoglou (2019), a two-way ANOVA on the pretest scores showed participants were comparable prior to the intervention (teaching method: $F(2, 37) = 0.44$, $p = .51$; education level: $F(2, 37) = 0.79$, $p = .46$; interaction: $F(2, 37) = 0.76$, $p = .47$; see Figures 1 and 2). A two-way ANOVA on the posttest scores revealed there was no significant interaction ($p = .61$) between teaching methodology and education level on the posttests scores,

TABLE 3

Content Assessment Grading Rubric

Points	If...
5	The student clearly understands how to solve the problem. Minor mistakes and careless errors can appear insofar as they do not indicate a conceptual misunderstanding.
4	The student understands the main concepts and problem-solving techniques, but has some minor yet non-trivial gaps in their reasoning.
3	The student has partially understood the problem. The student is not completely lost, but requires tutoring in some of the basic concepts. The student may have started out correctly, but gone on a tangent or not finished the problem.
2	The student has a poor understanding of the problem. The student may have gone in a not-entirely-wrong but unproductive direction, or attempted to solve the problem using pattern matching or by rote.
1	The student did not understand the problem. They may have written some appropriate formulas or diagrams, but nothing further. Or they may have done something entirely wrong.
0	The student wrote nothing or almost nothing.

TABLE 4

Means, Standard Deviations, and t Statistics for Condition and Education Level

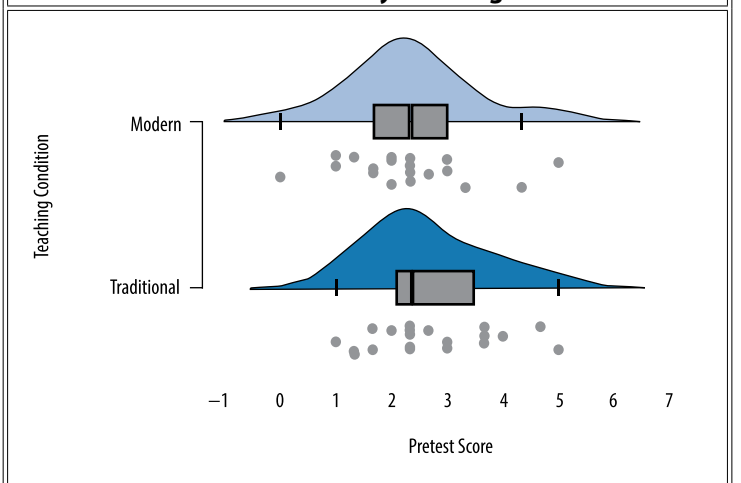
Group	Pretest		Posttest		$t(df)$	p	Cohen's d	95% CI
	M	SD	M	SD				
Overall	2.50	1.10	3.69	1.08	6.31	<.001***	0.96	[0.60, 1.32]
Traditional	2.67	1.07	3.99	1.05	4.50	<.001***	0.96	[0.44, 1.46]
Modern	2.33	1.13	3.37	1.03	4.46	<.001***	0.97	[0.44, 1.49]
Introductory	2.35	1.36	3.19	1.04	2.92	.009**	0.65	[0.16, 1.13]
Intermediate	2.39	0.76	4.17	0.74	8.40	<.001***	0.58	[1.28, 3.76]
Advanced	2.86	0.82	4.07	1.10	3.05	.01*	0.48	[0.19, 1.54]

Note. Positive scores represent improvement from pretest to posttest (paired samples t -test). The degrees of freedom (df) for each test were 42, 21, 20, 19, 10, and 11, respectively.

* $p < .05$. ** $p < .01$. *** $p < .001$.

FIGURE 1

Plot of Pretest Scores by Teaching Condition



Note. Graph generated by JASP.

TABLE 5

Descriptive Statistics for MMQ Subscales Across Education Level

Subscale	Educational Level						Cronbach's α
	Introductory	Intermediate	Advanced				
Intrinsic Value	2.35	1.36	2.39	0.76	2.86	0.82	.64
Self-Regulation	3.26	0.99	4.02	1.04	4.23	0.82	.67
Self-Efficacy	3.19	1.17	4.05	0.69	4.08	1.08	.69
Utility Value	2.86	1.16	3.82	1.06	3.96	1.02	.91
Test Anxiety	3.58	1.04	3.41	1.03	3.35	0.95	.76

Note. Total Cronbach's α = .81.

TABLE 6

Post-Hoc Results for Significant ANOVAs of MMQ Subscales Across Education Level

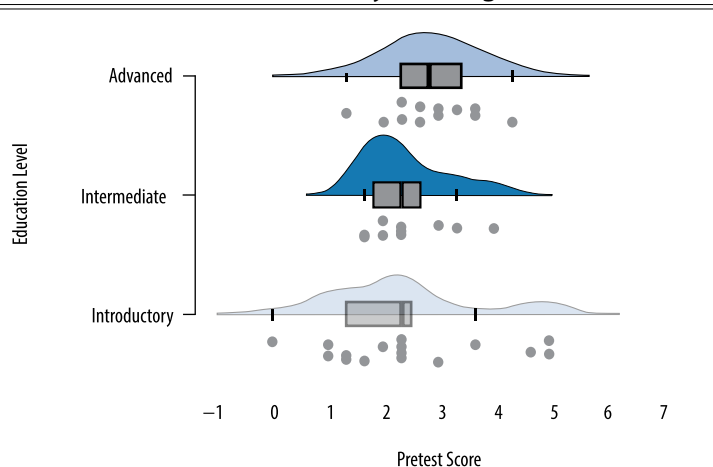
Subscale	$F(2, 40)$	p	η^2	Tukey's HSD	M_{diff}	t	p_{corr}	Cohen's d	95% CI
Self-Regulation	4.54	.02	.19	Intro vs. Inter	-0.76	-2.12	.09	-0.80	[-1.76, 0.17]
				Intro vs. Adv	-0.97	-2.77	.02*	-1.01	[-1.97, -0.06]
				Inter vs. Adv	-0.21	-0.52	.86	-0.22	[-1.26, 0.83]
Self-Efficacy	3.78	.03	.16	Intro vs. Inter	-0.86	-2.19	.09	-0.82	[-1.79, 0.14]
				Intro vs. Adv	-0.90	-2.35	.06	-0.86	[-1.80, 0.09]
				Inter vs. Adv	-0.04	-0.09	.99	-0.09	[-1.08, 1.01]
Utility Value	4.75	.01	.19	Intro vs. Inter	-0.96	-2.32	.06	-0.87	[-1.84, 0.10]
				Intro vs. Adv	-1.10	-2.74	.03*	-0.99	[-1.95, -0.04]
				Inter vs. Adv	-0.14	-0.31	.95	-0.13	[-1.17, 0.92]

Note. p value and confidence intervals adjusted using Tukey correction. Intro = Introductory, Inter = Intermediate, Adv = Advanced.

* $p < .05$.

FIGURE 2

Plot of Pretest Scores by Teaching Condition



Note. Graph generated by JASP.

$F(2, 37) = 0.50$, partial $\eta^2 = .03$. Taken separately, teaching method failed to reach significance, $F(1, 37) = 2.00$, $p = .17$, partial $\eta^2 = .05$ (see Figure 3), but education level was significant, $F(2, 37) = 3.96$, $p = .03$, partial $\eta^2 = .18$ (see Figure 4). Post-hoc tests with Tukey corrections showed only marginally significant differences between introductory and intermediate students, $M_{diff} = -0.87$, $t(2) = -2.30$, $p_{corr} = .07$, Cohen's $d = -0.89$, 95% CI [-1.89, 0.11], and introductory and advanced students, $M_{diff} = -0.84$, $t(2) = -2.33$, $p_{corr} = .06$, Cohen's $d = -0.85$, 95% CI [-1.80, 0.10]. There was no significant difference between intermediate and advanced students, $M_{diff} = 0.04$, $t(2) = 0.08$, $p_{corr} = .99$, Cohen's $d = 0.04$.

Motivation

Multivariate analyses of variance (MANOVAs) were conducted to investigate the effect of teaching methodology and education level on the subscales of motivation assessed by the MMQ. Due to insufficient observations when grouping by both teaching condition and education level, each factor was analyzed separately. Descriptive statistics for each subscale across education level are provided in Table 5.

The MANOVA for education level was significant, Wilks' Lambda = .59, $F(2, 40) = 2.16$, $p = .03$, indicating a difference between the groups on students' motivation across subscales. Follow up univariate ANOVAs showed education levels were significantly different ($p < .05$) on three subscales: self-regulation, self-efficacy, and utility value (see Table 6); there was no significant difference regarding intrinsic value, $F(2, 40) = 0.88$, $p = .42$, and test anxiety, $F(2, 40) = 0.21$, $p = .82$. Tukey's HSD test revealed significant differences ($p_{corr} < .05$) between the introductory and advanced students on self-regulation ($M_{diff} = -0.97$, $p_{corr} = .02$) and utility value ($M_{diff} = -1.10$, $p_{corr} = .03$), and a marginal but nonsignificant difference on self-efficacy ($M_{diff} = -0.90$, $p_{corr} = .06$). There was no significant difference between the traditional and modern teaching methods across the five subscales, Wilks' Lambda = .86, $F(1, 41) = 1.25$, $p = .31$.

Discussion

The goal of this study was to investigate the impact of different teaching methods on mathematical achievement and motivation in college students across various levels of collegiate mathematical education. The hypotheses predicted that students exposed to modern teaching methods would demonstrate higher scores in both achievement and motivation compared to their counterparts in the traditional teaching group. Additionally, it was expected that students with advanced mathematical experience would outperform those at intermediate levels, and so on for those at introductory levels.

Influence of Teaching Method

Contrary to other studies with similar college student participants such as Roop et al. (2018) and Voskoglou (2019), teaching method had little to no effect on achievement and motivation. Although there was a general improvement from pretest–posttest, the relative improvement was similar across the teaching conditions with near-equal effect sizes (see Table 4). Another possible explanation for the lack of differences may lie in the challenges of delivering content effectively within the constraints of relatively short instructional periods. This time limitation may have hindered students' ability to develop a deeper understanding of the material, regardless of the teaching method used.

It is important to also note the bimodal distribution of posttest scores of the modern group as seen in Figure 3. An exploratory Mann-Whitney U test—a weaker test than the t -test that is not reliant on the assumption of normality and is better suited for smaller sample sizes—indicates there is in fact some significant difference between the two teaching conditions, $W = 319.50$, $p = .03$, rank-biserial correlation = .38, 95% CI = [.05, .64], confirming our visual inspection. This divergence from a unimodal pretest distribution to a bimodal posttest distribution within the modern group warrants further investigation into the factors that may influence this trend.

Additionally, variations in the composition of participants across different instructional sessions may have contributed to the absence of significant findings. Factors such as pre-existing familiarity between students and potential instructor biases (as the researcher also acted as the instructor) could have introduced unintended variations in student experiences. However, when asked if the method of instruction was similar to their current enrolled course, 52% of those in the traditional group either agreed or strongly agreed, whereas 63% in the modern group disagreed or strongly disagreed, which was significantly different, $t(38) = 2.48$, $p = .02$, Cohen's $d = 0.79$, 95% CI = [0.13, 1.42]. Even though the students were not informed of their condition prior to the study, the majority of participants in the modern group noted a difference in teaching approach when compared to their current course's instruction. This perception of teaching method may possibly help explain the divergence in posttest scores mentioned previously, though future studies on perceived instructional method would need to further uncover this relationship.

Although differences were not reliably found between groups, it has been noted that having a wide range of instructional techniques is beneficial for students to gain developed and nuanced understanding that leads to eventual content mastery (San & Kis, 2018; Umugiraneza et al., 2017). Having a rich vocabulary of technical skills

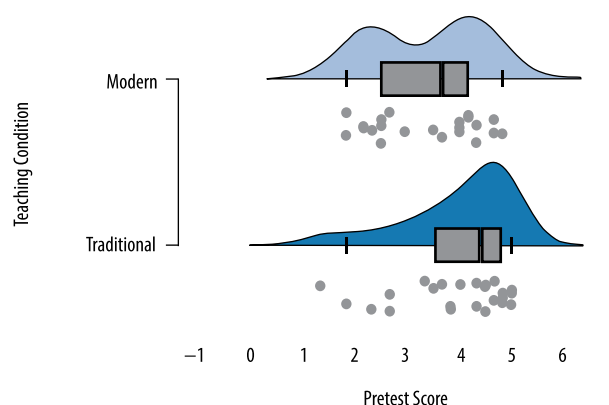
and instructional methods could prove beneficial for instructors of students of all ages, not just in higher education. Further research is needed to critically examine what techniques are utilized by professors and educators alike, how they came to use the particular instructional techniques implemented in their classroom, and how the cycle of education may perpetuate ineffective or outdated practices due to ease of use and application.

Education Level and Mathematical Motivation

The analysis revealed a noteworthy relationship between educational level and student motivation, where intermediate and advanced students exhibited higher motivational

FIGURE 3

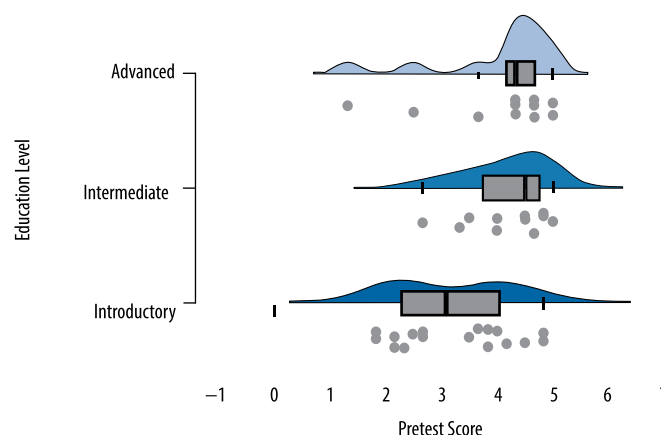
Plot of Posttest Scores by Teaching Condition



Note. Graph generated by JASP.

FIGURE 4

Plot of Posttest Scores by Education Level



Note. Graph generated by JASP.

scores, particularly regarding self-regulation, self-efficacy, and utility value (Table 6). This finding suggests that as students progress through their mathematical education, they may develop greater responsibility for studying math concepts (Brown & Hirschfeld, 2007), see themselves as capable of performing mathematical tasks (Ayotola & Adedeji, 2009), and gain a stronger understanding of its usability (Petersen & Hyde, 2017). Although not significant, there was a general increase in intrinsic value and corresponding decrease in test anxiety as educational level increased, which is consistent with contemporary research (Li et al., 2021).

Although previous studies have typically examined cohorts of students within the same course or grade level (see Akcakin, 2017; Damrongpanit, 2019) or focused on the perceptions of the teachers on student motivation and the effect of their practices (Damrongpanit, 2019; Hidalgo-Cabrillana & Lopez-Mayan, 2018; Umugiraneza et al., 2017), we were able to demonstrate how the level of education within the undergraduate framework affects motivation toward learning mathematics. Future research should further investigate mathematical motivation's development over time, both in degree programs heavy with mathematics materials as well as those that adjacently work with mathematical concepts.

Limitations

The most apparent limitations stem from the relatively small sample size and the specific context of a private liberal arts college in Arkansas. To have an appropriately powered independent samples test at around .80, at least 64 participants would have been needed in each group. Though the exploratory Mann-Whitney *U* test mentioned earlier notes a significant difference in distribution shape between the two conditions, further studies with larger sample sizes should be conducted to verify and validate the present results. Despite the small sample size, the study participants were largely representative of the greater college demographics in terms of the distribution of race and gender. Preliminary analyses of these populations showed no significant effect on the measured outcomes, but it is important to note historical disparities in education that unequally disadvantage those of historically marginalized backgrounds (Roop et al., 2018).

Additionally, there was some skew in terms of the percentage of majors and non-majors in the study, with participants classified as advanced students consisting of exclusively math majors and those classified as introductory overwhelmingly consisting of non-majors; however, the intermediate group was split evenly between the two groups. Although this was expected and anticipated via the operationalization of education level, further

investigation is needed to determine how the two groups comparatively operate, particularly toward their mathematical motivation. However, the current study may resonate and generalize to other similar smaller higher education institutions as a particular case study. Another context-specific limitation concerns the specific content covered. While the content was drawn from an advanced combinatorics course, the concepts covered – the basic counting principle, permutations, and combinations, see Table 2 – are introductory topics that are commonly taught in other courses, such as discrete mathematics, probability, and statistics, though at varying stages within the course.

It is also important to note the MANOVA assumption of multivariate normality was violated regarding the motivation scores across education level and teaching condition analyses as a result of the small sample size. Following the discussion by Ates et al. (2019), Wilk's Lambda should be robust enough to detect difference in the event of unbalanced observations in the sample (for more discussion on when to use different MANOVA statistics when assumptions are violated; see Olson, 1974, 1976, 1979). Additionally, the primary purpose of the MANOVA was to be an initial examination of the overall effect of motivation; the significant result prompted the follow-up ANOVAs on the individual motivation subscales to better understand which ones specifically contributed to the overall effect of motivation observed. It is acknowledged that the assumption violation may introduce some uncertainty in the results. However, significant findings in the subsequent post-hoc ANOVAs provide evidence of significant differences in motivation between education levels.

Conclusion

Overall, this study investigated the influence of teaching method on the mathematical achievement and motivation of college students. It is important to acknowledge the context, scope, and limitations in the interpretation of results. Further iterations of this line of research could include longitudinal studies that examine development of mathematical achievement over time as concepts and techniques increase in complexity. Additionally, collaborations across departments or institutions to implement experimental conditions in several locations could produce significant results, as well as increasing the diversity of the sample population. The novelty effect noted in some modern teaching methods, which initially pique students' interest, could be addressed through long-term studies that measure changes in motivation and achievement over time, providing a more comprehensive picture of the lasting impact of instructional approaches (Tularam & Machisella, 2018).

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Author Note. Benjamin J. Norton  <https://orcid.org/0009-0007-7835-6225>

Benjamin J. Norton is now at the Department of Leadership Studies at the University of Central Arkansas, AR.

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Correspondence concerning this article should be addressed to Benjamin Norton. Email: bnorton1018@gmail.com.

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Misinformation Beliefs, Intellectual Humility, and Vaccine Attitudes and Status

Amanda Bossert and Katrina Jongman-Sereno*
Department of Psychology, Elon University

ABSTRACT. The current research examined the role of openness to information—and misinformation—in vaccine attitudes and COVID-19 vaccine status. Openness to information was examined in 2 ways: misinformation susceptibility, or the extent to which people endorse alternative health beliefs, pseudoscience, and conspiracy theories, and intellectual humility, or the extent to which people are open to information differing from their current beliefs. Results showed that antivaccination attitudes were related to a lower likelihood of being vaccinated against COVID-19, $X^2(11, N = 107) = 43.78, p < .001, \exp(B) = .72, 95\% \text{ CI } [0.53, 0.99]$. Interestingly, endorsing pseudoscientific beliefs predicted a higher likelihood of being vaccinated against COVID-19, $X^2(11, N = 107) = 43.78, p < .001, \exp(B) = 1.30, 95\% \text{ CI } [1.05, 1.61]$. Endorsing antivaccination attitudes was related to greater belief in alternative health beliefs, $r(183) = .29, p < .001$, pseudoscience, $r(119) = .55, p < .001$, and conspiracy theories (generic: $r(182) = .73, p < .001$; vaccine: $r(180) = .88, p < .001$). Participants with high intellectual humility were more likely to endorse generic and vaccine conspiracy beliefs, $r(184) = .23, p < .001$ and $r(182) = .19, p = .01$, respectively, but no more or less likely to endorse other misinformation beliefs. Intellectual humility was not related to COVID-19 vaccine status. More research is needed to clarify the relationships among misinformation susceptibility, intellectual humility, and vaccine attitudes and status.

Keywords: intellectual humility, misinformation, antivaccine attitudes, COVID-19 pandemic



Open Data and Open Materials badges earned for transparent research practices. Data and materials are available at <https://osf.io/uqpkh/>

Public health relies on vaccines and the population's intentions to vaccinate when facing various diseases. Vaccine hesitancy was identified as one of the top ten threats to global health in 2019 by the World Health Organization (World Health Organization, 2019). Vaccination prevents two to three million deaths a year, which could further increase with higher vaccination rates (World Health Organization, 2019). The importance of vaccination has become particularly salient in the face of the COVID-19 pandemic. Experts estimate that COVID-19 vaccines could have prevented at least 318,000 deaths between January 2021 and April 2022 (Zong et al.,

2022). Past research has demonstrated the effectiveness of receiving COVID-19 vaccination against infection and hospitalization (Feikin et al., 2022; Link-Gelles et al., 2023; Zheng et al., 2022), leading experts to recommend that all eligible individuals to stay current with COVID-19 vaccinations (Plumb et al., 2022), especially for those who are immunocompromised (Link-Gelles et al., 2023). In addition, meta-analyses show that receiving the vaccine can reduce the risk of long COVID, whether the vaccine was administered before or after COVID-19 infection (Gao et al., 2022). There has been long standing hesitancy and refusal toward vaccines, and despite scientific evidence

and experts' recommendations supporting COVID-19 vaccination, this sentiment has translated into hesitancy toward the COVID-19 vaccine (Coustasse et al., 2021), especially in African American populations, pregnant women, and breastfeeding women (Yasmin et al., 2021).

As of March 29, 2023, about 81% of the population had received at least one dose of the vaccine (USA Facts, 2023). Despite these high vaccination rates, the United States took nearly a full year to fully vaccinate 60% of its population, and became the last high-income country to do so (Shah et al., 2021). The slow rate of COVID-19 vaccine uptake in the United States may be in part due to the great deal of misinformation circulating about the vaccine that contributed to antivaccination attitudes. During the COVID-19 pandemic especially, governments and search engines faced difficulty in controlling the quality of COVID-related information. Because society is heavily influenced by misinformation on the internet, the lack of regulation of COVID-19 media may lead to unfavorable effects, potentially in vaccination attitudes (Cuan-Baltazar et al., 2020). Despite the effectiveness and high rate of COVID-19 vaccination in the United States, many people still endorse antivaccination attitudes, which may ultimately impact the progress made continuing to increase vaccination rates (Romer & Jamieson, 2020). For example, antivaccination tweets on Twitter have increased since November 2020, when COVID-19 vaccine trial results were published (Quyen et al., 2023). Antivaccination attitudes may become a public health issue that needs to be addressed to slow the spread of COVID-19, which emphasizes the importance of the ability to discriminate between true and false information when making vaccination decisions. Because of the implications, including preventable illness and death, understanding psychological factors that contribute to antivaccination attitudes and behavior is important. The current project examined psychological factors involved in antivaccine attitudes and COVID-19 vaccine status. We were interested in two psychological factors related to openness to information including susceptibility to misinformation and intellectual humility.

Misinformation Susceptibility and Vaccine Attitudes, Intention, and Status

Research has shown that misinformation susceptibility is related to overall vaccine hesitancy as well as a reduced intent to receive a COVID-19 vaccine in particular (Loomba et al., 2021). However, no research has examined the relationship between misinformation susceptibility and vaccine status (i.e., whether people have been vaccinated). The present research built on previous research by examining two psychological factors concerning openness to information—suscepti-

bility to misinformation and intellectual humility—and vaccine status.

Misinformation Susceptibility

With today's technology, information—and misinformation—travels quickly and in great quantities. Misinformation and untrustworthy information have been shown to be widely consumed on the internet, particularly with information regarding health (Fox & Jones, 2009). There has been a great deal of misinformation surrounding vaccines in particular. Vaccine hesitancy is still tied to a questionable 2007 study, in which data on the MMR vaccine was skewed to create an illusory correlation between the MMR vaccine and autism (DeStefano, 2007); this study still affects vaccination attitudes despite comprehensive research rejecting its claim (Flaherty, 2011). Since then, other forms of vaccine misinformation have spread as well. Social media has been found to be a significant perpetrator of COVID-19 misinformation and related fake news stories (Naeem et al., 2020).

Belief in COVID-19 conspiracies in the United States has been and continues to be prevalent and stable across the course of the pandemic (Romer & Jamieson, 2020). COVID-19 misinformation may account for vaccine hesitancy (Romer & Jamieson, 2020). Misinformation surrounding vaccines is problematic because it can lead people to be resistant to get vaccinated, which can cause widespread health problems, and in this case, infection with COVID-19. Once people have been exposed to misinformation, debiasing can be difficult due to the prevalence of false information, as well as preexisting beliefs and worldviews that affect people's susceptibility to misinformation (Lewandowsky et al., 2012).

Despite the widespread prevalence of misinformation, not everyone falls prey to it. Some people are more susceptible to misinformation than others. Individual differences in misinformation susceptibility have been examined in a variety of domains, including pseudoscience, alternative health beliefs, and conspiracy theories.

Pseudoscience refers to topics that are scientifically framed but are not science, do not have scientific support, or have been shown to be false (Pigliucci & Boudry, 2013). For example, astrology and creationism are pseudoscientific beliefs that many Americans endorse (Pigliucci & Boudry, 2013). People who are more likely to endorse pseudoscientific beliefs may rely on these principles, and may be influenced by framing these statements in a way that appears scientifically based.

Alternative health beliefs refer to beliefs in complementary and alternative medicine, as well as holistic approaches in health (Lie & Boker, 2004). People who

are more likely to endorse alternative health beliefs may be persuaded to rely on ineffective health behaviors such as holistic or spiritual practices instead of effective interventions such as vaccines.

Conspiracy theories focus on suspicions related to the government or small groups of people in power keeping secrets or hiding information from the public. Conspiracy theory beliefs can involve suspicion around vaccines, terrorism, UFO-sightings, and many other subjects. Research has found that engaging in conspiratorial thinking is related to hesitancy to receive a COVID-19 vaccine (Hromatko et al., 2023). However, relatively little research has examined misinformation susceptibility and vaccine attitudes, and little is known about how misinformation susceptibility relates to vaccination behaviors.

Intellectual Humility

Another factor that may be related to misinformation susceptibility and people's vaccine attitudes and status is intellectual humility (IH), or how open people are to information that differs from their current beliefs (Leary et al., 2017). IH is related to cognitive patterns and behaviors that demonstrate openness to new information such as open-minded thinking (Krumrei-Mancuso et al., 2020) and knowledge acquisition (Baehr, 2016). Though it is imperative for people to be open to factual information about a new virus, this openness may backfire if people are also open to misinformation, which the current study aims to target by studying individual differences related to openness to information and misinformation.

Research examining the connection between IH and information discernment has been mixed. Some studies have found that IH is linked to cognitive tendencies that promote accurate discernment between true and false information. For example, IH is related to engaging in more critical thinking (Deffler et al., 2016; Zmigrod et al., 2019). In addition, Newman and colleagues (2022) found that IH was associated with a greater ability to discriminate between true information and "alternative facts" (i.e., falsehoods) related to general-knowledge topics (e.g., "Earth rotates eastward around its own axis, completing a full rotation once in about 24 hours" versus "Earth can change its rotation direction and flip its axis, and we will never notice it"). Though the mechanisms between IH and falsehood detection are still unclear, people high in IH are more likely to further investigate information—at least when the information is false (Koetke et al., 2021).

Though IH is related to detecting falsehoods, its relationship with misinformation susceptibility is mixed and may depend on the type of misinformation

(e.g., alternative health information, pseudoscience, conspiracy theories). Congruent with the connection between IH and discerning true from false information, research has shown that IH is inversely related to conspiracy beliefs (Bowes & Tasimi, 2022; Huynh & Bayles, 2022) and susceptibility to fake news (Bowes & Tasimi, 2022). However, research has not found such a relationship between IH and pseudoscientific beliefs (Bowes & Tasimi, 2022). The absence of a relationship between IH and pseudoscientific beliefs may be because pseudoscience is related to a lack of scientific knowledge rather than the ability to be influenced by misleading information (Bowes & Tasimi, 2021).

IH has also been examined in the context of vaccination attitudes and intent. IH has been linked to positive vaccine attitudes, as well as the intent to receive vaccinations against COVID-19 (Huynh & Senger, 2021). However, IH appears to have no relationship with intent to receive the flu vaccine (Senger & Huynh, 2020). No research has examined whether IH is related to actual COVID-19 vaccination status.

The Present Study

Previous research has established relationships between misinformation susceptibility and vaccine attitudes, misinformation susceptibility and IH, as well as IH and vaccination attitudes. However, no research has examined misinformation susceptibility and IH in the context of COVID-19 vaccine status (i.e., number of shots received). The current study examined the relationships among misinformation susceptibility, IH, vaccination attitudes, and vaccination status in the context of the COVID-19 pandemic. We hypothesized that people who endorsed misinformation beliefs and antivaccination attitudes would be less likely to be vaccinated against COVID-19. Given mixed results from previous research, we were curious to explore relationships among IH and alternative health beliefs, pseudoscience beliefs, conspiracy beliefs, and vaccine status.

Method

Participants

One hundred and ninety-four (77 women, 116 men, 1 did not report gender) participants were recruited through Amazon's Mechanical Turk (MTurk). Participants were required to live in the United States and speak English to be eligible to participate. Twenty-one participants identified as transgender, and one participant preferred not to say whether they identified as transgender or not. Participants' ages ranged from 20 to 72 years of age ($M = 28.34$, $SD = 11.03$). Most participants identified as White (82.9%), with 7.8% identifying as Black or African American, 2% identifying as Asian American,

0.5% identifying as American Indian or Alaska Native, 0.5% identifying as Native Hawaiian or Other Pacific Islander, and 0.5% identifying as mixed or of more than one ethnic or racial identity. More than half of the participants were Christian-Catholic (55.1%). The sample was also 13.2% Christian-Protestant, 8.8% Atheist, 6.8% Agnostic, 5.4% Christian-Other, 1.5% "other," 1% Jewish, 1% Buddhist, 0.5% Christian-Mormon, 0.5% Muslim, 0.5% Hindu, and 0.5% Unitarian. Participants mostly identified as democratic (61.5%), followed by republican (26.8%), and independent (6.3%). When identifying political ideology on a scale, 26.3% identified as very liberal, 16.6% as moderately liberal, 11.2% as moderate, 19% as moderately conservative, and 21.5% as very conservative. About half of the participants' highest level of education was a 4-year degree (50.7%). In addition, 0.5% of participants reported less than high school as their level of education, 5.9% reported a high school diploma or GED, 5.9% reported some college, 5.4% reported a 2-year degree, 17.1% reported a graduate degree, 6.3% reported a post-graduate degree, and 2.9% reported a professional degree.

Materials and Procedure

The current study was approved by the university's Institutional Review Board (IRB protocol #22-163). Participants were recruited through a link on MTurk advertising a study examining "attitudes and beliefs about the COVID-19 vaccine." After clicking on the link, participants first read an informed consent form. This form notified them that the study would take no longer than 30 minutes, that they would be compensated \$1.50 for their time, and that they must proceed to the end of the questionnaire to receive compensation (although they could skip particular questions if desired). After providing consent, participants completed scales assessing their IH, alternative health beliefs, pseudoscience beliefs, generic conspiracy beliefs, vaccine conspiracy beliefs, antivaccination attitudes, vaccine status, vaccine intent, and demographic information (questionnaires were shown in the same order for all participants). Data collection occurred in April 2022.

Intellectual Humility

Participants completed the 6-item ($\alpha = .74$) General Intellectual Humility Scale (GIH; Leary et al., 2017) to measure individual differences in IH. Sample items on the GIH Scale include "I reconsider my opinions when presented with new evidence" and "I like finding out information that differs from what I already think is true." Participants indicated the extent to which each item describes them from 1 (*not at all true or characteristic of me*) to 5 (*completely true or characteristic of me*). Previous

research has shown high construct, convergent, and discriminant validity (e.g., Leary et al., 2017).

Misinformation Susceptibility

Participants completed measures of misinformation susceptibility in the forms of alternative health beliefs, pseudoscience endorsement, and conspiratorial ideation. To measure alternative health beliefs, participants completed the 10-item ($\alpha = .65$) Contemporary and Alternative Medicine Health Belief Questionnaire (CHBQ; Lie & Boker, 2004). The CHBQ measures pseudoscience beliefs related to health. Sample items include "The physical and mental health are maintained by an underlying energy or vital source" and "Complementary therapies are a threat to public health" (reverse-scored). Participants indicated the extent to which they agree with each statement from 1 (*absolutely disagree*) to 7 (*absolutely agree*). Previous research has shown adequate criterion-related validity (Lie & Boker, 2004). Because the Cronbach's alpha we found was low compared to previous usage of the scale (e.g., Lie & Boker, 2004), an exploratory principal components factor analysis with a direct oblimin rotation was conducted to examine the scale's dimensionality in our sample. The Kaiser-Meyer-Olkin measure of sampling adequacy was .88, and Bartlett's test of sphericity ($p < .001$) indicated that using principal components factor analysis was appropriate. Two factors had eigenvalues greater than 1 and together accounted for 64% of the variance. Closer examination of the two factors showed that item structure may be causing the items to load on different factors. The first factor was composed of items that were not reverse-scored, and the second factor composed of items that were reverse-scored. Subscales created to reflect these two factors were indeed negatively related to each other ($r = -.449, p < .001$). We believe that the bidimensionality of the scale reflects participant error rather than differences in participants' beliefs. However, to maintain the integrity of the scale, we proceeded to use the full scale in our analysis. If anything, significant results are likely more reflective of a relationship between variables.

To measure endorsement of pseudoscience, participants completed the 10-item ($\alpha = .93$) Pseudoscientific Belief Scale (PSEUDO; Fasce & Picó, 2019). The PSEUDO focuses on general pseudoscience susceptibility. Sample items include "All the cells in our bodies store memories (cellular memories), ours or those of our ancestors" and "Quantum mechanics has great implications in the explanation of consciousness and/or in the treatment of disease." Participants indicated the extent to which they agree with each statement (0 = *strongly disagree* to 4 = *strongly agree*; separate option of *do not know*). Previous research has shown high construct validity (e.g., Fasce & Pico, 2019).

Next, participants completed the 15-item ($\alpha = .96$) Generic Conspiracist Beliefs Scale (GCBS; Brotherton et al., 2013) to measure individual beliefs in generic conspiracy theories. Sample items include “Secret organizations communicate with extraterrestrials, but keep this fact from the public” and “Technology with mind-control capacities is used on people without their knowledge.” Participants indicated the extent to which they believe each statement is true (1 = *definitely not true* to 5 = *definitely true*). Previous research has found high content, criterion-related, convergent and discriminant validity (e.g., Brotherton et al., 2013).

Finally, participants completed the 7-item ($\alpha = .96$) Vaccine Conspiracy Belief Scale (VCBS; Shapiro et al., 2016) to measure beliefs in conspiracy theories regarding vaccination. Sample items include “Vaccine safety data is often fabricated” and “The government is trying to cover up the link between vaccines and autism.” Participants indicated the extent to which they agree with each statement (1 = *strongly disagree* to 7 = *strongly agree*). Shapiro and colleagues (2016) found a moderate correlation between the VCBS and the existing

Conspiracy Mentality Questionnaire (CMQ; Bruder et al., 2013) indicating adequate convergent validity.

Vaccination Attitudes and Status

Vaccination Attitudes. The Vaccination Attitudes Examination Scale (Martin & Petrie, 2017) was used to gauge attitudes toward vaccinations in general. The scale includes 12 items ($\alpha = .91$) and sample items include “I feel safe after being vaccinated” (reverse-scored) and “Vaccines can cause unforeseen problems in children.” Participants indicated the extent to which each item is true of them (1 = *strongly disagree* to 6 = *strongly agree*). Higher scores indicate more negative attitudes toward vaccines. Previous research has shown moderate correlations with existing measures of vaccine attitudes indicating adequate convergent validity (Martin & Petrie, 2017). Moreover, people who score highly on the Vaccine Attitudes Examination Scale are less likely to be vaccinated, demonstrating good criterion-related validity (Martin & Petrie, 2017).

Vaccination Status. An ad hoc item was created to assess vaccination status: “Have you received a COVID-19 vaccine?” Participants responded “yes” or “no,” and if participants answered “yes,” they were asked “How many shots have you received?” and chose all that applied from the following options: “Dose 1 of vaccine,” “Dose 2 of vaccine,” and “Booster shot.”¹ If participants said they had not received a COVID-19 vaccine, they were asked about their vaccine intentions: “Do you plan to receive a COVID-19 vaccine?” Participants indicated their answer of “yes” or “no.”

Demographics

Participants reported their age, gender, race/ethnicity, education level, religious beliefs, and political ideology.

Once participants completed these measures, a debriefing page was shown, thanking them for their time and explaining that data from the study will be used to examine relationships among misinformation susceptibility, IH, and vaccine attitudes.

Results

Descriptive Statistics

Means and internal consistency for measures of IH, misinformation susceptibility, vaccine attitudes, and vaccine intentions are shown in Table 1. One hundred seventy-five (90.2%) participants were vaccinated against COVID-19. Of these participants, none had received only one shot, 41 (21.1%) had received two shots, and

¹At the time of data collection in April 2022, adults 18 years and older in the United States were eligible to receive a primary COVID-19 vaccine series (i.e., two shots of the mRNA Pfizer/BioNTech or Moderna vaccines or one shot of the Johnson & Johnson vaccine) and one booster shot (National Association of Attorneys General, 2022).

TABLE 1

Means and Internal Consistency for Intellectual Humility, Misinformation Susceptibility, and Antivaccination Attitudes

Measure	<i>M</i>	<i>SD</i>	α
Intellectual humility	22.45	3.83	.74
Alternative health beliefs	42.78	7.66	.65
Pseudoscience beliefs	88.88	21.17	.93
Generic conspiracy beliefs	46.92	16.55	.96
Vaccine conspiracy beliefs	29.76	12.73	.96
Antivaccination attitudes	41.36	12.62	.91

TABLE 2

Descriptive Statistics for Vaccine Status, Doses, and Plan

Vaccine status			
Yes		No	
	175 (90.2%)	18 (9.3%)	
Number of vaccine doses			
1 dose		3 doses	
0 (0%)	41 (21.1%)	49 (25.3%)	
Plan to get vaccinated			
Yes		No	
	1 (0.5%)	17 (8.8%)	

Note. *N* = 194

49 (25.3%) had received three shots. 18 (9.3%) participants had not received any doses of the COVID-19 vaccine. Of these participants one (5.6%) said they had a plan to get vaccinated against COVID-19, and 17 (94.4%) said they did not have a plan to get vaccinated against COVID-19. Correlations among indices of misinformation susceptibility, IH, vaccine attitudes, and vaccine status are shown in Table 2.

Vaccination Attitudes, Misinformation Susceptibility, and Vaccine Status

Antivaccination attitudes were positively related to alternative health beliefs, $r(183) = .29, p < .001$, pseudoscientific beliefs, $r(119) = .55, p < .001$, generic conspiracy beliefs, $r(182) = .73, p < .001$, and vaccine conspiracy beliefs, $r(180) = .88, p < .001$. Antivaccination attitudes were not significantly related to IH, $r(191) = .13, p = .07$.

To examine whether misinformation susceptibility and vaccination attitudes predicted vaccine status, a standard binary logistic regression analysis was conducted. The predictor variables in this analysis were alternative health beliefs, belief in pseudoscience, generic conspiracy beliefs, vaccine conspiracy beliefs, IH, and antivaccination attitudes. Race and political ideology were entered as control variables, as both are strongly related to vaccination attitudes, and we wanted to examine the relationship between misinformation beliefs and vaccination attitude independently of race and political beliefs (e.g., Baumgaertner et al., 2018; Fisher et al., 2020) which could potentially be confounding variables. Based on a classification threshold that predicted probability of vaccination as .5, results of the logistic analysis indicated that the model provided a statistically significant prediction of vaccination status, $X^2(11, N = 107) = 43.78, p < .001$. The Nagelkerke R^2 indicated that the model accounted for approximately 73% of the total variance. Classification accuracy for the cases based on a classification cutoff of .500 for predicted vaccination status in the successful group was moderately high, with an overall correct prediction rate of 92.5% and correct prediction rates of 20% for unvaccinated participants and 100% for those vaccinated. The Wald tests indicated that both pseudoscientific beliefs and vaccination attitudes were statistically significant predictors of success. Surprisingly, endorsing pseudoscientific beliefs was related to an increased likelihood of being vaccinated, $\exp(B) = 1.30, 95\% \text{ CI } [1.05, 1.61]$. As expected, endorsing antivaccination attitudes was related to a decreased likelihood of being vaccinated, $\exp(B) = 0.72, 95\% \text{ CI } [0.53, 0.99]$.

Misinformation Beliefs and Intellectual Humility

IH was positively correlated with endorsing generic

conspiracy beliefs, $r(184) = .23, p < .001$, and vaccine conspiracy beliefs, $r(182) = .19, p = .01$, but was not significantly related to pseudoscientific beliefs, $r(122) = .12, p = .18$, or alternative health beliefs, $r(187) = .09, p = .24$. To better understand the relationships among IH and misinformation susceptibility, individual items on the GIH Scale were correlated with measures of misinformation susceptibility (see Table 3). Two items were significantly related: "I question my own opinions, positions, and viewpoints because they could be wrong" was significantly positively correlated with generic conspiracy beliefs, $r(187) = .25, p < .001$, vaccine conspiracy beliefs, $r(185) = .22, p = .002$, and antivaccination attitudes, $r(187) = .19, p = .008$. The item was not significantly related to pseudoscientific beliefs, $r(124) = .18, p = .052$, or alternative health beliefs, $r(190) = .01, p = .864$. The item "I like finding out new information that differs from what I already think is true" was significantly positively correlated with alternative

TABLE 3

Correlations Among Intellectual Humility, Misinformation Susceptibility, Vaccine Attitudes, and Vaccine Status

	1	2	3	4	5	6
1. Intellectual humility	-	-	-	-	-	-
2. Alternative health beliefs	.09	-	-	-	-	-
3. Pseudoscience beliefs	.12	.63***	-	-	-	-
4. Generic conspiracy beliefs	.23**	.41***	.73***	-	-	-
5. Vaccine conspiracy beliefs	.19**	.33***	.69***	.81***	-	-
6. Antivaccination attitudes	.13	.29***	.55***	.73***	.88***	-

Note. * $p < .05$. ** $p < .01$. *** $p \leq .001$.

TABLE 4

Correlations Between General Intellectual Humility Scale Items and Misinformation Beliefs

	AHB	PB	GCB	VCB	AVA
I question my own opinions, positions, and viewpoints because they could be wrong.	.01	.18	.25**	.22**	.19**
I reconsider my opinions when presented with new evidence.	-.01	-.20	.09	.07	.01
I recognize the value in opinions that are different from my own.	.14	.01	.01	.02	.00
I accept that my beliefs and attitudes may be wrong	.03	.06	.08	.03	.01
In the face of conflicting evidence, I am open to changing my opinions.	.00	-.04	.09	.04	.01
I like finding out new information that differs from what I already think is true.	.15*	.19*	.19**	.24**	.20**

Note. AHA = Alternative health beliefs; PB = Pseudoscience beliefs; GCB = Generic conspiracy beliefs; VCB = Vaccine conspiracy beliefs; AVA = Antivaccination attitudes.

* $p < .05$. ** $p < .01$. *** $p \leq .001$.

health beliefs, $r(198) = .15, p = .04$, pseudoscientific beliefs, $r(122) = .19, p = .04$, generic conspiracy beliefs, $r(189) = .29, p < .001$, vaccine conspiracy beliefs, $r(185) = .24, p < .001$, and antivaccination attitudes, $r(187) = .20, p = .007$ (see Table 4). These patterns of correlations suggest that people high in IH are more likely to endorse misinformation beliefs at least in part because they are more likely to question their own views and are more open to information that differs from what they believe.

Discussion

The present study examined misinformation susceptibility, IH, and vaccination attitudes to further understand the psychological factors involved in COVID-19 vaccine status. The results revealed that harboring antivaccination attitudes and endorsing pseudoscientific beliefs were the strongest predictors of COVID-19 vaccine status. Specifically, people were more likely to be vaccinated against COVID-19 when they held positive vaccination attitudes, as expected. However, surprisingly, participants were more likely to be vaccinated against COVID-19 when they endorsed pseudoscientific beliefs. Given that all indices of misinformation susceptibility were positively correlated with each other and that all were positively related to antivaccination attitudes, the relationship between pseudoscience beliefs and COVID-19 vaccination status is unexpected. We are not sure why belief in pseudoscience is related to being more likely to be vaccinated. More research is needed to better understand the reason for this association, and whether it could be due to the nature of pseudoscience, sample representativeness, scales, or possibly policy behind vaccine mandates. Future research may examine this finding and can contribute to better understanding of possible mechanisms behind the association between pseudoscientific beliefs and COVID-19 vaccination status.

Antivaccination attitudes were positively and strongly related to all measures of misinformation beliefs (i.e., alternative health beliefs, pseudoscientific beliefs, and both measures of conspiracy beliefs) suggesting a strong connection between believing misleading information and harnessing negative views toward vaccines in general. These correlations suggest that antivaccination attitudes may be founded on misinformation opposed to credible, scientific evidence, further supporting claims that individuals who believe in COVID-19 vaccine misinformation tend to be less willing to receive the vaccine (Garett & Young, 2021; Islam et al., 2021).

Surprisingly, IH was positively correlated with both generic and vaccine-related conspiracy beliefs (but not other forms of misinformation susceptibility), whereas previous literature has found a negative relationship

between IH and conspiracy ideation (Huynh & Bayles, 2022). In particular, two items of the GIH Scale were significantly related to conspiracy beliefs: "I question my own opinions, positions, and viewpoints because they could be wrong" and "I like finding out new information that differs from what I already think is true." People who endorse these statements specifically may be more likely to seek out conspiratorial ideation and alternative theories precisely because these ideas differ from their current perspectives and beliefs. Indeed, people high in IH are more willing to question themselves and consider rival viewpoints (Colombo et al., 2021). Those who are motivated to seek out information that contradicts their points of view are likely to later endorse the new information they gain exposure to (Zajonc, 1968); because of this mere exposure effect, high IH individuals may be more open to believing misinformation due to exposing themselves to it. However, there is not yet evidence of this in peer reviewed literature.

One reason why IH may be related to endorsement of conspiracy beliefs but not to other forms of misinformation susceptibility is the specific content of conspiracy beliefs. Many of the items on the conspiracy belief scales include concerns about the government or organizations actively obscuring information from the general public (e.g., "The government is involved in the murder of innocent citizens and/or well-known public figures, and keeps this a secret"). Given this secrecy, a great deal of the information is difficult, if not impossible, to know or prove, introducing additional uncertainty. This uncertainty may especially appeal to high-IH people who are more likely to recognize the limitations of the evidence they have to form their beliefs, as they may not have access to all of the relevant information because it is being intentionally distorted or withheld. A positive relationship between IH and conspiratorial ideation is novel and suggests a possible drawback of high IH. More research is needed to better understand how IH relates to conspiracy ideation, considering how past research has found a negative relationship between conspiracy ideation and IH (Bowes & Tasimi, 2022; Huynh & Bayles, 2022).

Though previous research has shown that IH is related to positive vaccine attitudes and intention to vaccinate against COVID-19 (Huynh & Senger, 2021), IH does not seem to be related to COVID-19 vaccine behaviors. In the present study, IH was not related to COVID-19 vaccine status or the number of COVID-19 doses received. The literature that examines the relationship between IH and vaccine status and intention is also mixed, as IH has been found to predict COVID-19 vaccine intention but not flu vaccine intention (Senger & Huynh, 2021). It is possible that high-IH individuals

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intended to receive the vaccine at the time of data collection, yet they were waiting to move forward with receiving the vaccine, potentially to obtain more information first, which would be of characteristic for an individual high in IH. It is also possible that, though people high in IH intend to get the vaccine, their behavior is limited by logistical constraints (e.g., time, accessibility, availability).

Past research has shown that IH is related to engaging in other health-protective behaviors during the COVID-19 pandemic such as mask-wearing and social distancing (Jongman-Sereno et al., 2023). More research is needed to understand what connects IH to certain health-protective behaviors but not others, such as receiving the vaccination as seen in the present study. It could be possible that behaviors such as mask-wearing and social distancing are seen as low-risk, but receiving a vaccination may raise more inquiry and investigative behaviors for those high in IH.

One of the biggest limitations of the present research is that it did not assess situational or circumstantial factors (e.g., pressure to get vaccinated from employers, family) involved in vaccination status. Some people may get vaccinated because they fear losing social connections (e.g., family members requiring visitors to be vaccinated) or professional opportunities (e.g., employers requiring vaccines) even though they hold antivaccination attitudes and do not want to get vaccinated against COVID-19. Future research examining this topic should assess these factors.

In addition, although efforts were made to recruit a sample with more diversity in vaccination status (i.e., by recruiting participants on MTurk rather than using a subject pool at a university that requires vaccination), there was a high rate of COVID-19 vaccination in the sample. The vaccination rate in our sample was 90.2%, which is inflated compared to the rate of vaccination in the United States at the time of data collection. When these data were collected, 78% of the general population had received at least one dose, 66% had received two doses, and 31% had received an additional booster shot as of May 16, 2022 (USA Facts, 2023). Because so few participants in our sample were unvaccinated, the present study might not have attained adequate power in order to detect an effect.

The sample was also largely White (82.9%) and educated (over half of the participants had received a 4-year degree, and more than a quarter had received a graduate, postgraduate, or professional degree), and a more diverse sample could change the results. Research has shown that being Black and having low educational attainment are independently related to more vaccine hesitancy (Fisher et al., 2020). Future research should aim to collect a more racially and educationally diverse

sample to better understand the relationship between misinformation susceptibility, alternative health beliefs, IH, vaccine attitudes, and vaccine status. If the participants reflect more diversity in race and education, the data may yield different results. In addition, the questionnaire included demographics of race/ethnicity, but not necessarily culture and cultural background. Alternative health beliefs may be common in different cultures; research has shown that identification with cultural groups that identify with environmentalism, feminism, spirituality, and personal growth predicts alternative healthcare use (Astin, 1998). When taking cultural practice and otherwise belief in alternative health practices, the lines of what constitutes misinformation become blurred, and a much more complicated concept that categorizing items into “information” or “misinformation.”

In addition, the present study relied on self-report measures, which might have been biased by social desirability concerns. Future research should examine behavior or more objective measures of the constructs (e.g., uploading vaccination records).

Future research should further examine the relationship between IH and various forms of misinformation susceptibility to clarify contradictory findings—both within the current study and compared to previous research on the topics. More research is needed to understand the mechanisms that link IH with certain forms of misinformation susceptibility but not others. It is possible that the context or framing of some misinformation (e.g., pseudoscience, conspiracy theories) may be more closely related to IH than others. In addition, given that the current research found a link between IH and generic and vaccine-related conspiracy theory beliefs, future research should delve deeper into IH and whether there are negative consequences for being high or “too high” on this trait in the context of conspiratorial ideation. Furthermore, research should examine whether the link between IH and conspiracy beliefs has implications for behavior.

The personality trait openness to experience may help clarify the relationship between IH and misinformation susceptibility. Past research has found that IH is positively related to openness (Leary et al., 2017; Porter & Schumann, 2018). Future research could see whether specific facets of openness (e.g., intellectual curiosity) is related to IH. Further understanding of the relationship between IH and openness may shed light on circumstances under which people high in IH are “too open” to experiences such as accepting information (or in some cases, misinformation).

Together, the results shed light on psychological factors pertaining to openness to information that may underlie antivaccination attitudes and behavior. Having

antivaccination attitudes was related to being less likely to be vaccinated against COVID-19. In addition, people who were more likely to endorse alternative health beliefs, pseudoscience, and generic and vaccine conspiracy theories were more likely to have antivaccination attitudes. These findings suggest that susceptibility to misinformation underlies antivaccination attitudes, which may in turn lead people to be hesitant to get vaccinated. Given the implications of refusing vaccination, more research is needed to understand this important public health issue.

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Author Note. Amanda J. Bossert <https://orcid.org/0009-0005-0533-483X>
 Katrina P. Jongman-Sereno <https://orcid.org/0000-0002-5710-4148>
 Amanda J. Bossert is now a Candidate for the MS in Clinical Rehabilitation Counseling, 2025 at the University of North Carolina at Chapel Hill.

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Correspondence concerning this article should be addressed to Amanda J. Bossert, Department of Health Sciences, University of North Carolina at Chapel Hill. Email: abossert0212@gmail.com.

Correction to McKeon et al. (2020)

Regarding the article, "Supervisors' Gratitude and Employees' Feelings About Their Supervisor and Organization" by Emma J. McKeon, Kayla M. Trumbull, and Jennifer L. Hughes (*Psi Chi Journal of Psychological Research*, 2020, Vol. 25, No. 3, pp 272–277. <https://doi.org/10.24839/2325-7342.JN25.3.272>), the first author now identifies as Joseph W. McKeon.

The correct authorship listing (Joseph W. McKeon, Kayla M. Trumbull, and Jennifer L. Hughes) has now been corrected on the *Psi Chi Journal* website and should be used in all citations and references moving forward.

Psi Chi Journal recognizes challenges faced by transgender and nonbinary authors when updating their records to reflect their identities. The journal's Editorial Team is committed to supporting authors and facilitating name changes to best "respect the language people use to describe themselves" (APA Publication Manual 5.2 & 5.5). <https://doi.org/10.24839/2325-7342.JN29.2.167>

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