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Posters 1–7   Thursday Evening

Papers and Posters Presented at the 43rd Annual Meeting of the Psychonomic Society
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POSTER SESSION I
Crown Hall, Thursday Evening, 6:00–7:30

• VISUAL PERCEPTION •

(1)

Priming and Perception of Androgynous Faces: What You See Is Not What You Get. JAY FRIEDENBERG, SARIT KANIEVSKY, & MEGAN KWASNIAK, *Manhattan College*—Fifty-six participants judged the perceived sex and attractiveness of male, female, and morph faces. The morphs were 50:50 composite blends of single male and female faces. In the no-prime control, only morphs were presented. Each morph was preceded by its male face in the male-prime condition, and by its female face in the female-prime condition. The results showed a *reverse priming effect*. Participants in the male-prime condition perceived the morphs as predominantly female; those in the female-prime condition saw them instead as predominantly male. We hypothesize that primes fatigue an internal face representation, making the opposite-sex facial counterpart in the morph salient. The data surprisingly show that morphs were not rated as less attractive than primes. Women judged all the faces as significantly more attractive than did men and also spent significantly more time looking at morphs than did men. This perhaps reflects a more liberal response criterion for perceived attractiveness for women.

(2)

Dynamic Object-Based Inhibition Without a Physically Perceived Object. LISA N. JEFFERIES & VINCENT DI LOLLO, *University of British Columbia*—Objects are a critical component of our visual environment; we are continually examining where objects are and what objects are new in the visual scene. What the brain processes as an "object" and the level of representation at which objects exist, however, are not clearly understood. The present experiments utilized dynamic object-based inhibition of return and complete occlusion by illusory occluders to separate cognitive from sensory representations of objects and thereby to examine the level at which objects are represented in the brain. Previous research has suggested that a visible object and its concomitant sensory representation are required for object-based inhibition to occur. To the contrary, we show that a visible object is not necessary for inhibition to occur and that a cognitive representation of the object, rather than a sensory one, may be sufficient. We further demonstrate that the formation of cognitive representations depends on interpretation and expectation

(3)

Blank Fields on Noise Trials Improve Word Detection But Not Identification. GARY D. FISK, *Georgia Southwestern State University,* & STEVEN J. HAASE, *University of Wisconsin, Madison*—In previous work (Haase & Fisk, 2001, Psychonomic Society Annual Meeting), we used a signal detection approach to demonstrate that confidence in detection predicts identification and exclusion performance for briefly presented word stimuli. The noise condition consisted of three flashes of random letter strings (nonwords), and the signal+noise condition consisted of a nonword–word–nonword sequence. In the present study, the degree of noise on the noise trials was manipulated by (1) replacing the middle nonwords with strings of random digits and (2) inserting a blank field in place of the middle, nonword field. Stimulus detection closely predicted identification when nonword noise targets were replaced with numbers, similar to previous findings. In the nonword–blank-field–nonword condition, stimulus detection was improved, but stimulus identification did not show a comparable improvement. These results suggest that other stimulus information, such as luminance, is capable of influencing detection performance but may not improve identification.

(4)

Prerecognition Visual Processing of Words, Pseudowords, and Nonwords. BART A. VANVOORHIS, *University of Wisconsin, La Crosse,* & LLOYD L. AVANT, *Iowa State University*—Viewers made duration or brightness judgments for pre- and postmasked 15-msec inputs of words, pseudowords, and nonwords when the words were high-image nouns, abstract nouns, and verbs and when the pseudowords and nonwords were derived from letters of the same word or across the three word types. Results showed that for both brightness and duration judgments, the brain's knowledge of (1) individual words of each word type and (2) orthographic regularity was activated simultaneously with the earliest prerecognition processing of the graphic features of upper, lower, or mixed letter case.

(5)

Effect of Object Displacement on the Planning of Inter- and Intraobject Saccades. DORINE VERGILINO-PEREZ & JOHN M. FINDLAY, *University of Durham* (sponsored by Martin A. Conway)—The planning of saccades to or within objects was investigated by examining the effect of object displacement during the primary saccade. The results provide evidence for two different coordinate systems in the planning of inter- and intraobject saccade metrics. The artificial error in initial landing position, introduced by the displacement, is corrected only when the saccadic system selects a new object as a target for the second saccade. In this case, the interobject saccade, coded in a retinocentric coordinate system, is updated with respect to the eye position to aim for a precise position in the next object. When the second saccade is directed within the fixated object, the saccade is coded in an oculocentric coordinate system as a fixed-motor vector, executed regardless of the first fixation position on the object.

(6)

Does Need for Cognition Influence the Müller-Lyer Illusion? CHRISTOPHER KOCH & ELISSA S. HAYWORTH, *George Fox University*—Social psychologists often use principles from cognitive psychology to explain how people perceive social situations. One common term in social cognition is *need for cognition*. Need for cognition refers to people who enjoy thinking and problem solving. This study addresses whether or not need for cognition influences how people process perceptual tasks. Twenty-one graduate and 24 undergraduate students completed the Need for Cognition Scale and adjusted line lengths in a Müller-Lyer task. The amount of time to complete the trials and the amount of line overadjustment were recorded. Although there was a trend toward greater accuracy with higher need for cognition, this trend was not significant. However, those higher in need for cognition did take significantly longer to complete the task. The results suggest that additional thinking about a perceptual task does not necessarily improve performance on that task.

(7)

Eye-Movement–Based Measures of Memory as a Function of Prior Exposure Type. FRANK M. MARCHAK, *Veridical Research and Design,* & TODD DAVIDSON, *Montana State University*—Marchak and Alberts (1999) examined differences in the eye-movement–based memory effect (Althoff et al., 1998), which distinguishes between re-

peated and novel items (with previously seen items showing fewer fixations to fewer regions in a scene and lower levels of constraint in the patterns of eye movement transitions between regions), for photographs of faces of famous media and political figures known to subjects only from magazines, television, and cinema (2-D) and of faces of co-workers with whom they have had direct interactions (3-D). The present work examines the effect of prior exposure to real objects (3-D) and images of objects (2-D) on subsequent eye-movement–based measures of priming and the relationship between faces and objects as stimuli. It further defines the limits of the effect and its generalizability to alternative application areas.

(8)

Is the N170 ERP Component Face Specific? ALAN ROBINSON, *University of California, San Diego,* & JOANNA MORRIS, *Hampshire College*—Previous ERP studies have suggested that the N170 ERP component is specific to the visual processing of faces. We measured ERP responses to the presentation of human heads in increasing lateral rotation, from full frontal views of the face through views of the back of the head. Of interest was whether the N170 component would still be present when subjects viewed the back of the head and whether any systematic change would co-occur with rotation. It was found that all views of the head produced statistically significant N170 responses but that the nature of those components varied. For occipital electrodes, there was an increase in latency and a decrease in amplitude as rotation increased, but for parietal electrodes, there was no consistent significant effect for rotation. This suggests that the N170 is not always a face-specific response, although it is topographically sensitive to the presence of faces.

(9)

Cross-Modal Interaction Between Light and Sound: An Accuracy–Speed Analysis. YOAV ARIEH, ERIC C. ODGAARD, & LAWRENCE E. MARKS, *John B. Pierce Laboratory & Yale University*—Visual stimuli are classified (A vs. B) as faster when accompanied by an auditory stimulus than when presented alone. This is surprising because the auditory stimulus carries no information about the visual stimulus. Can the accuracy–speed tradeoff function (ASTF) account for the observed facilitation? Participants classified the color (green vs. red) of lights that were either accompanied by noise at different interstimulus intervals (ISIs) or presented alone. In one condition, participants were encouraged to respond as quickly as possible, and in another, to emphasize accuracy. In both conditions, the ASTF derived from performance on the noise trials at the various ISIs could predict performance on the no-noise trials. These results suggest that, on the noise trials, the auditory stimulus facilitated response time by lowering response criteria for deciding which color had been presented, and not by enhancing processing at a sensory level.

(10)

Landmarks Versus Path Integration When Learning a New Environment. PATRICK S. FOO, WILLIAM H. WARREN, JR., & MICHAEL J. TARR, *Brown University*—Humans, unlike ants, do not switch from path integration to landmarks as they learn shortcuts in new environments (Foo et al., 2002). Landmarks surrounding goal positions dominate navigation; however, humans rely on path integration when landmarks surround a starting position. How do landmarks at intermediate positions along a route affect the learning of shortcuts? Participants walked in a 40 × 40 ft virtual environment while head position/orientation were measured. The participants learned two legs of a triangle with feedback: *home* to Position A and *home* to Position B. Potential landmarks (colored posts) were placed along either a learned path (H–B) or a novel shortcut (A–B). The participants walked the learned legs or the shortcut without feedback. On catch trials, the posts were translated in order to probe reliance on landmarks. Results suggest that humans are sensitive to potential landmarks and will rely on them at the expense of metric navigation strategies when it is useful to do so.

(11)

Velocity Dependence of Optic Flow Strategy for Steering. PHILIP W. FINK & WILLIAM H. WARREN, JR., *Brown University* (sponsored by William H. Warren, Jr.)—Recent research has suggested that both the egocentric direction of the goal and optic flow are used to guide locomotion. Warren et al. (2001) proposed that a linear combination of the two variables is used to walk to a goal, with the contribution of optic flow dependent on the velocity of the flow field. To test this hypothesis, we varied the flow velocity during walking in a 12 × 12 m virtual environment. To dissociate the two variables, the focus of expansion was shifted 10º from the actual direction of walking, while flow velocity was manipulated by changing the *gain* between virtual and physical space. Participants continuously walked to targets located 8 m apart. The gain was randomly varied, increased, or decreased within a block of trials. Preliminary results suggest that optic flow increasingly dominates egocentric direction as the flow velocity increases. NIH EY10923, NSF LIS IRI-9720327

(12)

Eye Movement Search: Top-Down Influences on Focal and Peripheral Vision. HAROLD H. GREENE, *University of Detroit Mercy*—Recently published reports (e.g., Itti & Koch, 2000) show that bottom-up computation is sufficient for visual search. Do top-down mechanisms significantly guide search? Gaze-contingent moving window displays presented direction-coded and uncoded arrowhead distractors independently to focal (i.e., a 4º × 4º area) and peripheral vision. Half of the observers were informed when spatial organization of distractors predicted target location. Hence, these observers used top-down knowledge and bottom-up mechanisms in search of the target. Uninformed observers used only bottom-up mechanisms. Postexperiment query confirmed that uninformed observers were unaware of information provided about target location. Proportions of optimally placed fixations were influenced by top-down knowledge only when distractors within focal vision predicted target location. Similar results were found for fixation durations. These results and others (with a 1º × 1º foveal window) are discussed as potential constraints for biologically inspired models of visual search.

• SPEECH PERCEPTION •

(13)

Unsupervised Learning of Unidimensional and Multidimensional Auditory Categories. MARTIJN GOUDBEEK, ROEL SMITS, & DANIEL SWINGLEY, *Max Planck Institute for Psycholinguistics*—Infants' first steps in language acquisition involve learning language-specific phonetic categories. Studies of visual category learning in adults have shown the importance of feedback (supervision) and of explicit (verbal) mediation, neither of which is available to infants. With feedback, adults can learn more difficult category distinctions; with explicit mediation, success depends on category dimensionality. Here, a labeling procedure and a lexical decision task were used to investigate the influence of both factors on auditory category learning. Adults listened to sounds from uni- or multidimensionally defined categories. Depending on condition, they were given a lexical decision task (hindering verbal mediation), a tonal label perfectly correlated with category membership (a counterpart to feedback in traditional category learning tasks), or both. For unidimensional categories, category labels did not affect learning, whereas the secondary task impaired learning. Results comparing these findings with multidimensional category learning will be presented.

(14)

Highly Familiar Items Guide Initial Speech Segmentation. HEATHER BORTFELD & KAREN RATHBUN, *Brown University,* ROBERTA GOLINKOFF, *University of Delaware,* & JAMES MORGAN, *Brown University*—Spoken word recognition of newly familiarized words before 7.5 months is limited, although infants may recognize such highly familiar items as their own names. We investigated

whether infants can use their names to recognize adjacent words in fluent speech and whether this ability is restricted to their names or encompasses any highly familiar items. Using the HPP, infants were tested on their ability to recognize words adjacent to their names in the speech stream (Experiment 1). Experiments 2 and 3 tested this same ability with other familiar names, indicating that infants may use any names that occur frequently in input to assist in segmentation. Finally, Experiment 4 examined whether this ability is limited to names or emerges with any frequently occurring item. These results confirm that infants can use frequently heard items to segment neighboring words from the speech stream, thereby precipitating word recognition in fluent speech.

(15)
Diminutives Aid in Word Segmentation. VERA KEMPE, *University of Stirling,* STEVEN GILLIS, *University of Antwerp,* & PATRICIA J. BROOKS, *College of Staten Island and The Graduate School, CUNY*— One pervasive feature of child-directed speech is the use of diminutives. This study explores whether sublexical features of diminutives such as regular metric stress and increased similarity of word endings, can aid word segmentation. Adult native speakers of English were presented with a stream of synthesized Dutch pseudowords while drawing a picture. After 20 min of exposure, recognition of these pseudowords was compared with that for unfamiliar combinations of the same syllables. Stress and ending similarity were manipulated in a between-subjects design. Experiment 1 revealed a benefit for the recognition of trisyllabic strings resembling Dutch diminutives, as compared with strings resembling simplex nouns. Experiment 2 controlled for word endings and showed a benefit of trochaic stress over iambic or mixed stress. Experiment 3 controlled for stress and revealed additive benefits from similarity in word-final consonants and vowels. These findings shed light on which particular features of child-directed speech may aid in word segmentation.

(16)
Auditory Word Recognition in Dyslexic Children: Evidence From Eye Movements. MARC F. JOANISSE, AMY S. DESROCHES, & ERIN ROBERTSON, *University of Western Ontario*—Eyetracking was used to measure phonological interference effects in 8- and 9-year-old children with dyslexia, as compared with younger and same-age normal readers. Participants saw four pictures on a display and heard sentences directing them to look at one of them (e.g., "Look at the TOWER"). Phonologically related visual distractors were presented during some trials: cohort distractors (TOWEL), rhyme distractors (FLOWER), or both rhyme and cohort distractors (TOWEL and FLOWER). A no-distractor condition provided a baseline measure of recognition time. Consistent with adult data, children in the control groups showed slower auditory word recognition times when cohort and/or rhyme competitors were present. Children in the dyslexic group showed cohort interference effects similar to those of age-matched controls. In contrast, these children showed significantly faster recognition times in the rhyme distractor condition. The results are discussed with respect to models of phonological development in normal and reading-impaired children.

(17)
Are Context Effects in Speech Perception Modulated by Visual Information? JOSEPH D. STEPHENS & LORI L. HOLT, *Carnegie Mellon University*—An important goal in speech perception research is to understand the means by which the perception of speech sounds is influenced by surrounding context. Fowler, Brown, and Mann (2000) reported a shift in perception of a consonant–vowel syllable as a function of visual speech information accompanying a preceding syllable. That finding was interpreted as contradictory to a general auditory account of such context effects (e.g., Lotto & Kluender, 1998). In the present study, we attempted to replicate that finding. Replication was possible only by using the stimulus materials of the original study, and data from a modification of the original experiment suggest that the effect may have been caused by unintended variation in the visual

tracks of the original stimuli. Results will be described in terms of a general perceptual account of context effects in speech perception.

(18)
Memory for Multimodal Sentences. SONYA M. SHEFFERT & NATHAN BREWSTER, *Central Michigan University*—This study was designed to determine whether listeners are more likely to remember the linguistic content of a spoken sentence if they can both see and hear the speaker who produced the utterance. Participants heard a list of vocabulary definitions produced by either auditory or audiovisual talkers. The definitions varied in semantic coherence. After each trial, the participants attempted to recall the definition. They later completed a sentence recognition memory test, a working memory span task, and a memory strategy questionnaire. We found no evidence that audiovisual speakers enhance immediate memory or long-term memory for sentences. The results are interpreted in terms of current models of multimodal communicative processing and memory.

(19)
Neighborhood Effects in Auditory Word Recognition: Phonological Competition and Orthographic Facilitation. MATHILDE MU-NEAUX, JOHANNES C. ZIEGLER, & JONATHAN GRAINGER, *CNRS and University of Provence* (sponsored by Johannes C. Ziegler)— The effects of phonological neighborhood (PN) and orthographic neighborhood (ON) were investigated in auditory lexical decision in French. PN produced the standard inhibitory effect (poorer performance for words with many neighbors than for words with few neighbors). In contrast, ON produced a facilitatory effect (better performance for words with many orthographic neighbors). The facilitatory ON effect was replicated while controlling for phonotactic probability, a variable that has previously produced facilitatory effects. Almost identical results were obtained in a shadowing task, ruling out the possibility that the effects were due to task-specific lexical decision mechanisms. Finally, the facilitatory ON effect persisted in an off-line task (the neighbor generation task), which supports the claim that ON effects are structural residual effects that act upon representations rather than upon processes. Learning to read and write appears to permanently alter the way we perceive spoken language by restructuring, specifying, and reorganizing lexical representations.

• SPATIAL COGNITION •

(20)
How Far Is Near? Examining the Distance Conveyed by Spatial Terms. SHANNON R. KLATT, ERIC S. COVEY, & LAURA A. CARLSON, *University of Notre Dame*—Spatial expressions such as "The mug is below the coffee pot" specify the location of one object by describing its spatial relation to another object. The spatial relation is defined with respect to a spatial reference frame that assigns orientation and direction to space, thereby enabling the spatial term to be mapped onto the appropriate region. The present research demonstrates that spatial terms also convey a distance that is assigned to this space. Experiment 1 used an implicit measure of distance, comparing response times in a speeded sentence/picture verification task across consecutive trials that matched or mismatched with respect to the distance between the objects. Experiment 2 used an explicit measure of distance, comparing distance estimates across trials with differently sized objects. The results indicate that spatial terms convey a distance and suggest that spatial reference frames have a parameter that assigns distance onto spatial regions.

(21)
Acquiring Spatial Knowledge of Simple and Complex Virtual Environments With Various Interface Metaphors. WILLIAM B. LATHROP, *University of California, Santa Cruz,* & MARY K. KAISER, *NASA Ames Research Center*—Navigation through virtual environments may be accomplished with different interface metaphors that vary in input/output visual–motor couplings. Such couplings characterize the

interface fidelity of a system, with high-fidelity systems approximating the sensory relationships found in real-world navigation (Waller, Hunt, & Knapp, 1998). Previous research has suggested that vestibular and proprioceptive information provided by high-fidelity systems facilitates spatial behavior in small-scale environments (e.g., Lathrop & Kaiser, 2002; Wraga, Creem, & Proffitt, 1999). We examined whether this information impacts spatial behavior in large-scale environments that vary in complexity and configuration, concepts closely associated with Appleyard's (1970) notion of environmental legibility. Experiment 1 showed that, when navigating simple large-scale environments, providing an isomorphic relationship between sensory changes assists path integration. Experiment 2 investigated the effects of variable interface fidelity for complex large-scale environments. Performance results from these experiments will be discussed.

(22)

Further Evidence That Mental Rotation and Perspective-Taking Are Separable Factors. DAVID WALLER, *Miami University,* & MARY HEGARTY, *University of California, Santa Barbara*—Recent psychometric results (Kozhevnikov & Hegarty, 2001) have supported a distinction between mental abilities that require a spatial transformation of a perceived object (e.g., mental rotation) and those that require imagining how a scene appears from different viewpoints (e.g., perspective-taking). Two experiments provide further evidence for and generalize this dissociation. Experiment 1 shows that the separability of mental rotation and perspective-taking is not dependent on the method by which people are tested. Experiment 2 generalizes the distinction to account for perspective-taking within perceived small-scale and imagined large-scale environments.

(23)

Children's Use of Route and Survey Learning in Virtual Environments. AMY L. SHELTON, *Johns Hopkins University,* & KATHERINE C. TURNER, *Stanford University*—In adults, route navigation and survey (map-like) learning appear to have different behavioral and neural consequences; however, little is known about how children deal with different spatial perspectives. We explored route and survey spatial learning in children (ages 4–12). Children learned two virtual reality (VR) environments through desktop VR tours, one at ground level (route perspective) and one from an aerial view (survey perspective). Differences in children's models or descriptions of environments following route and survey learning were used to assess (1) whether children can learn large-scale virtual environments from route and survey perspectives and (2) whether differences between route and survey learning in children mirror differences observed in adults. Results suggest that facility with route and survey information in VR environments may vary as a function of age. We consider how these differences speak to spatial skill development and the role of spatial abilities in developing other important skills.

(24)

Dimensions of Spatial Strategies. JILLIAN L. PRESTOPNIK, *University of New Mexico,* & BEVERLY ROSKOS-EWOLDSEN, *University of Alabama*—We know little about the kinds of spatial strategies people use and whether they are related to performance. This study identified the strategies people use in wayfinding and orientation tasks and examined the perceived similarity of the strategies (Experiments 1 and 2). MDS and cluster analyses showed that a 2-D representation best fit the data for both spatial tasks, with high/low use of imagery as one dimension and ego-/exocentric relations as the other dimension. Experiment 3 investigated whether the type of strategy used predicted performance on an orientation task. Use of high-imagery strategies and exocentric strategies predicted strong performance. When spatial or nonspatial training was introduced, type of strategy used interacted with type of training. Spatial practice was far more beneficial to performance for those who used high imagery or exocentric strategies than for those who did not. Nonspatial practice was beneficial regardless of type of strategy used.

(25)

Landmark Recognition: Holistic or Parts-Based Processing? STEPHANIE K. FRAONE & M. JEANNE SHOLL, *Boston College* (sponsored by M. Jeanne Sholl)—Behavioral evidence from prosopagnosic and non–brain-injured populations suggests that faces are recognized holistically, in contrast to objects whose recognition is parts based. Recent anecdotal accounts from the neuropsychological literature suggest that landmark agnosics, who have difficulty using landmarks to navigate, may compensate for landmark recognition deficits with a parts-based recognition strategy. If so, landmark recognition may normally be a holistic process. The present experiment used an inversion paradigm to test for a holistic landmark recognition process in normal adults. The experiment was divided into two parts. Part 1 was an inspection phase, during which participants viewed familiar Boston College landmarks, famous faces, familiar objects, and two other object categories. Part 2 was a forced-choice recognition test. The results suggest that landmarks are recognized like common objects, and not like faces.

(26)

When You Say What You Do, Do You Do What You Say? Interaction Between Verbal and Spatial Representations. AMY L. LYNN, *San Jose State University,* IMMANUEL BARSHI, *NASA Ames Research Center,* ALICE F. HEALY & VIVIAN I. SCHNEIDER, *University of Colorado, Boulder,* & JON B. HOLBROOK, *National Research Council*—This study investigated the relationship between the verbal and the spatial representations involved in following orally presented navigation instructions. Participants heard messages instructing them to move within a two-dimensional depiction of a three-dimensional space consisting of four stacked grids displayed on a computer screen; the participants were asked to orally repeat the instructions and follow them. Three groups were compared: One group orally repeated the commands and then made the movements, a second group made the movements and then orally repeated the commands, and a third group simultaneously repeated the commands and made the movements. The results suggest that performance on both movements and oral readback was best for participants who made movements prior to making their oral responses, suggesting that a participant's verbal representation is affected by the spatial representation of the instructions.

(27)

Does Sense of Direction Predict Learning in Virtual Space? KAREN A. MUEHL & M. JEANNE SHOLL, *Boston College*—Self-reported sense of direction predicts the accuracy with which people can point to familiar but unseen landmarks in the environment. Vector representations of interlandmark relations, which code the as-the-crow-flies distances and directions separating landmarks in physical space, are a likely cognitive substrate for accurate pointing responses. In this experiment, we tested whether self-reported sense of direction is related to the ability to form a vector representation when sensory input is restricted to the visual modality. Without moving their bodies, participants observed, on a computer screen, a simulated walk through a virtual interior space. The findings reported here and elsewhere were not consistent with the formation of vector knowledge from visual input alone. However, the results did indicate that good-sense-of-direction people and males were better able to integrate interobject relations from visually simulated self-motion through a structured virtual environment than were poor-sense-of-direction people and females, respectively.

(28)

Visual Temporal Order Judgments in Unilateral Neglect and Normal Aging. MARY E. MACISAAC & GAIL A. ESKES, *Dalhousie University,* DAVID I. SHORE, *McMaster University,* & RAYMOND M. KLEIN, *Dalhousie University*—Studies of unilateral neglect using a temporal order judgment task (TOJ) have reported a right-sided attentional bias (shift in the point of subjective simultaneity, PSS) and that an alerting tone reduced this bias. The present study employed a

similar left/right task and a novel red/blue task that avoids potential response bias accounts of the PSS shift. In addition, we examined the just noticeable difference (JND), an index of temporal precision rather than attentional bias. Five patients with neglect, 9 elderly controls, and 8 young participants were tested. The size of both JND and PSS was related to neglect severity. Alerting tones improved the JND and PSS in individuals with moderate neglect. Elderly participants showed larger JNDs that were not affected by alerting. No differences were found between red/blue and left/right tasks. These results suggest that alerting may improve both spatial attention and temporal resolution in cases of neglect, but not in the normal elderly.

(29)

Egocentric Spatial Transformations of Bodies and Body Parts. SARAH H. CREEM-REGEHR & NATALIE M. SARGENT, *University of Utah*—Studies have demonstrated both cognitive and neural distinctions between spatial decision tasks involving egocentric and object-relative mental transformations. Egocentric rotation tasks themselves may be further differentiated by the spatial decision required and the extent to which imagined limb movements are involved. The present study compared two egocentric tasks involving body and hand rotation. In both tasks, participants learned the configuration of six colored hands relative to an icon representing their own body position in the display. In the body task, they named the color of the hand that was in a given position relative to their imagined facing direction. In the hand task, they named whether a given hand was a left or a right hand. The tasks were performed with participants' hands and heads in varying positions to influence their perceived potential for action. Similar RT functions resulted for the hand and the viewer tasks, suggesting some shared mechanisms for different egocentric transformations.

(30)

Orthogonal Stimulus–Response Compatibility as a Function of Response Location Relative to the Stimulus Display. YANG SEOK CHO & ROBERT W. PROCTOR, *Purdue University* (sponsored by Robert W. Proctor)—When vertically arrayed stimuli are mapped to horizontally arrayed responses, the mapping effect is influenced by the location at which responses are made. The up-right/down-left advantage obtained at a centered response location is enhanced at a right location and reverses to an up-left/down-right advantage at a left location. The end-state comfort hypothesis suggests that hand position relative to body midline determines the mapping preference, whereas the salient features coding hypothesis implies that coding of relative response location does. Our experiments consistently showed that the mapping preference was influenced by the response location relative to the stimulus display. Moreover, the response eccentricity effect occurred when the response locations were manipulated in terms of the stimulus display, but not when the hand position relative to body midline was manipulated. These results support the view that the response eccentricity effect is due to coding of relative response location.

(31)

A Prevalence Effect for Two-Dimensional Stimulus–Response Sets When Location Is Irrelevant. ROBERT W. PROCTOR, KIM-PHUONG L. VU, & RYAN NICOLETTI, *Purdue University*—When stimulus–response sets vary along horizontal and vertical dimensions simultaneously, a prevalence effect is obtained for which the compatibility effect for one dimension is larger than that for the other. The present study examined whether the prevalence effect would still be evident in a Simon task for which stimulus location is irrelevant. When the stimulus–response sets were presented equally far apart on the horizontal and vertical dimensions, Simon effects of similar magnitude for both dimensions were obtained. However, when spatial proximity was varied to increase the salience for one dimension relative to the other, the Simon effect increased for the salient dimension. This result is consistent with the salient features coding account of response selection that has previously been used to explain differential compatibility effects when location is relevant, but not when location is irrelevant.

• **HUMAN LEARNING & MEMORY** •

(32)

The Effects of Taking a Multiple-Choice Test on Later Production of Facts. ELIZABETH J. MARSH & HENRY L. ROEDIGER III, *Washington University*—Educators rely heavily on multiple-choice tests to assess their students' mastery of course material. Multiple-choice tests provide retrieval practice, which is known to aid memory. However, exposure to multiple-choice lures inappropriately increases later truth ratings (e.g., Toppino & Luipersbeck, 1993). Of interest in our experiments is whether exposure to lures affects students' ability to later produce the correct answer. Subjects took a multiple-choice test with two-, three-, and four-alternative forced-choice questions, followed by a cued recall test. In all experiments, a testing effect was obtained: Production of correct answers was highest for items that had been previously tested. However, in some conditions, the type of prior question mattered. When subjects were tested on difficult questions or on passages they had not read, they answered more cued recall questions correctly when the prior test question contained fewer alternatives. Under some conditions, multiple-choice tests may undermine knowledge.

(33)

Effects of Implicit, Explicit, and Synergistic Training on Learning an Artificial Grammar. THOMAS J. DOMANGUE & ROBERT C. MATHEWS, *Louisiana State University* (sponsored by Robert C. Mathews)—Participants were trained to generate exemplars of an artificial grammar by bubbling-in letters from exemplars (implicit training), observing a diagram of the grammar and then reproducing it (explicit training), or tracing the path of exemplars through a diagram of the grammar (synergistic training). Performance was measured using a cued-generate task. It provided a template for an exemplar with two letters filled in. Participants attempted to generate exemplars that fit the template. The computer corrected the exemplar when it matched at least 70% of the letters in a valid string. Results showed that both explicit and synergistic training led to generation of better quality exemplars (closer to 100% match). However, implicit and synergistic training led to generating more exemplars good enough (at least 70% match) to fit into a wide variety of contextual cues. The authors concluded that for both quality and generativity of exemplars, synergistic training seemed the most beneficial.

(34)

Schema-Driven Memory and Structural Alignment. C. HUNT STILWELL & ARTHUR B. MARKMAN, *University of Texas, Austin*—Much research in the 1970s and 1980s focused on the claim that what people remember about complex situations is driven by schemas. Interest in this approach waned, because of the lack of specific proposals about how schemas are represented and processed. We suggest that schemas are represented using structured hierarchical representations like those posited to play a role in analogy. These schemas serve as base domains that can be compared with new situations, using a process of structural alignment and mapping. Structural alignment focuses on the commonalities and alignable differences that emerge from such comparisons. As a result, these properties will be better remembered than will nonalignable differences. Furthermore, candidate inferences permit the base domain to add new information to the target. These candidate inferences are a source of schema-based intrusions. We present evidence consistent with this proposal, using studies in which people read pairs of complex stories.

(35)

Beer Experts and Novices Share a Perceptual Space, but Experts Describe it Better! SYLVIE CHOLLET, *ISA Lille,* DOMINIQUE VALENTIN, *University of Bourgogne,* & HERVE ABDI, *University of Texas, Dallas*—A first group of participants, the experts, were trained to detect and identify 15 beer off-flavors and to describe commercial lager characteristics. We evaluated their performance after 11, 42, and 63 h of training on a subset of the training stimuli. As a com-

parison, a second group of participants, the novices, performed only the evaluation test. We found that the experts outperformed the novices in a communication task but that the experts' performance increased only slightly with learning. However, the efficiency of the experts' vocabularies evolved during learning: The number of precise and efficient terms increased during learning, whereas the number of inefficient global terms decreased. On the other hand, the novices relied essentially on global terms to perform the task. Finally a factor analysis performed on a description task reveals that experts and novices shared a similar perceptual organization, even though experts were better at discriminating and were more reliable than novices.

(36)

Classroom Learning From Research Activities. PATRICIA A. DEWINSTANLEY, TYSZA GANDHA, KELLY ERHMAN, & JAN THORNTON, *Oberlin College*—As part of an assessment of Oberlin College's National Science Foundation's Award for the Integration of Research in Education, we conducted an experiment to see whether what our students were telling us about the value of their research experiences for learning in the classroom could be supported empirically. Introductory psychology students were randomly assigned to three groups. All the groups heard a short (10-min) lecture on selective attention. One group only heard the lecture, another group heard the lecture and then participated as subjects in an experiment, and the final group heard the lecture, then designed an experiment to demonstrate a conjunctive or singleton search, and then ran themselves through their own experiment. The group that designed the experiment learned the lecture material better than did the other two groups. Thus, we supported empirically the students' evaluation of the value of research-like activities for classroom learning.

(37)

A Multinomial Model of Event-Based Prospective Memory. REBEKAH E. SMITH & UTE J. BAYEN, *University of North Carolina, Chapel Hill*—The authors introduce the first formal model of event-based prospective memory—namely, a multinomial model that includes separate parameters for preparatory attentional processes and retrospective memory processes. The model was tested in two experiments. Manipulations of instructions to place importance on either the prospective memory task or the background task (Experiments 1 and 2) and manipulations of distinctiveness of prospective memory targets (Experiment 2) had expected effects on model parameters.

(38)

Investigating the Role of Working Memory Capacity in Prospective Memory. REBEKAH E. SMITH & UTE J. BAYEN, *University of North Carolina, Chapel Hill*—What role does working memory capacity play in prospective memory performance? A multinomial model of event-based prospective memory (Smith & Bayen, 2002) was used in two experiments to examine the influence of working memory span on both preparatory attentional processes and retrospective memory processes. In addition, a manipulation thought to influence the prospective component of prospective memory, or the retrieval of the intention (McDaniel, Robinson-Riegler, & Einstein, 1998), interacted with working memory span.

(39)

Spontaneous Use of Keyboard Mediators in Learning Spanish–English Vocabulary. ROBERT J. CRUTCHER, *University of Dayton*—An important issue in memory strategy research is the use of learning strategies by control groups. The present study investigated the use of keyword mediators in learning Spanish–English vocabulary pairs, comparing a free-strategy group with a keyword-instructed strategy group. Think-aloud protocols collected during learning monitored strategy use. As was predicted, keyword-instructed participants recalled significantly more word pairs than did the free-strategy group and required fewer trials to learn the pairs. In addition, the think-aloud verbal reports revealed that the free-strategy group spontaneously employed their own keyword mediators in learning many of the pairs, suggesting (1) that the recall difference between the groups probably underestimates the effectiveness of the keyword strategy, relative to other encoding strategies, and (2) that contrary to claims that the keyword method is an artificial learning strategy, the present findings demonstrate that learners sometimes spontaneously employ keyword strategies in learning vocabulary word pairs.

(40)

Episodic Associations and Retrieval-Induced Forgetting. DAVID YELLS, *Utah Valley State College,* & KENNETH A. DEFFENBACHER, *University of Nebraska, Omaha* (sponsored by Kenneth A. Deffenbacher)—Four experiments evaluated whether retrieval-induced forgetting (RIF) would be observed for stimuli among which relationships were based merely on being part of the same study list. RIF is the phenomenon in which retrieving some members of a study list reduces subsequent recall of nonretrieved members. Typical RIF research employs word lists in which there are preexisting semantic relationships among items. For each of the present experiments, participants studied a 15-item list of unrelated words for 90 sec. The intermediate task was either listing state capitals (control condition) or retrieving some of the study items on the basis of different criteria (initial letter or part of speech, experimental condition). Whether the intermediate retrieval task was based on part of speech or initial letter, RIF occurred when the critical items were verbs, but not when they were nouns.

(41)

Categorical Versus Magnitude Representation in Digit Recall. NEIL BERG & RICHARD B. ANDERSON, *Bowling Green State University*—Previous studies have found evidence for numerical magnitude representation (Brysbaert 1995; Dehaene, 1992). However, these studies have not examined magnitude representation in the context of serial recall. The present study examined the extent to which number representations possess magnitude properties that can be influenced by task structure. Subjects were encouraged to represent numbers either in a categorical fashion or in a magnitude fashion, using a recall manipulation. It was predicted that the percentage of errors, the mean absolute error, and the correlation between studied and recalled values (for error trials only) would depend on whether subjects were in the categorical-encoding group (these subjects recalled the information by typing in Arabic numerals about 70% of the time) or the magnitude-encoding group (these subjects recalled the information by clicking on a bar 70% of the time). The results partially confirmed the prediction that task structure can encourage different degrees of magnitude representation.

• RECOGNITION •

(42)

Sentential Context Facilitates the Incidental Formation of Episodic Associations Between Unrelated Words. ANAT PRIOR & SHLOMO BENTIN, *Hebrew University of Jerusalem* (sponsored by Shlomo Bentin)—We investigated the influence of semantic context on the formation of incidental associations between unrelated word pairs. Following five repeated exposures to words either as isolated pairs or embedded in sentences, participants studied the previously seen 72 pairs in a one-trial associative learning session and were tested by cued recall. Associative learning was better for pairs initially seen in sentential contexts than for words co-occurring context free. A second experiment replicated these findings and, using a recognition task, established that the sentential context effect did not result from enhanced memory for single items. In a third experiment, unrelated word pairs were embedded in either meaningful or semantically anomalous sentences. The formation of associations was probed, using a novel index of episodic associative priming in a recognition task for single words. We advocate the importance of semantic integration as a mechanism supporting the incidental formation of episodic associations, which might account for the sentential advantage.

(43)

Recognition in the Absence of Cued Recall. ANNE M. CLEARY, *Iowa State University*—The experiments reported here demonstrate that participants can recognize test cues as resembling studied words even when these cues cannot be used to recall the items that they resemble. After studying a list of words, participants were given a cued recall test for which half of the cues resembled studied words and half resembled nonstudied words. After trying to use a given cue to recall a study list item, participants gave a rating indicating the degree to which the cue resembled a studied word. For those cues whose targets could not be identified, the mean rating was higher when the cues resembled studied words than when they resembled nonstudied words. Various types of features can give rise to this effect; it was found when orthographic, phonemic, and semantic cued recall tasks were used.

(44)

Stereotypes as Vehicles for Memory Influence. HEATHER M. KLEIDER, *Claremont Graduate University*—The purpose of this research was to investigate the dynamics of stereotyping by extending the predictions of social memory models to include eyewitness accuracy. Of specific interest was whether social stereotypes increase vulnerability to schema-consistent false suggestions. In Experiment 1, participants saw pictures of people doing role-consistent and role-inconsistent tasks. A recognition test followed immediately or after 2 days. Results showed increased false alarms to consistent behaviors after delay and a decrease to inconsistent behaviors. In Experiment 2, pictures were presented for 2 sec or 6 sec each. False alarms to consistent behaviors decreased with increased exposure, while remaining unchanged for inconsistent behaviors. These results suggest that stereotypes are more likely to be relied upon when the memory trace for presented items is weak.

(45)

Can Memory Experts Provide Probative Value in Court ? ALBERT N. KATZ & ANDREA McKELLAR, *University of Western Ontario*—Increasingly, the probative value of psychologists' giving expert evidence on factors influencing the accuracy of eyewitness memory has been challenged—namely, whether the "expert" can relate knowledge or experience that goes beyond that known by judge or jury. In this study, samples of undergraduate students, law students, police trainees, and legal professionals (practicing lawyers or judges) completed an enhanced version of the "Knowledge of Eyewitness Behavior Questionnaire." Across samples, knowledge of the factors influencing eyewitness memory was fairly low, ranging from 40% (police trainees) to 53% (law students) correct. Nonetheless, certain factors influencing eyewitness recall accuracy were fairly well known by all the samples (e.g., the role played by how a question is asked, 91% overall) whereas other factors were poorly understood by all samples (e.g., the relation between confidence and accuracy, 21% overall). Experts can add probative value, especially with respect to selective aspects of the literature.

(46)

Migration of Objects and Inferences Across Episodes. SHARON L. HANNIGAN, *Bard College,* & MARK T. REINITZ, *University of Puget Sound*—Research has demonstrated that elements from one episode are sometimes falsely remembered as belonging to different episodes. This study explored whether cross-episode migration of objects is constrained by semantic knowledge and whether inferences, like objects, are vulnerable to episodic miscombination. Subjects viewed episodes portraying ordinary routines and later received a recognition test. In Experiment 1, objects from one episode were falsely recognized as belonging to other episodes described by the same abstract schema, but not to episodes anchored to different schemas; for example, objects migrated in memory from Restaurant Episode A at study to Restaurant Episode B at test, but not from a restaurant episode to a morning routine episode. Previously, we showed that upon exposure to "effect scenes," people sometimes inferred causes that were later falsely recognized. In Experiment 2, causal and schematic inferences

made during one episode were unwittingly generalized to other episodes described by the same schema. Furthermore, source confusion for schema-typical items was common. These findings suggest that objects and inferences are "composible units" from which episodic memories are constructed.

(47)

The Effects of Associative Activation on False Memories. JEFFREY S. ANASTASI, NATASHA BOORD, TAWNA GARCIA, ANGELA GROCH, SUSANA MARQUEZ, & AUTUMN STEWART, *Arizona State University West*—The present study consisted of four experiments that utilized two distinct methods for manipulating the amount of activation that took place when subjects encoded list items: word-sorting tasks and use of primary/secondary languages. Experiments 1 and 2 required subjects to use two word-sorting tasks that manipulated activation levels. Subjects sorted list items into categories that were either consistent or inconsistent with the associative nature of the list items in order to maximize or minimize the associative activation of the critical lures. Experiment 2 utilized similar sorting strategies but also added a 48-h retention interval in order to evaluate a competing theory. Experiment 3 investigated the incidence of illusory memories in bilinguals, in both their primary and secondary languages, as well as in monolingual English speakers. In Experiment 4, monolingual English speakers were tested with both English and Spanish lists. Overall, the results provide excellent support for activation-based explanations for memory illusions.

(48)

Effects of Selective Rehearsal and Retrieval Inhibition on False Recognition. YUH-SHIOW LEE, *National Chung-Cheng University*—This study examined whether false recognition produced by the DRM paradigm can be reduced by the directed-forgetting instructions. The numbers of to-be-remembered words (TBR) and to-be-forgotten (TBF) words within a semantically associated list were also manipulated. Experiment 1 used the item method and found that the amount of false recognition increased with an increasing number of TBF words within a list, suggesting that false recognition could be further induced by reducing the chance of elaborative rehearsal. Experiment 2 used the list method. Results suggested that TBF words did not contribute to the occurrence of false recognition; the rate of false recognition was determined mainly by the number of TBR words within a list. Implications of these findings, in terms of encoding and retrieval operations, in creating and reducing false recognition are discussed.

(49)

Processes Mediating the Recognition of Novel Visual Patterns. CATHERINE T. NGO, ANNE BROWN, DANIEL COLE, & STEPHEN DOPKINS, *George Washington University*—The process dissociation procedure was employed to determine the contributions of familiarity (F) and recollection (R) toward the recognition of novel visual patterns. Perceptual versus conceptual encoding type, number of pattern presentations, and perceptual similarity of study and test items were orthogonally varied to determine their relative effects on recognition components. Perceptual tasks required analyses of pattern features, whereas the conceptual tasks required associations of patterns to familiar objects or verbal labels. Study patterns were presented either one or five times. Conceptual encoding conferred an advantage for F at both levels of item presentation and for R after five presentations. Study–test perceptual similarity had no effect on either F or R. That conceptually mediated F operates after a single exposure is particularly interesting, for it suggests that linking a novel item with a preexisting semantic representation sets up a memory record robust enough to be fluently activated during recognition.

(50)

How Do Prior Warnings Reduce False Recall? BRADLEY J. NEADERHISER, JUSTIN WETTER, & BARBARA A. CHURCH, *SUNY, Buffalo*—Prior warnings about the Deese task can reduce the

likelihood of falsely recalling the critical lure (CL). Two hypotheses concerning how this occurs were explored: (1) Participants suppress the spread of activity within memory, never activating the CL, or (2) participants find the CL and repress reporting it. To test these hypotheses, word lists that produce high and low amounts of false recall were compared. Hypothesis 1 predicts that false recall should be reduced on all lists and that there should be better recall of the true list items (LI) with the warning, because of decreased retrieval competition. Hypothesis 2 predicts that false recall should be reduced only for high lists, because the CL is easier to find and repress. Recall of the LIs should also be reduced because of the increased competition. Results support Hypothesis 2. Implications for theories that assume that false recall can be consciously controlled will be discussed.

(51)

ROC Analyses of False Recognition Judgments. DONNA J. LAVOIE, HEATHER K. MERTZ, & MARK T. MORGAN, *Saint Louis University*—It is well established that participants in the false memory DRM paradigm produce high rates of false recognition for unstudied critical lures. These effects have been argued to be linked to spreading activation processes operating during encoding to increase the familiarity of critical lures. However, with the remember/know procedure, it has been reported that participants sometimes provide high rates of "remember" judgments to critical lures. These types of responses suggest that familiarity mechanisms alone may not be driving false recognition. We conducted an ROC analysis of false recognition and true recognition to assess the relative influence of familiarity and recollection processes in each type of recognition judgment. In addition, we present a model of false recognition to account for how familiarity and recollection processes operate to produce differing levels of false memory susceptibility in different populations.

• IMPLICIT MEMORY •

(52)

Picture Superiority Effect on a Conceptual Implicit Memory Test With Distinctive Cues. MARYELLEN HAMILTON, *Saint Peter's College,* LISA GERACI, *Washington University,* & SUPARNA RAJARAM, *SUNY, Stony Brook*—The picture superiority effect is thought to be mediated by conceptual processing. Surprisingly, recent studies have demonstrated that this effect is difficult to find using conceptual implicit memory tests (McDermott & Roediger, 1996; Weldon & Coyote, 1996; but see Vaidya & Gabrieli, 2001). This failure to find the picture superiority effect on conceptual implicit memory tests raises problems for the transfer appropriate processing view (Roediger, Weldon, & Challis, 1989). We attempted to isolate the conceptual processes that take place in pictorial encoding by examining different test cues. Specifically, we used typical conceptual cues and cues that accessed the individuating features of pictures. Similar to previous findings, we failed to find a picture superiority effect when using typical conceptual cues. However, when we used conceptual cues that emphasized the distinctive qualities of pictures, we obtained a picture superiority effect. We discuss the implications of these findings for current theories of implicit memory.

(53)

The Distinctiveness Effect Can Occur in the Absence of Conscious Awareness. LISA GERACI, *Washington University,* & SUPARNA RAJARAM, *SUNY, Stony Brook*—The distinctiveness effect (superior memory for unusual items) is not obtained on implicit memory tests (Geraci & Rajaram, in press; Hunt & Toth, 1990; Smith & Hunt, 2000). Two experiments were conducted to distinguish between two explanations for this finding: (1) that the distinctiveness effect requires conscious awareness of the study context or (2) that it requires a match of the distinctive processing from study. Participants studied lists containing some categorically isolated items, and their memory was tested. We manipulated conscious awareness by using explicit and implicit memory tests and processing match by using two different conceptual

implicit memory tests—category production and category verification. Both tests tapped category information, but the category verification test specifically recapitulated the distinctive processing from study. Only this test produced the distinctiveness effect. Thus, distinctiveness can aid memory even in the absence of conscious awareness when the implicit measure recapitulates distinctive processing from study.

(54)

Implicit Learning and Preference Acquisition for Musical Sequences Based on Artificial Rules. MICHAEL R. LEVITT & PAUL J. REBER, *Northwestern University*—Sequences of chords created from a synthetic frequency scale were constructed according to rules defining allowable chord series. Participants completed a study phase in which they listened to sequences sampled from the set of rule-conforming stimuli. On a subsequent test, half the participants classified new sequences according to whether they followed the rules (yes/no), and half the participants rated pleasantness of the test stimuli (1–6 scale). Participants correctly classified novel sequences that followed the underlying rules, but this effect did not generalize to sequences in which the stimuli were based on a novel frequency in the tonic chord element. Participants rated all sequences based on familiar tonic frequencies as more pleasant, but pleasantness ratings were unaffected by rule structure. These findings suggest that implicit learning of artificial chord sequence rules occurred with these stimuli but that implicit memory for pitch governed the effects of liking and learning.

(55)

The Intention Superiority Effect: Instructions to Complete or Forget an Intention Modulate Stroop Performance. ANNA-LISA COHEN, D. STEPHEN LINDSAY, & ROGER A. DIXON, *University of Victoria* (sponsored by D. Stephen Lindsay)—Research on the intention superiority effect has demonstrated that material from scripts that are to be performed later by the participant is processed faster than material from a neutral script. A primary objective of our research was to examine this effect within an interference paradigm, since this provides a stronger demonstration of the effect because color-naming latencies are assumed to be uncontaminated by strategies directed toward identification of the word itself. Participants received a brief Stroop list with critical words from an intention embedded within the list. We predicted that there would be more interference with naming the color of words belonging to an intention that was to be executed versus an intention that was not to be executed. Results of three experiments confirmed this prediction and showed that enhancing the processing of critical words by linking them to an intention appears to increase their power to interfere with color naming.

(56)

Hypermnesia in Implicit Memory. HAJIME OTANI, *Central Michigan University,* ROBERT L. WIDNER, JR. & PHILLIP N. GOERNERT, *Minnesota State University,* & KOICHI KATO & OLEKSANDRA G. SHAPOVALOVA, *Central Michigan University*—We investigated whether hypermnesia, or improvement across repeated tests, would occur in implicit memory tests. Participants were presented with either a categorized (Experiment 1) or a loosely categorized (Experiment 2) list and were asked to rate the pleasantness of each word. The third group, a control group, did not receive a list. Following a filler task, participants received either two explicit or two implicit memory tests. In these tests, the participants were presented with category labels (e.g., fruits) and were asked either to recall the items that belonged to each category (explicit) or to generate instances of each category (implicit). Improvement across tests was greater for the explicit memory test than for the implicit memory test. No improvement occurred for the control group. However, reminiscence, or item recovery on the second test, was similar between the explicit and the implicit memory tests. We concluded that item recovery does not require a conscious retrieval effort.

(57)
Implicit Category Learning of 3-D Objects. JOAN A. FISHER, KEN A. PALLER, & PAUL J. REBER, *Northwestern University*—Participants implicitly acquired category knowledge of 3-D crystals from 2-D images. The participants first made same–different judgments on sets of images presented in different orientations, scoring 77% (SE = 0.9%). The participants were then instructed that the crystals all came from the same category and were given a categorization test with novel category members and nonmembers. Categories were based on oblique versus orthogonal planar symmetry (half of the participants saw crystals with symmetry around 0–1 axis, and the other half saw crystals with symmetry around 2–4 axes). The participants correctly endorsed 60.1% (SE = 1.6%) of the category members significantly better than chance [$t(29)$ = 6.4, $p < .001$], although the participants who trained on less symmetric stimuli performed significantly better than those trained on more symmetric stimuli [$F(1,29)$ = 16.8, $p < .001$]. Few participants mentioned symmetry as a criterion for category membership. These results demonstrate that category learning using complex 3-D stimuli can take place in the absence of explicit knowledge.

(58)
Magazine Advertisements Implicitly Increase Positive Attitudes Toward the Products Depicted. KATHERINE M. MATHIS, *Millsaps College and Bates College,* KAREN SHERIDAN, ANDREA LUCAS, ERICA MARKS, & CHARLES LABORDE, *Millsaps College, &* TODD A. KAHAN, *Bates College*—Previous research has demonstrated that participants who are exposed to magazine advertisements rate those ads more favorably during a subsequent test phase, as compared with those ads they had not seen (Perfect & Askew, 1994). This was true both for explicitly and implicitly studied ads, although participants remembered only the deliberately studied items. The present study sought to determine whether these effects generalize to the actual products depicted in the advertisements. Participants deliberately or incidentally studied magazine ads, then were asked to rate ads or products on four dimensions, and finally were asked whether they had seen the ad or an ad for the product in the original phase. Results replicate and extend the mere exposure effect to the products depicted in the ads.

• WORKING MEMORY •

(59)
Nature or Nurture? Stability of Verbal and Spatial Working Memory Performance. JOSEPH W. LUDLUM, BRIAN D. NUEST, & MARILYN L. TURNER, *Wichita State University*—Is working memory (WM) a stable underlying process, or can it be enhanced with practice? Performance stability was examined using the sentence word (SW) and visual–spatial (VS) dual-span tasks. The SW task required participants to read aloud a series of sentences and to recall the last word of each sentence in serial order. The participants repeatedly completed the dual SW task five times in one massed-practice session. The VS task required the participants to remember, in serial order, the location of a target presented in a 5×5 matrix. The participants also completed the dual VS task five times in one practice session. Spans on the SW task, but not on the VS task, improved after the first session. Thus, VS spans demonstrated stable performance; SW spans were enhanced with practice. Possible explanations for these differences and their implications will be discussed.

(60)
STM and WM Are Conditioned by the Same Underlying Capacity Limitations. ROBERTO COLOM, FRANCISCO J. ABAD, & IRENE REBOLLO, *Universidad Autonoma de Madrid,* CARMEN FLORES-MENDOZA, *Universidade Federal de Minas Gerais,* & JUAN BOTELLA, *Universidad Autonoma de Madrid* (sponsored by Juan Botella)—A study was conducted in which 182 participants performed 10 diverse memory tasks involving short-term memory (STM) and working memory (WM). STM and WM verbal, quantitative, and spatial tasks are considered together. Confirmatory factor analyses showed that STM and WM latent factors are strongly related (.893). This strike relation precludes a hierarchical model in which a second-order factor predicts first-order factors representing STM and WM. A reanalysis of key previous studies was conducted to test the generalizability of the proposed hierarchical structure. The results support the model in which STM and WM tasks reflect the same underlying capacity limitations. STM cannot be considered a subset of a general WM system that includes a central executive. STM and WM could be conceived as subsets of a broader system comprising general capacity resources.

(61)
Attentional Processes in the Disruption of Serial Recall by Irrelevant Sounds. EMILY M. ELLIOTT, *Louisiana State University,* & NELSON COWAN, *University of Missouri*—We discuss evidence in children and adults suggesting that the disruption of attention is an important aspect of irrelevant-sound effects on serial recall, in contrast to some of the leading theories of these effects. In one study, young children showed a larger detrimental effect of irrelevant sounds on recall performance than did older children or adults, even when serial recall was equated for difficulty across individuals (Elliott, 2002). In another study, it was shown that irrelevant, changing tones disrupted performance only under circumstances in which rehearsal was likely: during a postlist retention interval or during the list presentation only if the list length was known and there was no retention interval to be used for rehearsal (Elliott & Cowan, 2002). It is difficult to account for these strategy-related effects without the assumption that irrelevant sounds draw attention away from the stimuli to be recalled.

(62)
Encoding and Distinctiveness Effects in Short-Term Recall of Order Information. THOMAS F. CUNNINGHAM, *St. Lawrence University,* ALICE F. HEALY, *University of Colorado, Boulder,* CARA E. BARBIERRI, *St. Lawrence University,* & JAMES A. KOLE, *University of Colorado, Boulder*—We examined how different encoding conditions and item distinctiveness affect short-term recall of order information. Adults recalled the order of letters in one of two 4-letter segments following a distractor task. They knew in advance the identity of the letters. A letter was made distinctive by replacing it with a red dash. Encoding conditions provided zero, one, or two overt opportunities to encode the distinctive letter. A negative distinctiveness effect (i.e., disadvantage for absent relative to present letters) was eliminated in the conditions that provided enhanced encoding opportunities. Responding in the regular (i.e., left-to-right) order was much less likely on trials with a distinctive letter than on trials with no distinctive letter. Further, this effect of trial type on regular order responses diminished as enhanced encoding opportunities increased. Thus, the negative distinctiveness effect is associated with output processes that are modified with enhanced encoding.

(63)
The Influence of Long-Term Associative Links on Immediate Serial Recall. JEAN SAINT-AUBIN & AMELIE MALENFANT, *Universite de Moncton*—Two studies investigated the influence of long-term associative links on immediate serial recall performance by testing the separation effect. In each list, there was a pair of weak associates (e.g., *web–poison*) that either were presented contiguously or were separated by one filler item. In Experiment 1, 24 subjects performed an immediate serial recall task with a forward recall, whereas in Experiment 2, a backward recall was used. Except for the lower recall performance with the backward recall requirement, the same pattern of results was observed in both experiments. Associated items were better recalled than control items, and recall was better for contiguous items than for those separated by one filler. Results are interpreted in light of a retrieval account in which degraded phonological traces must undergo a reconstruction process calling upon long-term knowledge of the to-be-remembered items. It is suggested that long-term associative links influence the accessibility of the long-term representations.

(64)

When Memory Load Increases Negative Priming. TODD A. KAHAN & KATHERINE M. MATHIS, *Bates College,* & ELEANOR JACKSON, *University of Southern Mississippi*—Previous research has found that individuals with high working memory capacity obtain negative priming, whereas those with low working memory capacity do not, and that negative priming occurs only with zero memory load (e.g., Conway, Tuholski, Shisler, & Engle, 1999). The present study investigated whether high memory load always eliminates negative priming. Three groups participated in a Stroop task in which they made a keypress response to the color of each item in prime–probe pairs. Group 1 had no memory load requirement. The other groups were prompted to recall the prime word after responding to the probe word's color. Group 2 was cued to recall the prime word on 12% of the trials, and Group 3 used cued to recall the prime word on 88% of the trials. Results indicate that negative priming increases with memory load demand. Implications of these findings for inhibition and episodic retrieval theories are discussed.

(65)

Deconstruction of Two-Column Subtraction. DONALD J. SEYLER & MARK H. ASHCRAFT, *Cleveland State University*—Extending our work in subtraction, we regressed structural and performance components and normative measures of difficulty, strategy use, and working memory capacity on performance in two-column subtraction problems. We also performed the same regression analyses on subtraction problems presented in a dual-task paradigm with letter set sequences of increasing lengths providing graduated levels of demand on working memory resources. Results indicate that the primary predictor of performance on two-column subtraction was the ones column basic fact reaction time, with the inclusion of the borrow algorithm adding to the prediction of error rates. Regression models provide evidence of the dependence on the central executive component of working memory for accurate completion of the borrow algorithm. The cycling of the letter sequences in the phonological loop influences the speed and accuracy of problem solving and also appears to hinder the retrieval of information stored in long-term memory.

(66)

Evidence for Multiple Processes in the *n*-Back Task: Fluid Intelligence Predicts Proactive but Not Reactive Control Strategy. GREGORY C. BURGESS, JEREMY R. GRAY, & TODD S. BRAVER, *Washington University*—The *n*-back task has become a widely used probe of working memory (WM) function. Although *n*-back performance is typically analyzed using global measures, multiple cognitive strategies might mediate performance. One strategy relies on actively maintained goal representations to proactively bias the response system. A second strategy is more reactive, relying on retrospective processes and the evaluation of familiarity signals. Two predictions were made: (1) Proactive strategies are dependent on the availability of cognitive resources (fluid intelligence), and (2) reactive strategies, engaged when proactive strategies fail, are susceptible to errors on "lure" trials (e.g., two-back repeats in a three-back task). Predictions were tested in 61 participants performing the three-back task and Raven's Advanced Progressive Matrices (in separate sessions). Fluid intelligence was negatively correlated with *n*-back "lure" errors, even after performance on nonlure trials was statistically controlled. Therefore, understanding WM function during the *n*-back may require more sensitive decomposition of task components.

(67)

The Effect of Working Memory Capacity on Age-Related Declines in Prospective Memory. HEEKYEONG PARK, *Carnegie Mellon University,* JUNG-MO LEE, *Sungkyunkwan University,* & YOUNG-SHIN PARK, *Catholic University of Korea*—The present study investigated the influence of working memory capacity on age-related declines in retrospective and prospective memory, particularly examining whether differences in previous findings on prospective memory can be explained by the interaction of age and working memory capacity. In both young and old groups, the performance on retrospective memory tasks was related to working memory capacity. However, prospective memory performance did not show the same pattern of results. Moreover, the influence of working memory capacity on the performance of prospective memory tasks differed by age group and task. The results have implications for prior research on the use of self-initiating processes in event-based and time-based tasks and on the relationship between cognitive load and cognitive resources.

(68)

Inhibitory Mechanisms Associated With Individual Differences in Working Memory. DANIEL L. TRAUGHBER & KANDI JO TURLEY-AMES, *Idaho State University*—Working memory (WM) performance has been associated with the ability to inhibit irrelevant information (Rosen & Engle, 1998). More specifically, low spans have more difficulty inhibiting irrelevant information than do high spans. In the present research, we examined whether low spans have difficulty with specific forms of inhibition or with inhibition in general. Participants completed a WM span task and a paired-associates task designed to assess three forms of inhibition (access, deletion, restraint; Hasher, May, & Zacks, 1999). High spans were better able to inhibit newly learned and overlearned material initially. Low spans were better able to inhibit remotely related information. Across trials, no difference in rate of inhibition was observed for newly learned material. For well-learned material, high spans inhibited at a faster rate than did low spans. These findings suggest that individual differences in WM performance are associated with specific inhibitory mechanisms and the rate at which certain inhibitory mechanisms become active.

(69)

Letter–Number Sequencing: Costs and Benefits of Reorganizing Items in Working Memory. LISA J. EMERY, JOEL MYERSON, & SANDRA HALE, *Washington University*—In four experiments using a modified version of the letter–number sequencing test, participants saw an alternating series of numbers and letters and reported the items either in the same order as that in which they were shown (forward condition) or with the numbers first, in ascending order, and then the letters in alphabetical order (sequencing condition). In all experiments, the participants remembered more items in the sequencing condition than in the forward condition, despite the increased processing demand of sequencing. Reducing the presentation rate decreased performance on the sequencing condition but not on the forward condition. Requiring participants to perform either a verbal or a spatial secondary task decreased performance in the sequencing condition more than in the forward condition. Finally, presenting ascending numbers followed by alphabetized letters improved memory for the items beyond that observed in the sequencing condition. Thus, letter–number sequencing performance involves a tradeoff between the benefit of organization and losses that may occur while organizing.

• **SELECTIVE ATTENTION** •

(70)

Negative Priming: Effect of Objectness. LESLIE A. VALDES & ANNE DICKHUDT, *St. Cloud State University*—Attending to a stimulus that has been previously ignored is more difficult than attending to a novel stimulus. This effect is known as negative priming. Numerous studies (e.g., Fox, 1994) have demonstrated that the magnitude of negative priming is affected by selection difficulty. In the present experiments, the degree to which the target and the distractors formed an object was manipulated in a letter identification task. Participants identified either a letter or a digit by pressing a key on a response box. Two identical distractors, which were either letters or numbers, surrounded the target. Either the stimuli were all letters or all digits, or the target and the distractors came from different categories. On some primes, the triad of distractors and the target created a pronounceable letter string (KAK). This condition resulted in more negative priming

than when the stimulus string was not pronounceable (EAE) or than when the distractors were digits (3A3).

(71)

Contingent Capture Does Not Require Spatial Shifts in Attentional Focus. SHAHAB S. GHORASHI, *University of British Columbia,* BAHADOR BAHRAMI, *School of Intelligent Systems, Tehran,* & ERIC EICH & VINCENT DI LOLLO, *University of British Columbia*—Contingent capture is often observed in studies of visual search, in which a target must be found among distractors. In such studies, a distractor captures attention when it shares the target's defining characteristics, resulting in slower identification of the target. According to the spotlight theory, this temporal deficit is due exclusively to the time taken by an involuntary shift in the focus of attention to the distractor location, thus necessitating a second shift to the location of the target. We eliminated spatial shifts in attentional focus by using a display with distractors presented in a central stream, followed by a target in the same location. The substantial contingent capture obtained with this paradigm suggests that spatial shifts in attention are not the sole source of delay. Rather, the evidence points to the time taken to process distractors that share the target's distinguishing characteristic as a second, independent source of delay.

(72)

Attentional Persistence to Frequency and Temporal Global–Local Structure in Audition. ALEXANDRA LIST & TIMOTHY C. JUSTUS, *University of California, Berkeley* (sponsored by Richard Ivry)—In vision, priming paradigms have demonstrated attentional persistence to global and local levels of hierarchical stimuli (e.g., Navon figures). Furthermore, neuropsychological evidence suggests right- and left-hemisphere biases for global and local processing, respectively. Potential parallels within the auditory system include (1) Ivry and Robertson's double filtering by frequency hypothesis, which proposes that low and high auditory frequencies are processed analogously to spatial frequencies in vision, and (2) Poeppel's asymmetric sampling in time hypothesis, which proposes that the auditory asymmetry lies instead in wide and narrow temporal sampling windows. We conducted two priming experiments in which we demonstrated auditory attentional persistence to (1) low- and high-frequency ranges and (2) global and local temporal structure. Future studies will combine both auditory paradigms with hierarchical visual stimuli in a cross-modal paradigm to test whether either of these visual-auditory analogies reflects common processing resources across the two modalities.

(73)

Explicit Mechanisms Do Not Account for Implicit Localization and Identification of Change. IAN M. THORNTON, *Max Planck Institute for Biological Cybernetics,* & DIEGO FERNANDEZ-DUQUE, *University of Toronto*—Localization and priming studies have revealed that changes that do not reach awareness can nevertheless influence behavior. Mitroff, Franconeri, and Simons (in press) have recently challenged this claim, arguing instead that explicit observer strategies may account for previous findings. Here, we present new evidence showing that this is not the case. We also discuss new behavioral, neuroimaging, and eye movement studies that further support the notion of implicit change detection.

(74)

Location Negative Priming in Identity Naming Is Contingent Upon Repeated Locations. HSUAN-FU CHAO & YEI-YU YEH, *National Taiwan University* (sponsored by Yuh-Shiow Lee)—Negative priming, as a result of selection in information processing, appears to manifest only when distractors are highly competitive in selection for behavioral goals. The contingency upon high competition has been demonstrated in identity negative priming. Negative priming occurs only when a small set of repeated stimuli is used in the experimental settings and is eliminated when a large set of stimuli is used. With repetition, activation strength increases, and distractors are highly competitive in the

former condition and show little competition in the latter condition. Using a naming task, in this study we examined whether location negative priming is also contingent upon the repetition of stimulus locations. The results showed the same pattern as that observed in identity negative priming. Location negative priming occurred only when stimulus locations repeated throughout the experimental session. When a large set of nonrepeated locations were used, positive priming surfaced.

(75)

The Role of Working Memory in Inhibition of Return. ALAN D. CASTEL & JAY PRATT, *University of Toronto,* & FERGUS I. M. CRAIK, *Rotman Research Institute*—Inhibition of return (IOR) refers to a bias against returning attention to a location that has been recently attended. The present experiments examined the role of working memory in IOR by introducing secondary tasks (in the temporal interval between the cue and the target) that involved a working memory component. When the secondary task was nonspatial in nature (monitoring odd digits or adding digits), IOR was present, although overall reaction times were greater in the presence of the secondary task. When the task involved a spatial working memory load (remembering the directionality of arrows), IOR was eliminated. However, when participants had incentive to process the directionality of an arrow, but with no memory requirement, IOR persisted at peripheral locations. Overall, the results suggest that the spatial working memory system is involved in IOR.

(76)

Break Expectancy in Duration Discrimination: Attentional Time-Sharing and Decisional Criterion. SEBASTIEN TREMBLAY & CLAUDETTE FORTIN, *Université Laval*—Effects of break expectancy observed previously in time production were examined in a series of experiments using a discrimination paradigm. Participants classified a tone as being *short* or *long.* Location and duration of breaks in tone presentation were varied. Proportion of *short* responses generally increased as the break occurred later in the duration to be estimated. Uninterrupted tones (introduced among interrupted tones) yielded a proportion of *short* responses similar to that observed with tones interrupted at the latest location. We conclude that, as in time production, attentional time-sharing elicited by break expectancy induces a loss in the accumulation of temporal information but that its effect on duration discrimination depends on the accumulation outcome relative to a decisional criterion.

(77)

Meaning Influences Search Efficiency. DANIEL SMILEK, MIKE J. DIXON, & PHILIP M. MERIKLE, *University of Waterloo*—We evaluated whether the meaning of objects influences search efficiency. Observers were trained to associate verbal labels with simple shapes. By training observers, it was possible to vary the semantic similarity between targets and distractors in the visual search displays while counterbalancing for visual similarity across the targets and distractors. In one condition, the target and distractor shapes were associated with the same verbal label and were therefore semantically similar. In another condition, the target and distractor shapes were associated with different verbal labels and were therefore semantically dissimilar. The efficiency of search was assessed in terms of the slopes of the search functions. The results showed that search was more efficient when the target and distractors were semantically dissimilar than when the target and distractors were semantically similar. These findings indicate that the meaning of objects influences search efficiency.

(78)

Effects of Asymmetrical Association on Positive and Negative Semantic Priming. KEITH A. HUTCHISON, *SUNY, Albany*—Participants made lexical decisions to asymmetrically associated prime–target pairs presented in either the forward (e.g., *stork–baby*) or the backward (e.g., *baby–stork*) direction. The critical new finding was that both

attended positive and *ignored* negative semantic priming occurred only for prime–target pairs presented in the forward direction. The results support either (1) a *spreading inhibition* model in which items associated to an ignored distractor are inhibited during prime selection or (2) a version of episodic retrieval theory in which the prime distractor and items associated to it are tagged "do not respond" during prime selection.

(79)

Attention Drives Emotion: Generating Affective Responses to Novel Stimuli. MARK J. FENSKE & JANE E. RAYMOND, *University of Wales, Bangor,* & NADER TAVASSOLI, *MIT*—Although emotional stimuli have been shown to impact processes of selective attention, very little is known about the impact of attention on the generation of emotional responses. In a study that combined a simple visual localization task with an emotional evaluation task, we found that novel visual images that had been previously ignored were judged more negatively than those that were previously attended (Raymond, Fenske, & Tavassoli, 2002). Here, we report research designed to replicate and examine the generality of this finding. Results indicate that the effect of prior attention state on the generation of emotional responses is robust for different stimulus sets and varying task demands. These findings provide support for the notion that the distinct systems underlying attention and emotion operate in a reciprocal manner to prioritize the processing of information needed to guide thoughts and actions.

• COGNITIVE CONTROL •

(80)

More on the Fragility of Skilled Performance: Choking Under Pressure Is Caused by Different Mechanisms in Cognitive Versus Sensorimotor Skills. SIAN L. BEILOCK, DEBORAH L. FELTZ, & THOMAS H. CARR, *Michigan State University*—Well-learned sensorimotor skills fail under pressure because pressure induces attention to proceduralized control structures that normally run outside of working memory (Beilock & Carr, 2001). Does this same form of "choking" occur in cognitive tasks? Two experiments examined mathematical problem solving under pressure. In Experiment 1, participants learned a complex arithmetic task and were exposed to a high-pressure test early and late in learning. Only difficult problems with large working memory demands choked, and only early in practice when capacity-demanding algorithms governed performance once. In Experiment 2, participants performed arithmetic problems once, twice, or 50 times each, followed by a high-pressure test. Again, difficult problems not highly practiced showed decrements under pressure. Thus, in mathematical problem solving, pressure-induced limitations on working memory cause choking. This contrasts with sensorimotor skills, suggesting a taxonomy of skills based on the representation of their real-time control structures. Fragility under pressure discriminates task categories in this taxonomy.

(81)

Rescheduling the Mental Processes in the Dual Stroop Task With the Critical Path Method. MIN-SHENG CHEN & JENN-YEU CHEN, *National Chung-Cheng University* (sponsored by Jenn-Yeu Chen)—Schweickert (1983) employed the critical path method (CPM) to study the mental processes underlying the Stroop task. In both the color-naming and the word-naming tasks, the results indicated that the subjects processed the irrelevant dimension first. We hypothesized that Schweickert's results were due to the author's artificially imposing the manual-first response order on their subjects. We replicated Schweickert's experiments (Experiment 1) and then repeated the same experiments, but leaving the subjects to decide on their preferred response order (Experiment 2). The results of Experiment 1 were similar to Schweickert's, and the results of Experiment 2 showed that the word was always processed first regardless of the task. It was also found that whether the dual processes took the form of serial order or of a Wheatstone Bridge depended on the difficulty of each of the tasks and on their combination.

(82)

Binding and Inhibition in Action-Planning: Evidence From Stop–Change Experiments. BERNIE CAESSENS & ANDRÉ VANDIERENDONCK, *Ghent University*—From a goal-based representation system for intentional actions, it can be argued that action coding is subject to a binding problem analogous to perception. In the present study, we applied a stop–change paradigm to investigate the possible role and conditions for such a binding mechanism in the light of multiple-task performance. More specifically, we investigated the role of response competition, response order, and response inhibition. In three experiments, we found that rapid switching of task goals was easier between actions sharing properties. We found that this facilitation is modality unspecific, exists for irrelevant action-features, and is insensitive to the relative processing speed of the tasks. Furthermore, response competition did not affect this switch benefit, which seems to pose problems for an inhibition view. However, in Experiment 4, we found that the direction of the action-priming effect depended on response order relative to stimulus presentation.

(83)

Strong Reduction of Task-Switching Costs With Second-Task Priming. PADMANABHAN SUDEVAN, JOHN D. HOLMES, CAROLINE A. VAN ZEELAND, CATHERINE A. NIEMANN, & SHANNON L. WEBER, *University of Wisconsin, Stevens Point*—We continued our exploration of a new task-switching paradigm in which two classification tasks are presented in succession, with either repeated or switched tasks, and with a large intertrial interval between the task pair. In the present work, we used a task prime interpolated between the two tasks to obtain very strong reductions in task-switching costs. We also explored the use of different prime–task intervals and of fixed and variable response–stimulus intervals in this paradigm.

(84)

The Role of Response Selection for Inhibition of Task Sets in Task Shifting. STEFANIE SCHUCH & IRING KOCH, *Max Planck Institute for Psychological Research*—Four experiments explored the role of response selection in task shifting, using a go/no-go methodology. The no-go signal occurred unpredictably with stimulus onset, so that all the trials required task preparation, but only go trials required response selection. Experiment 1 showed that shift costs were absent after no-go trials, indicating that response processes are crucial for shift costs. Experiment 2 showed that "backward inhibition" (Mayr & Keele, 2000) was absent after no-go trials. Experiments 3 and 4 demonstrated that response selection, rather than execution, causes backward inhibition. All four experiments showed effects of preparation time in go trials, suggesting that advance preparation must have also occurred in no-go trials. We conclude that inhibition of irrelevant task sets arises neither during advance preparation nor during response execution, but only at response selection, and that residual shift costs reflect such persisting inhibition.

(85)

Training Task-Switching Skill in Adults With Attention-Deficit/Hyperactivity Disorder. HOLLY WHITE, *University of Memphis,* & PRITI SHAH, *University of Michigan*—Task switching involves rapidly switching back and forth between multiple tasks and is part of an executive control system (e.g., Rogers & Monsell, 1995). Using a variable training approach, we found training on attention-switching tasks and transfer of training to related tasks (Shah, White, & Miyake, 1999). These findings have potential for those with impairments of executive function, such as older adults or people with attention deficit hyperactivity disorder (ADHD). Kramer, Hahn, and Gopher (1999) showed that age-related switch costs evident early in practice disappeared after training. Dowsett and Livesey (2000) trained children on several tasks involving executive control and found that a variable training procedure resulted in improvement of generalized response capabilities, such as inhibitory control. The present study applied the variable training procedure to adults with characteristics of ADHD and demonstrated that training effects are not limited to task-specific strategies.

(86)

Computational and Neural Mechanisms in Task Switching. JEREMY R. REYNOLDS & TODD S. BRAVER, *Washington University*—A neural network computational model was developed to investigate whether the types of task-switching phenomena observed in the literature might be due to the interaction of two underlying neural mechanisms: (1) phasic, dopamine-mediated gating of task-set representations in the prefrontal cortex and (2) weight-based Hebbian learning. Results indicate that performance on trials in which the gating mechanism fails is strongly influenced by the previous history of trials, resulting in large switch costs. Conversely, the gating mechanism allows appropriate task-set updating and maintenance, thus minimizing switch costs. These simulations provide a mechanistic account of task-switching phenomena, including results suggesting that performance in task-switching paradigms appears to be composed of a mixture of high- and low-cost trials (e.g., DeJong, 2000). More generally, the computational framework we have proposed indicates that task-switching phenomena are due to a complex interplay of general mechanisms subserving associative learning and specific systems subserving cognitive control.

(87)

A Latent Variable Analysis of Inhibition and Interference Control Functions. NAOMI P. FRIEDMAN & AKIRA MIYAKE, *University of Colorado, Boulder*—Despite its popularity, the concept of inhibition is murky in that the term has been used to describe a variety of potentially different processes. We used latent variable analysis to examine the relations among three often-postulated inhibition functions—prepotent response inhibition, resistance to distractor interference, and resistance to proactive interference (PI). Confirmatory factor analysis suggested that prepotent response inhibition and resistance to distractor interference were indistinguishable but were both unrelated to resistance to PI. Hence, prepotent response inhibition and resistance to distractor interference were combined into a single response-distractor inhibition latent variable. Structural equation modeling indicated that response-distractor inhibition and resistance to PI were differentially involved in task-switching ability, everyday cognitive failures, unwanted intrusive thoughts, reading span performance, and negative priming. These results suggest that the term *inhibition* has been overextended and that researchers may need to be more specific when discussing and measuring inhibition-related constructs.

(88)

Effects of Sequence on Task Switching. SOWON HAHN, *University of Oklahoma*—This study examined how a fixed sequence of task sets influences switch costs. Subjects performed addition, subtraction, even/odd judgment, and digit value comparison tasks in fixed-sequence and random-sequence blocks. For each trial, two single digits from 1 to 9 were displayed on the screen, along with a task symbol. The two digits of each pair were different in value, and the digits were either both even or both odd. Subjects responded by pressing one of the keys on the numeric keypad of the computer keyboard. For the fixed- and random-sequence blocks, each task occurred twice in a row and then switched to another task in a fixed or a random order. The random-sequence block showed slower and less accurate responses than did the fixed-sequence block, with greater disadvantage occurring for the switch trials than for the nonswitch trials. The role of planning on the task set preparation will be discussed.

(89)

Influences of Instructions and Visual Feedback on the Simon Effect for Wheel-Rotation Responses. DONG-YUAN DEBBIE WANG, ROBERT W. PROCTOR, & DAVID F. PICK, *Purdue University*—In three experiments, subjects responded to a high- or a low-pitch tone, presented in the left or the right ear, with a clockwise or counterclockwise wheel rotation. In Experiment 1, hand position (top, middle, or bottom of wheel) and visual feedback (presence or absence of a triggered cursor) were varied. A positive ear-rotation Simon effect

was obtained for the top and the middle hand positions, but not for the bottom position. Experiment 2 used only the bottom hand position, and instructions emphasized movement of the hands, the wheel, or a red tape at the top of the wheel. Hand instructions produced a negative ear-rotation Simon effect, whereas wheel- and tape-movement instructions did not. In Experiment 3, cursor movement produced a positive ear-rotation Simon effect when controlled by wheel position, but not when triggered by the response. The nature of the task and the instructed action goal influence the direction of the Simon effect.

• LETTER/WORD PROCESSING •

(90)

Semantic Neighborhood Effects on the Recognition of Homophonic Words. LAWRENCE LOCKER, JR., MARK C. YATES, & GREG B. SIMPSON, *University of Kansas*—A number of studies have shown that words that are homophonic with other words (e.g., MADE/MAID) are recognized more slowly in lexical decision tasks than are nonhomophonic words. This effect has been attributed to feedback from phonology to orthography. That is, one phonological code feeds back activation to multiple orthographic codes. The activation of disparate orthographic representations results in competition effects that slow processing. The present study examines whether processing at the orthographic level for homophones can be affected by meaning level information (i.e., semantic feedback). Semantic neighborhood (i.e., semantic-set size) of words and their homophonic mates was manipulated such that homophones with large and small neighborhoods, relative to their homophonic mates, were presented to participants. The results revealed that the homophone effect was partially a function of the relative size of its semantic neighborhood.

(91)

Representation of Lexical Form in the Perception of Spoken Words. CONOR T. McLENNAN, PAUL A. LUCE, & JAN CHARLES-LUCE, *SUNY, Buffalo*—In previous research using long-term repetition priming, we demonstrated that flapped intervocalic alveolar stops in American English may be mapped onto underlying /t/–/d/ representations during spoken word processing. Specifically, we found that casually articulated, flapped stimuli primed their carefully articulated counterparts (e.g., casually articulated *atom* primed carefully articulated *atom* and *Adam*), and vice versa. We argued that form-based ambiguity (present in our flaps) is one condition leading to activation of underlying representations. However, our flaps were also lexically ambiguous (e.g., flapped *atom* was ambiguous between *Adam* and *atom*). Is our observed priming effect lexically or sublexically mediated? The present research attempts to answer this question by examining form-based ambiguity in the absence of lexical ambiguity. Long-term repetition priming experiments were conducted with form-based ambiguous nonwords (e.g., *oytem*/*oydem*) and flaps without lexical pairs (e.g., *pretty*). Results provide further insights into the conditions under which underlying representations are activated during spoken word processing.

(92)

Bilinguals' Activation of Phonological Representations When Reading Silently. CORINNE HAIGH & DEBRA JARED, *University of Western Ontario*—Three experiments investigated whether bilinguals activate phonological representations from one or both of their languages when reading words silently in just one of their languages. Critical stimuli were English–French interlingual homophones, which are English words that sound the same as, but are spelled differently from, a word in French (e.g., MOW which sounds like the French word MOT). Both French–English and English–French bilinguals performed an English lexical decision task. Experiment 1 compared performance on interlingual homophones and matched English control words. In Experiment 2, English intralingual homophones (e.g., SEE and SEA) were added for comparison. And finally, in Experiment 3, the nonword fillers were changed to pseudohomophones (e.g., FITE) so that decisions could not be made on the basis of phonology. Only French–English bilinguals showed evidence that French phonological repre-

sentations were activated when reading in English. These findings suggest that the activation of phonological representations in bilinguals can appear to be both language selective and nonselective.

(93)

Will the Mood Congruence Effect Persist in a Short-Term Memory Retrieval Task? TUAN Q. TRAN & RICHARD J. HARRIS, *Kansas State University,* & LAREE A. HUNTSMAN, *San Jose State University*—Two experiments utilized the Sternberg task to investigate the mood congruence effect (MCE) on short-term memory retrieval. The stimulus words were closely matched in frequency and emotion relatedness. The participant's emotion was manipulated by videotape. Experiment 1's results failed to show an MCE. An explanation for the null finding may be that the procedure inadvertently weakened the emotion manipulation. In addition, the results suggest that the affective properties of the stimulus word may influence the scanning process. In Experiment 2, the participant's emotion was manipulated after one block of the task had been completed. The same pattern of results was obtained. We hypothesized that the failure to find an MCE may be due to the task's being automatic and fast-paced. Furthermore, we hypothesized that participants scan their memory sets serially, similar to a traditional serial exhaustive search. However, the direction of such search may be influenced by the affective nature of the stored materials.

(94)

The Influence of Age of Acquisition and Frequency on Eye Fixations. BARBARA J. JUHASZ & KEITH RAYNER, *University of Massachusetts, Amherst* (sponsored by Keith Rayner)—Age-of-acquisition (AoA) effects have been investigated in tasks such as lexical decision and naming. It has been found that words acquired earlier in life are processed faster than words acquired later in life. Two eye movement experiments examined the effects of word frequency and AoA on eye fixations during reading. The motivation for the experiments was to determine whether AoA would affect the reading of target words embedded in sentences. In the first experiment, word frequency and AoA were factorially manipulated. In this experiment, both variables affected target reading times. The second experiment used a regression framework in order to include stimuli with a larger range of frequency and AoA. In this experiment, both variables also predicted fixation time on the target word. Implications for AoA and eye movement research will be discussed.

(95)

The Role of Phonological Distinctiveness in Word Recognition and Episodic Memory Performance. JASON M. WATSON & DAVID A. BALOTA, *Washington University*—A speeded word-encoding task was combined with standard episodic memory tasks to investigate the role of distinct spelling-to-sound correspondence (e.g., *pint* vs. *hint*) in word recognition and episodic memory performance. At encoding, participants either named or made lexical decisions to high- and low-frequency regular and exception words. At retrieval, participants were given either a surprise free recall test or an episodic recognition test. The results of the speeded word recognition tasks yielded a large frequency $\times$ regularity interaction. However, exception words were recalled and recognized better than regular words, regardless of word frequency. In addition, the phonological distinctiveness effect in episodic recognition performance was larger when naming, as opposed to lexical decision, was used as the orienting task. The results are interpreted within an attentional control framework in which exception words are more likely than regular words to receive conceptual processing at encoding to help resolve irregular spelling-to-sound correspondences.

(96)

Letter-by-Letter Dyslexia: The Word Length Effect Revisited. DANIEL FISET, MARTIN ARGUIN, & ERIC MᴄCABE, *Universite de Montreal* (sponsored by Martin Arguin)—The hallmark of letter-by-letter (LBL) dyslexia is the word length effect: Naming latencies increase monotonically with the number of letters in the word. This is generally interpreted as indicating that word recognition in LBL dyslexia depends on the sequential identification of individual letters. The present investigation of the effect of letter confusability (visual similarity between a letter and the remainder of the alphabet) in 2 LBL patients questions this interpretation. In Experiment 1, the patients showed an increased reading latency with words made of high- (vs. low-) confusability letters. In Experiment 2, the word length effect diagnostic of LBL dyslexia was eliminated when words of different lengths were matched on the summed confusability of their constituent letters. These findings demonstrate that overt word recognition does not always require sequential letter encoding and that a letter-processing impairment is fundamental in LBL dyslexia. Implications for normal reading will be discussed.

(97)

Global Discourse Context Influences Lexical Ambiguity Resolution. TIMOTHY K. MIURA & GARY E. RANEY, *University of Illinois, Chicago*—The influence of global context on processing lexically ambiguous words was investigated, using a cross-modal priming procedure. In Experiment 1, participants listened to passages containing two occurrences of unbalanced homographs. The passages' discourse contexts weakly biased a particular meaning at the first occurrence and then strongly biased the same meaning by the second occurrence. The local context preceding the homograph did not bias a particular meaning. In Experiment 2, the passages contained only one occurrence of the homograph, and meaning frequency and passage strength were more strictly controlled. Results of both experiments indicated that meaning frequency had a larger influence than did the discourse context on probe naming times. Naming times were facilitated for probes related to their dominant meanings, relative to unrelated probes, regardless of contextual bias. Subordinate probes were facilitated relative to unrelated probes only in subordinate biased contexts.

(98)

Activation of Conceptual Representations During Spoken-Word Recognition. DELPHINE DAHAN, *Max Planck Institute for Psycholinguistics,* & MICHAEL K. TANENHAUS, *University of Rochester*—There is now strong evidence that the eye movements people make to visually present objects as the name of one the objects is heard provide a sensitive measure of the dynamics of lexical activation. The probability of fixating a picture varies with the goodness of fit between its name (or form representation) and the acoustic signal. Here, the target picture (e.g., a snake) was presented along with two distractors and a picture visually similar to the concept associated with the target's name, but with no phonetic overlap (e.g., a rope). As the first sounds of the target name were heard and processed, fixations to the target and its visual competitor rose, while distractor fixations dropped. This demonstrates that fixations observed in this task do not merely result from the match between the picture's name and the input. Rather, they can reflect the immediate activation of conceptual/visual representations associated with spoken words.

(99)

Modeling the Effects of Prime Duration and Location in Perceptual Identification. CHRISTOPH T. WEIDEMANN, *Indiana University,* DAVID E. HUBER, *University of Colorado, Boulder,* & RICHARD M. SHIFFRIN, *Indiana University*—In forced-choice perceptual identification studies, a masked target presentation followed one or two sequentially presented (nondiagnostic) primes. Neither, one, or both of the choice words repeated a prime word. As in Huber, Shiffrin, Quach, and Lyle (in press), short prime presentations produced a preference for repeated words, whereas longer prime presentations produced a small preference against repeated words. However, if the prime was presented again shortly after a long presentation, a preference for repeated words was observed. This surprising result was quantitatively handled with the ROUSE model of Huber, Shiffrin, Lyle, and Ruys (2001), positing the offsetting components of source confusion (features from primes are confused with the target) and discounting (evi-

dence from features known to have been in primes is discounted). In a critical condition, priming both choice words for different amounts of time, source confusion, and discounting effects combined to produce the largest priming effects overall.

• DISCOURSE PROCESSES •

(100)
Processing Discourse Roles in Scripted Narratives: The Influences of Context and World Knowledge. ANNE E. COOK, *University of Utah,* & JEROME L. MYERS, *University of Massachusetts* (sponsored by Jerome L. Myers)—Theories of effects of context upon comprehension of a word in a text have differed with respect to whether those effects have been ascribed to facilitation of lexical access or to integration of the target concept with the preceding text. In two experiments, we used eye-tracking measures to examine contextual influence on the integration of role fillers in scripted narratives. In both experiments, context had an early influence on integration of role fillers. However, measures of posttarget processing indicated that semantic knowledge continued to influence integration. The results are discussed in terms of several theories of contextual influence on reading. We propose a two-stage model of processing: First, incoming text is integrated with the contents of active memory; in the second stage, the link between the new and the old information is evaluated.

(101)
Character Profiles and the Activation of Predictive Inferences. KELLY A. DEREPENTIGNY & EDWARD J. O'BRIEN, *University of New Hampshire* (sponsored by Edward J. O'Brien)—Most evidence indicates that with supportive context, predictive inferences become activated. The present experiments were designed to investigate whether the characteristics of the protagonist can mitigate against activation of a predictive inference, even when the immediately preceding context supports the inference. Participants read passages containing a detailed description of the protagonist. The characteristics were consistent, inconsistent, or neutral with respect to a subsequent predictive inference. This character information was followed by a context that supported the predictive inference. Experiment 1 demonstrated that predictive inferences were activated, but not when it conflicted with the characteristics of the protagonist. Experiment 2 demonstrated that when activated, the inference was also instantiated into the long-term memory representation of the text. These results are discussed in terms of the memory-based view of text processing.

(102)
The Influence of Character Activity on Spatial Situation Models. DAVID N. RAPP & HOLLY A. TAYLOR, *Tufts University*—What cues influence reader construction of spatial situation models? One type of cue allows readers to make inferences about spatial relationships on the basis of the amount of time characters use to travel between locations. Participants read stories in which characters traveled from a start location to a final location. Characters engaged in activities that could take either a long or a short amount of time to complete during the journey. Participants' recognition latencies for start location probes were slower following long activities than after short activities and, overall, slower than probes for final locations. Similar results were obtained when stories provided explicit spatial information about distance. This pattern of data suggests that the accessibility of spatial information from situation models can be guided by readers' inferences about distance relationships. Reader expectations about the temporal component of character activity can influence the construction and application of spatial models during narrative experiences.

(103)
Lateralized Priming in Inference Verification. FRANZ SCHMAL-HOFER, JACKIE GRIEGO, & CARSTEN GRIESEL, *University of Osnabrück*—With hemifield presentation techniques, Beeman et al. (2000) and Long and Baynes (2002) have recently shown hemispheric differences in inferencing during text comprehension. Inferences encoded as text propositions are accessible faster in the left hemisphere. Inferences encoded in the situation model are accessible faster in the right hemisphere. Such differences in representation and location were further researched by a true/false verification task. After having read short texts, participants were sequentially shown two words, such as *actress–dead*, the first word always in the center and the second word in the left or right visual field. After the second word, the participants had to quickly decide about the truth of the sentence indicated by the words (e.g., *the actress is dead*). Lateralized priming effects were collected for predictive and bridging inferences and for explicit sentences. The results are discussed in terms of a unified model of inferencing (Schmalhofer et al., 2002).

(104)
Integrating and Disambiguating Texts. CHRISTOPHER KURBY, ANNE BRITT, & JOSEPH P. MAGLIANO, *Northern Illinois University* (sponsored by Joseph P. Magliano)—Understanding new experiences often requires readers to integrate them with prior experiences. This study examines the extent to which readers integrate information from related texts as a function of thematic and semantic overlap. Participants read and recalled ambiguous texts about events that were preceded by a descriptive text of the event, called a primer. The ambiguous texts were preceded by either an informative or a noninformative title. The primer text was always preceded by an informative title. Each text was propositionalized, and judgments were made as to which propositional constituents overlapped between texts. We identified the source of all the propositions across text pairs. A propositional constituent was only in the ambiguous text, only in the primer text, or in both. Shared propositional constituents were recalled better than those that were not shared—especially, shared predicates. These results suggest that semantic overlap, especially predicates, may cue text integration.

(105)
Negated Concepts Interfere With Anaphor Resolution. WILLIAM H. LEVINE, *University of Arkansas*—The present project explored the consequences of negation on anaphor resolution. Prior research has shown that negated concepts that are encountered during comprehension are reduced in accessibility. In the present experiments, short passages described a protagonist selecting one category member (e.g., "Justin bought a mango . . .") and sometimes not selecting another (e.g., ". . . but not an apple"). Reading time on a subsequent sentence that referred to the selected entity (e.g., "He ate the fruit") was longer when there was a negated concept present in the prior discourse, suggesting that the negated concept was sufficiently accessible to disrupt referent identification. The results are discussed with respect to the function of negation in discourse, suppression mechanisms, and the anaphor resolution process.

(106)
Knowledge-Based Inferences Are *Not* General. CONNIE SHEARS & CHRISTINE CHIARELLO, *University of California, Riverside*—Inference processes depend on general knowledge to form causal explanations. Processing differences between two areas of knowledge (physical cause–effect vs. goals/planning) were explored by comparing participants with planning deficits owing to acquired brain injuries (ABIs) to matched noninjured participants (NIs). We hypothesized that ABI participants would make physical, but not planning, inferences. Participants read two-sentence texts describing a causal relation (inference) or not (control) and provided measures of inference processes by probe recognition and comprehension questions. NI participants demonstrated equal inference processes across knowledge areas. ABI participants demonstrated greater evidence for inference processes for physical, as compared with planning, knowledge. This result indicated that the inference process was intact but that planning knowledge was less available to support comprehension in ABI participants. These data suggest that areas of knowledge may function differentially to support inferences involved in comprehension.

(107)

Twisting Arms: Figurative Language Effects in Persuasive Discourse. ROGER KREUZ, AARON ASHLEY, & KATHRYN BARTLETT, *University of Memphis*—The persuasiveness of various forms of figurative language was assessed in experiments using an editorial advocating a thesis requirement (Petty & Cacioppo, 1987). Specifically, the studies were an extension of Ottati, Rhoads, and Graesser (1999), who examined the persuasiveness of sports metaphors. The present research included idiomatic expressions and rhetorical questions, as well as individual differences measures, such as preexisting attitudes toward the topic, and need for cognition. When participants heard the editorials, a marginally significant interaction of argument strength and language form was found: Metaphors and idioms in the strong from of the editorials were more persuasive than rhetorical questions; for weak editorials, literal statements were more persuasive than idioms. When need for cognition and initial attitudes were used as covariates, a significant effect of attitude change was found (for the literal, metaphorical, and idiomatic conditions). Results from a written version of the editorials will also be presented.

(108)

Predictive Inferences With Multiple Consequences: Delayed but Not Lost. KRISTIN M. WEINGARTNER & ALEXANDRIA E. GUZMAN, *SUNY, Binghamton,* WILLIAM H. LEVINE, *University of Arkansas,* & CELIA M. KLIN, *SUNY, Binghamton*—Klin, Guzman, and Levine (1999) concluded that readers do not draw predictive inferences when there is more than one consequence of the critical events. This conclusion was based on finding no facilitation of a naming probe (e.g., *break*) 500 msec after the predictive context (e.g., *Steven threw the delicate vase*). Contrary to this conclusion, in Experiment 1, readers drew a predictive inference when the ISI was increased to 1,500 msec, suggesting that the additional consequence simply delayed the inference. However, in Experiment 2, there was no evidence of an inference when the 1,500-msec ISI contained additional text. To allow readers to allocate their time naturally, the probe task was eliminated in Experiment 3. Readers slowed down for a line that contradicted the targeted inference, suggesting that they drew a predictive inference. We conclude that predictive inferences are more prevalent than has been assumed previously but that some factors delay their completion.

(109)

Text Coherence Effects: Interactions of Prior Knowledge and Reading Skill. TENAHA P. O'REILLY & DANIELLE S. MCNAMARA, *University of Memphis*—College students (n = 146) read either a high-coherence or a low-coherence passage about cell mitosis and then answered open ended six text-based and six bridging inference comprehension questions about the passage. Participants' science knowledge, general knowledge, reading skill, and knowledge about metacognitive reading strategies were also measured. For bridging inference questions, there were effects of science knowledge and reading skill; however, reading skill only benefited high-knowledge participants. In addition, high-coherence text only benefited less skilled readers with low knowledge. Text coherence did not affect performance on the bridging questions for any other participants. In terms of performance on text-based questions, knowledge had a large effect for the low-coherence text but did not significantly affect comprehension of the high-coherence text. Conversely, reading skill influenced comprehension of the high-coherence text, but not of the low-coherence text. These and other interesting effects and interactions will be discussed.

Human Learning and Memory I
Atlanta, Friday Morning, 8:00–9:45

Chaired by Craig P. Speelman, Edith Cowan University

8:00–8:15 (110)
The Dual Effects of Recollection and Familiarity on Memory for Pragmatic Implications. KATHLEEN B. McDERMOTT & JASON C. CHAN, *Washington University*—People often extrapolate from the information they encounter and later remember inferences as having been stated. For example, when presented with "the karate champion hit the cinderblock," people often erroneously recollect having heard the verb broke (Brewer, 1977). We examined the influence of repetition, response deadline, and age on separating the dual effects of familiarity and recollection in contributing to this effect. Repetition enhanced the likelihood of recalling pragmatic inferences for older adults (with no deadline) and somewhat for young adults under a response deadline. However, when young adults were not rushed during retrieval, repeated presentations during study exerted the opposite effect (relative to a single presentation). These results are generally consistent with those in the DRM (Deese–Roediger–McDermott; Benjamin, 2001) and conjunction paradigms (Jones & Jacoby, 2000), suggesting that the pragmatic implication paradigm may prove useful for extrapolating false memory results from word list paradigms to prose materials.

8:20–8:35 (111)
Levels of Processing and False Memory: Why Are the Data Not Consistent? JERWEN JOU & JAMES W. ALDRIDGE, *University of Texas, Pan American*—Does deep semantic processing, as opposed to shallow orthographic processing, of words increase or decrease the tendency toward false memory? Both the theories and the data are contradictory at present. One reason may be that it is difficult to control the actual level of processing subjects perform on the words. Another reason may be that the depth relationship between the levels is not well defined. This study uses a design in which the levels of processing are cumulatively incremental such that the deeper level includes the shallower level as a subprocess plus some additional processing. Four processing conditions—(1) reading the words, (2) checking the spelling of words, (3) checking the spelling plus internally generating the correct words, and (4) checking the spelling plus typing out the internally generated correct words—have shown that the last three cumulatively incremented levels of processing produced a progressively decreasing rate of false memory.

8:40–9:00 (112)
Age Differences in Illusory Memories Produced by Forced Recall. MICHELLE L. MEADE & HENRY L. ROEDIGER III, *Washington University* (read by Henry L. Roediger III)—We studied effects of forced recall in younger and older adults (tested individually or in collaborating pairs) on later recall and recognition tests. Subjects were presented with categorized word lists and were asked to recall them, under standard cued recall instructions or under forced recall instructions requiring them to produce a given number of items even if they had to guess. Forced recall resulted in greater levels of false recollection on subsequent tests, and the effect was especially pronounced in older adults. In addition, older adults were more likely than younger adults to say that they remembered rather than knew the guessed responses from the original study episode. Collaboration resulted in reduced veridical and false recall for both young and older adults, although older adults were more likely than younger adults to accept the previous responses of another person as having actually occurred in the study list.

9:05–9:20 (113)
What Aspects of Their Memories Do People Most Want to Improve: A Follow-up Study. KENNETH L. HIGBEE, *Brigham Young University*—In a previous study, people in memory improvement classes answered this question: "What are the main benefits you hope to get from taking a memory improvement class? (That is, what are the memory questions or problems that you most want to have answered or solved?)." This study was designed to investigate the same question with interval-level data that would allow more powerful statistical analyses than did the nominal data (frequencies) in the previous study. Participants rated each of the 12 most frequent answers from the previous study on a 10-point scale for how important it was to them. The two groups of participants were comparable to those in the previous study—36 college students enrolled in a university memory improvement course, and 320 other people ages 14–86 years of age in a 3-h memory improvement seminar. Comparisons were made among the answers for each group and between the genders and different age groups.

9:25–9:40 (114)
Changing Odor Perception Via Associative Learning. RACHEL S. HERZ, *Brown University*—To test the associative learning hypothesis of odor perception, two experiments were conducted that varied with regard to whether a "target" odor was preexperimentally "pleasant" or "unpleasant" and the conditioned emotional association was positive or negative. Participants were randomly divided into three groups: (1) experimental, emotional experience + odor association; (2) control, emotional experience with no odor association; (3) control, neutral experience + odor association. Ratings of the "target" and three familiar "anchor" odors were taken several times over 1 week. In both experiments, no differences in baseline ratings to the target were found, but postmanipulation ratings in the experimental group were significantly different from those in the control groups. Somewhat different outcomes were obtained over time in each experiment, suggesting that different mechanisms may underlie stimulus–association interactions as a function of the significance of initial sensory hedonics and associated emotional context. Responses to the anchor odors were unaffected by time or experimental manipulation.

Psycholinguistics I
New York, Friday Morning, 8:00–10:10

Chaired by Peter C. Gordon, University of North Carolina

8:00–8:15 (115)
The Representation of Conceptual Relations. ZACHARY ESTES, *University of Georgia*—Evidence was obtained for specific, independent representation of conceptual relations (e.g., LEMON PEEL = peel OF a lemon; CONFERENCE POSTER = poster AT a conference). In Experiment 1, comprehension of target combinations (e.g., LEMON PEEL) was facilitated more by a prime combination that used the same thematic relation (e.g., FISH SCALES) than by a prime combination that used a different relation (e.g., COOKING UTENSILS). This facilitation in the absence of lexical repetition from prime to target suggests that relations are represented independently of any particular concept. In Experiment 2, comprehension of target combinations (e.g., LEMON PEEL) was faster after a prime that used the same specific relation (e.g., FISH SCALES) than after a prime that used the same relation but with a different specific instantiation (e.g., APPLE CORE). This result suggests that relations have specific rather than general representations. Implications for theories of relation representation and concept combination are discussed.

8:20–8:40 (116)
Evidence for Enriched Semantic Composition. BRIAN McELREE, *New York University,* MARTIN J. PICKERING, *Edinburgh University,* MATTHEW J. TRAXLER, *University of South Carolina,* & STEVEN FRISSON, *University of Massachusetts, Amherst*—A traditional view of semantic composition holds that the lexical representations of sentential constituents are simply combined in a manner that is informed by syntactic structure. However, recent formal analyses of common and seemingly simple expressions suggest that a more complex mechanism is needed to compute contextually appropriate interpretations. Compositional processes appear to enrich the meaning of expressions

by modifying default interpretations of individual constituents (sense extension), often by interpolating semantic structure not explicitly represented in the sentence or discourse. We present self-paced reading and eye-tracking studies that provide direct behavioral evidence for these kinds of enriched compositions and that provide insights into the what aspects of enriched composition cause processing difficulty. Seemingly simple sentences, like "The author began the book," which require the creation of an event interpretation for the complement "the book (e.g., "writing the book") are shown to be more costly to process than are control sentences.

8:45–9:00 (117)

Learning Language From the Input: Why Innate Constraints Aren't Implicated in Noun–Noun Compounding. MICHAEL J. A. RAMSCAR, *Stanford University*—Four experiments test the claim that the patterns of acceptability of plural forms in noun–noun compounds reveal the workings of innate constraints that exclude regular noun plurals from compounds while licensing the inclusion of irregular plurals (Alegre & Gordon, 1996; Gordon, 1985). These experiments show that contrary to nativist predictions, interpretations of "red rat/rats eater" do not reflect recursive-syntactic mechanisms (interpretations of "red mouse/mice eater" show the same patterns); that any bias toward *recursive interpretations* can be easily overridden by semantics; that contrary to findings with children (Gordon, 1985), adults prefer to include singular forms of irregular nouns in compounds, even when semantics indicate that the noun refers to multiple items: and finally, that when priming effects in Gordon`s experiment are controlled for, children prefer to describe a monster that eats mice as a "mouse-eater," in keeping with what they encounter in the input.

9:05–9:25 (118)

The Perceived Numerosity of Printed Words. IRIS BERENT, *Florida Atlantic University,* STEVEN PINKER, *Massachusetts Institute of Technology,* JOSEPH TZELGOV, *Ben Gurion University of the Negev,* URI BIBI, *University of Toronto, Scarborough,* & LIAT GOLDFARB, *Ben Gurion University of the Negev*—A series of Stroop-like experiments explores the effect of a word's grammatical structure and meaning on its perceived numerosity. Participants are asked to determine the number of words presented on a computer screen (one or two words) while ignoring their contents. We observe an asymmetrical effect of congruency between the number of words and their grammatical marking: One-word responses are impaired for plural (e.g., *dogs*) relative to singular (e.g., *dog*) words. Conversely, two-word responses are typically unimpaired for singular words (cf. *dog dog* vs. *dogs dogs*). Two-word responses, however, are affected by certain incongruent semantic attributes. These findings suggest that plural, but not singular, words are marked for number by the grammar. The default grammatical marking may be modified by semantic information. The word's grammatical structure and meaning each contributes to the representation of numerosity, and this representation is computed by readers in an automatic fashion.

9:30–9:45 (119)

The Argument-Adjunct Status of Two Types of Location Information. KATHY CONKLIN, GAIL MAUNER, & JEAN-PIERRE KOENIG, *SUNY, Buffalo* (read by Gail Mauner)—Linguistic criteria for determining the argument status of optional constituents are unclear. We argue that semantic participants are lexically encoded as arguments if they are true of a restricted class of verbs, but as adjuncts if true of most verbs. To test this hypothesis, we examined two types of locations: sources, which are associated with a restricted class of verbs requiring a source participant (e.g. *eject*), and event locations, which are associated with almost all verbs (e.g. *beaten*). We found that readers use argument information associated with source, but not with event location, verbs on line to integrate *wh*-fillers into representations of sentences like, "The noisy spectator was ejected from/beaten in the stadium by the security guard." These results suggest the need for a more semantically fine-grained notion of arguments and is consistent with a

multiple-constraints view of sentence processing where one important constraint is the semantic information lexically encoded in verbs.

9:50–10:05 (120)

Predicate Decomposition: Activities, States, and Changes of State. GAIL McKOON & TALKE MacFARLAND, *Northwestern University*—Event templates are predicate decompositional representations of the parts of verb meaning relevant to syntactic sentence structure. Manner of motion and emission verbs (*walk, chatter*) have an activity template, x (ACT), with one argument engaging in an activity. Existence verbs (*reside*) have a state template, x (AT LOCz), with two arguments: x exists at location z. Appearance verbs (*occur*) have a change of state template, x (BECOME AT LOCz), with two arguments and a change of state: x comes to be at location z. The increasing complexity of these templates—from activity to existence to appearance verbs—is mirrored in 10 experiments, in lexical decision response times and in comprehension times for both transitive and intransitive sentences.

Touch/Haptic Perception
Chicago A, Friday Morning, 8:00–9:35

Chaired by David A. Rosenbaum, Pennsylvania State University

8:00–8:15 (121)

Vibrotactile Pattern Localization: Influences of Body Site and Aging. ROGER W. CHOLEWIAK & AMY A. COLLINS, *Princeton University*—Spatial acuity of the skin has been examined for static or pressure stimuli, but not for vibratory patterns. The minimum separation necessary for accurate localization of such stimuli could depend on many factors, including such parameters as stimulus frequency or contactor area, as well as body site and age of the observer. Over 170 years ago, Weber described how localization accuracy is tied to reference points or body landmarks. Tactile physiology argues that localization should be poorest for high-frequency stimulation, over bony tissue, and for older persons because of the types, locations, and aging of receptors and the spread of mechanical energy. Localization accuracy was tested for single bursts of vibration on a seven-tactor linear array along the volar forearm. Stimulus frequency was not found to affect localization. Age played a minor role, whereas stimulus site as referred to body features was a major determinant of localization accuracy. Supported by NIH-NIDCD.

8:20–8:35 (122)

The Effect of Motion on Tactile and Visual Temporal Order Judgments. JAMES C. CRAIG & THOMAS A. BUSEY, *Indiana University*—Subjects made temporal order judgments (TOJs) of either tactile or visual stimuli. Subjects judged which one of two locations received a stimulus first. Moving, rather than static, patterns were used as stimuli. Although irrelevant to the judgments, the direction of movement had a large, consistent effect on TOJs. For the same stimulus onset asynchrony (SOA), reversing the direction of movement of the patterns resulted in drops in performance from over 80% correct to less than 20% correct. Similarly, changes in SOAs of as much as 170 msec were required to overcome the bias produced by the direction in which the patterns moved. Similar effects were obtained with both tactile and visual stimuli.

8:40–8:55 (123)

Perception of Correlation Via Electrotactile Displays. STEVEN J. HAASE & KURT A. KACZMAREK, *University of Wisconsin, Madison*—Two multielectrode matrix displays (abdomen, fingertip) were compared on several tactile perception tasks. The study comprised three phases: an evaluation of electrotactile waveform clarity, a digit identification task on two waveforms differing in clarity, and a correlation estimation task (with visual control condition) similar to Flowers, Buhman, and Turnage's (*Human Factors*, 1997, **39**, 341-351) auditory display study. The fingertip electrotactile display resulted in better digit identification performance, as compared with the same task on

the abdominal display. On both displays, the waveform rated as most clear produced better digit identification performance. The correlation estimation task (using the clearest rated waveform) was performed less well, as compared with Flowers et al.'s auditory display study. Similar levels of correlation estimation performance were obtained in the visual control condition, both in Flowers et al. and in our study. Correlation estimation performance was similar across the abdominal and fingertip displays, with a slight advantage for the abdominal display.

9:00–9:10 (124)

Haptic Perceptual Selectivity in the Blind. MORTON A. HELLER & KATHY L. WILSON, *Eastern Illinois University,* DENEEN D. BRACKETT, *Illinois State University,* & HEATHER STEFFEN & KEIKO YONEYAMA, *Eastern Illinois University*—Blindfolded sighted, congenitally blind, late-blind, and low-vision subjects were tested on a tangible version of the embedded figures test. All groups of blind subjects were significantly faster than the blindfolded sighted subjects. The results of ANOVAs on accuracy measures yielded superior performance by the low-vision and late-blind subjects, as compared with the sighted and congenitally blind participants. It is suggested that experience with pictures, combined with haptic skill, aids haptic perceptual selectivity.

9:15–9:30 (125)

Drawings by T.M., Totally Blind Woman: Individual and Grouped Objects. JOHN M. KENNEDY, *University of Toronto*—A 41-year-old totally blind woman, T.M., lost vision in early childhood. She was asked to draw individual objects and groups of objects, varying distance, location, orientation, and action. Objects were drawn using similarity of form. She selected vantage points to display informative features. For example, in drawing individual objects, she elected to draw a person from the front, a dog from the side, and an insect from above. A three-quarter view proved too challenging. On occasion, she used height in the picture plane and convergence to show depth and slant. Her drawings of the "three mountain problem" and of rows of glasses receding across a tabletop indicate that she uses parallel projection successfully. A rotating wheel was drawn with a metaphoric representation of motion.

Attention to Objects
Chicago BC, Friday Morning, 8:00–9:55

Chaired by Veronica J. Dark, Iowa State University

8:00–8:20 (126)

Dissociations Among Attention, Perception, and Awareness in Object-Substitution Masking. GEOFFREY F. WOODMAN, *Vanderbilt University,* & STEVEN J. LUCK, *University of Iowa* (read by Steven J. Luck)—When a target object is surrounded by four dots that begin at the same time as the target but persist after target offset, the four dots impair target discrimination performance. This phenomenon is called *object-substitution masking,* reflecting the hypothesis that both the target and the four dots are perceived but that the persisting representation of the four dots replaces the fragile representation of the target object. The present study tested this hypothesis by examining event-related potentials (ERPs) that were recorded as observers performed a visual search task with or without four-dot masking of the target item. The ERP recordings indicated that, although masking led to highly impaired behavioral performance, the target was detected and attention was shifted toward the target's location. However, by the time attention was shifted, only the mask remained visible, and this presumably caused the representation of the four dots to replace the representation of the target.

8:25–8:40 (127)

Decomposition of Configural Face Representations by Focal Attention. SHAUN P. VECERA, *University of Iowa*—Research on object-based attention has investigated how humans attend to entire objects. But, objects are also composed of parts, and previous research has demonstrated that attention exhibits part-based limitations. There are at least two possible sources of these part-based effects: Part-based attention could arise from within an object recognition system that decomposes an object into its parts, or part-based attention could arise from an attentional system that is separate from object recognition processes. We investigated part-based effects with faces. Faces and other overlearned stimuli are not decomposed into parts; they are represented as configural "wholes." If part-based effects arise from part-decomposition recognition processes, faces should not exhibit part-based limitations. However, we find that focal attention can decompose a face into its parts. Participants are more accurate reporting features of one part than multiple parts. These results suggest that part-based effects arise from an attentional system separate from object recognition processes.

8:45–9:05 (128)

Evidence for Early and Late Components of Object-Based Selection. EDWARD AWH, HARPREET DHALIWAL, SHAUNA CHRISTENSEN, & MICHI MATSUKURA, *University of Oregon*—Can visual selection be guided by spatially invariant object representations? Duncan (1984, *JEP:G*) demonstrated that observers are better at reporting two attributes from one object than one attribute from each of two objects, consistent with the idea of object-based selection. However, it has been suggested that this effect can be explained by the direction of spatial attention toward the contours of the relevant object (i.e., a *grouped-array* hypothesis). Our work suggests that selection in this task involves both grouped-array and object-based components. The spatial component of selection is observed when the relevant targets are cued before the onset of the stimulus display. But when the spatial component is eliminated, an additional object-based component remains. The object-based component can be demonstrated even when the relevant targets are cued after the target stimuli have been masked and replicates the original pattern of evidence observed by Duncan (1984).

9:10–9:25 (129)

Why So Slow? The Role of Speed Discontinuities in Maintaining Object Persistence Through Occlusion. BRIAN J. SCHOLL & GABRIEL H. NEVAREZ, *Yale University*—Beyond static object representations, perception involves *persisting* objects, which maintain their identities over time and motion. Suppose an object disappears behind an occluder, then later an object disoccludes: Did this involve a single object or two distinct objects? Intuitively, object persistence seems less likely when the disoccluding object appears too slowly (as if it had become momentarily "stuck") or too quickly (e.g., reappearing instantly). Here, we explore such issues, using a multiple-object tracking task. Subjects tracked a subset of identical randomly moving objects while they passed behind occluders and had to indicate their identities at the end of each trial. Performance was impaired by anomalous *slowdowns* during occlusion: the longer the delay, the worse the tracking. However, tracking was surprisingly resistant to anomalous *speed-ups*: Subjects showed no impairment even when objects reappeared instantly from behind occluders that were up to 10 times their widths. These results reveal some new principles responsible for maintaining object identity through occlusion.

9:30–9:50 (130)

Attention to Impossible Objects. ANNE P. HILLSTROM, JONATHAN KRAMER, & REBECCA WILLIAMS, *University of Texas, Arlington*—When an observer attends an object, attention is directed to a mental representation of the object. "The devil's pitchfork," a trident with two prongs on the base but three at the top, phenomenally shifts organization when attention moves from one end to the other. However, the observer maintains an impression of a coherent object. When attention is shifted, will object-based attention work on a single incoherent representation, or will it work on two coherent representations? Two different paradigms yielded the same results for the devil's pitchfork as for tridents with coherent organization. Thus, the organization at which

attention is operating seems to be unaffected by the structural incoherence of the impossible object.

Memory for Events
Chouteau, Friday Morning, 8:00–10:05

Chaired by Steven M. Smith, Texas A&M University

8:00–8:15 (131)
Memory for the Events of September 11, 2001. KATHY PEZDEK, *Claremont Graduate University*—Memory for the events of September 11 was assessed 7 weeks later in five samples: (1) 275 college students from Manhattan, (2) 167 college students from California, (3) 127 college students from Hawaii, (4) 53 United and American Airlines flight attendants and pilots, and (5) 68 fire fighters from California. Whereas event memory was most accurate in the New York sample most directly affected and most distressed by the event, autobiographical memory was least accurately reported in this sample. Constructive characteristics of memory are also evident in the data. Findings are compared with follow-up data collected 1 year after 9/11.

8:20–8:35 (132)
Tragic Memories: Flashbulb Memories of September 11, 2001. CHARLES A. WEAVER III & KEVIN KRUG, *Baylor University,* & ROBERT G. WINNINGHAM, *Western Oregon University*—Following the events of 9/11/01, we distributed flashbulb memory questionnaires (based on Weaver, 1993) at four times: within 48 h of 9/11, 1 week later, 1 month later, and 3 months later (we should have 1-year data by the time of the meeting). We scored responses for *memory* (self-reported recollection of details, unverified), *accuracy* (whether recollections matched responses given within the first 2 days), and *consistency* (whether recollections matched any prior responses). Self-reported memories for most details remained near ceiling, although the accuracy of these responses declined. However, memories given a week or more after 9/11 were remarkably consistent throughout, suggesting that flashbulb memories involve a consolidation-like process (Winningham, Hyman, & Dinnel, 2000). Furthermore, later recollections of "first thoughts" tended to incorporate statements of anger and desire for revenge, although these were relatively infrequent initially. Once these narrative memories take form, though, they are persistent (if not necessarily accurate).

8:40–8:55 (133)
Binding Actors and Actions in Eyewitness Memory. ALAN W. KERSTEN, JULIE L. EARLES, & EILEEN CURTAYNE, *Florida Atlantic University*—Two experiments provide evidence that even when observers remember which people they have encountered and which actions they have seen performed, they have difficulty remembering which people performed which actions. Participants saw 30 videotaped actions, each performed by a different actor. After a 1-week delay, participants were tested on their recognition of these actions. Some recognition stimuli were identical to those seen at encoding, some involved a new actor performing a familiar action, some involved a familiar actor performing a new action, and some involved a new actor performing a new action. The crucial test type, however, involved familiar actions and familiar actors that had never been paired together at encoding. Participants were found to be more likely to falsely recognize these novel pairings of familiar actors and actions than to recognize either a new action performed by a familiar actor or a familiar action performed by a new actor.

9:00–9:15 (134)
The Basis of Self-Reports of Memory Performance: Beliefs Versus Memory. DOUGLAS HERRMANN, *Indiana State University,* MIKE GRUNEBERG, *University of Wales,* REBECCA TORRES, *Indiana State University,* & SARAH JANE WILLIAMS, *University of Wales*—For over 2 decades, *memory questionnaires* have been used to investigate the reports of participants about their typical memory performance. These reports have consistently corresponded only slightly with actual memory performance. Researchers concluded that people have inaccurate knowledge about their memory performance and, instead, possess beliefs about such performance that are derived from largely incorrect sources (e.g., mistaken feedback from others). The present research required participants to recall occasions when their memory failed and then describe how the failure occurred. The recall of participants corresponded well with the recall of these failures by a participant's spouse. Thus, people demonstrate a more accurate memory for their memory performance than previously suggested by memory questionnaires. Apparently, the use of beliefs or memories to make judgments about one's memory depends on the kind of memory judgment asked of participants.

9:20–9:35 (135)
Consistency as an Indicator of Accuracy of Autobiographical Memory. RONALD P. FISHER, NADJA SCHREIBER, & TERRI PATTERSON, *Florida International University*—Outside the laboratory (e.g., in the courtroom), observers often have to use behavioral clues to infer the accuracy of another person's recollections. One such clue often used is consistency of recollection. For instance, eyewitnesses who recall events inconsistently are often perceived by others (e.g., jurors or police) to be incorrect. Using a derivative of Jost's law, we show that some conditions that promote inconsistent recollection lead to increased recall accuracy. We examine the theoretical and applied implications of these findings.

9:40–10:00 (136)
Are Young Children Susceptible to the DRM Illusion? CHARLES J. BRAINERD & VALERIE F. REYNA, *University of Arizona,* ROBYN E. HOLLIDAY, *University of Kent,* & RON WRIGHT, *University of Arizona*—Developmental studies supply differential tests of competing explanations of adult memory effects when one type of explanation invokes processes that are absent throughout childhood, whereas another type invokes processes that are present throughout childhood. The presence–absence of a target effect in children then argues against one or the other type of explanation. A case in point is provided by word association versus connected meaning ("gist") explanations of the DRM illusion. The memory development literature shows that word association norms are age invariant during childhood but that the ability to connect meaning across items on a word list emerges very slowly. Consistent with the gist explanation, several studies of the DRM illusion in young children have shown that (1) it is at floor on recall tests and (2) it is much reduced, relative to adult levels, on recognition tests. Also, several manipulations have qualitatively different effects on the illusion in children versus adults.

Categorization I
Empire, Friday Morning, 8:00–9:50

Chaired by Lawrence W. Barsalou, Emory University

8:00–8:20 (137)
Linguistic Diversity and Object Naming by Nonnative Speakers of English. BARBARA C. MALT, *Lehigh University,* & STEVEN A. SLOMAN, *Brown University*—Languages vary idiosyncratically in the sets of referents to which they apply common nouns. To use nouns as a native speaker would, second-language learners must acquire language-specific naming patterns, not merely a language-to-language correspondence. We asked second-language learners to name household objects in English and their native language, judge the objects' typicality, and give naming strategy reports. Early learners' naming and typicality judgments diverged substantially from native responses; more advanced learners improved, but even the most advanced retained some discrepancies from native patterns. Time spent immersed in an English-speaking environment was a better predictor of mastery than was years of formal instruction. Discrepancies do not appear to be due to mapping directly from the learner's own language. We discuss how in-

complete lexical knowledge may affect second-language naming and typicality judgments and the implications for models of second-language lexical development.

8:25–8:40 (138)

Does Language Shape Thought? Tense Markers and Event Representation in English and Indonesian. LERA BORODITSKY & WENDY HAM, *MIT,* & MICHAEL J. RAMSCAR, *Stanford University*—Does the language you speak shape the way you think about the world? Four studies investigate how English and Indonesian speakers encode and represent action events. Unlike English, Indonesian verbs do not include tense markers. Indonesian speakers are not required to indicate whether an event has already occurred, is happening now, or will occur in the future. Does needing to include tense to speak English grammatically change the way English speakers pay attention to, encode, and remember events? We find cross-linguistic differences in memory and similarity judgments between English and Indonesian speakers, as well as between Indonesian–English bilinguals tested in English and Indonesian.

8:45–9:00 (139)

The Role of Subordinate-Level Learning in the Development of Perceptual Expertise. JAMES W. TANAKA, *Oberlin College*—Is perceptual expertise influenced by the *kind* or the *amount* of perceptual experience? To address this question, participants learned to identify 12 members from the wading bird (owl) family by a given subordinate-level name and 12 members from the owl (wading bird) family by a basic-level name. During training, participants viewed basic- and subordinate-level members an equal number of times. After 6 days of practice, participants were asked to decide whether pairs of bird stimuli belonged to the *same* or *different* species. Overall, species discrimination was better for birds categorized at the subordinate level during training than at basic level. Importantly, in tests of perceptual transfer, novel species of birds were better discriminated if they were members of the subordinate-level bird family than if they were members of the basic-level bird family. These results suggest that object categorization, not just object experience, is important for the development of perceptual expertise.

9:05–9:20 (140)

Kinds of Categories and Properties and Category-Based Induction. SHARON LEE ARMSTRONG, *La Salle University*—This research investigates the generality of a formal model (developed by Osherson et al., 1990) of the induction of properties within/to categories. The model predicts the strength of category-based inductive arguments (robins have an ulnar artery/birds have an ulnar artery). Similarity relations among premise(s) and conclusions give rise to principles—for example, typicality, homogeneity, diversity, and monotonicity—that predict argument strength. The experiments used to confirm the model featured arguments composed of natural-kind (biological) categories and new properties called *blank properties.* Research here tested the model across different kinds of categories (biological, physical, psychological, behavioral) and kinds of properties (blank, biological, physical, psychological, behavioral). Results indicated that the model is not robust against variations in kinds of categories and properties. The notion of a blank property is discussed in the context of general knowledge frameworks that inform induction.

9:25–9:45 (141)

The Influence of Positive Affect on Category Learning. DOUGLAS H. WEDELL, *University of South Carolina*—Participants learned to classify figures with schematic faces into one of two categories on the basis of outcome feedback. Eight features of clothing were varied, with only one or two of these deterministically related to classification category. Thus, successful classification was dependent on ignoring irrelevant features and attending to relevant features. Affect was manipulated by altering the emotional expression on the schematic face so that it depicted a positive, a neutral, or a negative expression. Facial expression was manipulated between-subjects in Experiment 1 and within-subjects in Experiment 2. Consistent with the hypothesis that positive af-

fect increases attentional control (Ashby, Isen, & Turkin, 1999), categories were learned faster and more accurately in the presence of the positive face than in the presence of either the neutral or the negative face. A simulation was conducted using Kruschke and Johansen's (1999) RASHNL model to explore which aspects of categorization were likely affected by the manipulation.

Human Learning and Memory II
Atlanta, Friday Morning, 10:00–12:00

Chaired by Kenneth L. Higbee, Brigham Young University

10:00–10:20 (142)

Acquisition and Transfer of Implicit Expertise. CRAIG P. SPEELMAN, *Edith Cowan University,* & KIM KIRSNER, *University of Western Australia*—Skilled performance is often accompanied by a form of implicit expertise: Years of experience can render someone expert in a domain without a concomitant increase in verbalizable knowledge about the domain. The aim of this study was to determine whether the conditions under which implicit expertise develops are also responsible for limiting transfer of skilled performance to different environments. Training conditions were manipulated in order to affect the type of expertise that would result. Exposure to a large range of stimulus conditions and problem types during training resulted in expertise that was more likely to be verbalizable and transferable to different situations. In contrast, when experience was restricted during training, this encouraged the development of expertise that was routine, implicit, and less transferable. An explanation of these results is proposed whereby the manner in which skills are acquired determines the nature of the skills, which in turn determines transferability and verbalizability.

10:25–10:40 (143)

Perceptual or Motor Learning in Serial RT Tasks With Grammatical and Fixed Sequences. NATACHA DEROOST & ERIC SOETENS, *University of Brussels* (read by Eric Soetens)—We investigated whether sequence learning in a serial reaction time task is primarily perceptual or motor by varying the stimulus dimension on which the sequence structure was imposed. Earlier research of Mayr (1996) showed evidence for both types of learning. In our first experiment, using a two-choice task with fixed sequences of 32 elements, we found learning only when both the relevant color and the irrelevant location of the stimulus were structured. There was no evidence for pure perceptual (location) nor motor (color) learning. In the second experiment, with a four-choice task, we found evidence for motor learning, but not for perceptual learning. To enhance the learning effect, we switched to an artificial grammar in the third experiment. As was expected, the motor learning effect increased dramatically. The perceptual learning effect remains unclear. Results will be discussed in terms of the effects of sequence learning on the different processing stages.

10:45–11:05 (144)

Specificity of Hand–Eye Coordination: Training and Transfer Effects. ALICE F. HEALY, ERICA L. WOHLDMANN, & LYLE E. BOURNE, *University of Colorado, Boulder*—Eighty subjects were required to move a cursor on a computer monitor from a central start position to one of eight locations on the circumference of a circular clock face. Locations were labeled by digits, and the target digit was specified above the start position. Cursor movements were controlled by a mouse in one of four hand–eye compatibility conditions: up-down reversal, right-left reversal, combined reversals, or no reversal. Subjects were trained in one condition and returned 1 week later for retraining in either the same or a different condition. We found large improvements across training and perfect retention across the 1-week delay when the conditions were the same in both weeks. For the reverse conditions, we found little or no transfer when the conditions were different in the 2 weeks, even when training involved combined reversals and retraining involved a single reversal. These results illustrate severe specificity of training effects.

11:10–11:30 (145)

Time Delay and Transfer in Different Stages of Learning the Tower of Hanoi. ELI VAKIL & IRIS LOEWENSCHUSS, *Bar Ilan University,* & AVI KARNI, *Haifa University*—Three experiments were conducted in order to test the effects of time delay after practice and the ability to transfer the knowledge gained from training early and advanced stages in learning to solve the Tower of Hanoi (TOH). TOH was administered with three or four rings, 8–16 trials in one to three sessions with 24 to 48 h between-session delays. Time delay in the early stage of learning (after 3 trials or less) resulted in impaired performance in the following session, whereas a delay interval at an advanced stage (after 8 or more trials) resulted in improved performance by the following session. The *cost* of transfer conditions was, however, significantly larger at advanced, as compared with early, stages of learning. These findings are consistent with the hypothesis that consolidation, in skill learning, is triggered only after a critical amount of practice (late, not early, stage of the within-session learning process).

11:35–11:55 (146)

Spacing Versus Error Minimization: Effects on Learning Rate. HAL PASHLER, *University of California, San Diego*—It is widely assumed that after a learner makes an error, the person should be re-tested sooner rather than later, to ensure against recurrence of the error. We tested this idea using simple but practically important kinds of learning. On Day 1, subjects learned foreign language vocabulary (Experiment 1) or obscure English words (Experiment 2), undergoing several tests on each pair (followed by feedback providing the correct answer). The lag separating the first and the second tests was manipulated. Greater inter-study lags drastically reduced performance on the second test. However, they produced meaningfully better performance on a final test 1 day (Experiment 1) or 1 week later (Experiment 2). This held true even for items that elicited an error on the second test. Evidently, the benefit of spacing overwhelms any possible deleterious effects of producing errors. Implications for design of instructional software are discussed.

Language Production I
New York, Friday Morning, 10:20–12:00

Chaired by Michael S. Vitevitch, University of Kansas

10:20–10:35 (147)

Verb Types Generated in Describing Visually Presented Motion Events. DORRIT BILLMAN, *ISLE,* MEREDYTH KRYCH, *Montclair State University,* & RODOLFO GALINDO, *University of California, Santa Cruz*—Although there are extensive studies of object naming and categorization, there is little work on event labeling. We looked at variation in the verbs people use to describe visually presented motion events in everyday settings. Video clips were designed to provide clear illustrations of manner and path verbs. Scenes showed self-generated movement, and also some caused-motion events. One group of observers generated several descriptive verbs for each of a set of video clips, and a second group generated descriptive sentences. Observers generated a considerable variety of verbs, differing in granularity, generality, and focus, including motion verbs (manner and path), verbs of inferred intent and outcome, and body-part verbs. We compared distributions across order of generation and between generation in isolation or in sentence context, examined the role *basic-level* verbs, and considered how goal hierarchy information is expressed in verb choice.

10:40–10:55 (148)

Persistent Structural Priming From Language Comprehension to Language Production. KATHRYN BOCK, *Beckman Institute, University of Illinois, Urbana-Champaign*—To examine the relationship between syntactic processes in language comprehension and language production, the strength and persistence of structural priming were examined in a cross-modality priming task. Participants heard priming sentences and, on subsequent target trials, produced sentences to de-

scribe unrelated pictured events. Target trials followed the priming trials immediately or after 1, 2, 4, or 10 filler trials. The syntactic structures of the target sentences and their match to the structures of the priming sentences were examined. There was significant priming that persisted across all lags, and the magnitudes of priming approximated those observed in parallel studies using within-modality primes. In a final experiment, comparable persistence was observed with incidental encoding of the auditory primes. The results suggest that structural priming may be indifferent to the modality in which exposure to a target sentence structure occurs, underscoring its efficacy as a mechanism for the implicit learning of linguistic structure.

11:00–11:10 (149)

Incrementality in Language Production: Evidence From Island Violations. FERNANDA FERREIRA & BENJAMIN SWETS, *Michigan State University*—Incremental theories of language production assume that syntactic planning takes place over units smaller than the clause and even the phrase. Two production experiments suggest that language production is not so highly incremental. In Experiment 1, sentences with *wh*-island violations in relative clauses (e.g., "This is a dog that I don't know what it has") were elicited with a picture description task. Longer speech durations were observed for the beginnings of the island sentences with resumptive pronouns, in comparison with grammatical control sentences. Experiment 2 implemented a deadline procedure that forced participants to begin speaking quickly. Preliminary analyses indicate patterns of results similar to those in Experiment 1. In addition, a grammaticality judgment task demonstrated that island sentences with resumptive pronouns are considered ungrammatical, even though they are reliably produced by speakers. The evidence suggests that syntactic planning takes place over larger syntactic domains than would be expected on an incremental model.

11:15–11:30 (150)

Prosodic Persistence in Speech Production and Music Performance. MELISSA K. JUNGERS, SHARI R. SPEER, & CAROLINE PALMER, *Ohio State University* (read by Shari R. Speer)—Speakers and musicians show wide variability in the rate of their prosodically structured productions. When perceivers and producers interact, do they mutually influence each other? We demonstrate rate persistence effects from prime to target for both domains. Participants read two sentences aloud as a measure of their preferred speech rate. Next, they heard a prime sentence recorded by a naive female speaker at a slow or fast rate. Following each priming sentence, the listeners read structurally matched target sentences aloud. The rate of the participants' target sentences was slower for productions that followed a slow prime than for those that followed a fast prime. Speakers' rates were predicted by an additive model that included both prime and preferred rates, with preferred rates accounting for more of the variance. Findings from a parallel music experiment show similar rate persistence in the performance of melodies. The same model predicted musicians' performance rates, with prime rates accounting for more of the variance.

11:35–11:55 (151)

The Origins, Development, and Nature of Argument Understanding. NANCY L. STEIN, *University of Chicago*—The early emergence and development of argumentation skill are the topics of this presentation. We argue that the mental structures used to understand interactive arguments are as much governed by the desire to maintain or dissolve a relationship as they are by the desire to persuade another and understand their position. These personal goals influence the types of strategies used to resolve a conflict, the outcome, and memory for the conflict. Data from three studies will be presented to show the relationship among social goals, the content, structure, and outcome of an argument, and subsequent memory for the argument. We will illustrate that by 3 years of age, most children are using all parts of an argument schema and that they benefit, just as adults do, from explicit training focused on the nature, content, and organization of an argument.

Motor Control
Chicago A, Friday Morning, 9:50–12:00

Chaired by Morton A. Heller, Eastern Illinois University

9:50–10:10 (152)
Effects of Intention, Attention, and Awareness on Adaptation to Tempo Changes in Sensorimotor Synchronization. BRUNO H. REPP & PETER E. KELLER, *Haskins Laboratories*—Adaptation to tempo changes in sensorimotor synchronization is hypothesized to rest on two processes, one (phase correction) being largely automatic and the other (period correction) requiring awareness and attention. Participants tapped their fingers in synchrony with auditory sequences containing a tempo change and continued tapping after a sequence had ended. Their intention to adapt or not to adapt to the tempo changes was manipulated through instructions, attentional resources were varied by introducing a second task (mental arithmetic), and awareness was assessed through perceptual judgments. As was predicted, period correction was found to be strongly dependent on all three variables, whereas phase correction depended only on intention.

10:15–10:30 (153)
Lasting Hierarchical Control in a Sequential Keying Task: A Structural Limitation of Segment Length? WILLEM B. VERWEY, *Institute for Occupational Health,* & TEUN EIKELBOOM, *University of Utrecht*—Movement sequences are initiated and executed slower when they are longer, but these effects of sequence length are reduced with practice. This reduction has been attributed to the development of a single motor chunk representing the entire sequence, but it can be explained also by an increasingly efficient distribution of programming before and during execution. Detailed examination of the effects of extensive practice, of regularities in keypressing order, and of a preceding choice RT task on the production of a three- and a six-element discrete keying sequence showed, among other things, that the six-key sequence remained to be executed as a couple of successive segments. The data, therefore, support a lasting distributed programming of longer sequences, suggesting that the length of these segments is structurally limited. Segmentation of highly practiced, longer sequences has been overlooked in most earlier studies because the participants usually segment longer sequences in different ways.

10:35–10:50 (154)
Linear Versus Nonlinear Variability During Unimanual Versus Bimanual Fingertapping in Mixed Versus Strong Right-Handers. STEPHEN D. CHRISTMAN & RYAN WEAVER, *University of Toledo*—Mixed and strong right-handers engaged in unimanual and alternating bimanual fingertapping. Linear (standard deviation) and nonlinear (Lyapunov exponents) measures of variability were calculated. Left-hand tapping yielded greater linear variability than did right for both handedness groups. Bimanual tapping, relative to unimanual, yielded an increase in linear variability in strong, but not in mixed, right-handers. In contrast, nonlinear variability was greater in mixed right-handers across all tapping conditions. Thus, relative to strong right-handers, mixed right-handers demonstrated decreased linear and increased nonlinear variability during finger tapping. Mixed, but not strong, right-handers yielded negative correlations between measures of linear and nonlinear variability during bimanual tapping. Furthermore, increased nonlinear variability was associated with faster bimanual tapping in mixed, but not strong, right-handers, whereas increased linear variability was associated with slower bimanual tapping in all subjects. This indicates that linear and nonlinear sources of variability are distinct and suggests that increased nonlinear variability may be associated with enhanced performance.

10:55–11:05 (155)
Independence of Hand Movements During Bimanual Haptic Pursuit Tracking. DAVID A. ROSENBAUM, *Pennsylvania State University*—Recent research indicates that the source of bimanual coupling may be perceptual rather than motoric. If bimanual coupling is due to perception, it should be possible to show that people can move their two hands independently when each hand is guided by its own perceptual input, provided the stimulus–response compatibility is high. I tested this prediction with a bimanual haptic pursuit tracking task. Participants pushed with their two middle fingers against buttons mounted under vertically oriented shafts that were displaced rapidly, continually, and quasi-randomly in a horizontal plane either by one or two experimenters. Participants did equally well in the one- and two-experimenter conditions, which is remarkable in view of the fact that the shafts were moved essentially independently in the two-experimenter case. The result supports the perceptual account of bimanual coupling and provides the first evidence I know of for spatial and temporal independence of the two hands.

11:10–11:20 (156)
Kinesthetic Compensation for Sensorimotor Rearrangements: Attentional, Temporal, and Interpretive Factors. STEPHEN R. ELLIS, BERNARD D. ADELSTEIN, & ROBERT B. WELCH, *NASA Ames Research Center*—Previous experiments have shown that subjects are able to compensate for rotational sensorimotor rearrangements by using kinesthetic cues in the cross-modal transfer of movement coordinate information. We now show that this transfer benefits significantly from directed attention and that the onset of spontaneous movements initiated under conditions of rotational rearrangement is momentarily delayed. This delay is shown to be roughly proportional to the angular extent of rotation and may represent the computational costs of attempting to adopt a rotated frame of reference at the movement onset. The initial delay in movement is independent of the movement speed. The specific role of hand posture for the usefulness of the kinesthetic cue will also be reported

11:25–11:35 (157)
Short and Long Time Scale Components of Rhythmic Movement Variability. RICHARD C. SCHMIDT, *College of the Holy Cross,* & THEO G. RHODES, *University of Connecticut*—A number of studies have shown that the variability associated with behavioral responses is not random but is characterized by long-term correlations indicative of the system's underlying dynamic complexity. Often, this 1/f noise is time scale specific: The correlated noise is found only at long time scales, whereas unstructured noise is found at short time scales. Gilden (2001) hypothesized that this random component may be due to the variability of the motor response for which a white noise basis has been proposed (Wing & Kristofferson, 1973). A study using a rhythmic movement methodology was designed to test this hypothesis and also determine which movement properties predicted the degree of correlation at the long time scales. Results supported the conjecture that the random short time scale noise is due to the motor response and suggested that the degree of correlation at long time scales is constrained by dynamic movement properties.

11:40–11:55 (158)
Computing the Difficulty of Imagined Aiming. ANDREW B. SLIFKIN & SUZANNE M. GRILLI, *Cleveland State University*—Participants provided modulus-free magnitude estimates of the difficulty of imagined aiming in a Fitts (1954) cyclical aiming task. These perceived difficulty ratings were made following viewings of target displays where prescribed difficulty [$\log_2(2D/W)$] levels ranged between 1 and 5 bits. In addition, participants were exposed to different versions of each prescribed difficulty level by varying target width ($W = 0.1$ to 0.9 in.) and adjusting target distance (D) accordingly. Within each prescribed difficulty level, when W was very small, magnitude estimates exceeded the prescribed difficulty value. However, as W increased, the perceived difficulty estimates quickly converged on values equivalent to the prescribed difficulty value. The results support the notion that under a large range of W, computations of perceived difficulty were based on the logarithm of the D/W ratio. However, when W was very small, evaluations of required accuracy (W) were more heavily weighted in computations of perceived difficulty.

Spatial Cognition
Chicago BC, Friday Morning, 10:05–12:00

Chaired by Michael E. Masson, University of Victoria

10:05–10:20 (159)

Updating Self-to-Object Relations in Spaces Learned From Text.
MARIOS N. AVRAAMIDES & RICHARD A. CARLSON, *Pennsylvania State University* (read by Richard A. Carlson)—When people physically change their orientations in the environment, they update self-to-object relations in an on-line and effortless manner. This effortless updating is not possible with imagined movements. The studies reporting this finding (e.g., Presson & Montello, 1994; Rieser, 1989) asked participants to judge the locations of objects in previously viewed scenes, which elicited representations in sensorimotor frames centered on the participant. We report evidence that such sensorimotor encoding is required for effortless updating during real shifts of orientation. Participants read texts describing scenes, allowing them to represent locations, using imagined reference frames, which might be centered on the story's protagonist rather than on the participant. With such representations, egocentric updating was effortful with both physical and imagined rotations. A modified procedure evoked sensorimotor frames, allowing effortless egocentric updating concurrent with physical rotations. These results suggest that physical movements and sensorimotor representation of object locations are both prerequisites of effortless egocentric updating.

10:25–10:45 (160)

Grounding Working Memory in the World: A Dynamic Field Model of Position Discrimination and Spatial Memory Biases. JOHN P. SPENCER & VANESSA SIMMERING, *University of Iowa*—A fundamental challenge in dynamically changing environments is to maintain task-relevant information in working memory with enough fidelity to guide action. One strategy for maintaining a high-fidelity memory is to use stable visible cues that might provide a frame of reference for remembered information. Here, we discuss a dynamic field model of spatial working memory that captures how working memory and visual perception are coupled together. Results from a series of experiments provide support for a novel prediction of the model—that position discrimination is enhanced near visible reference frames, including *virtual* frames such as axes of symmetry. These results effectively link the processes that underlie position discrimination and the processes that give rise to category-like biases in spatial working memory.

10:50–11:10 (161)

Egocentric and Allocentric Updating of Spatial Memories. WEIMIN MOU, *Chinese Academy of Sciences,* & TIMOTHY P. McNAMARA, *Vanderbilt University* (read by Timothy P. McNamara)—Wayfinding and other actions in a familiar environment depend on remembered spatial relations among objects in that environment, and as we move through the environment, we must continuously update our location and orientation with respect to familiar elements of the landscape to avoid getting lost or disoriented. This project tested alternative models of spatial memory and updating. Our results are consistent with the following model. Egocentric self-to-object spatial relations are represented at a perceptual level, for the purpose of guiding action in space, but are not updated or maintained in an enduring form. Allocentric object-to-object spatial relations are preserved in an orientation-dependent representation, using an intrinsic reference system (e.g., rows and columns of chairs in a classroom). Spatial updating consists of updating the heading and the location of the observer with respect to the intrinsic axes or directions used to represent the spatial structure of the environment.

11:15–11:30 (162)

Priming Layout of Mixed Scenes: Evidence of Piecemeal Layout Representation. THOMAS SANOCKI, KIMBERLY MICHELET, & ERIC SELLERS, *University of South Florida*—Immediate priming was used to examine representations of scenic layout. A prime scene was presented for 1 sec, followed by a brief blank interval and then a target picture of the scene. Observers made a speeded spatial judgment about two spatial probes superimposed on the target. Typically, spatial processing of the target is speeded by a similar prime, relative to controls. We infer that the prime activated a representation relevant to the spatial processing of the target. The present experiments indicate that the representation can be piecemeal in nature—for example, it can consist of at least four separate pieces of pictures that are good in themselves but void of global, cross-picture relations. In the main experiment, priming was as strong with scenes constructed from four separate scene-pieces as with normal scenes.

11:35–11:55 (163)

Does Culture Affect Perception and Cognition? KENNETH R. PAAP, MARK D. DAVIS, SKYE L. PAZUCHANICS, & JOSHUA TOMPKINS, SARA A. NUEHRING, & MARINA ABALAKINA, *New Mexico State University*—Nisbett et al. (2001) concluded that culture influences the way we perceive and interpret the environment. Eastern cultures tend to be collectivist, emphasize interdependence between individuals, and lead to holistic perception and cognition. Western cultures tend to be individualistic, emphasize independence, and lead to analytic thought. The conclusion rests on an impressive array of experiments, but all involve a comparison between Eastern and Western participants. The obtained differences could be mediated by any systematic differences between societies, but the claim is made that the most important difference is the degree of collectivism versus individualism. Our research tests this hypothesis by determining whether the degree of field dependence in a rod-and-frame task can be predicted from measures of collectivism and individualism obtained from more than 100 participants. The measures include standard instruments (Gaines, 1997; Singeles, 1994; "I am . . .") and a new speeded RT task that is less open to demand characteristics.

Metamemory
Chouteau, Friday Morning, 10:20–12:00

Chaired by Douglas Herrmann, Indiana State University

10:20–10:40 (164)

Dissociation Between Cognitive Process and Subjective Experience: Effects of the Anxiolytic Drug Lorazepam on TOT States. ELISABETH BACON, *INSERM, Strasbourg,* LAURENCE PAIRE-FICOUT, *INRETS, Lyon,* & MARIE IZAUTE, *CNRS, Clermont-Ferrand*—Tip-of-the-tongue (TOT) states may be viewed as temporary and reversible "microamnesia." We investigated the effects of Lorazepam (LZ) on TOT states. With general information questions, LZ subjects provided more commission errors and more TOTs following commissions than did placebo subjects, whereas the amount of TOTs recorded after omissions was unimpaired, as was the resolution of the TOTs. The higher amount of incorrect recalls provided by LZ subjects may partially result from the fact that they were more frequently in a state of transitory inaccessibility of a known item, experimentally identifiable as a commission TOT: Subjects provide a persistent alternate and feel the TOT phenomenology only after having been informed of their error. This peculiar way of resolving the TOT conflict is discussed in the light of the anxiolytic effect of the drug. Furthermore, LZ led the subjects to generate more TOT persistent alternates while keeping the recognition ability intact.

10:45–11:00 (165)

Resolving Memory Blocks. STEVEN M. SMITH, HYUN CHOI, DAVID R. GERKENS, & RACHEL G. HULL, *Texas A&M University*—Tip-of-the-tongue (TOT) states can be caused by several factors related to memory and metamemory. Experiments consistent with the notion that some TOTs can be caused by memory blocks will be reported. Factors that affect TOTs and their resolution were examined, including incubation periods, serendipitous clues, and sensitization to initial mem-

ory failures. The efficacy of three hypotheses—memory blocking, partial trace activation, and metacognitive control hypotheses—was tested. Evidence consistent with the memory blocking hypothesis was found.

11:05–11:20 (166)

Metamemory and Cued Recall. PHILIP A. HIGHAM, *University of Southampton*—Thomson and Tulving (1970) demonstrated that, after studying weak associate pairs (*bats*–BLOOD), participants better remember the targets (BLOOD) if old, weak cues are provided at test (*bats*–?) than if new, strong cues are used (*donor*–?). However, using Type 2 signal detection theory, Higham (2002) demonstrated that this effect is dependent on memory monitoring; if participants respond to all cues at test, rather than having the option to withhold responses (as in Tulving and Thomson), weak and strong cue performance is equivalent. However, Higham did not address whether these newfound, forced-report memories to the strong cues were "lucky guesses" or productions due to having studied the targets. The present research addresses the nature of participants' productions in both free and forced reports. Experiments are reported that examine inclusion/exclusion performance, elderly participant performance, the effect of test delay, and normative production probabilities. The results are interpreted in terms of retrieval, monitoring, and report bias.

11:25–11:35 (167)

Locus of the Wishful Thinking Effect in Source Monitoring. RUTH-ANNA GORDON & NANCY FRANKLIN, *SUNY, Stony Brook* (read by Nancy Franklin)—When making source attributions, people tend to misattribute desirable predictions to reliable sources and undesirable predictions to unreliable sources. We have dubbed this the *wishful thinking effect*. In the present experiment, we examined whether this effect occurs at encoding or retrieval. Participants read predictions from reliable and unreliable sources. In the encoding condition, they first received additional information that made each prediction desirable or undesirable. In the retrieval condition, all information was effectively neutral at the time of encoding; participants did not receive biasing information until after they read the entire series of predictions. A subsequent source-monitoring test produced wishful thinking effects only when desirability had been instantiated at encoding. This suggests that in order for the effect to occur, people must be invested in a prediction at the time they learn about it.

11:40–11:55 (168)

Priming and Social Category Word Recall. EVA D. FERGUSON & JOEL HAGAMAN, *Southern Illinois University, Edwardsville*—The present study compares the effects of immediate versus long-term primes on recall of social category words. Social categories in autocratic, democratic, and laissez-faire paragraphs were presented immediately prior to lists containing words from these categories as well as neutral words. This study used the same paragraphs and social category words as, but different neutral words than, did a prior study. The first, but not the second, study found that neutral words were significantly better recalled than social category words (Von Restorff effect) and that paragraphs significantly primed social category word recall. Attentional factors can explain the failure of paragraphs to prime social category words in the second study. Although paragraphs primed recall in only the first study, both studies found significant effects of parental background on social category word recall. Discussion focuses on the role of immediate versus long-term social category priming.

Categorization II
Empire, Friday Morning, 10:05–12:00

Chaired by Vladimir M. Sloutsky, Ohio State University

10:05–10:25 (169)

Contrasting Categories: Boundary Effects on Stimulus Estimation. JANELLEN HUTTENLOCHER & LARRY V. HEDGES, *University of Chicago*—It is well known that people's estimates of categorized stimuli are biased. We present a general rational model that holds that this bias arises from adaptive (Bayesian) processes. According to the model, prior category information is combined with inexactly represented stimuli, decreasing the variability of estimates and thus increasing their average accuracy. Our earlier work identified one Bayesian process—weighting an inexact value with a category prototype. Here we describe another process, not previously discussed as a basis for Bayesian estimation, in which category boundaries restrict estimates to the range of a category, decreasing variability by truncating stimulus estimates and thus increasing average accuracy. In our experiments, people estimated stimuli that varied in size, forming two sets distinguished by category cues. We found large biases in estimation that can be explained by truncation owing to boundaries of the categories used.

10:30–10:50 (170)

Rules as Frameworks to Support Perceptual Learning in Categorization. LEE R. BROOKS & SAMUEL HANNAH, *McMaster University*—We previously argued that explicit rules commonly function to name the objects of perceptual learning, rather than give sufficient identification conditions. In new experiments, we show that the particular perceptual manifestations of rule features in the learning stimuli are particularly effective in determining categorizations even though several features named in the rule, but with a novel appearance, support another category. These named and familiar features are also more effective than are familiar and equally predictive nonrule features. This effect of familiar manifestations occurs even when participants are given mini-theories about the importance of various informational features (the perceptual effect is not overridden by semantic interpretation). These perceptually specific effects are reasonable given that (1) familiar manifestations provide more information than do features that match a rule only on an informational level and (2) the "rules" given in medicine or invented by participants are normally unweighted feature lists without a decision rule.

10:55–11:15 (171)

The Categorization Problem That Airport X-Ray Screeners Face. J. DAVID SMITH & JOSHUA S. REDFORD, *SUNY, Buffalo*, & DAVID A. WASHBURN, *Georgia State University*—Baggage screening at airport security checkpoints is a categorization task in which X-ray operators must recognize instances of target categories amidst multiple, overlapping images. However, categorization research has generally presented single objects in the clear. Scant research has explored how categorization strategies and performance change under conditions such as those in baggage screening. Accordingly, in research sponsored by the Transportation Security Administration, we have built a categorization task—the screener task—that bridges this gap. We teach participants a small set of target categories and then have them search for variable tokens of these target types in displays that approach the complex of images that luggage presents. In one set of experiments, we explored participants' tendency to learn to recognize specific, familiar target tokens instead of applying generalizable category-level information to the situation. This tendency may have implications for training screeners and for evaluating their performance on line.

11:20–11:35 (172)

Category-Based Inferences for Cross-Categorized Items. BRIAN H. ROSS, *Beckman Institute, University of Illinois*, & ANDREA L. PATALANO, *Wesleyan University*—Categories provide a means of bringing relevant knowledge to bear when an inference about an item is made. Although most items belong to multiple categories, much of the category-based inference research has examined situations with a single category. The small amount of work including multiple categories has generally contrasted categories of very different types, such as taxonomic and script categories. We investigated reasoning about items belonging to multiple categories of the same type (social categories, such as occupations and hobbies) and the role of the internal coherence of the category on such reasoning. Category coherence had a large influence on

which category was selected for examination, how much each category influenced the inference, and how much each category affected generalizations to new items.

11:40–11:55 (173)
Conclusion Typicality Affects Category-Based Induction. JAMES A. HAMPTON & IBEN KEMPFF-ANDERSEN, *City University, London*— Category-based induction is the willingness to project some newly learned property of one category member to other members of the same category. Previous research has established that the perceived strength of arguments of the form "A has property P, therefore B has property P" is influenced by the similarity of A to B and by the typicality or representativeness of A in a shared category. There is, however, little evidence that the relation between B and the category is influential. We present two experiments that were designed to test whether the typicality of B also has an effect on inductive argument strength. Using a regression (Experiment 1) and an experimental (Experiment 2) design, we show an effect of conclusion typicality such that people are more willing to project properties to more typical conclusions. Our results are interpreted in terms of an associative model.

**Invited Symposium: Approaches To Cognitive Control
and the Central Executive
Atlanta, Friday Afternoon, 1:00–3:00**

Chaired by Randall W. Engle, Georgia Institute of Technology

1:00–1:25 (174)
A Pension Plan for the Homunculus? ALAN D. BADDELEY, *Bristol University*—It has been claimed that the central executive component of Baddeley and Hitch's model is simply a convenient homunculus. My talk will outline the functions of the homunculus that require explanation. I continue to use the Norman and Shallice distinction between control by automatic schemata and by an attentionally limited executive. Assumptions need to include a basic energy concept, such as arousal, together with a mechanism for motivating and controlling action that is capable of operating across a hierarchy of levels. Active control depends on conscious awareness, which in turn depends on the episodic buffer component of working memory.

1:30–1:55 (175)
Working-Memory Capacity as a Unitary Attentional Construct. MICHAEL KANE, *University of North Carolina, Greensboro*—Working memory (WM) span tasks reflect a domain-general attentional construct that is important to higher level cognition. In support of this argument, we first present data from experiments in which high- and low-WM subjects, defined by a verbal span task, differ in attention control across a variety of tasks requiring goal-directed responses that conflict with habit (dichotic listening, antisaccade, Stroop). We then present a large, structural-equation-modeling study demonstrating that, in contrast to measures of short-term memory span, verbal and spatial measures of WM capacity represent a unitary, domain-general construct that is closely related to fluid intelligence, verbal reasoning, and spatial visualization.

2:00–2:25 (176)
Toward Solutions to Unsolved Problems in the Computational Theory of Executive Cognitive Control and Multiple-Task Performance. DAVID E. MEYER, *University of Michigan*—A complete theory of cognitive control and multiple-task performance requires answering questions such as the following: (1) Why is task switching often so difficult and task overlapping sometimes so easy? (2) What are the enabling conditions for virtually perfect timesharing in multiple-task performance? (3) How does learning occur during the acquisition of skill in multitasking? (4) Why and how do people differ systematically in their multitasking skills? (5) Which other brain regions besides the prefrontal cortex contribute to executive cognitive control, and exactly what are their contributions? The executive-process interactive control (EPIC) architecture (Kieras & Meyer, 2000; Meyer & Kieras, 1999) provides possible answers.

2:30–2:55 (177)
The Nature of Representations in the Prefrontal Cortex. JONATHAN D. COHEN, *Princeton University*—Cognitive control is the ability to guide thought and action in accord with internally represented rules or goals. Several decades of research have made important strides in our understanding of this ability at the cognitive level. However, we still know relatively little about how these are implemented in the brain. This presentation will review recent efforts to define the neural mechanisms underlying cognitive control, focusing on the function of the prefrontal cortex. Connectionist models will be described that implement the hypothesized role of the prefrontal cortex—in particular its ability to acquire and use internal representations that mediate the capacity for cognitive control.

**Psycholinguistics II
New York, Friday Afternoon, 1:00–3:15**

Chaired by Gail Mauner, SUNY, Buffalo

1:00–1:15 (178)
Thematic Role Information in Parsing: Syntactic Automaticity Revisited. CHARLES CLIFTON, JR., *University of Massachusetts, Amherst,* MATTHEW J. TRAXLER, *University of South Carolina,* MOHAMED MOHAMED, *University of Massachusetts, Amherst,* RIHANA S. WILLIAMS & ROBIN K. MORRIS, *University of South Carolina,* & KEITH RAYNER, *University of Massachusetts, Amherst*—Sentences containing a reduced relative clause ("The man paid by the parents was unreasonable") are often difficult to comprehend. Early experiments indicated that this difficulty remained when the initial noun was replaced by an inanimate noun ("ransom"); later experiments, with better-controlled materials, indicated that the difficulty disappeared. This latter finding has been taken as evidence for interactive use of semantic and syntactic information. The present eye-tracking experiments used well-controlled materials and varied (1) parafoveal visibility (preview) of the disambiguating "by the" phrase and (2) participant reading span. Evidence was obtained for substantial reading disruption even with inanimate initial nouns, regardless of parafoveal preview or reading span. The animacy of the initial noun and participant span primarily affected later stages of comprehension. The full pattern of data is most consistent with a depth-first serial account of parsing in which noun phrase inanimacy facilitates sentence interpretation, not initial parsing decisions.

1:20–1:40 (179)
Lexical Biases and Discourse Constraints in Language Production and Comprehension. AMIT ALMOR, *University of Southern California,* MARYELLEN C. MacDONALD, *University of Wisconsin, Madison,* ELAINE S. ANDERSEN, *University of Southern California,* DANIEL K. KEMPLER, *Emerson College,* & HOURI HINTIRIAN & UNJA HAYES, *University of Southern California*—We report the results from several experiments that examined lexical biases and discourse constraints in language production and comprehension. Lexical constraints were manipulated by employing verbs that varied in their bias to appear in specific syntactic constructions (e.g., passive vs. active). Discourse constraints similarly rendered some constructions preferable to others. To better understand the effect of lexical and discourse constraints, we tested participants from three populations: (1) young healthy participants whose lexical knowledge was intact and who had sufficient processing resources, (2) elderly healthy subjects, whose lexical knowledge was also intact but who had more limited processing resources, and (3) Alzheimer's patients whose lexical knowledge was impaired and whose processing resources were seriously limited. The results show an interesting interdependence between lexical biases and discourse constraints that is modulated by the availability of processing resources. This supports an interactive model of both language production and language comprehension.

1:45–2:00 (180)
Use of Prosody and Optional Words to Disambiguate Utterances. TANYA KRALJIC & SUSAN E. BRENNAN, *SUNY, Stony Brook* (read by Susan E. Brennan)—Evidence is mixed on whether speakers spontaneously use prosodic cues to resolve syntactic and situational ambiguity. We had speaker–addressee pairs sit side by side before an array of objects; the speakers viewed pictures showing which objects to move, as well as which objects to mention. From this pictorial guide, speakers directed addressees to move objects (e.g., "Put the dog <that's> in the basket on the star"). Half the trials had potential for

syntactic ambiguity ("in the basket" could be interpreted as a modifier or a goal if speakers did not insert the optional word "that's"). In addition, half the trials with potential syntactic ambiguity also presented situational ambiguity (objects included a dog in a basket, another basket on a star, and another star). Consistent with Schafer, Speer, Warren, and White (2000), speakers produced disambiguating cues when there was syntactic ambiguity, with less heed for situational ambiguity. Addressees appeared to use these cues.

2:05–2:20 (181)
Noun Phrase Interference in Sentence Processing. PETER C. GORDON & RANDALL HENDRICK, *University of North Carolina, Chapel Hill*—Sentence processing involves integrating the meanings conveyed by various constituents according to syntactically specified relations; most centrally, this involves using noun phrases (NPs) to determine the arguments of predicates conveyed by verbs. Performing this integration requires that the representations derived from the NPs be kept distinct, so that they can be integrated in the appropriate way. The present work uses eye tracking during reading to examine whether interference due to similar NPs affects the integration of meaning in simple sentences. We varied whether the subject NP and first object NP in double-object sentences were descriptions or names. The combinations of these NP types yielded matched sentences (name–name and description–description) and nonmatched sentences (name–description and description–name). Elevated gaze durations were found on critical words when the NPs were of matched type, as compared with when they were of nonmatched type, showing that similarity-based interference occurs in understanding simple sentences.

2:25–2:45 (182)
Down the Garden Path and Back Again: The Effects of Age and Working Memory on Eye Fixations. SUSAN KEMPER, *University of Kansas,* KAREN KEMTES, *University of Nevada, Las Vegas,* & ANGELA CROW, *University of Kansas*—Eye movements of young and older adults differing in working memory (WM) span were monitored while they read sentences containing temporary ambiguities (*The staff served in the cafeteria decided to attend*). First-pass fixation times, regressions, and total fixation times were examined for critical regions of the sentences. Both high- and low-span readers allocated additional processing time to the disambiguating second verb (e.g., *decided*); high-span readers resolved the ambiguity quickly, whereas low-span readers made many regressions to the subject noun phrase, resulting in an increase in total fixation times. High-span readers responded to probe questions (*Who served in the cafeteria?*) correctly, whereas low-span readers often responded incorrectly (e.g., answering "the staff"). High-span readers were also able to take advantage of the focus operator *only* (*Only staff served in the cafeteria . . .*), reducing first-pass fixation times. Age differences, after controlling for WM span, were minimal.

2:50–3:10 (183)
Interpretation-Based Processing: A Theory of Sentence Processing. RALUCA BUDIU & JOHN R. ANDERSON, *Carnegie Mellon University* (read by John R. Anderson)—We present interpretation-based processing—a model of sentence processing that performs real-time comprehension and goes from the parsing of words to the interpretation of a sentence. The model builds a syntactic and semantic representation for a sentence and relates it to discourse or background knowledge. Connecting with prior knowledge involves finding a known fact (called *interpretation*) that overlaps most with that sentence. The model is incremental: It builds the representations and tries to find an interpretation as it "reads" the words in the sentence (i.e., before reaching the end of the sentence). Fast comprehension is achieved through imperfect semantic processing and minimal inferences. The model offers a unified account of comprehension of literal sentences, metaphoric sentences, and sentences containing semantic illusions. We present the behavior of the model on two representative datasets—Gerrig and Healy (1983), concerning metaphors, and Ayers, Reder, and Anderson (1996), concerning semantic illusions.

Auditory and Speech Perception
Chicago A, Friday Afternoon, 1:00 - 3:00

Chaired by Joan A. Sereno, University of Kansas

1:00-1:10 (184)
Possible Role of Recognition Masking in Higher Level Auditory Perceptual Processes. RICHARD E. PASTORE, JEREMY GASTON, & MELODY S. BERENS, *Binghamton University*—Recognition masking, interference in the identification of a clearly detected stimulus, is fundamentally different from simple (detection) masking and is probably more relevant to speech and other types of cognitive processes. Past recognition-masking research, using minimally discriminable target stimuli, has found an absence of forward recognition masking, but significant backward recognition masking even for maskers delays of 100 msec or more. The present research measures recognition thresholds for large differences in pitch and in direction of pitch change under possible forward- and backward-masking conditions. The results demonstrate the magnitude of backward-recognition-masking effects and replicate the absence of forward-masking effects. The results are also show to predict differences in boundaries for speech consonant categories in CV and VC syllables, where the vowel may serve as the potential masking stimulus. Implications for other types of higher level organization are also discussed.

1:15–1:25 (185)
The Seashore Test Materials as Psychophysical Stimuli: Group Thresholds and Evidence of Effective Discrimination for Small Differences in Loudness and Pitch. JAN BERKHOUT, *University of South Dakota*—The Seashore test battery, including the loudness, pitch, rhythm, and tonal memory subtests, were administered to 640 students enrolled in the USD psychoacoustics course over a period of 23 years. The group JND for loudness was 1 dB, with evidence of some discriminant ability at 1/2 dB. The JND for pitch was 500 Hz ±2 Hz, based on the Seashore administration protocol, at a level of 78 dB. Neither loudness nor pitch discriminant ability was correlated with the rhythms or tonal memory subtest scores or any other aspects of musical skill or experience. Rhythm and tonal memory scores did reflect musical experience, but not necessarily talent or skill.

1:30–1:45 (186)
On the Contribution of Simple and Complex Sensitivity to Perceptual Organization of Speech. ROBERT E. REMEZ, STEPHANIE WISSIG, & CYNTHIA Y. YANG, *Barnard College*—The perceptual ability to find and to follow the nonstationary acoustic signal of speech has two aspects. First, perceivers are able directly to resolve the pattern of spectrotemporal variation unique to speech and to do this independently of the fine-grain constituents of the pattern. Second, perceivers are aided in organization by momentary satisfaction of the simple grouping principles of auditory scene analysis among the fine-grain signal constituents. Our study examines the evidence that comodulation among signal constituents fosters perceptual organization of a speech signal. In tests of auditory word recognition and sentence perception, we contrasted pastiche signals composed of sinusoids and resonances with signals of a uniform acoustic type. The results allow a precise measure of the relative contributions of simple and complex sensitivity in the perceptual organization of speech.

1:50–2:05 (187)
Hearing What You Can't Categorize: Evidence From Electrophysiology That the Ear Hears What the Mind Doesn't. CHERYL A. FRENCK-MESTRE, CHRISTINE MEUNIER, TAISSIA LELEKOV-BOISSARD, & ROBERT ESPESSER, *University of Provence,* & PHILIP J. HOLCOMB, *Tufts University*—The age-old adage is that we "lose the ability to perceive foreign linguistic sounds very early in life." This is sometimes true if it pertains to the ability to cognitively categorize stimuli. However, the electrophysiological responses of French listeners, obtained in a monitoring task [subjects were to mon-

itor the vowel /æ/ (extracted from *had*), placed in a continuous stream of 82% /ɪ/ (extracted from *hid*) and 15% /ɛ/ (extracted from *head*)], clearly show that French listeners can perceive a nonnative contrast (/ɪ/ vs. /ɛ/) despite their behavioral response to classify the two vowels within the same phonetic category in their native language. Moreover, the size of the MMN response appears to reflect the "size" of the acoustic difference (cf. also Näätänen et al., 1997). Lastly, the ERP responses we obtained clearly distinguish between *automatic auditory* responses (reflected in an early MMN response) and *late, cognitive* responses (reflected by a P300 response).

2:10–2:30 (188)
A McGurk Aftereffect: Incongruent Visual Speech Recalibrates Auditory Speech Identification. PAUL BERTELSON, *Université Libre de Bruxelles,* & JEAN VROOMEN & BEATRICE DE GELDER, *Tilburg University*—Exposure to spatially incongruent auditory and visual inputs produces both immediate crossmodal biases and aftereffects. But for event identification, rather than localization, only biases have been demonstrated so far. Taking the case of incongruent audiovisual speech, which produces the well-known McGurk bias effect, we show that, contrary to earlier reports (e.g., Roberts & Summerfield, 1981), aftereffects can be obtained. Exposure to an ambivalent auditory token from an /aba–ada/ continuum combined with the visual presentation of a face articulating /aba/ (or /ada/) increased the tendency to interpret test auditory tokens as /aba/ (or /ada/). The earlier results that were taken as disproving the possibility of visual recalibration of auditory speech identification were obtained with exposure to nonambiguous auditory tokens that (as we confirm in another experiment) created an auditory *contrast* effect in a direction opposite that of recalibration and, presumably, masked the effect of recalibration.

2:35–2:55 (189)
Informational Similitude Across Auditory and Visual Speech. LAWRENCE D. ROSENBLUM & NICOLAS M. SMITH, *University of California, Riverside*—Research will be discussed showing important similarities between visual and auditory speech information. First, both types of information seem best conveyed by the time-varying dimensions of the signals. Isolated dynamic dimensions of auditory and visual signals, as contained in sinewave and point-light stimuli, maintain rich speech information. Moreover, for both signals, vowel information can be conveyed more effectively in the dynamic, coarticulated portions of the signal. For these demonstrations, "blank-center" visual CVC syllables, analogous to auditory silent-center syllables, are shown to be as easily identified as intact syllables. A second way in which auditory and visual speech informational forms are similar is in their link to speaker-specific properties. For both modalities, speaker information can facilitate phonetic perception, and isolated phonetic information can inform about speaker identity. Implications of informational similitude for modality-neutral descriptions of the speech signal will be discussed.

Focal Attention
Chicago BC, Friday Afternoon, 1:00–3:10

Chaired by Edward Awh, University of Oregon

1:00–1:15 (190)
The Paradox of Selection: Antagonism Between the Selection and the Integration of Information. ROBERT D. MELARA, *Purdue University,* & DANIEL ALGOM, *Tel Aviv University*—The goal of ignoring distraction in selective attention tasks is opposed intrinsically by the human proclivity to integrate new and changing information. This is the paradox of selection. Whether selective attention succeeds or fails in a given situation depends on whether our conscious bids to dissociate targeted from irrelevant information can overcome our persistent, nonconscious tendency to associate the diversity of information available. To resolve the paradox, we propose a tectonic theory of selection in which two memory-based processing structures continually

disrupt efforts to differentially activate target from distractor representations. The theory is used to explain a range of task and congruity effects in the Stroop paradigm, including Garner interference and the effects of dimensional salience and dimensional correlation.

1:20–1:40 (191)
Stroop Interference Resolution and "Negative" Priming: A Time Course and Individual Differences Analysis. EWALD NEUMANN, *University of Canterbury,* & CARMI SCHOOLER, LESLIE J. CAPLAN, & BRUCE R. ROBERTS, *National Institute of Mental Health* (read by Carmi Schooler)—Negative priming tasks consisting of prime–probe couplets were used to investigate the basis of Stroop interference resolution. Participants named the ink color of a rectangular blob and ignored irrelevant white distractor stimuli (e.g., blue or iiiii in white ink). In prime displays, a range of SOAs was used such that the distractor item preceded, followed, or appeared simultaneously with the target color blob. In probe displays, the target and nontarget dimensions always appeared simultaneously. Congruent, neutral, and incongruent Stroop stimuli were used in equal proportions in Experiments 1 and 2. Surprisingly, instead of negative priming, the ignored repetition condition produced facilitatory (positive) priming at every SOA. In Experiment 3, the congruent Stroop stimuli were removed, and both younger and older adults were tested. As was anticipated, significant negative priming was produced by both groups. Implications regarding the inducement of different modes of attentional processing (diffuse vs. focused) are discussed.

1:45–2:00 (192)
Focal Attention and Illusory Conjunctions in the Time Domain. JUAN BOTELLA, MANUEL SUERO, & ISABEL C. AREND, *Universidad Autonoma de Madrid*—In the model proposed by Botella, Barriopedro, and Suero (2001) for the formation of illusory conjunctions in the time domain, there are two predictions for which there is no specific empirical support. The first one is that in a double-target paradigm, such as that of the attentional blink, the interference from T1 on T2 should show a slower time course when the response to the first target is an error (an illusory conjunction) than when it is a hit. This means that Lag 1 sparing is larger, but performance recovers later, when the response to T1 is an error. The second one is that when the attentional resources are reduced, performance should be impaired but the distribution of errors according to their origin in the series should be the same. We present new experiments designed to test those predictions. Results support both.

2:05–2:15 (193)
Evidence for Illusory Conjunctions From Semantic Priming With Color Confidence Judgments. VERONICA J. DARK, *Iowa State University*—Last year, I described an experiment in which 100-msec masked word pairs were presented 300 msec after a *prime* that was related to one word. One word was red, and one was green; color defined the target. Instructions were to try to report the target but to report any word that was seen, labeling the foils as such. Related foils were reported at a high rate without being labeled as foils, suggesting *illusory conjunctions* in which related foils were misperceived in the target color. However, because "target" was the default label, such misperceptions may have been overestimated. In the present experiment, participants gave color confidence judgments for every word reported. As was expected, more targets were identified than foils and more related words than unrelated. More color judgment errors occurred with related foils than with related targets. Although less dramatic than before, the pattern of errors provides evidence for priming-related illusory conjunctions.

2:20–2:40 (194)
The Spatial and Temporal Distribution of Attention Following an Initial Visual Event. ARTHUR G. SAMUEL & DONNA KAT, *SUNY, Stony Brook*—After a visual event, there is an initial period of facilitated processing at the event's location, followed by an inhibitory effect (*in-*

hibition of return). We have conducted a series of experiments that examine the spatial and temporal properties of the facilitation and inhibition. We will discuss three main findings. (1) There is a surprisingly long-lasting (at least 1,400 msec) facilitation effect that is object based, rather than location based. (2) Inhibition of return dissipates in about 3–4 sec. (3) For approximately 1 sec, the inhibition is spatially graded, decreasing as a function of distance from the initial event; for the final 2–3 sec of inhibition, the effect does not vary with distance. Any mechanisms that are proposed to account for the facilitatory and inhibitory effects must be consistent with the spatiotemporal patterns we have observed.

2:45–3:05 (195)

Attention Speeds Information Processing More at Less Privileged Locations. MARISA CARRASCO, ANNA MARIE GIORDANO, & BRIAN McELREE, *New York University*—Transient covert attention improves discriminability and accelerates the rate of information processing in visual search (Carrasco & McElree, 2001). Contrast sensitivity and spatial resolution are better along the horizontal than along the vertical meridian, and covert attention improves discriminability at all locations to a similar degree (Carrasco et al., 2001; Talgar & Carrasco, in press). With a response signal speed–accuracy tradeoff variant of an orientation feature discrimination task, we investigated whether (1) the rate of information processing differs for different locations at a fixed eccentricity and (2) the effect of transient covert attention on the dynamics varies as a function of location. Results indicate that performance is superior on the horizontal than on the vertical meridian because discriminability is higher and temporal dynamics are faster. Interestingly, whereas covert attention affects discriminability to a similar extent across the visual field, it speeds up information processing more at the least privileged locations—that is, on the vertical meridian.

Working Memory
Chouteau, Friday Afternoon, 1:00–3:15

Chaired by James S. Nairne, Purdue University

1:00–1:20 (196)

Strategic Learning and the Control of Memory. SUZANNA BECKER & CHRIS GILBERT, *McMaster University*—We present a computational model of the role of the prefrontal cortex in controlled memory use. The model self-organizes its own mnemonic codes, using internally derived performance measures. These mnemonic codes serve as retrieval cues by biasing retrieval in the medial temporal lobe memory system. We present data from several sets of simulations with the model and two experiments with human subjects that investigated strategic encoding and retrieval in the free recall of categorized lists of words. The results of the model are compared with results in the literature for frontally intact and frontally lesioned individuals, as well as for normal, healthy individuals under conditions of divided attention. In addition, we test two key predictions of the model in our own experiments. Overall, our model captures a number of aspects of human performance on free recall tasks. Shortcomings of the model are also discussed.

1:25–1:45 (197)

Presentation Format and Its Effect on Working Memory. PAULA GOOLKASIAN & PAUL W. FOOS, *University of North Carolina, Charlotte*—Three experiments examined the separate cognitive demands of processing and storage in working memory and looked at how effective the coordination was when items for storage varied in format/modality. A sentence verification task involving arithmetic facts was combined with a span task involving two to six items presented in picture, printed word, or spoken word format. The first two experiments were the same, except for the added requirement of articulation of the math sentence in Experiment 2. Experiment 3 varied length of the span item and compared recall with recognition performance. Results show that both spoken words and pictures produce superior

recall and recognition, as compared with printed words, and are consistent with Baddeley and Logie's (1999) and Mayer's (2001) models of working memory. Also, the differences in processing performance across span support the resource allocation model (Foos, 1995).

1:50–2:05 (198)

Auditory and Visual Memory Span in Younger and Older Adults. KAREN A. KEMTES, *University of Nevada, Las Vegas*—The auditory superiority of short-term recall is relatively well documented for simple word lists. It has not been established for more complex working memory measures, such as the reading and listening sentence spans. Furthermore, modality of presentation may differentially impact individuals who experience auditory or visual sensory declines with age. In this study, visual and auditory versions of short-term and working memory tasks were compared: the forward digit span (FDS), the backward digit span (BDS), and the sentence span (SS). Overall, both age groups exhibited superior recall in the auditory FDS, but only older adults exhibited superiority in the auditory BDS. For the SS measure, span level and total words recalled were superior in the visual modality. These effects were independent of visual and auditory acuity. The superiority effect is not consistent intraindividually or interindividually. The effect differs by span task, by age group, by span level, and by individual.

2:10–2:25 (199)

Working Memory Constraints in Sequence Production: Speech and Music. CAROLINE PALMER & ZACHARY A. SCHENDEL, *Ohio State University*—How does working memory constrain temporally structured production tasks? We test the span over which speakers and musicians can plan elements of a sentence or melody during production. Participants memorized short sequences of nonsense syllables (Experiment 1) or melodies (Experiment 2) and produced them at different rates indicated by a metronome. Serial-ordering errors produced in both experiments indicated similarity-based confusions consistent with a metrical hierarchy of strong and weak beats, and the span between interacting elements was influenced by production rate. A two-component model of planning that incorporates metrical similarity and working memory constraints was fitted to the error data; the model's memory parameter values for the error spans of each producer correlated positively with individual digit span measures. Working memory constraints limited the span of sequence elements that speakers and musicians could prepare.

2:30–2:50 (200)

Dissociating Short- and Long-Term Recency. MARIUS USHER & EDDY J. DAVELAAR, *University of London,* & HENK J. HAARMANN, *University of Maryland*—We contrast activation- (or buffer-) based accounts with scale invariant temporal discriminability based accounts for recency in free recall (FR). These two accounts are distinguished in terms of two predictions. First, a dissociation is predicted between short- and long-term recency (contrasting performance in immediate FR and the continuous distractor task, CD), as a result of a semantic manipulation (with pairs of associates) in terms of a zigzag pattern at recency in FR, but in the CD. Second, the activation-based (but not the discriminability) theory predicts a shift from recency to primacy with an increase in the presentation rate in immediate recall. Both predictions are confirmed in a set of experiments. The results suggest that an activation-based mechanism is likely to contribute to the performance in memory tasks on top of the contributions that originate from retrieval mechanisms based on temporal discriminability.

2:55–3:10 (201)

The Role of Working Memory in Analogical Reasoning. ROBERT G. MORRISON, KEITH J. HOLYOAK, ARDEN A. ASH, & ERIK J. ERICKSON, *UCLA* (read by Keith J. Holyoak)—Is it possible to distinguish the roles of different components of working memory (central executive, phonological loop, and visuospatial sketchpad) in analogical reasoning? We present several experiments that used a dual-task methodology to address this question. College students solved verbal, figural, or

picture analogy problems alone or while performing a variety of dual tasks designed to tax specific modules of working memory. The pattern of interference effects indicated the involvement of a domain-general central executive, as well as of slave systems (phonological loop and/or visuospatial sketchpad) consistent with the modality of the reasoning task.

Processing of Objects, Scenes, and Faces
Empire, Friday Afternoon, 1:00–3:05

Chaired by Timothy P. McNamara, Vanderbilt University

1:00–1:15 (202)
Representing Occluded Objects in Scenes: Are All Occluding Edges Equal? HELENE INTRAUB, MICHELLE AKERS, & MELISSA FIORITO, *University of Delaware*—Viewers remember having seen the region just outside a photograph's borders (boundary extension). Is this extrapolation specific to view boundaries (thus supporting integration of successive views) or does it occur whenever occlusion is present? Two experiments contrasted immediate memory for objects that were occluded by a scene border or by another object in the scene. Twelve multiobject scenes (digital photographs) were individually tested. Each one was studied for 10 sec followed by a mask (500 msec, 1 sec, or 10 sec), and then reappeared. Subjects adjusted placement of objects and scene borders, using a mouse (multiple graphics layers allowed for placement behind or in front of other objects or borders). Although the identical object fragment was always visible, occlusion by view border resulted in object extrapolation, whereas occlusion by another object did not. Results replicated even when view borders were composed of occluding objects. Implications for theories of scene representation will be discussed.

1:20–1:30 (203)
Development of Animal Recognition: Features or Wholes. JULES DAVIDOFF, *University of London,* & DEBI ROBERSON, *University of Essex*—A series of three experiments examined children's recognition of animals by their features (parts) and by the relative scale of the parts (wholes). They were asked to identify the correct picture of an animal they could name from the original plus two computer-generated alternatives. We examined the developmental trends associated with upright (Experiments 1 and 3) and inverted (Experiment 3) presentations. Experiment 2 ruled out potential artifacts concerned with discriminability of stimuli. The experiments confirmed children's superior ability in dealing with the recognition of animal parts over animal wholes, especially for the younger ages tested (6- and 10-year-olds). It was not until the surprisingly late age of 15–16 that children demonstrated equal performance on whole and part items. The late acquisition of whole animal recognition is compared with the late-acquired configural skills proposed for face recognition.

1:35–1:50 (204)
Gesturing and Naming: Analysis of Functional Knowledge in Object Identification. DANIEL N. BUB, MICHAEL E. J. MASSON, & CINDY M. BUKACH, *University of Victoria* (read by Michael E. J. Masson)—Studies using functional imaging show reliable activation of the premotor cortex when observers view manipulable objects. This result has led to the view that knowledge of object function is represented as physical actions. It is believed that this gestural knowledge, corresponding to the function of an object, plays a causal role in identification. This argument, however, is based entirely on correlational evidence. To obtain relevant evidence regarding a causal role for gestural knowledge in object identification, subjects learned gesture–color associations and then attempted to identify objects presented in a color denoting a gesture that was congruent or incongruent with the object's use. A strong congruency effect was observed when subjects gestured the use of an object, but not when they named an object. We conclude that our procedure constitutes a sensitive measure of the recruitment and causal role of gestural knowledge and that this recruitment is not present when objects are named.

1:55–2:10 (205)
Recognition of Moving Faces: A Psychological and Neural Synthesis. ALICE J. O'TOOLE, DANA A. ROARK, & HERVE ABDI, *University of Texas, Dallas*—We propose a neural and psychological framework for understanding the effects of facial motion on memory for faces. Information for identifying a human face can be found both in the invariant structure of features and in idiosyncratic movements and gestures. The available psychological evidence indicates that when both kinds of information are available, (1) dynamic information contributes more to recognition under nonoptimal viewing conditions, (e.g., poor illumination, low image resolution, recognition from a distance), (2) dynamic information contributes more as a viewer's experience with the face increases, and (3) a structure-from-motion analysis can make a perceptually based contribution to face recognition. These findings can be accommodated in the neural framework proposed recently by Haxby et al. (2000), which suggests a primary role for the superior temporal sulcus in processing the social information in moving faces and for the fusiform face area in identifying faces from static features.

2:15–2:35 (206)
Holistic Face Processing, Ecphory, and Conjunction Errors in Face Recognition. JAMES C. BARTLETT, MARSHA NEVILLE-SMITH, & HERVE ABDI, *University of Texas, Dallas*—A new face composed of old features is often recognized as *old.* Although such *conjunction errors* have been attributed to feature-based processing, new behavioral evidence and a computer simulation suggest an interpretation that links the ecphory and conversion components of Tulving's (1983) GAPS model to the functioning of an autoassociative neural net. The neural net employs a low-level visual code that is holistic in the sense that neither facial features nor spatial relations (configurations) are explicitly represented. We suggest that configural and featural processing operate on ecphoric information (the product of ecphory) and are linked to the experience of conscious recollection that a face, or a feature, has been seen before.

2:40–3:00 (207)
A Neurocomputational Theory of Perceptual and Cognitive Pleasure. IRVING BIEDERMAN & EDWARD A. VESSEL, *University of Southern California,* & MARK S. COHEN, DAVID C. GLAHN, & RICHARD M. ALBISTEGUI-DUBOIS, *UCLA*—People prefer some perceptual inputs to others, an effect readily manifested in visual fixations during free viewing. This preference may be based on the activity of five-opiate receptors that, surprisingly, are found in the ventral cortical pathway for visual recognition. Novel but interpretable perceptual inputs would lead initially to the most neural—and hence opiate—activity in the anterior regions of the ventral pathway, where the receptors are most dense. Repetition of a scene would result in less activity because of competitive interactions. The magnitude of the endomorphin (the effective ligand) activity would subserve preference, resulting in a preference for patterns that are both novel and richly interpretable, because such patterns would initially activate many associations in memory. Ratings of scene preference and their decline with repetition reliably correlate with fMRI activity during passive 1-sec viewing of scenes. Nonpreferred scenes produce high activity in areas associated with attention.

Implicit Memory
Atlanta, Friday Afternoon, 3:15–5:25

Chaired by Geoffrey R. Loftus, University of Washington

3:15–3:30 (208)
The Effect of Midazolam on Performance in the Exclusion and Inclusion Tasks. ELLIOT HIRSHMAN, *George Washington University,* JULIA FISHER, *University of Colorado, Denver,* THOMAS HENTHORN, *University of Colorado Health Sciences Center,* JASON ARNDT, *Middlebury College,* & ANTHONY PASSANNANTE, *University of North Carolina*—Prior research has demonstrated that

midazolam produces anterograde amnesia on explicit memory tasks but has limited effects on conceptual implicit memory tasks. The present research examines the effect of midazolam on priming in free association following inclusion and exclusion instructions (i.e., the process-dissociation procedure). On the basis of the assumption that explicit memory produces opposing effects on the inclusion and exclusion tasks, we hypothesized that midazolam amnesia would increase the generation of target items in the exclusion task and reduce the generation of target items in the inclusion task. Our results demonstrated that midazolam increased the generation of target items to baseline levels in the exclusion task, while permitting substantial residual priming in the inclusion task. These results are consistent with the hypothesis that midazolam has greater effects on explicit than on implicit memory and suggest how midazolam can be used in the process-dissociation procedure to explore the characteristics of implicit memory.

3:35–3:50 (209)

The Importance of False Alarm Data in Testing Models of the Process-Dissociation Recognition Paradigm. FRANCIS S. BELLEZZA, *Ohio University*—The process-dissociation model of recognition (Jacoby, 1991) assumes that the proportion of false alarms in tests of inclusion and exclusion are the same. But the two-high-threshold source-monitoring model (Bayen, Murnane, & Erdfelder, 1996; Yu & Bellezza, 2000), assumes that the false alarm rates are different. An experiment is described that attempted to make the false alarm rates comparable in value in the two tests by using the phenomenon of probability matching. Nevertheless, the resulting proportions of false alarms were unequal. Consequently, the two-high-threshold source-monitoring model fit the data, and the process-dissociation model did not. Using the procedures described by Erdfelder and Buchner (1998), it was also shown that the dual-process signal-detection model of Yonelinas (1994) could not fit the data. It is suggested that process-dissociation models incorporating two familiarity parameters, F_i and F_e (Yu & Bellezza, 2000), may be of value.

3:55–4:10 (210)

Explicit and Implicit Measures of Repetition Blindness. CATHERINE L. HARRIS, *Boston University,* ALISON L. MORRIS, *Iowa State University,* & AYSE AYCICEGI, *Istanbul University*—When words containing repeated letters are briefly, sequentially displayed (e.g., WINDOW *index*), the second word is poorly recalled, relative to a control sequence (e.g., BRIGHT *index*), a phenomenon known as repetition blindness (RB). Three experiments found that words with repeated letters show RB in serial report, but not in word stem completion. However, when the word stem had to be completed using a word from the just-presented list (*inclusion* condition), strong RB emerged, indicating that the word was not accessible to explicit recall. When the word stem had to be completed using a word not on the list (*exclusion* condition), RB was eliminated, suggesting that participants avoided both episodically remembered and merely familiar words. The finding that words suppressed by RB are accessible to implicit measures supports Kanwisher's original proposal that word types are identified but not given an episodic instantiation.

4:15–4:35 (211)

Decomposition of Priming Components in Picture Naming and Translation. WENDY S. FRANCIS, NUVIA I. CORRAL, JOSÉ C. ARZATE, GENOVEVA LUÉVANO, MARY L. JONES, & PILAR REGALADO, *University of Texas, El Paso*—The cognitive mechanisms underlying repetition priming were examined in a series of experiments meant to decompose the components of repetition priming that lead to decreased response times in picture naming and translation, using selective influence and additive factors methodology. Following a literal transfer-appropriate processing logic, the designs incorporated distinct sets of encoding conditions that would selectively facilitate either stimulus identification/comprehension processes or response selection/production processes. These manipulations were implemented by using bilingual materials and changing the exemplar pictured, the task,

or the response language from study to test. Across experiments, both positive and negative selective influences were applied and combined factorially. Data were collected from 250 Spanish–English bilinguals and 96 additional students (48 English speakers, 48 Spanish speakers). Selective influences on comprehension and production processes had linearly additive effects on response time, suggesting that these processes are independent and adequately described by a sequential model. Supported by NIH Grant MH61765.

4:40–4:55 (212)

Decision Processes in Remember–Know Judgments. CAREN M. ROTELLO, *University of Massachusetts, Amherst,* JOHN A. REEDER, *University of Wisconsin, Stevens Point,* NEIL A. MACMILLAN, *Brooklyn College, CUNY,* & MUNGCHEN WONG, *University of Massachusetts, Amherst*—Remembering and knowing are typically identified with separate recognition processes, such as recollection and familiarity. Such process-pure interpretations, however, ignore any bias to respond "remember" or "know" regardless of those processes. According to the two-dimensional signal detection model proposed by Rotello, Macmillan, and Reeder (2001), recognition probes are remembered when a weighted sum of their global and specific memory strength exceeds an old/new criterion and a weighted difference exceeds an independent remember/know criterion. Consistent with the model's predictions, two experiments demonstrated that instructions to respond either "old" or "remember" more conservatively had independent effects on the two criteria. In addition, receiver-operating characteristics illustrated how, under certain experimental conditions, a conservative remember/know criterion can produce rates of remembering that are consistent with a high-threshold decision process. Under more typical conditions, however, remembering could be attributed only to a continuous property of information in memory.

5:00–5:20 (213)

Divided Attention in Young Adults and Adult Age Differences in Episodic Memory: A Common Associative Deficit Mechanism? MOSHE NAVEH-BENJAMIN, *University of Missouri, Columbia, and Ben Gurion University of the Negev,* & JONATHAN GUEZ, *Ben Gurion University of the Negev*—This research attempts to determine whether there is a common mechanism underlying the adverse effects on episodic memory of the withdrawal of attention in young people and of aging. In particular, the issue studied is whether an associative deficit hypothesis, recently suggested to explain older adults' deficient episodic memory performance, can also explain memory performance of young people under divided attention, as a common-mechanism hypothesis would suggest. Several experiments, using different types of episodes and episodes components, will be reported, in which older adults, younger adults under full attention, and younger adults under divided attention studied information and then were tested on their memory for both the episodes' components and the associations between them.

Discourse Processes
New York, Friday Afternoon, 3:25–5:30

Chaired by Herbert H. Clark, Stanford University

3:25–3:40 (214)

Skipping Through Space: Updating the Unexpected in Situation Models. HOLLY A. TAYLOR, DAVID N. RAPP, & JESSICA L. KLUG, *Tufts University*—How do readers access information about a character's location? Previous research has reported changes in accessibility owing to reader focus. These effects indicate that the character's current physical or conceptual position and locations spatially proximal to that point are most accessible. However, these studies have assumed that characters move linearly through an environment. The present study compared the accessibility of information when characters moved linearly or nonlinearly through an environment. Linear movement involved characters, either walking or using a video surveillance system to move

sequentially through rooms. Nonlinear movement was achieved with the video system moving in a nonsequential order. Results suggest a change in accessibility pattern when linear movement is not assumed. The exploration method (walking vs. video) also influenced accessibility. These results suggest that reader expectations affect updating and access processes for situation models during narrative experiences.

3:45–4:05 (215)

Narrative Time Shifts Affect On-Line Working Memory Availability. NICOLE K. SPEER & JEFFREY M. ZACKS, *Washington University* (read by Jeffrey M. Zacks)—When a reader comprehends a narrative, there is reason to think that he or she builds a structured representation that parses the text into events or episodes. We hypothesized that this parsing would affect the availability of narrative information in working memory. To test this, we constructed narratives in which an object was named and then was later referred to by using different words (an anaphor). Intervening between the original mention and the later reference was either a time shift (an hour later) or a control phrase (a moment later), plus from zero to three filler sentences. Reading of anaphor sentences was affected by the presence of time shifts and filler sentences. These results extend previous findings from recognition memory to an on-line measure of information accessibility. We conclude that narrative structure building affects the contents of working memory, whether or not the reader expects those contents to be explicitly probed.

4:10–4:20 (216)

Agonistic Shift in Perspective in a Political TV Interview. DANIEL C. O'CONNELL & JENNIFER ALBER, *Loyola University of Chicago,* & SABINE KOWAL, *Technical University of Berlin*—Two interviews by Christiane Amanpour on CNN television, one with Ehud Barak and one with Yasser Arafat, were analyzed. Generally, the same indicators of personal perspective were found as in Suleiman, O'Connell, and Kowal (2002). Arafat's interview was extraordinarily agonistic, as manifested in his excessive use of first-person singular and second-person pronominals, hesitations, questions, and interruptions. In this interview, Amanpour moved toward a more personal perspective by speaking proportionally more and by using more first-person singular pronominals and hesitations but maintained a professional style in turn transitioning. Dialogical and agonistic aspects of perspective are discussed.

4:25–4:45 (217)

Effects of Presentation Format and Repetition on Following Navigation Instructions. VIVIAN I. SCHNEIDER & ALICE F. HEALY, *University of Colorado, Boulder,* & IMMANUEL BARSHI, *NASA Ames Research Center*—Subjects were shown navigation instructions varying in length, directing them to move in a space represented by grids on a computer screen. They followed the instructions by clicking on the grids in the locations specified. Some subjects repeated back the instructions before following them, whereas some did not, and others repeated back the instructions in reduced form, including only the critical words. The commands in each message were presented simultaneously for half of the subjects and sequentially for the others. For the longest messages, performance was better on the initial commands and worse on the final commands with simultaneous than with sequential presentation. Instruction repetition depressed performance, but reduced repetition removed this disadvantage. Effects of presentation format were attributed to visual scanning strategies. The advantage for reduced repetition was attributable either to enhanced visual scanning or to less output interference. A follow-up study with auditory presentation supported the visual scanning explanation.

4:50–5:05 (218)

Discourse Understanding in Readers With Autism. TIM WAHLBERG & JOSEPH P. MAGLIANO, *Northern Illinois University* (read by Joseph P. Magliano)—The following study assessed whether readers with autism are capable of drawing upon prior knowledge during reading. Readers with autism and matched normal readers read ambigu-

ous texts that described well-known historical events. The presence of an informative or noninformative title and the presence of primer texts that explicitly described the events were manipulated. After reading all of the ambiguous texts, they were told to recall as much as they could remember from them. Readers with autism did not show a benefit of the presence of a cue to background knowledge when recalling the ambiguous texts, as did readers without autism. Readers with autism were, however, able to take advantage of cues to background knowledge to activate and associate at some general level the events referenced in ambiguous texts. Their difficulty appeared to specifically involve an ability to use the activated knowledge to interpret the ambiguous text.

5:10–5:25 (219)

How Examiners' Discourse Cues Affect Scores on Intelligence Tests. SEAN P. CONDON & MICHAEL F. SCHOBER, *New School for Social Research* (read by Michael F. Schober)—One of the major ways to measure people's cognitive abilities is by asking them questions, using standardized instruments. In analyzing 17 videotaped administrations of the Wechsler Adult Intelligence Scale (WAIS-III), we found that examiners' behavior affects people's responses and even changes their scores. For example, the decision to ask a follow-up question rather than moving on, which relies heavily on the examiner's judgment, leads to higher scores. Examiners even affected scores by presenting backchannels ("mm-hm"); scores for comparable incorrect, incomplete, or imprecise answers followed by backchannels were higher than scores that were not. Examinees look to the examiner for cues as to whether they understood the question properly or should clarify, elaborate, or give an entirely different answer. A more interactive view of the administration of intelligence tests has significant implications both for how tests are administered and for how we understand what they measure.

Visual Perception I
Chicago A, Friday Afternoon, 3:15–5:20

Chaired by James R. Pomerantz, Rice University

3:15–3:35 (220)

Color/Luminance Dissociation Across "How" and "What" Processing of Normal Participants. CHARLES E. WRIGHT, CHARLES CHUBB, SUSAN ANDERSON, & PETER KIM, *University of California, Irvine*—Visual processing splits into ventral (what) and dorsal (how/where) streams. Whereas the ventral stream receives input from both the magnocellular and the parvocellular pathways, the dorsal stream receives only magnocellular input, suggesting that the "how" system may lack chromatic sensitivity. Here we assess the relative sensitivities for targets differentiated from the background by luminance versus chromaticity in two tasks: a "what" task (shape identification) and a "how" task (precision hand-movement guidance). Each task used (1) equiluminant green targets varying in saturation and (2) isochromatic gray targets varying in luminance. Psychometric functions of green-target saturation and of gray-target luminance were obtained in the "what" task. In the "how" task, we measured movement duration and endpoint accuracy. As was expected, for saturation Green(p) and luminance Gray(p) yielding identical success rate p in the "what" task, Green(p) targets yielded movement trajectories in the "how" task that were significantly slower and/or less accurate than those for Gray(p) targets.

3:40–3:50 (221)

Dichoptic Simultaneous Lightness Contrast Effects. JOSEPH CATALIOTTI, *Ramapo College,* & FREDERICK BONATO, *Saint Peter's College*—Simultaneous lightness contrast (SLC) effects have been regarded as perceptual consequences of low-level retinal interactions, even though high-level cortical processes have been shown to play a significant role in mediating these effects. The present study uses a simple dichoptic technique in which the gray targets of a classic SLC display are presented to one eye while the inducing backgrounds are

presented to the other. Contrast effects were obtained when the sign of the target-to-surround luminance relationship in one eye was equal to the sign of the contra-target-to-surround luminance relationship (partial edge correspondence) in the other eye. Surprisingly, dichoptic viewing yielded stronger SLC effects than did normal viewing. Also, as the background brightness and size are manipulated, the magnitude of the contrast effect is influenced under both dichoptic and normal viewing. Overall, these findings suggest that a similarly designed high-level process may be responsible for dichoptic and normal SLC effects.

3:55–4:15 (222)

Lightness Computation in the Simplest Images. ALAN L. GILCHRIST, *Rutgers University*—By placing an observer's head inside a large hemisphere, we have studied the computation of lightness under the minimal stimulus conditions for perceiving a surface color—namely, when two surfaces fill the entire visual field. Three rules describe the computation: (1) The highest luminance appears white, (2) the larger the area of a region, the lighter it appears, and (3) the perceived range tends toward the canonical black–white range. In one experiment, we varied the luminance range within the dome. We found that the perceived range is larger than the actual range in direct proportion to the truncation of the canonical range. In a second experiment, we held range constant, but varied relative area of the two regions. Area strongly influenced lightness, but not according to the exact function we expected. A third experiment showed an additional factor at work: the absolute luminance levels in the dome.

4:20–4:35 (223)

Scission and the Perception of Lightness. BARTON L. ANDERSON, *MIT*—Two theoretical views have emerged to explain the perception of surface lightness. Intrinsic image analysis assumes that image luminance is decomposed (or *scissioned*) into multiple layers: an illumination map and a reflectance map. Anchoring theory assumes that lightness is determined by decomposing images into frameworks and then applying an anchoring rule that maps the highest luminance to the perception of white. Here, we show that it is possible to unequivocally demonstrate the role of scission in the perception of surface lightness by using textured targets. A broad class of new illusions are reported in which the same patch can appear as either black or white, depending on the contrast relationships to its surround. It is argued that that anchoring (or normalization) and scission (layered image representations) interact to determine the perception of surface lightness.

4:40–4:55 (224)

Concurrent Modulations of Orientation and Frequency in Textures Are Processed Jointly by a Single Mechanism. NICOLAAS PRINS & FREDERICK A. A. KINGDOM, *McGill University*—Modulations of orientation and spatial frequency in the visual image provide observers with important information. For example, variations in depth are accompanied by variations in both orientation and spatial frequency in a consistent manner. Two classes of models have been proposed to account for the processing of such modulations. In one class of models, the features (orientation, spatial frequency) are processed separately. In the second class of models, concurrent variations of orientation and spatial frequency are processed jointly by a single mechanism, which essentially compares the contrast of a narrow range of orientations and spatial frequencies between different regions. We presented observers with textures containing concurrent modulations of orientation and spatial frequency. We determined which orientations and spatial frequencies were employed while the modulations were processed. Results clearly indicate that the modulations were processed by a single mechanism that analyzed the orientation and spatial frequency information jointly, disputing a feature-based analysis.

5:00–5:15 (225)

Evidence for Perceptual Trapping and Adaptation in Multistable Binocular Rivalry. SATORU SUZUKI & MARCIA GRABOWECKY, *Northwestern University*—When a different pattern is presented to each eye, the perceived image spontaneously alternates between the two patterns—bistable binocular rivalry. The dynamics of these alternations have been demonstrated to be stochastic. However, the dynamics of multistable binocular rivalry (involving four dominant percepts) can also be structured in the form of path dependence. The present results suggest that (1) spontaneous perceptual transitions tend to get trapped within a pair of related global patterns (e.g., opponent shapes and/or symmetric patterns) and (2) during such trapping, the probability of continued perceptual dominance of the trapping images gradually decreases for certain shapes, indicative of postselection pattern adaptation. Thus, spontaneous alternations of visual awareness during multistable rivalry can be strongly path dependent, likely constrained by global shape coding and regulated by adaptation.

Automatic Processes
Chicago BC, Friday Afternoon, 3:20–5:30

Chaired by Robert D. Melara, Purdue University

3:20–3:40 (226)

Visual Masking Reveals Two Qualitatively Different Levels of Unconscious Cognition. ANTHONY G. GREENWALD & RICHARD L. ABRAMS, *University of Washington*—Experiments 1–3 show that practice classifying visible words as pleasant or unpleasant enables word parts as small as single letters to function as subliminal primes having valence of the words they came from. Subliminal primes were 33 msec in duration, forward and backward masked. Experiments 4 and 5 showed no subliminal priming by words that lacked parts of practiced words. Experiment 5 also included longer prime durations, at which unpracticed words *did* produce priming. The latter effect was both unconscious and qualitatively different from the shorter prime duration effect, revealing a second mode of unconscious cognition.

3:45–4:05 (227)

Feature Integration Across Perception and Action. BERNHARD HOMMEL, *Leiden University*—The integration of stimulus and response features was studied by having people perform simple, prepared responses (R1) to the mere presence of *go* signals (S1) before carrying out a freely chosen R2 to another stimulus (S2). Subjects were more likely to repeat the previous response if stimulus shape or color was repeated. Repeating stimulus location affected response repetition only if location was made task relevant by using spatial responses, requiring report of S2 location, or having S1 to be selected against a distractor. Findings suggest that task-relevant stimulus and response features are spontaneously integrated into independent, local "event files," each linking one stimulus to one response feature —which represents a challenge for most accounts of stimulus/response repetition effects. Apparently, both perceptual events and action plans are cognitively represented in terms of their features, and feature-integration processes cross borders between perception and action.

4:10–4:25 (228)

The Effect of Mapping Words to Manual and Vocal Responses in the Stroop Task. SHAI DANZIGER, HILA HOCHMAN, & AVISHAI HENIK, *Ben Gurion University of the Negev*—The Stroop effect is usually larger for verbal responses than for manual responses. In several experiments, we explored whether Stroop interference was affected by whether the color indicated by the task-irrelevant word was mapped to a verbal or a manual response. In each experiment, subjects responded to two colors vocally and two colors manually. This enabled us to compare interference from color words linked to verbal responses with interference from words linked to manual responses when the relevant ink color indicated either a manual or a verbal response. Surprisingly, more interference was found when the irrelevant word was mapped to a verbal response rather than to a manual response regardless of the type of response to the relevant color. The results are discussed in relation to translation and dimensional overlap models.

4:30–4:50 (229)

Comparing Simon to Stroop: Which One Is Automatic? MEI-CHING LIEN & ROBERT S. McCANN, *NASA Ames Research Center, &* PHILIP A. ALLEN & ARYN HARRISON, *University of Akron* (read by Philip A. Allen)—In an attentional filtering task, participants respond to one dimension of a bidimensional stimulus (the relevant dimension) while attempting to ignore the other dimension. When the irrelevant dimension interferes with performance, the interference is taken as strong evidence that processing the irrelevant dimension is outside of attentional control—that is, is automatic. Two of the most widely studied examples of interference from the irrelevant dimension are the Simon effect (spatial dimension irrelevant) and the Stroop effect (linguistic dimension irrelevant). Should attention theorists treat these forms of interference similarly? Previous research has shown that when central attention is withheld from the filtering stimulus, by incorporating the filtering task into the standard PRP paradigm as Task 2, only the spatial dimension shows evidence of automatic processing (Fagot & Pashler, 1992; Lien & Proctor, 2000; McCann & Johnston, 1992). We report a series of experiments exploring this dissociation.

4:55–5:10 (230)

Reaction Time Complexity Varies With Accuracy and Task Difficulty. J. SCOTT JORDAN & DENEEN D. BRACKETT, *Illinois State University*—Researchers often assume that the dynamical structure in consecutive reaction times (RTs) should reduce to a small number of dynamically interacting variables (Clayton & Frey, 1997; Cooney, 1998; Cooney & Troyer, 1994). Given the complex diversity of neurocognitive structures that need to be coordinated in real time if a proper outcome (i.e., correct response) is to be produced, we argue that such variability should actually be rather complex, yet should decrease somewhat as task difficulty increases and produces coordination problems. We tested these hypotheses by having subjects complete four RT tasks of varying difficulty. Half the subjects were asked to be as accurate as possible, and the other half as fast as possible. Complexity was high in all data sets and decreased with increased task difficulty. The speed–accuracy instruction did not produce differences in complexity. However, high-accuracy subjects produced significantly less complex data sets than did low-accuracy subjects.

5:15–5:25 (231)

Is There a Controlled Component to Dynamic Attending? MICHAEL A. MOTES, TIMOTHY L. HUBBARD, LAURA K. BAILEY, & ERIN R. McCRIGHT, *Texas Christian University* (read by Timothy L. Hubbard)—According to dynamic attending theory (Jones, 2000), recurring isochronous sound onsets capture focal attention and create attention-based temporal expectations for subsequent onsets. However, in a series of reaction time experiments, we found evidence suggesting that listeners may control focal attending to recurring isochronous onsets. Listeners heard eight entrainment tones (1000 Hz, lasting 50 msec), separated by 550 msec of silence, and then responded to a different test tone that played either earlier, on time, or later than the expected onset. Listeners were equally fast at responding to early, on-time, and late test tones. If test intervals without a test tone were included, then on trials in which test tones were presented listeners were equally fast at responding to early and on-time test tones but were slower at responding to late test tones. However, when the probability of a very late test tone was high, listeners were generally equally fast at responding to early, on-time, and late test tones.

Cognitive Control
Chouteau, Friday Afternoon, 3:30–5:30

Chaired by Janet Metcalfe, Columbia University

3:30–3:50 (232)

Is the Homunculus Involved in the Explicit Task Cuing Procedure? GORDON D. LOGAN, *Vanderbilt University,* & CLAUS BUNDESEN, *University of Copenhagen*—The explicit task cuing procedure presents a cue indicating which task to perform, followed by a target after some interval (SOA). At short SOAs, RT is slower when the task alternates than when it repeats. This difference decreases, sometimes to zero, as SOA increases. We evaluated formal models of this time course function. One model assumes that an endogenous act of control occurs on alternation trials, but not on repetition trials. The other assumes no endogenous act of control and interprets the benefit of repetition as facilitation of cue encoding. Model fits to several data sets favored the second model over the first. A final experiment used two cues for each task and found that cue repetition was much faster than task repetition, which was almost as slow as task alternation, also favoring the second model. The results suggest that the homunculus is not involved in the explicit task cuing procedure.

3:55–4:15 (233)

Effects of Task Foreknowledge on PRP Performance. ELIOT R. HAZELTINE, ROBERT S. McCANN, & MEI-CHING LIEN, *NASA Ames Research Center* (read by Robert S. McCann)—In the psychological refractory period paradigm, participants perform two speeded tasks in rapid succession. Typically, the nature and order of the tasks is fixed, giving participants foreknowledge of Task 1, Task 2, and task order. To what extent do participants exploit this foreknowledge to optimize dual-task performance? We report experiments that systematically manipulate foreknowledge of Task 1 identity, Task 2 identity, and whether the transition from Task 1 to Task 2 involves a task switch or a task repetition. Foreknowledge primarily reduced response compatibility effects between Tasks 1 and 2 when Task 2 was a repeat of Task 1. These results add to recent evidence that PRP performance is determined partly by an ensemble-level representation of Task 1 and Task 2. Implications for the nature of the ensemble-level representation will be considered.

4:20–4:35 (234)

Activation Level of the Task Set in the PRP Paradigm. GUIDO P. BAND, *University Leiden* (sponsored by Gezinus Wolters)—Two experiments tested the hypothesis that the PRP effect is partially caused by control processes related to task switching. In a three-task sequence (Experiment 1), task repetition from the first to the third task facilitated the third response. This shows that the first task set was not suppressed to allow performance on the second task. In a two-task sequence (Experiment 2), proactive interference of the first task set with performance on the second task was observed. Both experiments showed no time dependence of proactive effects of the old task set. Apparently, then, the activation level of the old task set was not modified for the dual-task requirements. Moreover, the size of the PRP effect was unrelated to the proactive effects of the old task set on subsequent tasks, showing that the PRP effect was not (partially) caused by control processes for the old task set.

4:40–5:00 (235)

Stopping Real and Imagined Movements. ALLEN OSMAN & BRIAN RUSS, *University of Pennsylvania,* & ROBERT ALBERT, *University of Utah*—Event-related brain potentials (ERPs) were recorded from subjects while they (1) made simple movements, (2) imagined the same movements, (3) stopped themselves while initiating the movements, or (4) attempted to stop themselves from imagining them. Movement-related components of the ERPs revealed activation of cortical motor areas during motor imagery, despite the lack of muscle activity. Motor cortex activation began later and lasted longer during imagined than during real movements. Thus, the imagined movements were not merely the initial covert stages of real ones stopped before reaching overt execution. Low-resolution tomography was used to locate the sources of ERPs arising during inhibition. Electrical changes in the anterior cingulate and/or the right prefrontal cortex were found to be associated with the inhibition of both real and imagined movements. This suggests that the inhibition of imagined movements may involve some of the same control processes used to stop real movements.

5:05–5:25 (236)
Encoding and Implementation of Task Rules in Neurons of the Posteriorparietal Cortex (PPC) of Macaque Monkeys. GIJSBERT STOET & LAWRENCE H. SNYDER, *Washington University*—We studied neural correlates of task information and task-specific stimulus processing in 378 neurons in 2 macaque monkeys. Two discrimination tasks were randomly interleaved (task-switching paradigm). Depending on the task, animals judged either stimulus color or orientation. Trials started with a 250-msec task instruction, followed by a 450-msec preparation interval. Finally, a colored, oriented target appeared, requiring a left or a right buttonpress. During the preparation period, 18% of the neurons in the lateral bank of IPS (IPS-L) were modulated by the task instruction, regardless of the instruction format ($p < .01$). Furthermore, the response of task-selective cells in IPS-L to identical targets was larger during performance of the preferred task, as compared with the nonpreferred task. These data indicate that IPS-L cells encode task information and suggest that they are involved in the task-specific processing of visual information.

Categorization III
Empire, Friday Afternoon, 3:20–5:25

Chaired by Sharon Lee Armstrong, LaSalle University

3:20–3:40 (237)
Knowledge Partitioning in Categorization. LEE-XIENG YANG & STEPHAN LEWANDOWSKY, *University of Western Australia* (read by Stephan Lewandowsky)—Knowledge partitioning is a theoretical construct that holds that knowledge is not necessarily integrated but can be partitioned into independent parcels that contain mutually contradictory information (Lewandowsky, Kalish, & Ngang, 2002). One characteristic of knowledge partitioning is that once people choose to rely on a parcel to solve a problem, they largely ignore knowledge contained in other parcels. We applied this construct to categorization and examined whether people will partition their knowledge if a complex categorization problem is presented in different contexts. We report several category-learning experiments, using both numeric and perceptual stimuli, that consistently revealed the presence of knowledge partitioning: People applied different strategies in different contexts, and each strategy was used in its preferred context without reference to opposing knowledge that was demonstrably present in other contexts. We show that the data present difficulties for instance models (e.g., ALCOVE) and are better explained by a mixture-of-experts approach.

3:45–4:05 (238)
A Similarity-Based Model of Categorization and Induction in Young Children. VLADIMIR M. SLOUTSKY & ANNA V. FISHER, *Ohio State University*—We propose a similarity-based model of induction and categorization in young children. The model suggests that both perceptual information and linguistic labels contribute to young children's similarity judgment, induction, and categorization, specifies computations of similarity over perceptual features and linguistic labels, and predicts similarity judgment, induction, and categorization performance. In particular, the model predicts that if the task consists of similarity, induction, or categorization judgment from a test stimulus to a target, the probability of choosing one test stimulus over the others is determined by the ratio of similarity of the test stimulus and the other test stimuli to the target. Predictions of the model were tested and confirmed in three experiments, in which 4- to 5-year-olds par-

ticipated in similarity judgment, induction, and categorization tasks using both artificial labels and real labels. Results corroborate the similarity-based account of young children's induction and categorization, and they support predictions of the model.

4:10–4:30 (239)
Feedback and Response Characteristic Effects on Rule-Based and Information Integration Category Learning. W. TODD MADDOX, *University of Texas, Austin*—Rule-based and information integration category learning was examined in two experiments. In Experiment 1, immediate feedback was compared with delayed feedback. In Experiment 2, separate buttonpresses were associated with each category label (A or B) or were associated with *yes* or *no* responses to the query, "Was that an A (or a B)?" The delay and A/B versus *yes/no* response manipulations had no effect on the accuracy of responding or on the distribution of best-fitting models in the rule-based category-learning task. However, delayed feedback and *yes/no* response requirements resulted in less accurate responding in the information integration category-learning task and in an increase in the use of rule-based strategies to solve the information integration task. These results suggest that rule-based and information integration categories are solved by different category-learning systems that are mediated by different neural circuits.

4:35–4:55 (240)
Action and Conceptual Processing. ARON K. BARBEY, W. KYLE SIMMONS, JENNIFER A. RUPPERT, & LAWRENCE W. BARSALOU, *Emory University* (read by Lawrence W. Barsalou)—Action and conceptual processing appear to be closely related. In one experiment, listing properties for concepts produced bodily movements appropriate for interacting with the concept (looking up for a bird, smiling for a complimentary remark). Not only does conceptual processing affect action, in turn, action affects conceptual processing. In several lines of work, participants performed arm actions while either categorizing visual objects or listing properties for concepts. To disguise the critical hypothesis, on most trials, the action was inconsistent with the target concept's function, and the cover story stated that the experiment was about the interference of factory actions on other factory tasks. Across experiments, actions affected conceptual processing. Consistent actions facilitated visual object recognition (a turning motion for faucet) and led to the production of action-consistent object properties (a pulling motion increased internal properties for dresser). Much evidence in social cognition further demonstrates a close link between action and conceptual processing.

5:00–5:20 (241)
Scaling and Clustering in the Study of Semantic Disorders. GERT STORMS, *University of Leuven*—In the past decade, several studies have used scaling and clustering techniques to document semantic storage deficits in patients with Alzheimer's disease and in schizophrenia. In this presentation, I argue that many of the conclusions drawn from these studies are unjustified by the data. I review the methodology used in these studies, and I present data from simulation studies to further investigate the validity of their conclusions. Next, I elaborate on the criteria needed to exclude alternative accounts of the data. I also present empirical data from patients with Alzheimer's disease and normal control subjects to demonstrate that analyses of the patients' proximities do not provide unambiguous evidence for a generalized semantic storage deficit.

POSTER SESSION II
Crown Hall, Friday Evening, 5:30–7:00

• AUDITION, MUSIC, AND SPEECH PERCEPTION •

(242)
Gender Differences on a Dichotic Emotion Recognition Task.
DANIEL VOYER, *University of New Brunswick,* & AILEEN M. RUS-
SELL & JOHN E. MCKENNA, *St. Francis Xavier University*—The
present study tested the hypothesis that improved control of report
strategies would increase the likelihood of detecting significant gen-
der differences in a dichotic task with nonverbal material. Men and
women completed a dichotic emotion recognition task in one of two
assigned reporting conditions. The free recall condition allowed par-
ticipants to report emotions in any order they chose, whereas the dis-
crimination procedure required participants to indicate whether a bin-
aural probe was one of the stimuli presented dichotically on the same
trial. The hypothesis was confirmed when the results showed a sig-
nificant right-ear advantage (REA) in both genders in the free recall
condition but a significant REA only in men in the discrimination
condition. The discussion emphasizes the influence of idiosyncratic
report strategies on gender differences in laterality, as well as the role
of attention deployment in the measurement of auditory asymmetries.

(243)
**Visual Motion Influences the Contingent Auditory Motion After-
effect.** JEAN VROOMEN & BEATRICE DE GELDER, *Tilburg Univer-
sity*—In this study, we show that the auditory contingent motion after-
effect (Dong et al., 1999) is strongly influenced by visual motion
information. During an induction phase, participants listened to rightward-
moving sounds with falling pitch that alternated with leftward-moving
sounds with rising pitch (or vice versa). When a visual stimulus moved
in the same direction as the sound, auditory aftereffects (i.e., a shift in
the psychometric function for unimodal auditory motion perception)
were bigger than when no visual stimulus was presented. When the
visual stimulus moved in the direction opposite to the sound, aftereffects
were reversed and contingent upon visual motion. When the visual
motion stimulus was combined with a stationary sound, no aftereffect
was observed. These findings indicate that there are strong perceptual
links between the visual and the auditory motion processing systems.

(244)
**Detecting Pitch Changes in Rhythmically Varying Targets After
Different Delays.** W. JAY DOWLING & MEGAN BISSCHOP, *Univer-
sity of Texas, Dallas,* & BARBARA TILLMANN, *CNRS*—Surprenant
(2001, Experiment 3) had listeners judge pitch changes in the second of
two 5-tone sequences after delays of 0.5 or 2.0 sec, varying the propor-
tional total duration (PTD) of the target tone. She found improvement
in primacy items with longer delays, an effect we have been studying
with complex musical stimuli (Dowling, Tillmann, & Ayers, 2002).
Here we replicated several Surprenant findings, including the impor-
tance of PTD as a predictor of accuracy and primacy improvement
with longer delays for low-PTD (brief) targets. However, when our lis-
teners performed 56 warm-up trials, performance improved, especially
at the shorter delay, eliminating the primacy-improvement effect.
Listeners may improve their rapid encoding strategies during warm-
ups, particularly aiding short-target encoding. We varied the rhythmic
distinctiveness of targets, keeping PTD constant. Distinctiveness im-
proved performance for primacy and recency (but not middle) items.
We expected distinctiveness, presumably involved with encoding, to
interact with delay, but it did not.

(245)
Response Latencies in Duration Judgments. JACQUELYN C. TOFT
& J. DEVIN MCAULEY, *Bowling Green State University*—Two ex-
periments used a shorter–longer choice RT task to extend
Kristofferson (1977). Participants judged the duration of a comparison
stimulus relative to a 600-msec standard, responding shorter or longer.

Consistent with Kristofferson's real-time criterion model, reaction
times in Experiment 1 (measured from the onset of the comparison in-
terval) increased linearly as a function of stimulus duration for com-
parisons shorter than the standard but were approximately constant for
comparisons longer than the standard. In Experiment 2, comparisons
that began unexpectedly early or late, relative to the continuation of
the implied rhythm of the 600-msec standard, were found to delay or
advance, respectively, the placement of the criterion. The latter results
suggest that the timing of the criterion is not triggered (reset) by the
comparison onset, but rather has oscillatory characteristics consistent
with recent entrainment models (Large & Jones, 1999; McAuley &
Kidd, 1998).

(246)
Interruption in Time Estimation. CLAUDETTE FORTIN & MARIE-
CLAUDE BEDARD, *Université Laval*—A time interval may be pro-
duced by pressing a key twice, with a predetermined target duration
to be estimated between the two keypresses. In previous experiments,
an auditory stimulus, of which onset and offset coincided with the
first and the second keypresses, respectively, was temporarily inter-
rupted at some point during the interval production. The task was to
produce the target interval, while interrupting timing during the break
in tone presentation. Generally, the results suggest that participants
are timing, stopping, and resuming timing in the prebreak, break, and
postbreak periods, respectively. In the experiments reported here, con-
ditions of stimulus presentation as well as break duration and location
were manipulated. In addition to the typical effect of break location,
the produced intervals shortened with increasing break duration, and
this effect interacted with conditions of stimulus presentation. The re-
sults are interpreted in an accumulator framework, where accumulat-
ing temporal information is under attentional control.

(247)
Memory Retrieval and Expression in Skilled Piano Performance.
ROGER CHAFFIN, *University of Connecticut,* GABRIELA IMREH,
& TONY LEMIEUX & COLLEEN ARMITAGE, *University of Connect-
icut*—The practice of a concert pianist was recorded as she learned the
third movement of J. S. Bach's Italian Concerto (Presto). Tempo varia-
tion during practice performances was assessed by measuring interbar
intervals (IBIs). Multiple regression related IBIs to characteristics of
the music reported by the pianist for each bar (fingering, technical dif-
ficulties, familiar patterns, phrasing, dynamics, tempo, pedal, three types
of cues attended to during performance, and structural boundaries).
Comparing practice performances at different points in the learning
process allowed identification of effects that were due to memory re-
trieval difficulties and to deliberate, expressive variation. Memory effects
decreased and expressive effects increased with practice. Surprisingly,
some memory effects persisted to almost the end of the learning process,
and some expressive effects emerged only in the final performance.

(248)
**Varying the Units of Analysis in Music to Arrive at a Malleable
Representation.** HELGA NOICE, *Elmhurst College,* TONY NOICE,
Indiana State University, & JOHN M. JEFFREY, *Elmhurst College*—
A computer scientist/professional musician employed his knowledge
of both fields to generate visual and verbal representations of the
process of learning new music. Using a tree structure diagram and
verbal protocols, the participant demonstrated how stored knowledge
of jazz and popular melodies allows the musician to recognize typi-
cal and atypical sequences of chords and notes. This recognition leads
to a mental representation that permits the same tune to be played in
various styles (blues, jazz, rock), used as a basis for improvisation, or
rendered note for note.

(249)
Reliability of Dichotic Laterality Effects With Neutral Words.
NANCY L. RUSSELL & DANIEL VOYER, *University of New Bruns-
wick* (sponsored by Daniel Voyer)—Previous research has suggested

that words pronounced with an emotional component produce relatively reliable laterality effects in a dichotic word detection task. The present study tested the hypothesis that removal of the emotional component would improve the reliability of laterality effects in word detection, when compared with previous work. Participants completed a word detection task in which the words *bower*, *dower*, *power*, and *tower* were pronounced in a neutral tone of voice. Test–retest reliability was assessed by having participants complete each task twice. The hypothesis was not confirmed. Specifically, the reliability of the right-ear advantage was similar to that observed when the emotional component was included. These findings suggest that the emotional component might not influence auditory laterality when the task involves focusing solely on the language aspects of the stimuli.

(250)

Electrophysiological Correlates of Place Assimilation Context Effects. DAVID W. GOW, JR., *Massachusetts General Hospital and Salem State College,* & PHILIP J. HOLCOMB, *Tufts University*—Recent behavioral studies have demonstrated a combination of regressive and progressive context effects in the processing of place-assimilated English speech, suggesting that listeners rely in part on context to determine the underlying form of lawfully modified segments. In the present study we explored the neurophysiological correlates of these context effects, using event-related potentials. Listeners heard a series of sentences in which the contextual viability of a spontaneous assimilation (e.g., *cat* pronounced in a labial context as [kætp]) was manipulated by cross-splicing. Cross-spliced contexts were designed to be semantically appropriate under one lexical interpretation of the modified item (*The cat played*), but not under the other (*The cap played). This allowed for the simultaneous examination of progressive effects (indexed by early perceptual components) and regressive effects (indexed by the N400). The results are discussed in terms of a perceptual account of the processing of assimilated speech.

(251)

Syllabification, Segmentation, and Long-Term Auditory Priming. MIN JU & BARBARA A. CHURCH, *SUNY, Buffalo* (sponsored by Erwin M. Segal)—Norris et al. (1997) found that listeners were slower and less accurate at detecting words in a word-spotting task when the target and the adjacent segment formed a single syllable (e.g., *fapple*) than when they were separate syllables (e.g., *vuffapple*). This suggested that syllabification influences segmentation of continuous speech input. The present study investigated whether syllabification affects the encoding of words in long-term memory and whether particular processes used during encoding modulate the effects (if they exist). A series of long-term auditory priming experiments were conducted using syllabified and nonsyllabified embedded words at encoding and varying the encoding task. A significant effect of syllabification was found: Greater priming was observed for nonsyllabified words. However, this effect was present only when listeners focused on detecting words at encoding, and not when they engaged in shallow processing. The results are discussed in the context of theories of word segmentation and word recognition.

(252)

How Do We Acquire Words? Insights From the Lexical Footprint Phenomenon. NICOLAS DUMAY & GARETH GASKELL, *University of York*—Three experiments tracked vocabulary acquisition through the emergence of lexical competition in spoken-word recognition (or lexical footprint). Participants were required to learn nonce words that overlapped with existing (baseline) words (*cathedruke* for *cathedral*). In Experiment 1, good explicit knowledge of the novel items was obtained after one session of exposure, whereas their inhibitory influence on identification of the baseline words (measured by auditory lexical decision) required several successive days of learning to emerge and was restricted to onset-overlap (*cathedruke* vs. *yothedral*). Experiments 2–3 disentangled the roles of time and frequency-of-exposure in the acquisition process. In lexical decision, low-frequency novel items in-

duced facilitation immediately after exposure but no effect after 1 week, whereas high-frequency items produced inhibition immediately and 1 week after. In shadowing, robust facilitation was obtained only by low-frequency items immediately and, independently of frequency, 1 week after. Implications for models of word acquisition and recognition are discussed.

• HUMAN LEARNING AND MEMORY •

(253)

Learning Mathematics in Early Grades by Doing Hands-on Tasks. PATRICIA BAGGETT, *New Mexico State University,* & ANDRZEJ EHRENFEUCHT, *University of Colorado, Boulder*—Children in all grades like lessons in which mathematics is embedded in an interesting problem with a large hands-on component. Such lessons are also highly motivating, and children show diligence and patience, achieving high rates of success in the tasks that they are given. But the question remains: How efficient is this approach in conveying mathematical knowledge and skills? Such lessons were taught in several third and fourth grade classrooms in New Mexico. Children were asked later, as an independent classroom assignment given with different delays, to describe in writing what they did and what they learned from the lessons (free recall). The results indicate that a large part of what they learn is related to nonmathematical aspects of the tasks but, also, that the mathematics that they do recall is well integrated into the rest.

(254)

Imagery's Effect in an Intentional Forgetting Task: Bugelski (1970) Revisited. LAURA A. DA COSTA & JAMES A. WHITLER, *University of Illinois, Springfield*—There have been few published studies showing the effects imagery would have in an intentional (directed) forgetting paradigm. The two known studies showed contradictory findings when using an item method version of the paradigm. Bugelski (1970) showed that forgetting did not occur; however, Basden and Basden (1996) showed that it did occur. The purpose of our study was to reconduct the older Bugelski study, with few changes, to determine whether the findings would be replicated. The Bugelski study, conducted before the rise of intentional forgetting, had a different way of cuing participants, compared with more modern methods. Participants in our study were able to forget imaged items (contrary to Bugelski, 1970), even when the cue to forget occurred as soon as the participants viewed the words.

(255)

Lists Length Effects in List-Method Directed Forgetting. DAVID DRISCOLL, MATTHEW VENTURA, & WILLIAM MARKS, *University of Memphis*—Successful compliance with a cue to forget in the list-method procedure of directed forgetting requires a new set of to-be-learned items following the forget cue. An important question concerns the amount of new and old learning that is required to observe directed forgetting. We addressed this question in three conditions that varied the number of words in List 1 relative to List 2 (5 vs. 15, 15 vs. 15, and 15 vs. 5 for List 1 and List 2, respectively). Directed forgetting was observed under each of these conditions. Similar results occurred when participants were provided with information about the number of List 2 items that they might expect. The findings indicate that there may be minimal constraints on the amount of old and new learning that is necessary to initiate the memory control processes associated with list-method directed forgetting.

(256)

Learning Abstract Sequence Structure With a Connectionist Model of the Prefrontal Cortex. DAVID C. NOELLE, *Vanderbilt University*—Both adults and infants are capable of rapidly identifying simple abstract patterns in collections of syllable sequences—patterns that sometimes depend critically on relations between sequence constituents, such as repetitions of syllables, rather than on surface properties of the sequences, such as the frequency of co-occurrence of particular syllable pairs. This has led some researchers to claim that human learning

mechanisms must include an inherent bias toward representing patterns in a manner analogous to algebraic rules (Marcus et al., 1999). Counter to this claim, we demonstrate that such abstract sequential patterns may be quickly identified by a connectionist model of prefrontal cortical function incorporating a dopamine-based working memory mechanism (Braver & Cohen, 1999). Critically, this model lacks any explicit mechanism in support of the representation of formal rules, suggesting that such a mechanism is not necessary to account for human performance.

(257)

Directed Forgetting and Autobiographical Memories. SUSAN L. JOSLYN & MARK A. OAKES, *University of Washington*—Evidence (Geiselman, Bjork, & Fishman, 1983) suggests that instructions to forget result in poorer memory for "to-be-forgotten" items than for "to-be-remembered" items in a list-learning paradigm. The present study investigated whether the effect extends to autobiographical events. In anticipation of a memory test, participants recorded two unique events a day for two 5-day intervals. After handing in the events for the first interval, half of the participants were told to forget those events (forget group). The remaining participants (remember group) were given no such instructions. A free recall test revealed that the forget group remembered fewer events for Interval 1 (to-be-forgotten items) than did the remember group. There were no group differences for Interval 2 events (to-be-remembered items). Results suggest intentional forgetting of autobiographical memories and may have implications for forgetting of traumatic events. Also investigated was the concurrent impact on memory of intention to learn, emotionality, self-relevance, and centrality of details.

(258)

Serial Position Effects in List-Method Directed Forgetting: Evidence of Selective Rehearsal. ERIN D. SHEARD & COLIN M. MACLEOD, *University of Toronto, Scarborough*—Directed forgetting effects under the list method have been attributed to inhibition of the *forget* sublist, in contrast to those under the item method, which have been attributed to selective rehearsal favoring *remember* items. However, a serial position analysis in the list method showed that the directed forgetting effect stems from elimination of the recency effect in the forget sublist (i.e., the relatively unrehearsed portion of the sublist), and not from inhibition of the entire forget sublist. These comparisons followed the standard practice of comparing an initial forget sublist with a subsequent remember sublist in a within-subjects design. Further experiments removed this order confound by using a between-subjects design, comparing the first sublist from a forget–remember group to the first sublist from a remember–remember group. The follow-up experiments confirmed that selective rehearsal plays a key role in list-method directed forgetting.

(259)

Evidence Against a Surprise-Based Explanation of the Bizarre Recall Advantage. JAMES B. WORTHEN, *Southeastern Louisiana University*—Two experiments examined the role of surprise in obtaining the often found recall advantage for bizarre verbal information. In Experiment 1, participants rated the surprisingness of common and bizarre sentences appearing in either mixed or unmixed lists. In Experiment 2, participants rated the surprisingness of common and bizarre sentences appearing in categorized and uncategorized lists. The results of both experiments were consistent with previously presented research (Worthen & Starns, 2001) by demonstrating an elimination of the bizarre recall advantage with a suprisingness rating task. The results also demonstrated that the elimination of the bizarreness advantage could not be explained by a reduction in the perceived surprisingness of the stimuli as a result of the orienting task. Casting serious doubts on surprise-based explanations of the bizarreness effect, the results indicated a significant positive relationship between surprisingness and memory disruption.

(260)

Conformity to the Power PC Theory of Causal Induction Is Dependent on Type of Probe Question. DARRELL J. COLLINS & DAVID R. SHANKS, *University College London* (sponsored by David R. Shanks)—Cheng's (1997) power PC theory of causal induction proposes that causal estimates are based on the power (p) of a potential cause, where p is the contingency between the cause and the effect, normalized by the base rate of the effect. Previous tests of the theory have provided, at best, mixed support. In the present experiments, participants were required to judge the strength of generative causes and were probed for this judgment with either a causal or a counterfactual test question. Consistent with previous studies, the participants' estimates violated the power theory when made in response to causal questions. However, when responding to the counterfactual probe, participants based their judgments on p. Consistent with research that has suggested that the wording of a probe question can have a qualitative impact on responses, the present experiments suggest that counterfactual questions encourage participants normatively to consider the base rate of the effect.

(261)

Processing Tasks and Analogical Transfer. ANGELA BRUNSTEIN & JOSEF F. KREMS, *Chemnitz University of Technology* (sponsored by Josef F. Krems)—The dissociation between superficial and structural similarity for analogical transfer usually results in orthogonal experimental designs and in the use of relatively simple base and target representations. This study investigated superficial and structural transfer for learning complex English grammar concepts. Forty students at the intermediate level processed two grammar chapters, in varying order, for solving tasks. They were guided by either structural-oriented instruction or detail-oriented instruction. The number of solved tasks was higher for the second processed chapter independently of instruction and concept order, indicating unspecific transfer. Again, the quality of solutions improved only for learners with structural instruction, but not for learners focusing on details. Moreover, there was an asymmetric pattern structural transfer, depending on order of concepts. Results demonstrate that the reported dissociation holds also for complex learning settings. Moreover, transfer of superficial attributes precedes transfer of structural correspondences, but it does not determine the direction of transfer.

(262)

Affective Pleasantness and Affective Intensity of Words Enhance Free Recall. HARRIETT AMSTER & KIMBERLY WEAR, *University of Texas, Arlington*—The effect of quality and intensity of semantic affectivity on free recall was studied in six lists of unrelated words. Cognitive neuropsychological models suggest that for unpleasant affect, recall increases with intensity of affect, but no comparable effects are implied for pleasant affect. A variety of psychological theories imply that both intensity and quality of affect may affect memory. In all significant comparisons, pleasant words were recalled better than unpleasant or neutral words. In a list containing subsets of mildly pleasant and equally mild unpleasant words, the pleasant words were recalled reliably better. Extremely pleasant words were also recalled better than extremely unpleasant words from parallel lists and were recalled better than mildly pleasant words in the same list. Other evidence indicates that quality and intensity of semantic affectivity play independent roles in recall.

• RECOGNITION MEMORY •

(263)

The Effects of Irrelevant Perceptual Information on Memory for Faces. RACHEL A. DIANA & LYNNE M. REDER, *Carnegie Mellon University*—Participants were asked to recognize photographs of males wearing various accessories. The match between these accessories at study and test was manipulated, such that some faces were presented with the same accessory at test, whereas others were presented with a swapped or a novel accessory. We found that memory performance was improved when the ostensibly irrelevant perceptual information in the photograph matched between study and test. This finding is

analogous to Reder, Donavos, and Erickson's (2002) finding of superior word recognition when the font of the test word matched its encoding font. They also found that the extent of the advantage was modulated by the number of words that had been studied in a font. The present research examined whether face recognition was also affected by the number of faces associated with an accessory and by the race of the face to be judged, as compared with the race of the participant.

(264)

The Effect of Negative Mood on False Memories. MASANOBU TAKA-HASHI, *University of the Sacred Heart,* & ATSUO KAWAGUCHI, *Kinki Welfare University*—The present study attempted to determine the effect of negative mood state on false recall and later false recognition of nonpresented critical lures. In two experiments, participants were experimentally induced into a particular mood state by a musical mood induction procedure and then studied a long list of semantically related negative-toned words. Results of both experiments demonstrated that participants who were induced into a negative mood state recalled and recognized no greater proportion of critical lures than did the participants who were induced into neutral and positive mood states. The present findings therefore lend no support to theories that attribute false memories to automatic activation-based factors.

(265)

Face Distinctiveness Is a Better Predictor of Remember/Know Judgments Than Is Study List Organization. GERALD A. EPLING, *MindJava*—Varying the level of organization between two different study lists provides one method of selectively engaging two complementary psychological processes, item-specific processing and relational processing. These primitive processes of cognition may also be selectively engaged by different levels of distinctiveness in the stimuli. Review of data from a recent face recognition study shows that the substitution of face distinctiveness for study list organization produces an improved model of face recognition, accounting for more than 75% of the variance in the production of correct remember and know judgments with one encoding trial and with multiple encoding trials.

(266)

How Do Instructional Warnings Reduce False Recognition? CARMEN E. WESTERBERG & CHAD J. MARSOLEK, *University of Minnesota*—After studying lists of *related* words (e.g., *bed*, *rest*, *awake*, . . .) highly associated to one *critical* word (e.g., *sleep*), participants often falsely recognize critical words as having been presented. However, warning participants of this memory illusion significantly reduces false recognition. We report a study testing how warnings reduce false recognition and addressing mechanisms that may underlie this effect. During encoding, participants studied both related word lists and unrelated word lists. During test, old and new critical words, old and new related words, and old and new unrelated words were presented, allowing signal detection analyses of recognition performance. One group of participants was warned of the memory illusion before encoding, another was warned before test, and another was unwarned. The results addressed whether warnings cause participants to effectively encode specific features of particular words, activate and "tag" the critical words during encoding, or enhance a discriminative process (e.g., MINERVA2 cubing process) during retrieval.

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Does Memory for Intentions Decay Over Time? JESSICA LANG NOWINSKI & R. KEY DISMUKES, *NASA Ames Research Center*—Many memory theories postulate decay of activation over time, in the absence of active rehearsal. Assuming that activation is essential for retrieval of goals, traditional memory theories therefore predict that prospective memory performance should decline with increasing delay between encoding and the window of opportunity for executing the intention. In contrast, other theories suggest a special status for intentions in memory and predict either no decline or even a rise in performance over time. Participants in the present study performed an ongoing

task, as well as an event-based prospective memory task. Targets appeared at varying intervals after a prospective task reminder. In contrast to a previous study (Loftus, 1971), prospective memory performance did not differ between targets presented at longer and shorter intervals. The results may indicate a fundamental difference in the way that naturalistic and laboratory prospective memory tasks are performed.

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Warning Participants Can Reduce Memory Conjunction Errors. JAMES M. LAMPINEN & TIMOTHY N. ODEGARD, *University of Arkansas*—Participants studied a list of compound words one time or three times and then took a recognition memory test that included targets, conjunction lures, features lures, and new items. Half of the participants were warned that the recognition memory test would include new compound words made by combining features of the presented compound words. The warned participants falsely recognized fewer conjunction lures.

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Model for Memory Errors in a Lineup Study. SCOTT D. GRONLUND, *University of Oklahoma*—Estes's (1997) perturbation model was used as a starting point to explore data arising from a lineup study. Type of encoding (relative vs. absolute) and type of lineup (simultaneous vs. sequential) were manipulated. Suspect height, rather than identity, was varied across individuals. The extant model adequately matched the absolute encoding data, but modifications were necessary to match the relative data. The sequential lineup advantage reported in the literature might be limited to situations involving absolute encoding (governed by transfer-appropriate processing) and situations in which a distinctive characteristic was encoded. The latter resulted in long-term memory encoding of the distinctive characteristic, which might be a prerequisite for the use of a recollective process in a sequential lineup.

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Social Contagion of False Memories in Naturalistic Environments. MICHAEL P. TOGLIA, *SUNY, Cortland,* ELIZABETH L. PRESTON, *University of Alabama, Huntsville,* JOSEPH S. NEUSCHATZ, *Roger Williams University,* & JEFFREY S. NEUSCHATZ, *University of Alabama, Huntsville*—The goals of this study were to extend research on the social contagion effect to more ecologically valid environments and to determine how passage of time influences contagion information. To this end, individual participants and an experimental confederate collaboratively recalled items present in a graduate student's office in which they had been previously seated. The confederate either recalled only items actually present (control condition) or additionally reported two items not present in the room (contagion condition). On the individual recognition test that included recalled items and nonpresented lures, contagion condition participants were more likely to recognize contagion items, but they did not differ from the control subjects on recognition of presented and nonpresented items. Subjects' remember/know judgments indicated that, over time, contagion information was experienced with as much phenomenological detail as were true memories. We argue that the memories of the contagion participants were changed to incorporate the contagion information.

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When Memory is Worse for Infrequent Items: Familiarity-Based Misattributions of Recency. PATRICK O. DOLAN & ELISABETH PLORAN, *Drew University*—Uncommon low-frequency (LF) words are better recognized than more common high-frequency (HF) words. We investigated whether or not this advantage would extend to judgments of relative recency. In two experiments, subjects judged which of a pair of studied words had occurred most recently. Accuracy was highest when a recent LF word was paired with an older HF word. Accuracy was lowest when a recent HF word was paired with an older LF word. We interpreted this as a bias effect; the stronger episodic trace strength of the LF word was misinterpreted as signaling recent

study. This improved performance when the LF word was in fact the most recent word but led to errors when the LF word was the older of the pair. In the case of recency judgments, LF words are only advantaged when the judgment is congruent with a subject's bias to interpret trace strength as recency.

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Waiting for Recollection, Fast Recollection, or Illusory Recollection: What Do Response Latencies Tell Us? DAVID A. GALLO, *Washington University,* DAVID I. DONALDSON, *University of Stirling,* & PATRICK O. DOLAN, *Drew University*—Across three memory tasks, we compared the time course of recognition judgments typically thought to be associated with recollection and/or familiarity. With the first task, we compared response latencies for *remember* judgments with those for *know* judgments on a standard recognition test. With two other tasks, associative recognition and category-based false recognition, we compared latencies to hits (ostensibly based on recollection, in addition to familiarity) and to false alarms (ostensibly based on familiarity). Across all three tasks and contrary to conventional wisdom, responses associated with recollection were faster than those associated with familiarity. We offer three alternative explanations: (1) Recollection is typically faster than familiarity, (2) familiarity-based judgments take more time because they involve qualitatively different processes (e.g., monitoring and/or illusory recollection), or (3) before making a familiarity-based response, subjects simply "wait for recollection."

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The Stability of Associations to High- and Low-Frequency Words. DAVID G. SMITH, *Defence Research and Development Canada*—In recognition memory experiments low-frequency (LF) words produce higher hit rates but lower false alarm rates than do high-frequency (HF) words. The exact reason for this phenomenon is unclear. One way of explaining the data is based on associations activated internally by studying a word. It is possible that LF words activate rare associations, whereas HF words activate more common associations. At test, LF words are at an advantage because memories for their associations are more unique and, hence, more diagnostic of previous exposure than are the associations for HF words. I report an experiment in which participants were asked to produce word associates during study and test phases. As was predicted by this account, the participants were more likely to be able to reproduce the same associate for LF words than for HF words.

(274)

Familiarity and Source Misattribution as Contributors to Imagination Inflation in Older Adults. AYANNA K. THOMAS, *Washington University*—Researchers have begun investigating false memory creation in older adults. However, little research exists that examines whether and why older adults are subject to false memories as a result of repeated imagination. The goal of the present study was to investigate the underlying mechanism of imagination inflation in older adults. In these experiments, participants performed or imagined simple unusual actions (i.e., kiss the frog) in an encoding session. In Session 2, 24 h later, the participants were presented with both old and new actions. Two weeks later, the participants' memory for Session 1 activity was tested. The imagination inflation effect was evidenced by an increase in false did responses as the number of imaginings increased in Session 2. Session 2 activity was manipulated to test source monitoring and familiarity misattribution as explanations for imagination inflation. The role of perceptual and sensory characteristics in false memory judgments is discussed.

• IMPLICIT MEMORY •

(275)

Directed Forgetting Effects Under Conditions of Optimized Memory Performance. KEITH D. HORTON, *Wilfrid Laurier University*—MacLeod and Daniels (2000) hypothesized that directed forgetting effects could be eliminated when test performance is optimized. Horton

and Nash (1999) described a fragment completion study task that appeared to optimize implicit fragment completion test performance. In the present study, this fragment completion study task was used along with other encoding manipulations to assess directed forgetting effects in free recall, implicit and explicit fragment completion, and speeded reading. The results provide some support for the predictions of MacLeod and Daniels, although unexpected small directed forgetting effects were observed in some conditions, perhaps owing in part to the compounding of study tasks.

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Schematically Generated False Memories and the Misinformation Effect: Memory Characteristics Compared. JENNIFER L. TOMES & MELANIE D. TRACY, *Mount Allison University*—An investigation into the characteristic differences between two types of illusory memories via internal processing and via external suggestion was conducted. Novel schematic narratives were developed to generate internal false memories, and the misinformation paradigm was employed to create externally suggested false memories. Participants were placed into two groups (immediate and 48-h delay). It was predicted that (1) the novel materials would be successful in generating both types of illusory memories, (2) more schematic false memories would be produced over time, and (3) characteristic differences between illusory memory types would be found in terms of the participants' phenomenological ratings of their "memories." Results supported Hypotheses 1 and 3. The results and implications for future illusory memory research using different types of materials and procedures are discussed.

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Implicit and Explicit Learning in a Visual Search Task. COLLEEN A. RAY & EYAL M. REINGOLD, *University of Toronto*—Participants' eye movements were monitored as they performed a visual search task in the "change blindness" flicker paradigm. In each trial, participants were asked to detect a letter that differed across otherwise identical alternating letter arrays. Either bold or regular letter stimuli were displayed, and for a subset of trials, this variation in letter thickness perfectly predicted target identity. Half of the participants were told of the existence of this covariation (informed group), and the other half were not notified of this regularity (uninformed group). In both groups, reaction time data indicated that visual search was facilitated for trials that contained the covariation. However, the informed group demonstrated greater magnitude of learning and greater rule flexibility than did the uninformed group. Furthermore, eye movement data show that the participants in the informed group, but not those in the uninformed group, guided eye movements to potential targets on the basis of the covariation information.

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Presentation and Response Structure in Implicit Learning. BENJAMIN A. CLEGG & W. GEOFFREY O'SHEA, *Colorado State University*—The Hebb digit task involves short-term memorization of a series of nine digits (1 to 9 in varying orders). Unbeknownst to participants, every third sequence of numbers repeats exactly the same order of items. Improved performance on the repeating pattern, as compared with random sequences, occurs regardless of awareness of the pattern. We sought to examine whether changes to the structure of stimuli and responses would mediate learning. Chunking the sequence during presentation enhanced performance, as compared with a nonchunked format. Implicit learning was also observed on a continuous performance version of the task.

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Evidence for Cross-Lingual Repetition Priming in Conceptual Implicit Memory Tasks. RENÉ ZEELENBERG, *Indiana University,* & DIANE PECHER, *Erasmus University, Rotterdam*—Previous studies have failed to find evidence for cross-lingual repetition priming (i.e., presentation of the Spanish word *casa* does not facilitate responding to its English translation equivalent, *house,* on a subsequent

presentation). The present study tested the hypothesis that failure to find cross-lingual repetition priming in previous studies was due to the use of tasks that rely primarily on perceptual or lexical processing of the stimuli, instead of conceptual processing. Consistent with this hypothesis, the present study obtained reliable cross-lingual repetition priming when conceptual implicit memory tasks were used. The present results support theories of bilingual memory that assume language-specific lexical representations but integrated semantic representations.

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The Mere Exposure Effect in Concept Formation. KEN MATSUDA & TAKASHI KUSUMI, *Kyoto University*—We examined how stimulus typicality and exposure frequency influence concept formation, using a mere-repeated-exposure paradigm. Participants were exposed to pictures of unfamiliar fish with 10 feature dimensions zero, one, three, five times. Later, they were presented with a series of fish pictures and were asked to rate typicality, liking, prettiness, nostalgia, familiarity, and recognition of each picture. The pictures with medium typicality showed a greater mere exposure effect on liking judgments than did the pictures with high or low typicality. Furthermore, recognition judgments were influenced by exposure frequency, which influenced memory strength, as well as by stimulus typicality, which influenced false alarm rate. These results indicated that the participants formed an integrated representation (i.e., a prototype) of each picture that enabled them to process the pictures on the basis of feature frequency. These prototypes then influenced liking and recognition judgments.

• **SELECTIVE ATTENTION** •

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Inhibition of Return and Saccade Curvature: Oculomotor Versus Attentional Inhibition. RICHARD GODIJN & JAN THEEUWES, *Vrije Universiteit Amsterdam*—After presenting a peripheral cue, a subsequent saccade to the cued location is delayed (oculomotor IOR). The present study shows that both a peripheral onset and a color singleton cue can generate oculomotor IOR. Furthermore, subsequent saccades curve away from the cued location. Both of these effects are greater with an onset cue than with a color singleton cue, suggesting that both effects are caused by a common inhibitory mechanism. However, a dissociation is found in the time course of curvature and IOR. We propose that oculomotor IOR is caused by inhibition in the attentional system after the presentation of the cue and that saccade curvature is caused by inhibition in the oculomotor system when a decision is made to execute a saccade. The results are discussed in terms of the relationship between attention and saccades.

(282)

Object-Based Inhibition of Return Is Modulated by Object-Internal Structure. IRENE REPPA & E. CHARLES LEEK, *University of Wales*—It has recently been shown, using divided-attention tasks, that targets are detected more accurately when they occur on the same structural part of an object than when they occur on different parts (Vecera et al., 2000). This suggests that attention can be directed toward object-internal features. We present converging evidence, using an implicit measure of selection based on the object-based inhibition-of-return (IOR) paradigm with 2-D and 3-D object displays. The results show that IOR is larger when cues and targets appear on different parts of an object, relative to when they appear on the same part. These findings suggest that object-based mechanisms of selection can operate over shape representations that give explicit information about object-internal structure. In addition, we also show how the patterns of modulation of IOR can elucidate the structure of the object shape representations mediating visual perception.

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The Role of the Locus Coeruleus in Mediating the Attentional Blink: A Neurocomputational Model. BENJAMIN D. HOLMES, *New York University,* & SANDER T. NIEUWENHUIS, MARK S. GILZENRAT, & JONATHAN D. COHEN, *Princeton University* (sponsored by Jonathan Cohen)—The attentional blink refers to the transient impairment in perceiving the second of two targets presented in close temporal proximity. Recent work has suggested that the locus-coeruleus–norepinephrine system potentiates the processing of target stimuli via a phasic poststimulus release of norepinephrine. Following this phasic increase in activity, the locus coeruleus exhibits a period of refractoriness that coincides with the timing of the attentional blink. This has led us to hypothesize that the attentional blink may be mediated by the momentary unavailability of noradrenergic potentiation of target stimuli. To test this hypothesis, we extended a recently developed computational model of locus coeruleus activity and its impact on cognitive performance. The model accurately simulates the time course of the attentional blink, including Lag 1 sparing. The involvement of norepinephrine in the generation of the P300 may explain the intimate relation between this electrophysiological component and the attentional blink.

(284)

Stroop Interference Within a Single Domain Using a Unimodal Musical Stroop Task. MICHAEL D. HALL, *University of Nevada, Las Vegas,* & CHRISTOPHER KOCH, *George Fox University*—Several researchers have examined interference with auditory versions of the Stroop task. Unfortunately, such tasks do not solely examine auditory interference, since they are cross-modal. Three experiments were conducted using a unimodal musical version of the Stroop task. In each experiment, two tones with distinct pitches were presented simultaneously to opposing ears. Subjects were instructed to identify the instrument timbre (violin or clarinet) of the tone in a particular ear. In Experiment 1, the subjects were slower and made more errors when the presented timbres were incongruent. Inclusion of filtered white noise distractors (Experiment 2) revealed that spectral envelope did not predict the interference effect. Similar results were obtained with attenuated versions of the stimuli (Experiment 3) that eliminated masking as a potential source of interference. Thus, interference occurs both unimodally and cross-modally when stimuli are presented from the same or similar information domains and in close temporal proximity.

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Attending to a Nontarget Stimulus: Evidence for the Processing of the Irrelevant Dimension. ZHE CHEN, *University of Canterbury*—Does attending to a nontarget stimulus result in the processing of its relevant, as well as its irrelevant, dimensions? This question was examined in several experiments. Participants saw stimuli that varied in one or two features. The task was to respond to a specific feature on separate trials. The results show that participants' responses are influenced by both the relevant and the irrelevant dimensions of an attended nontarget object. Furthermore, the processing of the irrelevant dimension is not limited to identical physical properties or to the specific behavioral task in the experiment. These findings suggest that features of an attended nontarget stimulus can have automatic access to response mechanisms regardless of response selection.

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Perceptual Load Effects: The Role of Individual Differences in Working Memory Capacity. DONALD J. TELLINGHUISEN & EMILY GEENEN, *Calvin College*—Do individual differences in processing capacity influence distractor effects? According to Lavie's (1995) perceptual load hypothesis, irrelevant peripheral distractors influence target identification when attentional capacity is not fully utilized by a central search task. If individuals with higher working memory capacities have higher visual attention capacities, they may experience larger distractor effects than do individuals with lower capacities. In our study, participants indicated which of two target letters was presented within a circular display of letters. Nontargets varied in perceptual similarity to other nontargets, such that the perceptual load of searches could be lower (similar nontargets) or higher (dissimilar nontargets).

Peripheral distractors were target compatible or target incompatible. Working memory capacity was measured via a variety of tasks. Lavie's perceptual load effects were replicated. The relationship of these effects to individual differences in working memory was less clear and may be specific to the type of working memory task used to measure capacity.

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Tests of an Instance Theory of Attention and Memory. THOMAS J. PALMERI, GORDON D. LOGAN, & JEFFREY D. SCHALL, *Vanderbilt University*—We tested an instance theory of attention and memory (ITAM) recently proposed by Logan (2002). The model combines elements of the theory of visual attention of Bundesen (1990) and the exemplar-based random walk model of Nosofsky and Palmeri (1997). The model aims to account for identification, categorization, and visual search behavior within a unified theoretical framework. We describe attempts to apply ITAM to account for stimulus identification, single-item target/distractor categorization, and multiple-item target search by individual human subjects. We also describe attempts to extend the model to account for single-unit neural activity and visual search behavior in awake behaving monkeys (Schall, 2001).

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Emotion-Elicited Enhancement in Visual Processing. CLARK G. OHNESORGE & RHIANNON FERMOYLE, *Gustavus Adolphus College*—The emotional valence of visually presented stimuli has been shown to influence performance in cognitive and perceptual tasks. The standard explanation is that negative stimuli attract or receive more attention than do positive or neutral stimuli and produce changes in the performance of concurrent tasks as a function of that differential demand. In previous research, we supported this explanation by tracing the dynamic unfolding of an attentional channel following the presentation of emotionally valenced lexical stimuli. The data from our low-level visual task revealed that an attentional enhancement effect (reduced RT without increased errors) occurred for stimuli presented within the region of space formerly occupied by the emotion-eliciting stimulus. Two alternative explanations for this effect are perceptual enhancement and response facilitation. The present study tested between them by altering the experimental task from speeded classification to perceptual identification under backward masking. The results support the perceptual enhancement account.

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Attention and Reading of Nonfixated Words. JOEL LACHTER & ERIC D. RUTHRUFF, *NASA Ames Research Center,* & KENNETH I. FORSTER, *University of Arizona*—Over the last 2 years, we have presented evidence that unattended words are not read. The evidence for this claim is that, when subjects focus their attention on one location, a peripherally presented masked prime word presented in an unattended location does not prime a subsequent lexical decision. Here, we present evidence that a peripherally presented prime word that is attended does produce priming. Attention was drawn to the prime either by using an exogenous cue consisting of flickering nonwords or by encouraging subjects to spread their attention endogenously across several possible target locations. These results show that attention, but not foveal presentation, is necessary for the processing of masked words. Preliminary data further suggest that subjects can spread their attention with little "fan-out" effect.

• AUTOMATIC PROCESSES •

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Irrelevant Attention Shifts Produce a Simon Effect. WIM NOTEBAERT & ERIC SOETENS, *University of Brussels* (sponsored by Eric Soetens)—The Simon effect is the observation that trials in which the irrelevant stimulus location and the response location correspond are faster than trials in which locations do not correspond. The present study investigated the attention-shift explanation for the Simon ef-

fect. In Experiment 1, subjects had to react to the pitch of a tone that was presented in the left or the right ear with a left or a right response. Two response–stimulus intervals (RSIs) were used in order to manipulate the attention shifts during the task. With short RSIs, there was no Simon effect for location repetitions, because no attention shift toward the stimulus location was needed. In Experiment 2, subjects reacted to the color of a centrally presented visual signal. At stimulus onset, a tone was presented in one ear. The data demonstrated a Simon effect according to the auditory signal. This demonstrates that even an irrelevant attention shift produces a Simon effect.

(291)

Stimulus Processing and Task Dependency. DENIS COUSINEAU, HELIE SEBASTIEN, DOMINIC CHARBONNEAU, & CHRISTINE LEFEBVRE, *Université de Montreal*—Stimulus-dependant processing was studied with the idea that processing was mediated by the stimulus presented. Garner opposed two kinds of stimuli: integrated versus separated (Garner, 1970). The problem was that this distinction did not always hold across tasks. We suggest that both stimulus composition and task requirements play a role, resulting in a task × stimulus interaction. We tested integrated (gratings) and separated (CCC) stimuli in tasks that required the integration of wholes (XOR problem, visual search) or the processing of parts (OR problem, visual search of parts). We found that tasks whose requirements matched with stimulus structure were faster and easier. In addition, stimuli that were the easiest in one task were the most difficult in a different task, as is predicted by this framework. These findings have important implications for choices of a combination of tasks and stimuli in future empirical research.

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Disentangling Illusory Conjunctions From Feature Misperception in Vision and Audition. MICHAEL D. HALL, GRETCHEN KAMBE, KIMBERLY WIEBERG, & JANE KARWOSKI, *University of Nevada, Las Vegas*—Within the visual search literature, illusory conjunctions have been used as evidence for a feature integration process. However, multinomial models of visual illusory conjunctions have recently been questioned. Illusory conjunctions may be an artifact of failing to explicitly model feature misperception (Donk, 1999, 2001). We examined the relative contribution of feature misperception and illusory conjunctions in vision and audition. A new paradigm permitted the generation and comparison of multinomial models containing separate theoretical parameters for feature misperception and illusory conjunctions. In four experiments (two visual, two auditory), participants performed a four-way forced-choice identification task for arrays of simultaneous events composed of two distinct features (color/shape, pitch/timbre). Across modalities, models that included feature misperception parameters fit the data significantly better than models of guessing and illusory conjunctions. Furthermore, the combination of illusory conjunctions with feature misperception did not enhance model predictions. Implications for theories of feature integration will be discussed.

(293)

Pitting Target–Distractor Similarity Against Stimulus–Response Mapping in Visual-Memory Search. SERGE LAROCHELLE, CHRISTINE LEFEBVRE, & DENIS COUSINEAU, *Université de Montréal*—The experiments reported pit target–distractor similarity against stimulus–response mapping in an attempt to determine which principle is more critical to the automatization of visual-memory search. In the consistent mapping (CM) condition of the experiments, different sets of stimuli served as targets and as distractors, but no single feature allowed discrimination of the two sets. By contrast, a single feature allowed discrimination of the two sets of stimuli used in the other condition of the experiments (called *categorical varied mapping*, or CVM), but the two sets of stimuli switched roles as targets and distractors. Response times provided evidence of automatization in the CVM condition, but not in the CM condition, even after twice

as much practice. Performance on single-feature search trials in the CVM condition remained very efficient when such trials were mixed with conjunction search trials. Overall, the results show a greater influence of similarity than of mapping on visual-memory search.

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The Taboo Stroop and Related Effects of Emotion on Memory and Attention. DONALD G. MacKAY & MEREDITH A. SHAFTO, *UCLA,* LISE ABRAMS, *University of Florida,* & JENNIFER DYER, *University of Michigan*—The taboo Stroop refers to effects of emotion on attention and memory that occur when people name the color of randomly intermixed taboo and neutral words: Color-naming times are longer for taboo than for neutral words, and participants recall more taboo than neutral words in surprise memory tests following color naming. Results of two experiments ruled out response inhibition and strategic attention to taboo words as accounts of the taboo Stroop but indicated that individual taboo words trigger specific emotional reactions that habituate with repeated activation. A third experiment examined immediate recall of rapidly presented lists containing taboo and neutral words in order to test three accounts of the superior recall of taboo words in taboo Stroop experiments. Results ruled out accounts based on retrieval factors and emotion-induced reductions in short-term memory capacity but supported the hypothesis that emotional reactions automatically facilitate storage of taboo words via amygdala-to-hippocampus connections.

• **Letter/Word Processing** •

(295)

The Unselected Meaning of Ambiguous Words: Is There Evidence of Suppression? KIMBERLY WEAR, DAVID S. GORFEIN, & HARRIETT AMSTER, *University of Texas, Arlington*—Two-process theories predict facilitation when the same meaning of an ambiguous word is required on a second occurrence, but when the meaning is changed, suppression of the first meaning is predicted. On the first occurrence, homographs were presented followed by a word associated to one meaning (SEAL–*dolphin*). Participants made timed relatedness decisions. Conditions included a single occurrence in which the homograph was presented once and tested with either a same meaning pair (*walrus–otter*) or a different-meaning pair (*glue–shut*) and a contrasting occurrence in which the homograph was presented a second time with an associate word related to the other meaning. Results supported previous findings by Gorfein (2001): Facilitation was observed in the single occurrence condition, but suppression was not observed in the contrasting condition. Other conditions examined repetition of the homograph and repetition of a contrasting meaning. The results are evaluated relative to baseline, where no homograph was presented.

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Time Course and Task Differences of Spelling-to-Sound and Sound-to-Spelling Mappings. ALEXANDRA JESSE & DOMINIC W. MASSARO, *University of California, Santa Cruz* (sponsored by Dominic W. Massaro)—One of the critical issues in visual word recognition is whether and how orthographic information maps into phonology and vice versa. Interactive and noninteractive theories make different predictions about a potential number of influences in written word recognition. Statistical occurrence and spelling-to-sound regularity have been factors assumed by noninteractive theories. Interactive activation theories posit spelling-to-sound and sound-to-spelling consistency as important factors. We describe a series of experiments addressing this controversy, as well as provide an analysis of previous studies. Tasks included lexical decision, naming, and our new tasks of perceptual identification and naming at several delays. Dependent measures were reaction time, accuracy of performance, and a new measure of duration of the pronunciation of the initial phoneme of the test word. Important factors in resolving the controversy included the type of task, proper controls such as familiarity, accuracy of measurement, and item analyses.

(297)

Reasserting the Role of Category Differences in the Alphanumeric Category Effect. PAUL HAMILTON & THAD A. POLK, *University of Michigan*—Do letter and digit recognition depend on the same or different cognitive mechanisms? Letters are detected faster among digits than among letters; this alphanumeric category effect (ACE) suggests that different mechanisms underlie recognition of these two categories. There are, however, systematic physical differences between letters and digits (e.g., letters tend to be straighter, digits more curvy), and perhaps the ACE is an artifact of these differences. We manipulated the physical similarity among letters and digits, as well as the salience of the categorical difference (by using both upright and inverted characters). Both manipulations had significant effects, but the categorical difference between letters and digits had an effect over and above the effect of physical differences. These findings suggest, therefore, that letter and digit recognition are, at least to a degree, functionally independent.

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Representation of Visual Word Forms in fMRI Habituation Paradigms. DONALD J. BOLGER & WALTER SCHNEIDER, *University of Pittsburgh* (sponsored by James Voss)—Brain-imaging studies of word processing suggest the presence of a visual word form (VWF) area in the ventral fusiform lingual cortex. This area responds differently for words and letter strings (e.g., Petersen et al., 1989). In this experiment, we sought to identify visual features, using an fMRI habituation study (e.g., Grill-Spector & Malach, 2001), in which cortical areas show reductions of activation when there is a repetition of higher level features even when lower features are altered. The degree of habituation provides a metric of representation selectivity at a given region/stage of processing. We compared the adaptation of the cortical response for differential word types (words, pseudowords, symbol strings) and compared repeating orthographic codes (e.g., "th") in order to show the relative habituation at progressive stages of visual linguistic processing (V1, V2, V4, VWF, SPTG, Broca's areas). The results of these studies suggest early orthographic lexical representations in the visual system.

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Bilingual Identity Priming. IRA H. BERNSTEIN & KAY ERUSU, *University of Texas, Arlington*—Participants classified Arabic numerals as odd versus even in a reaction time task. Prior to the appearance of these targets, primes appeared in the form of (1) a dot (control), (2) the same Arabic numeral, or (3) the same numeral in Hindi. As was expected, only the Arabic numeral primed reactions for non-Hindi readers. However, Arabic and Hindi numerals primed Hindi readers to an equivalent extent. This illustrates one form of cross-linguistic priming.

(300)

Control Over Response Timing in the Tempo-Naming Task. CHRISTOPHER T. KELLO, *George Mason University*—In the tempo-naming task (Kello & Plaut, 1998, 2000), readers exhibit precise control over the amount of processing time alotted for naming a printed stimulus. Five tempo-naming experiments are presented in which the nature of this control mechanism was investigated. A total of 100 participants each named 600 words in one of five possible conditions: standard naming and mixed or blocked tempo-naming with or without pressure for rapid processing. Tempos were set at rates between 200 and 650 msec. Results are discussed with respect to the following four questions: (1) How agile is the mechanism of control over processing time, (2) what is the relationship between the time course of processing and the time course of response execution (i.e., naming duration), (3) what do errors in tempo-naming tell us about reading, and (4) how do stimulus and control factors combine to determine response times?

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"Slips of the Pen" and the Internal Structure of Graphemic Representations. JOCELYN R. FOLK, *Kent State University,* & BRENDA RAPP, *Johns Hopkins University*—We investigated the internal struc-

ture of graphemic representations by examining the writing errors of unimpaired subjects, called *slips of the pen*. Ninety-six subjects listened to a tape-recorded sentence twice and then had to write the sentence as quickly as possible while also engaging in a secondary task. The secondary task involved counting the number of taps that each subject heard on the tape while writing and was included to increase the number of writing errors. Subjects listened to a total of 138 sentences that included 330 target words. The words were designed to allow us to examine whether the following factors would influence the rate and type of errors made: syllable boundary, graphemic versus phonological length, position of a consonant within a cluster, syllable stress, silent letters, double letters, and affixation.

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L1 Dependency for Number Processing in Arabic–French Bilinguals. ETSUKO T. HARADA, *Hosei University,* HIROMI ODA, *Hewlett-Packard Laboratories,* AKIFUMI TOKOSUMI, *Tokyo Institute of Technology,* SATORU SUTOH, *Chuo University,* AKIKO MOTOYOSHI, *Kyoto Notre Dame University,* & JUN'ICHI ODA, *Tokyo University of Foreign Studies*—Previous studies comparing English and Japanese language processing of objects and numbers in native Japanese speakers have reported an L1 dependency in number processing. This study examined whether the same phenomenon would be observed in bilinguals, as Kolers (1968) suggested on the basis of interviews with bilinguals. Twenty-three Lebanese university students, who were all Arabic–French bilinguals, were asked to name either in Arabic or in French a series of objects and numbers. The objects were presented as pictures, Arabic words, or French words, whereas the numbers were presented either as usual numerals (Arabic figures) or as Indian figures. Errors and pauses were analyzed for 54 responses in 12 trials for each participant. The results showed greater errors in naming numbers in Arabic and greater errors and more pauses in naming objects in French. Language dominance and L1 dependency for number processing are discussed.

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Conditional Naming of Pictures and Words. REMO JOB, LORELLA LOTTO, & FRANCESCA PERESSOTTI, *DPSS University of Padova*—Participants were required to categorize and name pictures and to categorize and read words. Categorizing a word before reading it led to an increase in RTs, as compared with the condition in which reading was not conditional on the categorization of the word. No cost was associated with the conditional naming of pictures. The effect persisted even when uncertainty in naming pictures was controlled for. This result is discussed in terms of multiple procedures operating to retrieve the phonological form of pictures and words.

(304)

The Role of Syllable Structure in Word Recognition During Silent Reading. JANE ASHBY, KEITH RAYNER, & ALEXANDER POLLATSEK, *University of Massachusetts* (sponsored by Alexander Pollatsek)—Two eye movement experiments sought evidence for sublexical levels of phonological structure in word recognition during silent reading. Primes that were syllabically congruent or incongruent with the initial syllable of two types of targets (e.g., de.cay or sig.nal) were presented using boundary change techniques. A comparison of fixation times for congruent and incongruent conditions tested whether primes containing the first syllable boundary would facilitate word recognition more than would primes violating the syllable boundary. Experiment 1 used fast-priming to present a syllabically congruent or incongruent foveal prime. Word recognition was facilitated by syllabic congruency and by more letters in the prime. Experiment 2 used the parafoveal preview technique. With parafoveal presentation, syllabically congruent primes yielded shorter fixation times for all words, with a larger congruency effect for CV words (20 msec) than for CVC words (11 msec). Word recognition was facilitated by syllabic congruency, offering evidence for the representation of sublexical phonological structure.

(305)

Grammatical Gender Does Not Carry a Semantic Content in Italian. CRISTINA CACCIARI & ROBERTO PADOVANI, *University of Modena*—In Glucksberg et al. (2000), we replicated Banaij and Hardin's (1996) study on gender stereotyping in a gender-marked language, such as Italian, and in English. Subjects decided the gender of masculine or feminine personal pronouns that were preceded by a word having a natural gender (*mother*), a stereotypical gender (*nurse*), or an arbitrary one (*table*, masculine in Italian). No clear gender prime effect was obtained for object nouns. The present experiments further investigated whether the arbitrary gender associated to objects in Italian carried a semantic content. Despite the Whorfian hypothesis, only natural and stereotypical gender effects were obtained.

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Asymmetric Aging Effects on Semantic and Phonological Processes: Naming in the Picture–Word Interference Task. JENNIFER K. TAYLOR, *Claremont Graduate University,* & DEBORAH M. BURKE, *Pomona College*—In two experiments, young and older adults named pictures while ignoring auditory word distractors varying in their relation to picture names. Only semantically related distractors produced more interference for older than for young adults. Distractors that were semantically related to the nondepicted meaning of homophone pictures (e.g., *prom* for a picture of a toy ball) facilitated naming via top-down phonological connections (e.g., via dance ball) for young adults (Cutting & Ferreira, 1999), but not for older adults. Facilitation from phonologically related distractors was age invariant, except in distractors that were both semantically and phonologically related. Slowing from unrelated distractors, as compared with white noise, was also age invariant. These results are inconsistent with age-linked deficits in inhibition of distracting or irrelevant information from either internal or external sources. Rather, aging affects priming transmission in a connectionist network, with asymmetric effects on semantic and phonological connections involved in comprehension and production, respectively.

(307)

Feedback From Semantics to Phonology: Evidence From a False Memory Paradigm. CHRIS WESTBURY, *University of Alberta,* & LORI BUCHANAN, *University of Windsor*—Converging evidence from neuropsychology and experimental psycholinguistics has indicated that semantic activation may impinge on phonological selection during lexical access, suggesting that there is early and rapid feedback from phonology to semantics during the access process. This evidence has implications for the functional organization of the lexical access process. We report on two experiments that used a false memory paradigm to study this feedback, one in the written and one in the auditory modality. We semantically primed words in the study list and tested for false memories on words that overlapped in systematic ways with the unseen primes. With an auditory presentation, we found evidence of strong phonological feedback from semantics. No evidence of feedback was found in the written modality. The implications for lexical organization are discussed.

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Metaphor Comprehension Is Influenced by Semantic Distance and Working Memory. DAWN G. BLASKO & VICTORIA A. KAZMERSKI, *Pennsylvania State University, Erie,* DEBRA A. TITONE, *McGill University,* & MATTHEW R. STEVENSON & BANCHIAMLACK DESSELEGN, *Pennsylvania State University, Erie*—Participants ($N =$ 84) read word-by-word three types of metaphorical sentences varying in aptness and semantic overlap (high-apt/high-overlap, low-apt/high-overlap, and low-apt/low-overlap) and judged their meaningfulness. The stimuli were presented either in an unfolding or a moving window display. Each sentence was presented in one of three contexts: metaphor supportive, neutral, and literal. The participants completed a listening

span task as a measure of verbal working memory and were classified as high or low working memory on the basis of their score. Metaphor type interacted with context such that metaphorical contexts were more beneficial to comprehension if semantic overlap was high. Reading time per character for the full sentence showed that for the metaphors that were most difficult (low-apt/low-overlap), the low working memory group showed little benefit from the metaphorical context, in comparison with the neutral group, whereas the high group was significantly slowed when integrating the contextual information.

(309)

Morphology in an Inflectionally Rich Language: Implications for the Rules Versus Connections Debate. JELENA MIRCOVIC & MARK S. SEIDENBERG, *University of Wisconsin, Madison,* & MARC F. JOANISSE, *University of Western Ontario* (sponsored by Mark S. Seidenberg)—Inflectional morphology is often said to be rule governed, but this claim may be related to the fact that most studies have focused on English, which has a very simple inflectional system. We examined the representation of inflectional morphology in Serbian, which has a complex inflectional system encoding number, gender, and case for nouns. As in English, Serbian inflectional morphology contains numerous partial regularities and neighborhoods that vary in size and consistency (i.e., it is quasiregular). A connectionist model trained on 3,244 nouns learned to generate correctly inflected phonological forms from a specification of a word's lemma, gender, number, and case and generalized to untrained cases. The performance of the model suggests that, as in English, generating correctly inflected words involves satisfying a small number of simultaneous probabilistic constraints. Thus, common computational mechanisms may govern the representation and use of inflectional information across typologically diverse languages.

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Scope of Facilitation for Highly Predictive Simple and Complex Sentences. ERIC S. PETERSEN, GEORGE KELLAS, & KIMBERLY METCALF, *University of Kansas*—In their seminal research, Schwanenflugel and colleagues (Schwanenflugel & LaCount, 1988; Schwanenflugel & Shoben, 1985) demonstrated a narrow scope of facilitation for upcoming words in highly constrained sentences. Expected sentence completions were facilitated, whereas completions semantically related to expected completions were not. The results were related to featural constraints imposed by contexts. However, it is unclear whether this outcome is related to automatic feature generation or to postaccess inferences enabled by the use of a lexical decision task with a long ISI. The present research reexamined this issue, employing a naming task with 0 ISI for both simple and complex predictive sentences. The results indicated that expected completions, as well as words semantically related to expected completions, were facilitated for both sentence types. In addition, the magnitude of facilitation was greater for simple than for complex sentences. The pattern of results was interpreted within a feature-based model of word processing.

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This Construction Needs Learned: Acquisition of Novel Syntactic Patterns by Adults. MICHAEL P. KASCHAK & ARTHUR M. GLENBERG, *University of Wisconsin, Madison*—It is typically assumed that whereas children are good at acquiring syntax, adults are not. We present data suggesting that this is not necessarily the case. In two experiments, we demonstrated that adults were capable of learning new syntactic patterns within the confines of their native language. Learning was demonstrated using a text-reading paradigm. Initially, the novel constructions (e.g., "The floor needs cleaned.") and the low-frequency constructions (e.g., "Him be a doctor?") used in our experiments caused processing difficulty for readers. Nonetheless, by the end of the experiment, readers came to process these sentences as readily as they processed higher frequency, standard constructions in English (e.g., "The floor needs to be cleaned." and "He is a doctor?"). These data suggest that the ability to learn syntactic patterns is not specific to children; rather, adults are capable of learning new syntactic patterns in their native language.

(312)

Past Tense Verb Generation in Aging and Dementia of the Alzheimer's Type. MICHAEL J. CORTESE, *Morehead State University,* & DAVID A. BALOTA & SUSAN D. SERGENT-MARSHALL, *Washington University*—Younger adults, older adults, and individuals with dementia of the Alzheimer's type (DAT) produced the past tense of a verb based on a present tense carrier sentence (e.g., *Everyday I ding the bell. Yesterday, I _____ it.*). After completing the past-tense task, participants performed a task that indicated their level of understanding of verb meanings. Five main findings were obtained: (1) across all groups, fewer regularization errors occurred for irregular consistent words than for inconsistent verbs; (2) for correct responses, a consistency effect in reaction time was obtained for regular verbs only; (3) the proportion of regularization errors decreased across age and increased by DAT; (4) other errors (e.g., *ding-donged*) increased across age and DAT; and (5) the comprehension measure correlated weakly (but significantly) with the proportion of regularizations and strongly with other errors. These results are discussed in terms of the role of attentional control of linguistic processing dimensions.

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Lexical Retrieval and Memory in Simultaneous Interpreting: Expertise and Language Proficiency. INGRID K. CHRISTOFFELS & ANNETTE M. B. DE GROOT, *University of Amsterdam*—Simultaneous interpreting is a complex skill, where language comprehension and production take place at the same time in two different languages. In this study, we tried to identify some of the cognitive skills involved in interpreting. We focused on basic language skills and working memory. Picture naming and word translation in two languages were used to indicate retrieval time of lexical items. Also, (working) memory tasks (a word span, a reading span, and a speech span in two languages) and two control tasks measuring vocabulary and basic reaction time were presented. Comparison of professional interpreters with subjects without any experience in simultaneous interpreting showed better performance for the interpreters on most of the tasks. Moreover, the role of language proficiency in task performance was studied by including a third group of participants (English teachers).

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Entropy in Language(s): A Cross-Linguistic Investigation. SUSANNE R. BORGWALDT, *University of Amsterdam,* FRAUKE M. HELLWIG, *Max Planck Institute for Psycholinguistics,* & ANNETTE M. B. DE GROOT, *University of Amsterdam* (sponsored by Jeroen G. W. Raaijmakers)—During the past decades, many studies have investigated the role of spelling–sound transparency in visual word recognition. Alphabetic languages show more or less ambiguous relations between spelling and sound patterns. The degree of spelling–sound (un)ambiguity is one of the variables that affect visual word recognition. Recent investigations into the (un)ambiguity of alphabetic orthographies (cf. Smith & Silverberg, 2002, for English; Lange & Content, 1999, for French; and Martensen et al., 2000, for Dutch) have focused on expressing this ambiguity in terms of entropy values, a concept proposed by Shannon (1948), and measuring the unpredictability of a variable. In this study, we present a computational analysis of bidirectional spelling–sound entropy values for Dutch, English, German, French, and Italian. To validate the generated cross-linguistic data, we demonstrate that various entropy variables predict performance on word recognition tasks. Implications for current models of word recognition will be discussed.

• DISCOURSE PROCESSES •

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The Role of Working Memory Capacity and Textual-Causal Constraints in the Hemispheric Processing of Backward and Forward Inferences. TRACY A. LINDERHOLM, *University of Florida,* &

SANDRA M. VIRTUE & PAUL W. VAN DEN BROEK, *University of Minnesota*—The role of working memory (WM) capacity and textual-causal constraints in the processing of inferences in the hemispheres was examined. Low and high WM capacity participants read high and low causally constraining texts that promoted either backward or forward inferences and performed a lexical decision task to inference-related probe words presented to the right visual field–left hemisphere or to the left visual field–right hemisphere. Both low and high WM capacity readers showed similar levels of activation for high-constraint inferences in the left and right hemispheres. Low WM capacity readers showed greater levels of activation for low-constraint inferences in the right hemisphere than in the left hemisphere. These patterns were observed for both backward and forward inferences. Thus, high WM capacity readers showed a similar pattern of activation in response to textual-causal constraints in each hemisphere, whereas low WM capacity readers had a unique pattern of activation in each hemisphere. These results provide evidence that low WM capacity readers process inferences across hemispheres differently than do high WM capacity readers.

(316)

It's Not Just What You Say: The Influence of Discourse Status on Sentence Production. H. WIND COWLES, *University of Sussex,* & VICTOR S. FERREIRA, *University of California, San Diego*—Language comprehension research suggests that different structural options attribute different discourse statuses to a sentence's arguments. However, production research has suggested that speakers tend to place easily retrieved arguments early, in a manner that may not depend on their discourse status. Three experiments examined the role of discourse status on sentence production by comparing topichood and givenness. Experiment 1 measured how often a noun that was previously heard in a sentence as either topic or given was mentioned first in a subsequent target sentence. Results revealed that topic arguments show an early-mention advantage over given arguments, suggesting that topichood exerts a specific effect on sentence production. Experiments 2 and 3 extended this result and provided evidence that the early-mention advantage is not due to lexical activation alone and that it is dependent on the topic status of the argument, and not on its syntactic position in a prior context.

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Can Specific Predictive Inferences Be Encoded Into Long-Term Memory? MARK A. CASTEEL, *Pennsylvania State University, York*—Recent research disagrees on whether specific predictive inferences can be instantiated and form part of the long-term memory representation for a text. Cook, Limber, and O'Brien (2001), for instance, suggested that only general state changes are actually represented in memory, rather than specific inference concepts. In a series of studies, this research attempted to examine this claim. Participants read stories that implied an outcome or explicitly presented a *state change* outcome (but the outcome was not the specific inference). Reading time was measured to a target line that either explicitly presented the inference or repeated the state change outcome. Results will be compared with previous findings and interpreted in light of current discourse-processing models.

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Causality and Time: Two Dimensions of Situation Models (SMs) in Text Comprehension. JACQUELINE WANIEK & JOSEF F. KREMS, *Chemnitz University of Technology*—Although SMs are multidimensional, most studies have examined only single dimensions. The goal of this study was to investigate the generation of inferences on the SM dimensions of time and causality. Participants read different texts in which events were presented as causal-coherent/temporal-incoherent (Condition 1) or causal-incoherent/temporal-coherent (Condition 2). In a second experiment, participants with differently manipulated preknowledge (causal vs. temporal) read texts in a similar learning situation. Results show that readers do not generate inferences to the same extent on all the dimensions of SMs. Causal relations were un-derstood even when the presented text was causally incoherent or when readers did not have causal preknowledge. In contrast, temporal relations were understood only when events were presented temporally coherent or when readers had temporal preknowledge. Causal relevance of temporal relations was a high predictor for readers' generation of temporal inferences. Results suggest that readers focused on causal relations.

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Grounding Multiple Tasks in Different Communication Media. MIJA M. VAN DER WEGE, *Carleton College*—The use of Internet communication tools, such as instant messaging, has become an increasingly popular form of communication. Instant messaging can take one of two forms. In the first, which I will call *synchronous conversation*, the people conversing can see what their partners type as they type it, letter by letter. In the second, which I will call *asynchronous conversation*, the people conversing can see each turn only after they send it. A study done recently by Hancock and Dunham (2000) found that in completing a collaborative reference task, the asynchronous conversations were more effective. The present study investigated whether these results would generalize to a variation on the collaborative reference task in which the participants collaborate on multiple goals simultaneously.

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Shallow Semantic Processing of Text: An Individual-Differences Perspective. BRENDA HANNON & MEREDYTH DANEMAN, *University of Toronto*—We used Barton and Sanford's (1993) anomaly detection paradigm to investigate text-processing differences between skilled and less skilled readers. All the readers had the tendency to process text in a shallow or incomplete manner, frequently failing to detect anomalous nouns (or noun phrases) in questions such as "When an airplane crashes, where should the *survivors (surviving injured)* be buried?" This finding suggests that all readers are not scrupulous about processing and integrating every word into their representation of the text and will often assume coherence as a default, as long as there is sufficient global coherence. However, it was only the less skilled readers who had particular difficulty noticing locally anomalous noun phrases such as *surving dead*, suggesting that less skilled readers frequently fail to establish the meaning of a noun phrase prior to integrating it into the rest of the text.

(321)

Speech Act Theory Informs Behavior Change in Drug Addicts, or "Searle Hits the Streets." PAUL C. AMRHEIN, *University of New Mexico and Montclair State University*—Client language from a motivational interview (MI) and subsequent drug use were investigated. Interview videotapes of 84 drug abusers were coded for frequency and strength of utterances expressing commitment or underlying sincerity/preparatory conditions: desire, ability, need, readiness, and reasons to change or maintain the drug habit. Commitment utterances were most frequent, followed by reasons, desire, ability, need, and readiness utterances. Cluster analysis revealed three outcome groups: high abstinence at intake and follow-up (maintainers), low abstinence at intake/high abstinence at follow-up (changers), and low abstinence at intake/low-to-moderate unstable abstinence at follow-up (strugglers). Commitment language strength generally increased during MI, although group-specific patterns emerged. Commitment strength was independently influenced by the strength of sincerity/preparatory conditions but predicted behavior better than any of them, suggesting that commitment can mediate their influence on behavior. Results provide ecological support for speech act theory concerning the making of "felicitous" verbal commitments.

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Eye Movements for Reading of Overlearned Text. CYNTHIA H. NULL, *NASA Ames Research Center*—Eye movements have been used to investigate perceptual and cognitive processes in reading for

decades. Reliable results include the findings that eye fixation position and gaze duration can be predicted from word frequency and predictability from the linguistic context. Much of the work, however, has focused on first-time reading of narrative text. In a variety of work places, such as aircraft cockpits, highly trained individuals reread familiar procedures on a daily basis. How does what we know about the reading process help predict eye movement patterns for highly familiar text? In a series of experiments, the question of whether the findings from less practiced reading conditions generalize to overlearned conditions will be examined.

• CATEGORIZATION •

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Recall of Categories With Shared Features. ROGER M. DUNN, *San Diego State University*—Two procedures investigated recall of categories acquired on a successive discrimination task. Each category comprised 12 features, but only 3 of the features were presented on a training trial. In the first procedure, the categories shared all 12 features with some features more probable in one category or the other. These predictive features were recalled earlier, but not more often, than noninformative features. In the second procedure, categories included unique features, predictive features, and equally common features. Unique features were recalled earliest and most often. Again, predictive (other than unique) features were recalled earlier, but not more often, than common features. In both procedures, the recalled categories were more distinct—that is, had fewer shared features—than did the trained categories. The results will be discussed with reference to elemental models of generalization and peak shift.

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The Effects of Multiple Examples on Mapping in a Generation Task. CYNTHIA M. SIFONIS, *Oakland University,* THOMAS B. WARD, *Texas A & M University,* & DEDRE GENTNER, *Northwestern University*—The effects of multiple examples on object and relation mapping was examined in a creative generation task. Participants were presented with two examples of a novel category domain and were instructed to generate three examples of their own. The objects, the relationships between objects, or the higher order relationships between objects were maintained across the examples seen by participants. Of interest was the degree to which consistencies across examples were incorporated into participants' novel products. The results indicated that consistencies in the higher order relationships across examples were incorporated into the novel products generated by participants. We propose that participants were making comparisons across the examples given to them. This resulted in increased attention to consistencies in the higher order relationships between objects and an increased tendency to incorporate those relationships into their novel products.

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Similarity Representation and Categorization: An ADDTREE-Based Application. TOM VERGUTS, *University of Ghent,* & TIMOTHY VERBEEMEN & GERT STORMS, *University of Leuven*—An adaptation of the generalized context model (Nosofsky, 1986) and a general prototype model are presented using feature-based similarity structures provided by an ADDTREE analysis (Sattath & Tversky, 1977). They are compared with the common geometric (MDS) approach, reanalyzing data from Smits et al. (in press). Categorization of well-known and novel foods into the categories of fruits and vegetables was predicted. Of all four similarity structure × categorization strategy combinations, the ADDTREE-based exemplar approach fitted best for well-known stimuli, whereas the geometric exemplar approach fitted best for unknown stimuli. When the feature-based prototype was combined with the geometric exemplars in a single prediction for novel stimuli, the fit value clearly improved, arguing for a combination of strategies (Smith & Minda, 1997, 2000).

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False Prototype Enhancement Effects in Dot-Pattern Categorization. SAFA R. ZAKI, *Williams College,* & ROBERT M. NOSOFSKY, *Indiana University*—Dot-pattern categorization studies have sometimes yielded small prototype enhancement effects that could not be accounted for by a pure exemplar model. However, in these experiments, the status of the prototype was confounded with properties of the individual items, as well as with the frequency of presentation of the prototype during testing. In a mock subliminal experiment, participants made typicality judgments to patterns that were generated as prototypes or high-level distortions of different categories. Participants rated the prototypes as being more likely to be members of a category, although none of the patterns were presented during training and all of the patterns were unrelated. In another experiment, greater prototype enhancement effects were observed when the prototype and low-level distortions were presented with greater frequency during transfer. These results suggest that these prototype enhancement effects may not be due to a prototype abstraction process.

(327)

Hierarchical Organization for Concrete and Abstract Concepts. KATJA WIEMER-HASTINGS, *Northern Illinois University*—Three experiments tested the view suggested by previous research that abstract and concrete concepts, denoted by nouns, are organized hierarchically. The first experiment showed that depending on the word sample, noun concepts are organized in hierarchies or in matrices, where feature dimensions overlap across clusters. Experiments 2 and 3 showed that hierarchies are obtained when words are sampled evenly from a large range of categories (e.g., not just artifacts, or not just emotions), but that within such categories, concept organization resembles a matrix more. The experiments further suggest that only concrete concepts are organized around predicates. Abstract concepts seem to be organized around the characteristics of situations. This suggests that the representation of abstract and concrete concepts does not just differ in terms of the quantity of observable features but, rather, that their features are qualitatively different. Data from a separate feature generation experiment support this view.

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Multiple Representations in Inductive Category Learning: Evidence of Stimulus- and Task-Dependent Representation. MICHAEL A. ERICKSON, *University of California, Riverside,* & JOHN K. KRUSCHKE, *Indiana University*—ATRIUM, a rule-and-exemplar theory of category learning, posits that people can learn to use different psychological representations to classify different stimuli. This entails that people's representations will change from stimulus to stimulus at a given time and will change over time. Experiment 1 extended work by Aha and Goldstone (1992) to demonstrate that participants utilize multiple representations once training is complete and that the representation that is selected varies systematically from stimulus to stimulus. Experiment 2 extended work by Nosofsky, Clark, and Shin (1989) to demonstrate that many participants use exemplar-similarity–based representations during training and shift to rule representations when feedback is eliminated and participants are required to generalize to novel stimuli. ATRIUM is able to account for the data and is able to assay participants' representations.

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The Incidental Learning of Characteristic Attributes in a One-Dimension Rule Sorting Task. GUY L. LACROIX, *Brock University,* & GYSLAIN GIGUÈRE & SERGE LAROCHELLE, *Université de Montréal*—The use of a single dimension to classify exemplars in sorting tasks is a robust finding (Ahn & Medin, 1992; Regehr & Brooks, 1995; Lassaline & Murphy, 1996). In prior research, participants rarely deviated from this strategy, unless the experimental conditions allowed them to focus on individual items. However, these studies rarely included any transfer phase, thereby possibly preventing participants from demonstrating knowledge about characteristic

attributes that might have been learned but not used in the sorting task. To address this question, we propose two experiments, which include transfer phases, to study the effect of changes in characteristic attributes on performance.

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Exemplar- Versus Rule-Based Accounts of Unidimensional Perceptual Categorization in Monkeys. SIMON FARRELL, ROGER RATCLIFF, ANIL CHERIAN, & MARK SEGRAVES, *Northwestern University*—Recent investigations of perceptual categorization in monkeys (Ratcliff, Seagraves, & Cherian, 2002) has produced response probability and response time data similar to that found in humans (e.g., Ratcliff & Rouder, 2001). The study presented here was concerned with the performance of monkeys on a simple unidimensional perceptual categorization task with probabilistic feedback. The feedback function was constructed such that use of exemplars (as in the generalized context model; Nosofsky, 1986) predicted a nonmonotonic decrease in response probabilities toward one end of the function (i.e., probability matching), whereas use of boundaries (as in general recognition theory; Ashby, 2001) predicted a monotonic increase in the same region. Quantitative fitting of the empirical results, using AIC model selection, favored GRT. Furthermore, the results suggested that the monkeys in this task always used a single boundary even when optimal performance required use of a second boundary.

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Paralinguistic Correlates of Conceptual Structure. DALE J. BARR, *University of California, Riverside*—How is conceptual knowledge transmitted during conversation? When speakers refer to an object, the name they choose conveys information about category identity. In addition, I propose that a speaker's confidence in a classification can convey information about category structure. Because atypical instances of a category are more difficult to classify than typical instances, when speakers refer to them, their lack of confidence will manifest itself paralinguistically—that is, through hesitations, filled pauses, or rising prosody. An experiment in which listeners learned novel color categories from a speaker found that listeners were sensitive to this correlation between speaker certainty and category structure. When the speaker's confidence was consistent with the category structure, listeners learned categories faster and showed better category differentiation than when it was inconsistent. These findings have implications for theories of category learning and conversational coordination.

(332)

Affect as a Dimension of Category Formation. L. ELIZABET CRAWFORD, *University of Richmond* (sponsored by Janellen Huttenlocher)—Affective responses constitute an important dimension of experience that may serve as a basis for category formation. By presenting positive and negative images in separate areas of space, we investigated whether people would form spatial categories to capture areas in which affectively similar stimuli were clustered. Results indicate that through experience with stimuli, people learn which spatial regions are likely to contain positive or negative stimuli and that they can use this information to predict the locations of novel stimuli. In addition, results from a spatial memory task indicate that these affectively defined regions are used to reconstruct memories of where individual stimuli previously appeared.

• METACOGNITION •

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Metacognitive Knowledge and Error Detection in Fronto-Temporal Dementia. DIEGO FERNANDEZ-DUQUE & SANDRA E. BLACK, *University of Toronto*—People have a tendency to overestimate their own abilities. This actor–observer asymmetry is largest in the prediction of future performance and smallest in the estimate of past performance. One of the reasons why task experience contributes to a more realistic self-assessment is that it offers the opportunity to experience errors and failures. However, patients with denial of deficit believe that their cognitive abilities are spared, despite daily evidence to the contrary. To explore whether denial of deficit stems in part from an inability to detect errors, we administered a Stroop and a change blindness task to fronto-temporal dementia patients who exhibited denial of deficit. Relative to normal controls and patients with Alzheimer's disease, patients with denial of deficit were overconfident in their abilities both before and after testing.

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Perception of Tutoring Efficacy Before and After Grading. JULIE B. MORRISON & JEAN-PAUL NADEAU, *Bryant College*—Do students reinterpret their tutoring experiences after receiving grades on tutored assignments? This study investigated students' perceptions of the efficacy of consultations at a college writing center (WC) before and after the assignment was graded. Fifty-three students in a psychology course were individually tutored by WC consultants, immediately after which the students evaluated the experience, using Likert scales. Approximately 1 week after receiving their grade and 3 weeks after making the initial evaluation, students reevaluated the experience. Overall, ratings on the primary *satisfaction with experience* scale were lower after grades had been received than before. However, ratings did not differ by student grade, with all students equally reducing their ratings. The decline in students' perceptions of tutoring efficacy cannot be attributed to dissatisfaction with grades. Alternate explanations for this effect, including the realization, after the initial WC rating, of the effort needed to implement the consultant's suggestions, are under investigation.

• DEVELOPMENTAL PROCESSES •

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Age-Related Differences in Within-Subjects Irregular Preferences. C. BLAKE BERGERON, ALISSA GREENBERG, CLAIRE HESS, KATRINA PAPADOPOULOS, KEA SHERWOOD, & KRISTI S. MULTHAUP, *Davidson College,* & MARK E. FAUST, *University of South Alabama*—When asked to choose from {Coke, Pepsi, and RC Cola} or {Coke and Pepsi}, people who choose Coke from one set and Pepsi from the other set demonstrate a reversal of preference that has been labeled *irregular.* Previous research has shown that younger adults are irregular in their preferences, whereas older adults are not. However, prior research has involved between-subjects designs in which participants were assigned to either the {A, B, C} or the {A, B} condition. Thus, it is possible that individuals may not show irregular preference patterns, even though groups of individuals (e.g., younger adults) do. The present research manipulated the choice set size ({A, B, C} and {A, B}) within subjects. In this stronger test, younger adults still demonstrated irregular preferences, whereas older adults did not. Measures of expertise did not account for the irregular preferences.

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Attention Context, Trauma History, and Preschoolers' Memory for Threat-Related Information. KATHRYN A. BECKER, *University of New Hampshire,* JENNIFER J. FREYD, *University of Oregon,* & KATHERINE C. PEARS, *Oregon Social Learning Center* (sponsored by Jennifer Freyd)—Dissociation is a cognitive process by which people remain unaware of aspects of their experience. Dissociation may be adaptive for caregiver abuse survivors, since it allows children to avoid the reality of abuse and remain attached to caregivers (Freyd, 1996). Research on adults' performance on Stroop and directed forgetting tasks indicates that, under divided attention, high dissociators recall more neutral information and less trauma-related information than do low dissociators, supporting the hypothesis that high dissociators have developed divided attention skills to avoid traumatic reminders (e.g., DePrince & Freyd, 1999). In this study, preschool children completed an analogous task. Eighty 4- and 5-year olds viewed neutral and charged pictures under selective and divided attention. Under divided attention, traumatized children remembered fewer charged

pictures, as compared with nontraumatized children. Implications for the development of dissociative, attentional, and memory processes for children living in stressful and abusive environments are discussed.

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What Causes the Specific Age-Related Impairment in Learning Proper Names? LORI E. JAMES, MARY STEPHENS, & KINNARI SHAMBHU, *University of Colorado, Colorado Springs*—We tested the prediction that proper names are particularly difficult to learn in older adulthood. In Experiment 1, young and older participants saw pictures of previously unknown men, identified by name and occupation. On subsequent presentations of each picture, participants attempted to recall each man's name and occupation. Both young and older adults made more errors involving names (name errors) than errors involving occupations (occupation errors). Older adults committed more name errors than did young adults, but there was no age difference in occupation errors, indicating a specific age-related impairment in proper name learning. Experiment 2 replicated Experiment 1 and included a detailed analysis of the errors committed (e.g., "don't know" responses, confusions of names and occupations, etc.). Findings help clarify the causes of the specific age-related impairment in proper name learning and are explained within the framework of the transmission deficit hypothesis and node structure theory (MacKay & Burke, 1990).

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Reminiscing About the Not-So-Good Old Days: Mother–Child Conversations About Negative and Neutral Events. MELISSA M. BURCH, JOLAINE B. McNAMARA, & PATRICIA J. BAUER, *University of Minnesota*—Children learn to reminisce through conversations with adults. Whereas the majority of these conversations are about positive or neutral events, emotionally negative events provide a special opportunity for understanding and interpreting emotional experiences. The present research compared the contributions of 50 mothers and their 3-year-old children when discussing neutral and negative events. Across the two event types, mothers did not differ in their levels of elaboration and repetition. Children provided informationally denser narratives and more internal states and rationalizations for negative than for neutral events. Relations between mother and child contributions differed across event types. After controlling for maternal talkativeness, few relations were found within neutral events. However, within negative events, the ratio of maternal elaborations to repetitions predicted the density of children's narratives and their questioning of their mothers. Thus, mothers who provided a stronger narrative model when discussing negative events had children who were more involved in these discussions.

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Development of Binding in Children's Memory. E JULIA SLUZEN-SKI & NORA S. NEWCOMBE, *Temple University* (sponsored by Nora S. Newcombe)—*Binding* refers to the combination of memories to form more complex units. Binding may form the basis of source discriminations and, more generally, episodic memory (e.g., Chalfonte & Johnson, 1996). Of interest in the present study was whether there are changes in binding in the preschool years, a finding that could account for corresponding changes in episodic memory. Four-year-olds, 6-year-olds, and adults viewed pictures of animals, each in a unique background. Subjects were then tested on memory for isolated animals, isolated backgrounds, or animals in their respective backgrounds (binding condition). Planned comparisons revealed that 4-year-olds performed comparably to 6-year-olds on animals and backgrounds but worse in the binding condition. In addition, 6-year-olds performed worse than adults in both the background and the binding conditions. These findings suggest that binding undergoes development before and possibly after age 6 and may contribute to developmental changes in memories for complex events.

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Effects of Age on Skilled Performance in Elite Senior Golfers. D. ZACHARY HAMBRICK, JENNIFER L. MILLER, & KATHER-INE R. SHELDON, *Michigan State University*—Research has established that various perceptual, cognitive, and motor abilities decline in adulthood. However, it is unclear whether and to what extent complex real-world skills that may involve such abilities decline as well. With this in mind, the purpose of the present study was to investigate effects of age on skilled performance in the domain of golf. Cross-sectional data sets for four years (1989, 1993, 1997, and 2001) were obtained from archival sources and included performance measures for Senior PGA Tour players (ranging in age from 50 to 70 years) in two facets of golf: the "long" game (e.g., driving) and the "short" game (e.g., putting). Correlational analyses revealed that negative effects of age were greater for long-game skills, which require explosive strength, than for short-game skills, which require precision. Possible explanations for why certain aspects of skilled performance may be less vulnerable to age-related decline than are others are discussed.

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Is There a Reminiscence Bump for Flashbulb Memories? ALI I. TEKCAN & CEYLAN DEMIR, *Bogazici University*—People remember disproportionately more from their adolescence and early adulthood. This effect, known as reminiscence bump, occurs for different tasks, including recall of autobiographical memories and recognition of general knowledge information. The purpose of the present study was to see whether reminiscence bump extends to recall of flashbulb memory details (i.e., personal details of how one first learned about surprising and consequential events). Seven public events from the last 65 years were selected, and 218 participants (ages 17–90) were interviewed about the events that occurred in their lifetime. Collapsed over all events, elderly participants' recall was better for events that occurred during their adolescence and early adulthood. Moreover, when data from each event were analyzed separately, a clear reminiscence bump was also present for all seven events. Thus, in addition to semantic information and autobiographical memories, age-at-event has a clear effect on flashbulb memories.

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Counting Span, Counting Knowledge, and Procedural Competencies in Children With Mathematical Disabilities. JENNIFER BYRD-CRAVEN, MARY K. HOARD, & DAVID C. GEARY, *University of Missouri* (sponsored by David C. Geary)—Complex relations among understanding of counting, ability to remember numbers, and competency of strategies used to solve simple arithmetic problems were examined in 237 first, third, and fifth grade children, while controlling for math and reading achievement and IQ. Counting knowledge was assessed to determine whether poor conceptual understanding of counting persists in mathematically disabled (MD) children beyond second grade. The relationship between counting span and counting-procedure competency in an addition strategy task was examined to determine whether procedural deficits can be predicted from span deficits. Relations among counting knowledge, counting span, and addition strategy were examined, since counting span (e.g., working memory) might be one mechanism contributing to the development of counting knowledge and because counting knowledge may contribute to the procedural competencies of MD and other children. A pilot study showed a significant correlation between counting span and frequency of finger counting. The results of the present study are presented.

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Recalling What Wasn't There: When Older Adults Perform as Younger Adults. KARIN M. BUTLER, MARK A. McDANIEL, & COURTNEY C. DORNBURG, *University of New Mexico,* HENRY L. ROEDIGER III, *Washington University,* & AMANDA L. PRICE, *University of New Mexico* (sponsored by Mark A. McDaniel)—False memory was assessed in young and older adults, using the DRM paradigm (Deese, 1959; Roediger & McDermott, 1995). Older adults were

divided into groups on the basis of their scores on a composite measure of frontal functioning. As has been shown previously, older adults were less likely to correctly recall list items but were more likely to falsely recall highly related nonpresented items than young adults were (e.g., Norman & Schacter, 1997). This age difference in the incorrect recall of critical items was found only for low frontal functioning individuals; high frontal function older adults had equivalent veridical recall rates and equivalent levels of false recall to those of young adults. These results suggest that differences in performance on tasks associated with frontal lobe functioning can predict age differences in false memory.

• TOUCH/HAPTIC PERCEPTION •

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The Face Inversion Effect: Does It Apply to Haptic Face Processing? ANDREA R. KILGOUR & SUSAN J. LEDERMAN, *Queen's University*—Are faces processed more by configuration or by features? Visual "inversion" paradigms show that inverted faces are more difficult to process than upright faces; in contrast, nonface objects (e.g., houses) elicit no inversion effect. Researchers have interpreted this finding as evidence for greater configural processing in visual face recognition. Recently, Kilgour and Lederman (2002) showed that people are capable of recognizing faces by hand alone. Experiment 1 asks whether configural processing is also important for haptic face recognition. University students performed a same–different task in each of four stimulus conditions: upright faces, inverted faces, upright teapots, and inverted teapots. There was a significant inversion effect for faces, but not for teapots. Experiment 2 temporally restricted manual exploration to force subjects to focus more on individual features of the same stimulus objects. The inversion effect for faces disappeared. We conclude that haptic face recognition relies more on configural processing.

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Gap-Detection as a Measure of Tactile Spatial Sensitivity. GREGORY O. GIBSON & JAMES C. CRAIG, *Indiana University* (sponsored by Gabriel P. Frommer)—Tactile sensitivity was measured using a gap-detection task, a nominal measure of spatial sensitivity. Psychometric functions were generated at four locations that varied in density of innervation: index fingertip, proximal fingerpad, palm, and forearm. Performance was also measured with and without a latex glove. Gap-detection sensitivity varied as a function of location in a predictable manner, and the latex glove had only a small effect on performance. These results were similar to those obtained previously with a grating-orientation task but unlike those obtained in a smooth-groove task. The gap-detection task appears to be a good measure of spatial acuity, one that can be used across a wide variety of body locations. These results will be discussed in terms of how psychophysical manipulations may be used to reveal the underlying neural code, spatial or intensive, for various measures of tactile sensitivity.

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Effects of Modality, Surface Type, and Smoothness on Texture Discrimination. CHRISTINA C. MENDAT, SLATER E. NEWMAN, & DONALD H. MERSHON, *North Carolina State University* (sponsored by Slater E. Newman)—Results from previous research comparing visual and haptic discrimination of smooth textures have been mixed. Heller (1989, Experiment 2), using Japanese waterstone surfaces, reported greater accuracy under the haptic condition, but in an experiment by Bozoglu-Sinclair (2001), using sandpaper surfaces, visual examination was the more accurate. In the present experiment, participants judged the smoothness of visually or haptically examined smooth and rough pairs of waterstone and sandpaper stimuli. Although accuracy was not affected by any of the independent variables, inspection time was shorter under the visual condition and for the rougher stimuli. Accuracy in judging the stimuli was found to be better predicted using optical profilometry to assign surfaces of smoothness than using the scale provided by the manufacturer. Implications of these results will be discussed.

• MOVEMENT PERCEPTION •

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The Influence of Animation on Judgments of Incline Speed. DOUG ROHRER, *University of South Florida*—Previous findings have revealed that many people mistakenly attribute an object's speed at a point along an incline to the incline's slope at that point. By this slope–speed belief, a roller coaster ought to be faster at a "steep point" along a downhill than at a "gradual point" near the bottom of the hill. In fact, the roller coaster is faster near the bottom of the hill, because its incline speed is greater at points of lower elevation. In the present study, college students observed animations of incline motion that obeyed either the slope–speed belief or Newtonian theory. Whereas other false beliefs about motion typically lose their appeal once people have seen the corresponding animations, the slope–speed animation was judged as "more natural" than the Newtonian animation.

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Representational Momentum and the Flash-Lag Effect. RYAN OWENS & MARGARET P. MUNGER, *Davidson College*—When shown a flashed object that is actually aligned with a moving object, participants report that the flash appears to lag behind (FLE). FLE seems to depend on the moving object's continued presence. Representational momentum (RM) is a distortion in which the final orientation of a moving object is misremembered as farther along the trajectory. When participants judged the position of a spinning rod with or without an additional flashed object, the addition of a flashed object led to even larger downward forward distortions, suggesting that the RM task provides sufficient illusory motion to produce FLE. Across all experiments, larger RM was observed for downward rotations, suggesting sensitivity to gravity within the observer's representation.

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Do Chromatic Patterns Affect Vection-Induced Motion Sickness? ANDREA BUBKA & FREDERICK BONATO, *Saint Peter's College*—Within seconds, when the interior of a large rotating optokinetic drum is viewed, vection, or subjective motion, is often experienced; for longer periods of time, motion sickness symptoms are reported. Seated observers viewed three patterns inside the drum: (1) chromatic stripes, (2) black and white stripes, and (3) gray stripes (different reflectances) that matched the luminance levels of the chromatic stripes. The onset time and mean overall vection and motion sickness symptoms were measured. It has been hypothesized that as the complexity of the visual field increases, the magnitude of vection and motion sickness also increases. The results indicate that the chromatic complexity hastens the onset of vection and symptoms. These results will also be discussed in the context of neurological pathways related to color and motion perception.

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Representational Momentum for a Target Not Pursued by Eye Movements. MASAYOSHI NAGAI & JUN SAIKI, *Kyoto University*—The judged final position of a moving target is displaced forward (representational momentum, RM). Recently, Kerzel (2000) found RM with smooth pursuit eye movements (SPEMs) but no RM with eye fixation, and suggested that RM was elicited by SPEMs, after a target's offset, that moved the target's persisting image in the direction of motion. We examined RM for a target that was not pursued by the eyes. The target and a small dot moved in the same or opposite directions. Participants were instructed to pursue the small dot and locate the final position of the target. In both conditions the target's motions in the retina were equal to each other. The persisting image hypothesis predicts negative RM for the target moving in the opposite direction of SPEMs. Although RM in the opposite condition was substantially small, positive RM in both conditions was found. Therefore, the hypothesis was questionable, and other explanations are discussed.

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Evidence That Environmental Size Is Estimated Prior to "Mental Scaling" on a Form-Matching Task. DAVID J. BENNETT, *Brown University*—Reaction time increases with inceases in the size ratio in a same–different form-matching task (Bundeson & Larsen, 1975). Bennett and Warren (*P&P*, 2002) varied both retinal and environmental size ratios in a simultaneous same–different task by placing random, untextured forms at different distances along a (simulated) textured hallway, viewed monocularly. Roughly equal effects of environmental and retinal size ratios were found. The present study enriched scene size information by using simulated stereo and textured forms. Forms with smooth outlines and forms with spiky outlines were used in separate experiments. In each case (*same* trials), there was a large effect of environmental size ratio but no effect of retinal size ratio. Experienced subjects showed a similar pattern. The results suggest that, with the stimuli used, size coding is entirely controlled by scene size information. The paradigm employed holds promise as an indirect reaction time measure of size perception.

Memory Theory
Atlanta, Saturday Morning, 8:00–10:00

Chaired by Francis S. Bellezza, Ohio University

8:00–8:20 (352)

Modeling Midazolam's Effect on the Hippocampus and Recognition Memory. KENNETH J. MALMBERG, RENÉ ZEELENBERG, & RICHARD M. SHIFFRIN, *Indiana University* (read by Richard M. Shiffrin)—The benzodiazepine midazolam causes dense, but temporary, anterograde amnesia, similar to that produced by hippocampal damage. We ask whether the action of midazolam on the hippocampus causes less storage, or less accurate storage, of information in episodic long-term memory. This question is addressed by using the REM model (Shiffrin & Steyvers, 1997) to fit data collected by Hirshman, Fisher, Henthorn, Arndt, and Passannante (in press) on the effects of midazolam, study time, and normative word frequency on both yes–no and remember–know recognition memory. A very simple version of REM could account quantitatively for these data, contrary to the expectations of Hirshman et al. Use of the REM modeling framework demonstrated that the data were consistent with the view that midazolam causes less accurate, rather than less, storage of information in episodic memory.

8:25–8:45 (353)

Contrasting Signal Detection and Multinomial Process-Tree Approaches for Recognition Memory. RICHARD A. CHECHILE, *Tufts University*—Chechile and Meyer (1976) devised a memory task that randomly intermixed recall and old/new recognition test trials so that participants did not know in advance the type of memory test trial used. The task also requires participants to give 3-point confidence judgments for their recognition response. Data collected with this experimental task can be modeled by either a signal detection analysis or a multinomial process-tree model. The signal detection model of recognition memory is demonstrated to have fundamental problems in regard to (1) the predicted y-axis intercept for the ROC curve and (2) the effect of target–foil similarity on the sensitivity measure. The process-tree approach for memory measurement does an excellent job of correcting for response bias and estimating the underlying memory processes.

8:50–9:10 (354)

Multidimensional Analysis of Recognition Memory. WILLIAM P. BANKS, ADOLFO J. RUMBOS, & LAUREN L. KONG, *Pomona College*—A number of issues in recognition memory can be resolved by treating memory as a multidimensional space, rather than as having only unidimensional strength. I will report some results that are based on applications of general recognition theory (GRT) to recognition memory. GRT is a multidimensional version of signal detection theory, normally used in psychophysical paradigms but ideally suited to recognition memory. The talk will show how to generate a multidimensional memory space and how to interpret it. A simplified version of GRT relates source and old–new discrimination and makes excellent predictions for exclusion performance, false fame, and the effect of secondary tasks and other variables on these measures. The approach also yields an interpretation of the constancy of the slope of the memory zROC. The shape of the ROC as memory approaches zero is given by this analysis, and a serious possible error in interpreting such ROCs is discussed.

9:15–9:30 (355)

The Four-States Model of Memory Retrieval Experiences. EDGAR ERDFELDER, *University of Mannheim,* & UTE J. BAYEN, *University of North Carolina, Chapel Hill*—A model is presented that accounts for judgments of remembering, knowing, and guessing in old–new recognition tasks by assuming four disjoint latent memory states: recollection, familiarity, rejection, and uncertainty. The model can be applied to both Tulving's remember–know procedure (RK variant) and Gardiner's remember–know–guess procedure (RKG variant). It is

shown that the RK variant of the model fits remember–know data approximately as well as the single-process detection model does. In contrast, the RKG variant of the four-states model clearly outperforms the corresponding detection model even if unequal variances for old and new items are allowed for. We show empirically that the two variants of the four-states model measure the same state probabilities. However, the RKG variant, requiring remember–know–guess judgments, provides parameter estimates with smaller standard errors and is therefore recommended for routine use.

9:35–9:55 (356)

An Inverted-Face Effect? It Depends on Your Theory. GEOFFREY R. LOFTUS, MARTIN OBERG, & ALLYSS DILLON, *University of Washington*—A true but often sublimated fact of research is that one's conclusion depends on one's theory of the phenomenon under investigation. We illustrate this point, using the inverted-face effect: The perceptual disadvantage of inverting a face is generally greater than the disadvantage of inverting other visual stimuli. Recognition memory was measured for novel faces or houses initially shown at varying durations either inverted or upright. As was expected from past data, the inversion effect was greater for faces than for houses, based on the traditional stimulus type × orientation interaction. However, we generated a theory that assumes that, for both stimulus types, duration and orientation combine at perception into a single measure (*strength*) and that face and house recognition performance are then determined by separate monotonic functions of strength. This theory, which implies the inversion effect to be identical for faces and houses, makes a very strong prediction that was perfectly confirmed.

Language Production II
New York, Saturday Morning, 8:00–10:05

Chaired by Fernanda Ferreira, Michigan State University

8:00–8:20 (357)

Phonology and Morphology Occur in Parallel in Child Language Production. JOSEPH P. STEMBERGER, *University of British Columbia*—Some models of language (both connectionist and symbolic) posit that phonological processing (construction of the pronunciation of a word) occurs in parallel with morphological processing (construction of a word out of meaningful morphemic subunits), rather than serially (morphological processing prior to phonological processing). Parallel models predict that phonological factors can affect the outcome of morphological processing. This ChiLDES-based study focuses on two types of morphological error in child language development: overtensing ("Did I *missed* it?" for "Did I *miss* it?") and overregularization ("*breaked*" for "broke"). The phonological dimension examined is whether the error creates a basic cluster or rime (e.g. /kt/, /ɪst/) that can appear in monomorphemic English words versus a derived cluster or rime (e.g., /vd/, /aɪkt/) that can occur only in morphologically complex words. It is shown that errors more frequently involve basic clusters and rimes than derived clusters and rimes. Implications for models of language production are discussed.

8:25–8:35 (358)

The Interaction of Words and Phonological Segments in Speech Production. MICHAEL S. VITEVITCH, *University of Kansas*—Numerous studies have suggested that the initial phoneme of a word (or syllable onset) plays an important role in speech production. Recent findings have also demonstrated the importance that the number of similar sounding words has in lexical retrieval during speech production. The results from a picture-naming task demonstrate that the number of words that share the onset of the target word also influences speech production: the more words that share the onset, the more slowly the picture was named. These results suggest that information about words and phonological segments interact to retrieve items from the lexicon during speech production. The implications for feedforward and feedback models of speech production will be discussed.

8:40–8:50 (359)
Telling the Future: Timing Word Preparation and Articulation.
ZENZI M. GRIFFIN, *Georgia Institute of Technology*—Speakers must coordinate their processing of ideas, words, and movements over time, but they have some flexibility. Participants were asked to name two objects without pausing between names. Everything else being equal, participants began speaking earlier when the first objects had long names (*skeleton–pipe*) rather than short ones (*scarf–pipe*). Inserting the words "next to" between names allowed speech to begin even earlier, with more preparation of the second name occurring during speech. These effects were observed in speech onsets, speech durations, and eye movements to objects. Similar timing occurs in gazes while describing scenes (Griffin & Bock, 2000) and in initiating sequences of arm movements (Ketelaars, Garry, & Frank, 1997). Thus, people are sensitive to the amount of time it takes to prepare and perform an action or say a word. When speakers choose to, they can use this information to minimize advance preparation and buffering of words while speaking fluently.

8:55–9:15 (360)
The Production of Inflected Words. MICHELE MIOZZO & BRIDGID FINN, *Columbia University*—It takes longer for speakers to name pictures shown with word distractors. The word interference effect varies as a function of word frequency: Low-frequency words interfere more than high-frequency words. Various experimental results indicate that the distractor frequency effect has its locus at the level of word selection for production. We examined the distractor frequency effect to understand how English speakers produce inflected nouns (e.g., *chairs*) and verbs (e.g., *coloring*). In a series of experiments, we used inflected words as distractors for picture naming, and we factorially varied the distractor stem frequency (determined by the sum of the occurrences of all the inflected forms of the stem) and the frequency of the distractor inflected form. We consistently found that the stem frequency (not the frequency of the inflected form) was a reliable predictor of distractor interference. These results support lexical models proposing that inflected words are represented as morphologically decomposed forms.

9:20–9:40 (361)
Jailbird and Hummingbird Help Naming a Picture of a Bird: Effects of Semantic Transparency and Morphological Complexity in Picture Naming. JENS BÖLTE, PETRA DOHMES, & PIENIE ZWITSER-LOOD, *University of Münster*—There is a long debate whether morphologically complex words are stored in a decomposed manner or in full form. Semantic transparency has been used as a tool to investigate this issue. Semantically transparent compounds (e.g., *Buschrose*, *bush rose*) produce larger priming effects to morphologically related targets (e.g., *rose*) than do semantically opaque compounds (e.g., *Gürtelrose*, *shingles*). We addressed this question for the production of nouns from pictures. Pictures (*rose*) were paired with morphologically related words (*Buschrose* or *Gürtelrose*) or with unrelated words (e.g., *Windmühle*, *windmill*). Two immediate and one delayed variant of the picture–word interference paradigm were used. All experiments showed clear facilitation of picture-naming latencies by morphologically related words. Surprisingly, the degree of semantic transparency did not modulate this effect. The results suggest that morphological complexity in speech production is utilized at a level of lexical form that is unaffected by differences in semantic transparency.

9:45–10:00 (362)
Effects of Orthography on Speech Production in a Form Preparation Paradigm. MARKUS F. DAMIAN & JEFFREY S. BOWERS, *University of Bristol*—The potential influence of spelling on single-word speech production was investigated. A form preparation paradigm that shows priming effects for words with initial form overlap was used to investigate whether words with form overlap but different spelling (e.g., *camel–kidney*) also show priming. In two experiments, we show that such words did not benefit from the form overlap, suggesting that the incongruent spelling disrupted the form preparation effect. To divert participants' attention from the spelling of the targets, a further experiment was conducted entirely in the auditory domain but yielded the same outcome as before. These findings open the possibility that orthographic codes are mandatorily evoked in speech production by literate speakers.

Movement Perception I
Chicago A, Saturday Morning, 8:00–10:00

Chaired by William H. Warren, Jr., Brown University

8:00–8:10 (363)
Toward a Complexity Theory of Vection (Illusory Self-Motion).
FREDERICK BONATO & ANDREA BUBKA, *Saint Peter's College*—Illusory self-motion (vection) is often experienced when a large portion of a stationary observer's visual field moves. Vection occurs in driving and flight simulators and even IMAX movie theaters. We report on experiments in which seated observers viewed the interior of a large rotating cylinder (optokinetic drum). Dependent measures included onset latency (in seconds) and vection saliency for a 1-min period. Onset latency was shortest and vection saliency was greatest when the interior of the drum was (1) spatially complex (more visible surfaces) or (2) chromatically complex (chromatic as opposed to achromatic). These results support our developing theory in which any increase in overall visual complexity facilitates vection. Increases in visual complexity more closely approximate the natural environment, which is perceived as unmoving. Results will be discussed in the context of evolution psychology and neurological pathways that are known to play a role in color and motion perception.

8:15–8:30 (364)
The Effect of Object and Event Orientation on Perception of Biological Motion. THOMAS F. SHIPLEY, *Temple University*—Experience appears to influence biological motion perception. Detection and recognition of point light walking is reduced when displays are upside down. However, it is not clear whether this is a consequence of presenting the human form in a novel orientation or the event of walking in a novel orientation, since the two are confounded. To tease apart the effects of object and event orientation, detection accuracy was determined for upright and inverted displays of point light walking on hands. Detection in the upright display, which had a familiar event and an unfamiliar object orientation, was higher than in the inverted display. When the experiment was repeated with only arm or leg points visible, there was no effect of inversion for walking on feet and a small effect for walking on hands. These findings support accounts of event perception based on detection of dynamics, over those based on bootstrapping from knowledge about objects.

8:35–8:50 (365)
Something in the Way She Moves? Experience Effects in Action Perception. ALISSA JACOBS & MAGGIE SHIFFRAR, *Rutgers University* (read by Maggie Shiffrar)—Human observers exhibit impressive visual sensitivity to human movement. Why? To test the hypothesis that observers are particularly sensitive to human movement because they have extensive experience watching other people move, visual sensitivities to frequent and rare human movements were compared. Point-light displays of humans walking on a treadmill at 10 different speeds and in three different manners (common, energetically efficient gaits plus two rare, inefficient gaits) were created. Observers performed 2AFC gait speed discrimination tasks. If experience determines visual sensitivity to human movement, then observers should perform more accurate speed discriminations with common gaits than with unfamiliar gaits. The results indicate, however, that visual sensitivity to walker speed is frequency independent under noninteractive conditions. Conversely, when observers performed a walker-identity discrimination task with the same point-light stimuli, significant experience effects were found. Thus, visual experience can influence the visual analysis of human action under functionally relevant conditions.

8:55–9:10 (366)

Perceiving Distance: The Role of Effort and Intent. JESSICA K. WITT, DENNIS R. PROFFITT, & WILLIAM EPSTEIN, *University of Virginia* (read by Dennis R. Proffitt)—Perceiving egocentric distance is not only a function of the optical variables to which it relates, but also a function of people's current physiological potential to perform intended actions. In a set of experiments, we show that as the effort associated with walking an extent increases, perceived distance increases if people anticipate walking the extent, but not if they anticipate throwing a ball that distance. Conversely, as the effort associated with throwing increases, perceived distance increases if people anticipate throwing, but not if they anticipate walking. Perceiving distance combines the geometry of the world with our behavioral goals and the potential of our body to achieve these goals.

9:15–9:30 (367)

Environmental Context Affects Visual Distance Perception. AMY L. SHELTON, *Johns Hopkins University,* & JOSEPH S. LAPPIN, JOHN J. RIESER, & DAWN M. WILLIAMS, *Vanderbilt University* (read by Joseph S. Lappin)—Classical research has frequently assumed that visual space has an abstract structure independent of its particular contents. Accordingly, the specific environmental context was often regarded as either irrelevant or a source of extraneous "cues" for inferring sizes and distances. We present two experiments demonstrating that visually perceived distances vary in unexpected ways with the environmental context. The method of adjustment (Experiment 1) and the method of constant stimuli (Experiment 2) were used to assess the perceived midpoints of egocentric distances in an open lawn, a hallway, and a building lobby. Perceived midpoints were accurate on the lawn, but in both the lobby and the hallway they were too far, opposite the usual foreshortening effect. Variable errors were consistently greater in the hallway. The specific contextual characteristics responsible for these effects are not yet known, but these results challenge the idea that perceived space is independent of its contents.

9:35–9:55 (368)

Sex, Brains, and Acceleration: Converging Evidence for an Evolutionary Bias for Approaching Auditory Motion. JOHN G. NEUHOFF, *College of Wooster,* FRANCESCO DI SALLE, *University of Naples,* & ERICH SEIFRITZ, *University of Basel*—Perceptual overestimation of increasing acoustic intensity may provide a selective advantage by specifying that an approaching sound source is closer than actual, thus affording listeners advanced warning of the approaching source. Here, we provide converging evidence for this evolutionary hypothesis. We found that listeners perceived increasing intensity to change more than equivalent decreasing intensity, that rates of intensity changes specifying accelerating approach changed more in loudness than did equivalent intensity changes specifying decelerating approach, and that consistent with evolutionary theories of sex-specific spatial attributes, females had ratios of rising to falling loudness change almost twice as large as those of males. Finally, using functional magnetic resonance imaging in conjunction with approaching and receding auditory apparent motion, we found that as compared with receding sources, approaching sources activate a specific cortical network that subserves behaviorally fundamental and adaptive functions of the auditory system and that responds with high priority to stimuli associated with looming sources.

Selective Attention
Chicago BC, Saturday Morning, 8:00–9:50

Chaired by J. Scott Jordan, Illinois State University

8:00–8:15 (369)

Ability to Control Attention and Working Memory Capacity. RANDALL W. ENGLE & JOSEF C. SCHROCK, *Georgia Institute of Technology*—The antisaccade task requires subjects to resist looking toward an abruptly displayed target and instead move their eyes in the opposite direction. In Experiment 1, we tested high and low working memory span participants on blocks of antisaccade and prosaccade trials. High working memory span subjects were faster and more accurate in the antisaccade task than were low spans. We found no span differences for the prosaccade task. In Experiment 2, pro- and antisaccade trials were presented within blocks. Low spans were more likely to make a saccade in the wrong direction for both pro- and antisaccade trials. The results from Experiments 1 and 2 are consistent with the idea that measures of working memory reflect a basic capacity to control attention. Individual differences in working memory capacity predict performance in the antisaccade task, a task that makes minimal demands on storage and long-term memory but does require attentional control.

8:20–8:35 (370)

Contingent Oculomotor Capture. ARTHUR F. KRAMER, *Beckman Institute, University of Illinois, Urbana-Champaign,* MATTHEW S. PETERSON, *George Mason University,* & CHARLES L. FOLK, *Villanova University*—According to the contingent capture hypothesis, only objects that match a top-down attentional set will capture attention. For example, if the task is to look for a color singleton, only color singletons will capture attention, and onsets can be ignored. At Vision Sciences 2002, Peterson, Kramer, and Irwin introduced a new technique for simultaneously measuring covert and overt (eye movements) attention. Using this technique, we find that although a top-down attentional set does affect the degree of attentional capture, the effect is not as strong as predicted by the original contingent capture hypothesis. For example, when the target is a color singleton, onsets should not capture attention. In contrast, we find that not only does an onset capture attention, but also that the degree of attentional capture is modulated by whether the onset matches the color of the singleton target.

8:40–9:00 (371)

The Role of Personal Importance in Attention Capture: A Combined Behavioral and Psychophysiological Study. NURIT GRONAU, ASHER COHEN, & GERSHON BEN-SHAKHAR, *Hebrew University of Jerusalem* (read by Asher Cohen)—Studies that have investigated capture of attention by semantically important stimuli (e.g., one's own name) have reached inconsistent results, possibly because of improper control of the subjects' attention. Our research measured both RTs and the orienting response (OR) and controlled visual attention by using a Stroop-like task in which subjects were requested to respond to a central color and ignore a word presented either centrally (i.e., at the focus of attention) or peripherally (outside the focus of attention). Slower RTs and larger ORs were obtained for important items relative to neutral items when the words appeared at the focus of attention. However, these effects largely disappeared when the words appeared in a peripheral, unattended location. The peripheral words interfered with the color-naming task only when they were relevant to task demands, indicating an attentional capture by the semantic content of unattended stimuli only under endogenous, but not under exogenous, conditions.

9:05–9:20 (372)

The Effect of Key Labels on Reverse Stroop Congruity. JOHN S. MONAHAN, CARRIE R. TARATUTA, TRESSA E. KENDALL, & CHRISTINA M. SCHOFIELD, *Central Michigan University*—Automaticity, translation, and dimensional imbalance models of Stroop congruity were tested using responding to normal and reverse Stroop congruity via keyboard response on keys labeled with either color words or color paint. Four groups of 30 participants responded to four sets of 48 trials, one group per Stroop-direction–key-label combination. Initially, reverse Stroop participants with word labels showed nonsignificant congruity, and those with color labels showed a very high level of congruity. For the other three trial blocks, both groups showed significant reverse congruity, with greater congruity with colored keys. Normal Stroop participants showed little difference in congruity with key label or with practice. All four groups became faster with practice. These results fit neither translation nor dimensional imbalance models but do fit

a model of stimulus processing and response processing automaticity. They also suggest that response conditions may be important in determining dimensional relations among stimuli.

9:25–9:45 (373)

Converging Operations Revisited: The Case of Attention. LAWRENCE M. WARD & DAVID A. PRIME, *University of British Columbia,* & JOHN J. MCDONALD, *Simon Fraser University*—There has been some disagreement about whether visual and auditory cues can orient auditory or visual attention (i.e., auditory–visual cross-modal orienting). We report two experiments that demonstrate that the disagreement is apparently attributable to differences in task demands. Uninformative visual precues facilitated processing of sounds both near and some distance away from their location in an implicit (azimuthal) localization task, whereas they failed to do so in an up–down discrimination task. Such cases are reminiscent of the subliminal perception discussion in the 1950s, where the concept of converging operations was first employed. Although the point has been raised before in attention (e.g., Kahneman & Treisman, 1985), it seems necessary to raise it anew: Paradigms in experimental psychology are complex and engage many psychological processes, and different paradigms tend to emphasize different subsets of these. Thus, it is wise to perform converging empirical operations before making general claims about any psychological process, especially one as ill-defined and complex as attention.

Animal Learning I
Chouteau, Saturday Morning, 8:00–9:35

Chaired by William D. Timberlake, Indiana University

8:00–8:15 (374)

Trial Number and Temporal Relationship as Joint Determinants of Second-Order Conditioning and Conditioned Inhibition. STEVEN C. STOUT, *SUNY, Binghamton,* MARTHA ESCOBAR, *Auburn University,* & RALPH R. MILLER, *SUNY, Binghamton* (read by Ralph R. Miller)—Two conditioned lick suppression experiments with rats used feature-negative training (A+, XA−) to analyze the role of the number of compound stimulus presentations and the temporal relationship of elements within the compound (simultaneous or serial) as determinants of the resulting behavioral control. Treatment, consisting of interspersed reinforced element (A+) and nonreinforced compound trials (XA−), showed second-order conditioning (i.e., excitatory behavioral control by X) to decline as the number of XA− compound trials was increased and, further, to decline more rapidly if X and A were presented simultaneously, as opposed to serially (i.e., X before A). Conditioned inhibition to X, as assessed by summation and retardation tests, increased with the number of XA− trials and did so more quickly for simultaneous than for serial pairings of X and A. The results clarify a longstanding dispute about factors that promote excitation versus inhibition with this protocol.

8:20–8:35 (375)

The Role of Temporal Intervals in Blocking. KIMBERLY K. KIRKPATRICK, *University of York*—The present study investigated the role of temporal variables in mediating blocking effects in an appetitive classical conditioning paradigm. Rats were given pretraining with CS–US pairings in which CSA was short (10 sec) or long (30 sec). In the compound training phase, a novel CSB was presented in compound with CSA. The CSB duration was either short (10 sec) or long (30 sec). There were four groups that received different combinations of CSA–CSB training: S–S, L–L, S–L, or L–S. The S–S and L–L groups received overlapping compounds, but the compounds in the S–L and L–S groups only partially overlapped. Blocking was most robust in Group S–S that received a 10-sec CSA and a 10-sec CSB in an overlapping temporal arrangement. The results indicate that both absolute duration (S–S vs. L–L) and relative duration (S–S vs. L–S) play a role in blocking effects.

8:40–8:55 (376)

Partial Reinforcement Attenuates Consummatory Successive Negative Contrast. SANTIAGO PELLEGRINI, *Universidad de Buenos Aires,* & MAURICIO R. PAPINI, *Texas Christian University* (read by Mauricio R. Papini)—Rats given access to a 32% sucrose solution later reject a 4% solution significantly more than do controls that have received only the 4% solution. In Experiment 1, this consummatory successive negative contrast effect was attenuated by the administration of a mixture of trials involving the 32% solution and water, in a 50% partial reinforcement schedule, relative to a continuous reinforcement group. In Experiment 2, the administration of the benzodiazepine anxiolytic chlordiazepoxide during water trials restored the contrast effect in the partially reinforced group. Parallels between the effects of partial reinforcement on consummatory and instrumental situations will be discussed.

9:00–9:10 (377)

Effects of Extinguishing a CS on Competition With Another CS. TODD R. SCHACHTMAN & CARLA H. BILLS, *University of Missouri,* & OSKAR PINENO, *Deusto University*—Rats were used in a conditioned taste aversion procedure to examine the effects of extinction of a CS on competition of this CS with a novel CS during compound conditioning. One flavor was paired with LiCl and then received CS-alone extinction trials. This CS was then paired with LiCl in the presence of a novel, added CS. A control condition involved conditioning and extinction with a control flavor. The results showed that conditioning and extinction of the pretrained CS produced greater conditioning to the added, target CS than for the control condition. An additional experiment found that the good acquisition with the added CS that is obtained when it is reinforced in compound with an extinguished CS is attenuated by a retention interval's occurring prior to compound conditioning. The results are discussed with respect to the different processes involved during competition among CSs.

9:15–9:30 (378)

Incentive Learning in Pavlovian Conditioning. TERRY L. DAVIDSON & ANDREA L. TRACY, *Purdue University,* & JAVIER R. MORELL, *Star Enterprises, Inc. and Indiana University*—Changes in degree of food deprivation may have little effect on instrumental responding for food unless rats have previously eaten the food under the changed deprivation level. One interpretation of this effect is that rats must learn that the incentive value of food has changed before satiation can suppress or hunger can augment instrumental responding. In two experiments, rats received Pavlovian training where a tone signaled sucrose pellets. For rats that were trained food deprived and tested food sated, suppression of test responding to the tone (relative to a nonexposed control) was greatest when sated exposure to sucrose pellets followed, rather than preceded, Pavlovian training. For rats trained sated and tested hungry, augmentation of test responding to the tone was greater when food-deprived exposure to sucrose preceded, rather than followed, Pavlovian training. The results show that incentive learning occurs within Pavlovian procedures. Inhibitory learning may contribute to this effect.

Decision Processes I
Empire, Saturday Morning, 8:00–9:50

Chaired by Gideon Keren, Eindhoven University of Technology

8:00–8:15 (379)

Empirical Demonstration of Logical Strategy. BRADLEY J. MORRIS, *Grand Valley State University,* & CHRISTIAN D. SCHUNN, *University of Pittsburgh* (read by Christian D. Schunn)—We propose a conceptual framework for explaining logical reasoning in terms of competing strategies. The logical strategy model (LSM) describes a series of strategies, each of which has unique processing demands. Strategy selection is based on the match between its processing demands and a problem's task demands. The LSM specifies how each strategy is distinguished theoretically and empirically and was tested with 45

University students. Each student was given 24 deductive problems, 12 conditionals and 12 syllogisms, and was asked to reflect on how they solved a problem by selecting one of five strategy descriptions, each corresponding to the processing operations of a strategy. Results indicate that (1) subjects used a variety of strategies over the problem set, (2) there was a relationship between problem types and strategy use, (3) strategies had different costs as reflected in processing time, and (4) strategy choice was related to performance

8:20–8:40 (380)

Framing Effects on the Evaluation of Outcomes and Decision Makers. SANDRA L. SCHNEIDER & ALEX JACKSON, *University of South Florida*—Framing of a risky choice can reliably be expected to lead to a more favorable response to a sure thing prospect under a positive than under a negative frame. In this study, we extend these findings to show that framing also influences how the outcome and the decision maker are evaluated after the choice is resolved and the outcome has been experienced. We show that it is the outcome itself—and not the choice—that dictates affective reactions to the decision situation. Furthermore, we demonstrate how framing influences affective evaluations, providing evidence of the importance of anchoring processes in the creation of framing effects. We argue that sensitivity to frame can be a rational response by decision makers in an attempt to anticipate the reactions of others to their choices.

8:45–9:00 (381)

Dynamic Queries for Decisions: Generating a Cognitive Functional Processing System. KENT L. NORMAN, *University of Maryland*—Many real-world decisions are made on the basis of looking up information from an on-line database. New methods of database query affect not only the decision process, but also what the decision maker learns about underlying functions among the variables. A dynamic query interface was used to study acquisition of decision-making knowledge, using a database of geographic variables. Thirty-six participants queried the visual map of the United States to locate states that met certain criteria (e.g., Variable A > 60, Variable B < 40). Queries were performed dynamically by setting sliders for the variables. The set of states that met the criteria was continuously updated and highlighted. Participants tended to be fairly fast and accurate in deciding what states fit the criteria. In addition, participants encoded relationships among the criterion variables by generating a cognitive functional processing system, which allowed them to use one variable to predict another.

9:05–9:25 (382)

Can Errors Be Predicted Before They Happen? Continuous Evaluation of Skilled Performance. JAMES SHANTEAU, RICKEY THOMAS, BRIAN M. FRIEL, & JOHN RAACKE, *Kansas State University*—A continuously updated, moving-window measure of skilled performance was applied to a simulated air-traffic-control microworld task. The simulation ("CTEAM," developed by the FAA) requires continuous, dynamic control of multiple aircraft through an air space. Twelve participants were trained to proficiency in a 2-month longitudinal study. The new measure (C-CWS for continuous-CWS) captured between-session improvements in performance (learning), and within-session shifts in behavior owing to changes in task difficulty. Skill development was related to discrimination and internal consistency (both part of C-CWS) but was not related to consensus (which is not part of C-CWS). Unexpectedly, drops in C-CWS values were discovered to be predictive of errors before they happened. These results have clear relevance for error prevention and reduction. The findings also have implications for selection, training, and evaluation of skilled performers in technologically complex tasks. Finally, the results are important for theories of expertise.

9:30–9:45 (383)

Likelihood Judgment in Multialternative Cases: The Dud-Alternative Effect. PAUL D. WINDSCHITL & JOHN R. CHAMBERS, *University of Iowa*—When people judge the likelihood of a focal hypothesis, how is evidence regarding nonfocal alternatives evaluated? According to a normative model, the judged likelihood of a focal hypothesis should decrease as the evidence supporting alternatives increases. However, in demonstrations of the *dud-alternative effect*, adding weak (*dud*) alternatives to a set of hypotheses causes a counter-normative increase to the subjective likelihood of a focal hypothesis. We describe studies in which the inclusion of duds influenced judged likelihoods about trivia question options and raffle outcomes. It appears that, when all else is equal, the judged likelihood of a focal hypothesis will be greater when the level of evidential support for that hypothesis (relative to the levels of support for other individual hypotheses) ranks high. Several explanations and implications of the effect are identified, and the relationship between this effect and support theory is addressed.

Recognition Memory I
Atlanta, Saturday Morning, 10:15–12:00

Chaired by Douglas L. Hintzman, University of Oregon

10:15–10:35 (384)

Comparing Sequential Sampling Models for Two-Choice RT Tasks. ROGER RATCLIFF, *Northwestern University,* & PHILIP L. SMITH, *University of Melbourne*—Four sequential sampling models for two-choice decisions—Wiener diffusion, Ornstein–Uhlenbeck (OU) diffusion, accumulator, and Poisson counter models—were evaluated by fitting them to RT distributions and accuracy data from three experiments. Each model was augmented with the assumptions of variability in accumulation rate, response criteria, and nondecisional base time across trials. Although there was substantial model mimicry, especially within model classes (diffusion, or counter–accumulator), some conditions were identified under which the models made discriminably different predictions. The best accounts of the data were provided by the Wiener diffusion model, the OU model with small-to-moderate decay, and the accumulator model with long-tailed (exponential) distributions of criteria, although the latter was unable to produce error RTs shorter than correct RTs.

10:40–11:00 (385)

Event-Related Potential Correlates of Interference Effects on Recognition Memory. KENNETH A. NORMAN, *Princeton University,* & TIM CURRAN & KATHARINE TEPE, *University of Colorado, Boulder* (read by Tim Curran)—A fundamental question for dual-process theories of recognition memory is how interference affects these processes; in particular, do different interference manipulations differentially affect recollection and familiarity? To address this question, we examined how list length and list strength manipulations affect hypothesized ERP correlates of recollection and familiarity (the "parietal old–new effect" and the "FN400 old–new" effect, respectively; Curran, 2000). We found that the ERP correlate of recollection-based discrimination was adversely affected by both list length and list strength. In contrast, the ERP correlate of familiarity showed a different pattern of results across list length versus list strength experiments. We present converging evidence for these conclusions from remember/know studies. Results are discussed in terms of a recently developed dual-process neural network model of recognition memory (the complementary learning systems model; Norman & O'Reilly, 2001).

11:05–11:15 (386)

Recognition Memory for Pseudowords. ROBERT L. GREENE, *Case Western Reserve University*—On recognition tests, both hit rates and false alarm rates are typically higher to pronounceable pseudowords than to words. A series of experiments supports the conclusion that pseudowords may be greater in familiarity than are words. The pseudoword effect was found on both forced-choice and yes–no tests. It was increased by using fast presentation rates. The pseudoword effect was found in frequency judgment, but not in associative recognition.

11:20–11:35 (387)

Triazolam-Induced Amnesia and the Word Frequency Effect in Recognition Memory. MIRIAM Z. MINTZER, *Johns Hopkins University*—Acute administration of the benzodiazepine drug triazolam induces temporary amnesia. This double-blind, placebo-controlled, repeated measures experiment used triazolam-induced amnesia to test predictions of the dual-process account of the word frequency effect in recognition memory (the reliably observed finding that low-frequency words have higher hit rates and lower false alarm rates than do high-frequency words) in 28 healthy adult volunteers. According to the dual-process account (Joordens et al., 2000; Reder et al., 2000), the hit rate component of the word frequency effect is driven by recollection, whereas the false alarm rate component is driven by familiarity. On the basis of evidence that triazolam produces relatively greater impairment in recollection-based recognition than in familiarity-based recognition, the dual-process account would predict that the hit rate effect should be eliminated or reversed in the triazolam condition but that the false alarm rate effect should be relatively unaffected by drug condition. These predictions were confirmed.

11:40–11:55 (388)

Is There a Prospective Memory System? ROBERT WEST & JASON KROMPINGER, *University of Notre Dame*—Prospective remembering arises from the activity of those neural and cognitive processes that allow an individual to form and later realize intentions at the appropriate time. Behavioral evidence indicates that similar variables influence the efficiency of prospective memory and related areas of cognition, including working memory and episodic memory; however, other evidence indicates that deficits in prospective memory can be dissociated from the functional integrity of episodic memory. In this study, we used event-related brain potentials (ERPs) to examine the neural correlates of prospective memory, selective attention, working memory, and episodic memory. Across a variety of paradigms, we observed modulations of the ERPs that dissociated prospective memory from each of the other domains. The results of these experiments lead to the suggestion that distinct neural processes are recruited during the formation and realization of intentions, providing evidence for the existence of a prospective memory system.

Priming of Lexical Access
New York, Saturday Morning, 10:15–12:00

Chaired by Simon P. Liversedge, University of Durham

10:15–10:30 (389)

Masked Repetition and Phonological Priming Within and Across Modalities. JONATHAN GRAINGER, *University of Provence,* KEVIN DIEPENDAELE, *Ghent University,* ELSA SPINELLI, *University of Grenoble,* & LUDOVIC FERRAND, *University of Paris V*—In five lexical decision experiments, response latencies to word targets presented either visually or auditorily were faster when directly preceded by a briefly presented pattern-masked visual prime that was the same word as the target, as compared with different word primes. Cross-modal (visual–auditory) repetition priming effects were approximately the same magnitude as priming effects within the visual modality. Following all experiments, participants were asked to identify prime stimuli (while ignoring target words) under the same presentation conditions as in the main experiment. Removing participants who correctly identified at least one prime stimulus did not modify the pattern of results. In these presentation conditions, primes that were pseudohomophones of target words did not influence target processing, as compared with either orthographic control primes (Experiment 1), or unrelated primes (Experiments 2 and 3). Within-modal and cross-modal priming from pseudohomophones did emerge with slightly longer prime exposures in Experiments 4 and 5.

10:35–10:55 (390)

Knowing What Is Not: Frequency and Masked Priming Effects in Semantic Categorization. KENNETH I. FORSTER, *University of Arizona*—Balota and Chumbley (1984) reported an absence of a frequency effect for nonexemplars in a semantic categorization task, triggering a debate about the role of frequency in lexical access. Subsequent research has confirmed the presence of a frequency effect, at least for large categories (e.g., *animals*). However, for small categories (e.g., *months*), it appears that they were correct, raising the question of how we can know that a word is not a *month* without accessing its lexical entry (or activating its semantic properties). This puzzle is further complicated by the fact that there is a clear masked priming effect for nonexemplars in such a task, which is usually taken to indicate that lexical access has occurred. A solution to the puzzle is offered that involves postulating a category search mechanism.

11:00–11:15 (391)

Estimating the Baseline in the Semantic Priming Effect. SACHIKO KINOSHITA, *Macquarie Centre for Cognitive Science*—Two experiments using the semantically primed lexical decision task are reported. Experiment 1 examined the effect of mixing all trials in one block (as in a standard semantic priming experiment) versus presenting the neutral trials (the prime consisting of a row of Xs) in a separate block from the block containing the context trials. Although the context trials were unaffected by block type (pure vs. mixed) and the size of the overall semantic priming effect remained constant, the neutral trials were slower when mixed with the context trials. Experiment 2 investigated whether this slowdown of neutral trials in the mixed block reflected a cost of switching strategies. This possibility was supported by the finding that the neutral trials that followed a context trial were slower than those that followed a neutral trial. Implications for interpretation of facilitation and inhibition components of the semantic priming effect will be discussed.

11:20–11:30 (392)

Native and Nonnative Phonology Effects on Lexical Access in ASL. RACHEL I. MAYBERRY & PAMELA E. WITCHER, *McGill University*—Linguistic experience has been widely shown to affect phonological pattern perception in spoken language. Is phonological pattern perception in sign language equally sensitive to linguistic experience? We investigated the question with a primed lexical decision task using American Sign Language (ASL) sign pairs presented at two inter-stimulus intervals, 300 and 1,000 msec. Some stimuli were minimal pairs that differed in only one articulatory parameter and, thus, were phonologically similar in ASL. Nonsigns were either phonologically possible or impossible with respect to three types of ASL phonological parameters. Participants were 45 deaf adults who had varying ASL experience, native signers who learned it in infancy, and nonnative signers who learned it in either childhood or adolescence. In comparison to nonnative learners, native learners recognized ASL signs more quickly and showed greater phonological priming effects with different response patterns to ASL phonological parameters, for both signs and nonsigns, especially at the 300-msec ISI.

11:35–11:55 (393)

Two *B*s or Not Two *B*s: Repetition Blindness in a Counting Task. W. TRAMMELL NEILL & CHRISTOPHER J. ANDERSON, *SUNY, Albany* (read by W. Trammell Neill)—A repeated item in a rapid serial visual presentation is often missed. Theories disagree on whether this *repetition blindness* (RB) occurs during identification or during subsequent report and whether it is due to response bias or to loss of stimulus information. In the present experiments, subjects judged whether one or two letters appeared in a stream of digits. Discrimination (d') between one versus two letters was impaired for blocks with repeated letters, relative to blocks with unrepeated letters. Because report requirements are equated in the counting task, we conclude that RB is due to impaired identification. Further experiments found the effect restricted to same-case letters. However, RB was found for same-case letters even when presented in spatially separated streams, excluding a sensory integration account of RB.

Speech and Music Perception
Chicago A, Saturday Morning, 10:15–11:55

Chaired by Robert E. Remez, Barnard College

10:15–10:25 (394)

Perception of Accented Speech by Native and Nonnative Listeners.
JOAN SERENO, JOYCE McCALL, & ALLARD JONGMAN, *University of Kansas,* & TON DIJKSTRA & WALTER van HEUVEN, *University of Nijmegen*—The present study investigates the perception of foreign-accented speech. Two word recognition experiments were conducted comparing the perception of Dutch-accented with native English speech. Stimuli were selected on the basis of phonetic inventory. Half of the stimuli contained phonemes that are unique to English and do not occur in Dutch (e.g., /th/ as in *think* and /ae/ as in *cat*), and the other half contained only phonemes that are similar in both English and Dutch (e.g., /s/, /i/). Both word and nonword stimuli were included to also investigate the role of lexical status. Stimuli were then presented to American and Dutch listeners, using a randomized blocked design in a lexical decision experiment. Results will be discussed in terms of the influence of foreign accent on word recognition processes.

10:30–10:45 (395)

Spoken Word Recognition in Lexically Ambiguous French Utterances With Liaison. JAMES M. McQUEEN, *Max Planck Institute for Psycholinguistics,* ELSA SPINELLI, *Université Rene Descartes,* & ANNE CUTLER, *Max Planck Institute for Psycholinguistics*—The final /r/ of a French word such as *premier* is not pronounced before a consonant-initial word (e.g., in *premier rapport*, first report). Before a vowel-initial word, however, it is pronounced (e.g., in *premier apport*, first contribution); this is called *liaison.* Phrases like *premie*[r]*apport* become, thereby, ambiguous. Four cross-modal identity priming experiments examined word recognition in such phrases. French participants saw visual targets (e.g., APPORT) midway through the final word of the spoken phrases. Lexical decisions to both vowel- and consonant-initial targets were faster after the ambiguous spoken primes than after phonologically dissimilar control primes. But this facilitation was only reliable when the targets actually matched the speaker's intended segmentation (APPORT after *premier apport*; RAPPORT after *premier rapport*). Acoustic analyses showed that liaison consonants are reliably shorter than word-initial consonants. Speakers thus produce subphonemic information about their intentions, which is used by listeners in the resolution of lexical ambiguity.

10:50–11:05 (396)

Factors Influencing the Effects of Accentedness on Spoken Word Recognition. LYNNE C. NYGAARD & JENNIFER S. QUEEN, *Emory University*—Recent research suggests that a variety of talker-, listener-, and item-related factors impact the perception and retention of spoken language. The present study assessed the effects of one type of variability, foreign accentedness, on spoken language processing. Native, American English listeners transcribed English sentence- and word-length utterances produced by native Spanish-speaking adults from the same region of Mexico. Transcription accuracy and speed were measured as a function of amount of exposure to individual talkers' voices and to Mexican-accented English in general. The results suggest that sentential context (i.e., sentence- vs. word-length utterances) and lexical factors (i.e., word frequency and lexical neighborhood density) both influence the degree to which accent affects spoken word recognition. In addition, accentedness ratings correlated strongly with measures of intelligibility, suggesting that judgments of accentedness may be determined by the same acoustic-phonetic properties that impact intelligibility. These findings provide support for dynamic, token-based models of word recognition.

11:10–11:30 (397)

The Speeded-Speech Effect in Aging: Cognitive Slowing or Perceptual Degradation? BRUCE A. SCHNEIDER & MEREDYTH DANEMAN, *University of Toronto,* & DANA MURPHY, *University of Nipissing* (sponsored by Meredyth Daneman)—Speech comprehension declines more rapidly in older adults than in younger adults as speech rate increases (speeded-speech effect). This effect is usually attributed to a slowing of the cognitive functions subserving language comprehension. Alternatively, the speeded-speech effect could reflect the inability of the older adult's auditory system to cope with speed-induced stimulus degradation. We speeded speech by (1) deleting every *n*th amplitude sample in the digitized signal, (2) dividing the speech signal into 10-msec segments and deleting every *n*th segment, and (3) deleting only steady-state and silent portions of the speech signal. The first two methods distort the speech signal and produce significant speeded-speech effects. However, both age groups were equally affected by speeding when the third method, which preserves much of the transient information in the speech signal, was used. Hence, auditory decline rather than "cognitive slowing" may be responsible for the speeded-speech effect.

11:35–11:50 (398)

Musical Training and Pitch Perception. E. GLENN SCHELLENBERG & TAKEO NODA, *University of Toronto, Mississauga*—Musically trained and untrained undergraduates were tested on a variety of pitch perception tasks. The musically trained group (*n* = 20) had at least 8 years of formal music lessons. The untrained group (*n* = 20) had no music lessons. Each task was an adaptive procedure that tested the limits of listeners' abilities. Musically trained listeners outperformed their untrained counterparts at detecting mistunings to familiar melodies, at discriminating low-frequency (400 Hz) tones, and on a test of auditory inspection time (a measure of pitch discrimination speed). Performance across these tasks was positively correlated. The groups did not differ, however, in their ability to discriminate high-frequency (4000 Hz) tones. The groups were also equivalent on a measure of intelligence (Raven's Advanced Progressive Matrices). Musical training appears to enhance pitch perception on a variety of tasks that are relevant to music listening.

Task Switching
Chicago BC, Saturday Morning, 10:05–12:00

Chaired by John S. Monahan, Central Michigan University

10:05–10:25 (399)

Switching Between Tasks: What Constitutes a Task Unit? DANIEL GOPHER & DEGANIT BARNEA, *Technion-Israel Institute of Technology*—Task switching is a popular contemporary paradigm in the study of control processes and the evaluation of task demands. Switching costs from one task to another are taken to reflect the control efforts associated with the requirement to stop the previous task activities and/or the reconfiguration called upon by the new task. In a sequence of experiments, we investigated the question of what constitutes a task unit. That is, in a long sequence of trials, what makes one segment distinguishable from another, such that task switching costs can be observed between the two. In particular, we were interested in contrasting the influence of internal events, such as attributed subjective significance, with those of changing task features or response requirements, The talk will describe the main results of these experiments and will discuss bottom-up and top-down determinants of task segmentation and switching costs.

10:30–10:50 (400)

Decomposing the Effect of Articulatory Suppression on Switch Costs: The Role of Inner Speech in Goal Retrieval. JEUNG-CHAN AHN & AKIRA MIYAKE, *University of Colorado, Boulder* (read by Akira Miyake)—Recent task-switching studies have shown that articulatory suppression (AS) dramatically increases switch costs (Baddeley, Chincotta, & Adlam, 2001; Emerson & Miyake, in press). In two dual-task experiments, we examined which subcomponent of AS—speech–motor programming, auditory interference, or dual-task demand—is

responsible for this increase. The primary task involved responding to the color or the shape of a stimulus. Each secondary task implicated one or more of the subcomponents of AS (e.g., holding a tongue depressor between one's tongue and lower lip, listening to irrelevant speech, mouthing, lip-syncing). Comparing the switch costs among these conditions indicated that disruption of speech–motor programming was responsible for increased switch costs, whereas auditory interference or dual-task demand was not. These results suggest that one important aspect of task-set reconfiguration may be the verbal retrieval of task goals from long-term memory and that this retrieval process is supported by the speech–motor programming component of inner speech.

10:55–11:10 (401)
Effects of Task Shifting and Response Compatibility in Dual-Task Situations. RONALD HÜBNER, *Universität Konstanz*—Although both the dual-task paradigm and the task-shift paradigm have been used to investigate mental control processes, they are usually applied separately. Here, an experiment is reported in which a dual-task situation was combined with task shifting. That is, the primary task and the secondary task of the dual-task situation were either of the same type or different. As was expected for responses to the secondary task, PRP effects, as well as shift costs, were observed, which, however, did not interact. Interestingly, a similar pattern of effects also occurred for responses to the primary task. Furthermore, there were significant effects of response compatibility between the tasks, which varied with SOA and with task shifting. Altogether, the results give further insight into the interaction between serial and parallel process during dual-task performance.

11:15–11:30 (402)
Alternating Switch Costs in the Elderly: Inhibitory Processes in Aging. CHRISTINA L. FALES & BARBARA J. KNOWLTON, *UCLA* (read by Barbara J. Knowlton)—Task switching is a cardinal executive function and may be impaired in populations with reduced executive function. Switching abilities are measured as the time difference to perform a task on a switch trial versus a repeat trial. Backward inhibition is believed to be an important factor in switch costs. It is measured as the difference in switch costs for alternating versus nonalternating situations (e.g., for three tasks, ABA vs. CBA). We measured alternating switch costs in the elderly, using three classification tasks. Elderly participants showed longer times to perform the tasks in repeat, single-switch, and alternating switch conditions. However results showed no disproportionate costs for single or alternating switches. These data suggest that switching deficits do not necessarily accompany aging and that this aspect of executive function may be relatively intact.

11:35–11:55 (403)
Explorations in Task Space: Shared Components of the Task Set Facilitate Switching From One Task to Another. CATHERINE M. ARRINGTON, ERIK M. ALTMANN, & THOMAS H. CARR, *Michigan State University* (read by Thomas H. Carr)—Task switching was examined within a space of task representations. Four experiments explored task space by manipulating similarity among tasks, defined as overlap in component mental operations. Experiment 1 introduced two pairs of tasks involving judging dimensions of a rectangle—height and width, color and brightness. Similarity was defined as shared attentional control settings within pairs, based on integrality of dimensions within pairs versus separability between pairs. Task similarity facilitated switching. Experiment 2 examined effortful and automatic processes behind this similarity effect by manipulating preparation time and response-to-stimulus interval (RSI). Similarity effects disappeared with increasing preparation but were not influenced by RSI, suggesting that establishing attentional control settings is effortful. Experiments 3–4 were analogous but defined similarity as shared response modality—manual or vocal. Similarity again facilitated switching, but in contrast to changing attentional settings, changing response modality involved automatic, in addition to effortful, processes.

Control of Memory
Chouteau, Saturday Morning, 9:50–11:45

Chaired by Gijsbert Stoet, Washington University

9:50–10:10 (404)
What Disrupts Verbal STM? Implications for Theory. ALAN D. BADDELEY, *Bristol University,* & JANET LARSEN, *John Carroll University*—The Baddeley and Hitch phonological loop model gives a simple account of the rich data from the study of verbal STM. It has, however, been challenged by alternative models, notably the feature hypothesis of Nairne and Neath, and the Jones object-oriented episodic record hypothesis. All three give an account of most major phenomena. We describe three experiments that aim to challenge the theories by looking for interactions between major variables on the grounds that these were less likely to have been explicitly considered in model construction. Subjects recalled six phonologically similar or six dissimilar letters under disruption by (1) irrelevant speech, (2) articulatory suppression, or (3) manual tapping. We varied number of irrelevant token items and whether they were presented in a regular or a syncopated rhythm. An account of our results is given in terms of the phonological loop model, and some potential challenges to alternative theories are highlighted.

10:15–10:35 (405)
Study Time Optimization and the Dynamics of Information Uptake. JANET METCALFE, *Columbia University*—Five experiments investigated the optimality of people's study time allocation. In Experiment 1, when free to choose, people chose items of medium difficulty preferentially, although a performance return measure overwhelmingly favored the easy items. When experimentally manipulated, performance was best with preference to the easy items, in Experiment 2, but to the medium items, in Experiment 3. The main experimental difference was time allowed for the easy items when not preferred—0.5 sec (Experiment 2) and 1 sec (Experiment 3). Experiments 4 and 5 revealed an extremely steep information uptake function for easy items for study of up to 1 sec. Thus, an initial brief study of easy items is very important for learning, but continued perseverance on these items is not as useful. This finding allowed reconciliation of the differences between Experiments 2 and 3. We conclude that, given the dynamics of information uptake, people's spontaneous study time allocation strategies were rather good.

10:40–11:00 (406)
Explaining the Delayed-JOL Effect: Evidence of a Heisenberg Effect. DANIEL R. KIMBALL & JANET METCALFE, *Columbia University*—In the delayed judgment-of-learning (JOL) effect, later recall is better predicted by JOLs made at a delay (rather than immediately after study) on the basis of cues alone (rather than cues and targets). If the effect occurs because retrieval at the time of judgment is similar to (and hence diagnostic of) retrieval at test in the delayed cue-only condition, then presenting the target immediately following the judgment should not affect predictive accuracy. However, if the effect results because the delayed cue-only judgment has a Heisenberg-like effect—increasing the memorability of the retrieved items, given high JOLs, but not of the unretrieved items, given low JOLs—then a brief post-judgment presentation of the target would offset the effect by tending to equate study opportunity at the time of judgment across retrieved and unretrieved items. Data from three experiments support the Heisenberg explanation.

11:05–11:20 (407)
Metamemory Beliefs and the Confidence–Accuracy Relation in Human Memory. WILLIAM F. BREWER & CRISTINA SAMPAIO, *University of Illinois, Urbana-Champaign*—Two experiments are described that are part of a larger project designed to identify the fundamental cognitive mechanisms that underlie confidence judgments in memory. We hypothesize that metamemory beliefs about the accuracy of memory processes are one of the core mechanisms underlying confi-

dence judgments. Experiment 1 examined the relationship between confidence and accuracy with simple recognition procedures. Nondeceptive items showed a strong positive relationship between confidence and accuracy, whereas there was little relationship for deceptive items. Experiment 2 replicated the first experiment, but with forced-choice memory procedures. There was a strong positive confidence–accuracy relation for both deceptive and nondeceptive items. We hypothesize that with simple recognition, participants are frequently not aware of their memory errors for deceptive items, leading to a low confidence–accuracy relation, but that with forced-choice procedures, participants are aware of the deceptive nature of the deceptive items and adjust their confidence appropriately.

11:25–11:40 (408)
Working Memory and Behavior: From Executive Control to Self-Control. PAUL WHITNEY, TINA JAMESON, & JOHN HINSON, *Washington State University*—Executive control functions of working memory play a critical role in many theories of performance of complex tasks, but relatively little evidence addresses whether individual differences in executive control predict performance outside of laboratory tasks, particularly in nonclinical samples. We present data that address two questions concerning the relationship between executive control and behavior: (1) Do laboratory assessments of executive function predict executive control problems in daily life? (2) Do laboratory assessments of executive function predict individuals' problems with self-control, as shown in their alcohol use? In a college student sample, we administered the Trails test, a neuropsychological instrument, and a modified Sternberg task, to assess executive control functions. We found that a pattern of executive control that can be characterized as impulsive predicts (1) self-reported experiences of executive slips in daily life and (2) problems related to alcohol use.

Decision Processes II
Empire, Saturday Morning, 10:05–12:00

Chaired by Christian D. Schunn, University of Pittsburgh

10:05–10:25 (409)
On the Link Between Curiosity and Probability Assessments. GIDEON KEREN, *Eindhoven University of Technology*—Consider two agents who assess the probability of an event to be 60% and 80%, respectively. Which of the two is more curious? Following an information theory perspective, the higher the uncertainty, the more information there is to be obtained, and hence, 60% should entail higher curiosity. Alternatively, a higher probability implies getting "closer" to resolving uncertainty, thus associating the probability of 80% with higher curiosity. Several experiments designed to delineate the circumstances under which one or the other account is more viable will be presented. Are you curious enough to come to the talk?

10:30–10:50 (410)
Frames, Reference Points, and Risk Distributions. X. T. WANG, *University of South Dakota*—The author examines how people make use of risk distributions (i.e., variations in expected payoffs) to maximize the probability of reaching a goal and to minimize the likelihood of falling below a minimum requirement (MR). A bounded risk distribution model is used to account for strong risk-taking on behalf of a kin group (Wang, 1996). This hypothesis was tested against an alternative accountability/responsibility avoidance hypothesis. The results showed that the accountability manipulation had little effect on risk-taking preference. The setting of MR was largely determined by the kinship context and was further fine-tuned by the framing of the choice outcomes. In a second study, this model was tested, using real decision problems. Interbirth intervals varied with a family's wealth

and the sex of a child. The findings are discussed in terms of differential reproductive variance in sons versus daughters and their implications for the models of risky choice.

10:55–11:10 (411)
Individual Differences in Framing and Risk Perception: Strength of Handedness as a Predictor in Decision Making. JOHN D. JASPER & STEPHEN D. CHRISTMAN, *University of Toledo*—Framing has been one of the most studied effects in decision making in recent years. However, recent research has demonstrated that not everyone is equally susceptible to the way in which information is presented. For example, Levin, Gaeth, Schreiber, and Lauriola (under review) showed that the magnitude of framing effects can be predicted using various personality traits. The present study examines another predictor: strength of handedness. Half the participants received negatively framed information concerning the fetal risk of using a safe drug during pregnancy (1%–3% chance of having a malformed child); the other half received positively framed information (97%–99% chance of having a normal child). Only "mixed handers" were affected by framing; "strong handers" did not differ in risk estimates as a function of information frame. A belief-updating theory centered around the notion of hemispheric specialization and the communication between the two halves of the brain is introduced to account for these data.

11:15–11:30 (412)
Impact of Freedom to Choose on Biases in Memory. KRISTEN E. BENNEY, *University of North Florida,* & LINDA A. HENKEL, *Fairfield University* (read by Linda A. Henkel)—Previous research demonstrates that after choosing between two options, people tend to alter their memories of the objective features of the options, as well as their subjective evaluations of them, in ways that favor the chosen alternative. The present experiment tested whether these *choice-supportive* memory attributions occurred when people were assigned to an option, rather than having free choice. Participants were given a series of choices between two options, with each option having both positive and negative features. Some participants had free choice between the options, whereas a computer made the choice for other participants, either randomly or in their best interest. Results indicated that those in the free-choice and best-interest conditions made significantly more choice-supportive memory attributions than did those in the random-choice condition. In addition, the magnitude of choice-supportive memory attributions was positively correlated with happiness and optimism for participants in the best-interest group.

11:35–11:55 (413)
Improving the Quality of Probability Judgments by Means of Performance Feedback. DAVID V. BUDESCU & JONATHAN L. TEMPLIN, *University of Illinois, Urbana-Champaign,* & THOMAS S. WALLSTEN, *University of Maryland*—The shortcomings of subjective probability judgments are well documented. Previous attempts to improve their quality through coaching and feedback have achieved relatively limited success. In an effort to understand the types of feedback that will be effective and under what conditions, we contrasted two types of feedback (performance and outcome) on probability judgments of events of various levels of difficulty and involving distinct sources of uncertainty (external aleatory and internal epistemic) and analyzed a wide variety of measures of the judgments' quality. In two experiments, performance feedback (implemented through a proper scoring rule) improved considerably the quality of judgments regarding hard-to-predict aleatory events with uncertainty from external sources. The feedback caused respondents to reduce the use of extreme confidence levels. Consequently, they displayed better calibration and resolution and significantly less overconfidence. Feedback under other conditions was not effective.

POSTER SESSION III
Crown Hall, Saturday Noon, 12:00–1:30

• MOTOR CONTROL •

(414)

From Instruction to Action: The Influence of Verbal Instruction on Action Coding. DORIT WENKE & PETER A. FRENSCH, *Humboldt University* (sponsored by Peter A. Frensch)—Before a psychological experiment starts, research participants are verbally instructed how to respond in arbitrary situations. Researchers agree that type of instruction is extremely important for the outcome of an experiment. However, it is quite unclear by which processes and mechanisms verbal instruction of the task (task sets) are implemented within subjects' cognitive systems. In three experiments, we approach this question by manipulating verbal instruction of responses and asking whether the manipulation affects compatibility or congruency effects. The present data indicate that the type of verbal instruction influences performance on compatibility tasks.

(415)

First Trial "Adaptation" in Prism Exposure Does Not Arise From Ordinary Motor Control. GORDON M. REDDING, *Illinois State University,* & BENJAMIN WALLACE, *Cleveland State University*—Terminal target pointing error on the first prism exposure trial is usually less than would be expected from the optical displacement. Such "adaptation" cannot be attributed to ordinary motor undershoot or terminal correction and is unrelated to prism aftereffects. A possible explanation is "visual capture" of felt head position

(416)

Automatic Activation of Movements in Typewriting Experts. MARTINA RIEGER & BIRGIT ELSNER, *Max Planck Institute for Psychological Research*—Traditional models of typewriting assume three phases of that process (encoding, planning, and execution). However, the speed with which typewriting can be performed by experts gives rise to the hypothesis that visual material can directly and automatically activate typewriting movements. In several experiments, participants had to react to two-dimensional stimuli (colored letters) on external response devices. Reactions were based on color. Stimuli in which the letter was thought to activate the same finger movement as the color were classified as congruent. Typewriting experts, in contrast to nonexperts, showed a congruency effect (50 msec). This congruency effect was obtained for several features of the keyboard. It can be concluded that, in typewriting experts, the perception of expertise-specific stimuli automatically activates the corresponding movements, even though those are totally irrelevant in the current context. This points to a fast and automatic link between perception and action in typewriting.

(417)

Attentional Focus on Supra-Postural Tasks Influences Balance Learning. GABRIELE WULF, *University of Nevada, Las Vegas,* MATTHIAS WEIGELT, *Max Planck Institute for Psychological Research,* POULTER R. DAMIAN, *University of Reading,* & NANCY H. McNEVIN, *Wayne State University*—The influence of the attentional focus induced by a "supra-postural" task on the learning of a balance task was examined. Participants balanced on a stabilometer (postural task) and were required to hold a tube with both hands and to keep it horizontal (supra-postural task). Participants were instructed either to focus on keeping their hands horizontal (internal focus) or to focus on keeping the tube horizontal (external focus; Wulf & Prinz, 1998). External focus participants showed superior performance on the supra-postural task. More important, their balance learning was also enhanced, as compared with that of internal focus participants. This suggests that the attentional focus regarding the supra-postural task affects not only performance and learning of the supra-postural task itself, but also those of the postural task.

(418)

Comparison of "Reactive" and "Willed" Actions by Means of ERPs. FLORIAN WASZAK, EDMUND WASCHER, GISA ASCHERSLEBEN, & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research,* & DAVID A. ROSENBAUM, *Pennsylvania State University*—How are voluntary, operant actions different from externally triggered actions? We investigated participants' actions in two experimental settings that were identical with respect to the sequence and timing of stimuli and movements. In both conditions 35 visual stimuli appeared in a fixed temporal sequence (every 1,200 msec). Participants were asked to produce keypresses to "bisect" the intervals between two subsequent stimuli. In the voluntary action condition, participants pressed one of two keys to determine the position of the next stimulus. By contrast, in the reaction condition, participants pressed the key corresponding to the position of the preceding stimulus. We found that keypresses were shifted in time toward the corresponding stimuli. Moreover, EEGs recorded from 60 scalp positions showed that movement- and stimulus-related cortical potentials differed in the two conditions.

(419)

Retrieving Motor Plans. PETER DIXON, *University of Alberta*—Subjects touched a target location while avoiding an obstacle. The movement trajectory and the manner in which the obstacle was avoided resembled those used on the preceding trial, but only if the stimulus configuration was similar. When the preceding stimulus was dissimilar, the manner of avoiding the obstacle was likely to resemble the trajectory used on the trial before that. The results suggest that motor plans are retrieved rather than computed and that the observed repetition effect is essentially a memory recency effect.

(420)

Exploiting Individual Difference to Study Processes of Perceptual–Motor Learning. YVONNE LIPPA, MARY HEGARTY, & DANIEL R. MONTELLO, *University of California, Santa Barbara,* & FRANK TENDICK, *University of California, San Francisco*—Novices learned to operate an angled laparoscope (a surgical instrument), using a virtual reality system. In addition, we assessed their cognitive and perceptual–motor ability to determine information processes that underlie learning. Consistent with previous accounts (Ackerman, 1988; Fleishman, 1962), we assumed that an association between learning performance and cognitive ability indicates declarative processing and that an association between learning performance and perceptual–motor ability indicates procedural processing. In contrast to previous findings, early learning was independent of cognitive ability but was associated with perceptual–motor ability, indicating that procedural (not declarative) learning took place in the early stages. We propose that the amount of declarative and procedural processing in skill acquisition and, thus, the association between performance and cognitive or perceptual–motor ability, varies with a person's intention to learn explicit rules or to focus on performance-related aspects of a task.

(421)

Learning of Action Effects: Do We Learn What We Expect? MICHAEL ZIESSLER, *University of Sunderland,* & DIETER NATTKEMPER, *Humboldt University*—Learning of the effects of own actions seems to depend on the anticipation of possible effects in action planning. In Experiment 1, participants had to respond to two successive stimuli. Stimulus 2 could be seen as an effect of Response 1. Learning of the Response 1–Stimulus 2 relationship was impaired when an additional tone stimulus was presented during planning of Response 1, whereas an additional tone between Response 1 and Stimulus 2 had no effect on learning. Effect learning obviously depends on response planning, which includes the anticipation of effects. In Experiment 2, responses were facilitated when the effects were additionally presented during response planning. Effect presentation before or together with the stimulus had no effect on responses. In Experiment 3, each response had two effects. Response–effect learning was

found only for the effect that had to be produced following the instruction, but not for the unintended effect.

(422)

Movements of Experts and Novices in Piano Playing. SUSAN ANDERSON & CHARLES E. WRIGHT, *University of California, Irvine* (sponsored by Myron L. Braunstein)—Movements of both experts and novices, as well as the musical outcome of those movements (keypress data), were studied using the Optotrak LED 3-D motion and position tracking system for piano-playing tasks. Expert and novice participants played sequences of piano keys (e.g., standard technical piano exercises, such as scales and arpeggios). The movement trajectories suggest that experts' movements were faster, more fluent, and less variable than novices'. Also, experts' movements were characterized by anticipatory kinematics analogous to coarticulation in speech. In addition, experts' movements, as compared with novices', were characterized by large rhythmic movements of the arm and torso. On the other hand, novices' movements, although highly variable, were characterized by "nonpurposeful" finger movements (e.g., a nonplaying finger moving in a counterproductive direction). Inferences are made concerning the cognitive representations underlying these motor productions and how those representations are acquired.

• SPATIAL COGNITION •

(423)

Functional Groups in Scene Perception. COLLIN B. GREEN & JOHN E. HUMMEL, *UCLA*—We investigated whether functional groups—collections of objects that enter into shared functional relations—are an explicit component of the mental representation of visual scenes. Subjects judged whether two target features embedded in a simple scene were the same or different. The target features were embedded in pairs of objects that either shared or did not share a functional relation. The distances between objects and between features were controlled. Subjects were faster to respond correctly to target features embedded in objects that shared a functional relation. This result suggests that functional groups are explicit units in the representation of visual scenes and that they may influence scene processing by guiding the allocation of visual attention.

(424)

Racial and Spatial Categories in Map Memory. KEITH MADDOX, DAVID N. RAPP, HOLLY A. TAYLOR, & SEBASTION BRION, *Tufts University* (sponsored by Holly A. Taylor)—Distinct psychological traditions have separably demonstrated the impact of racial and spatial category knowledge on social and spatial organization in memory. Category knowledge can bias memory by exaggerating similarities within and differences between categories. Little is known about how these categories might influence each other. Two experiments examined the impact of racial category information on spatial organization in memory. Participants studied maps depicting various businesses, organizations, and descriptions about employees. Employees belonged to one of four racial/ethnic categories. Subsequently, participants matched locations with individuals and estimated distances between locations. In both studies, participants made more within-race than across-race confusion errors when matching locations with individuals. Racial category information also influenced distance estimates. Furthermore, Experiment 2, which pitted racial versus spatial organization, demonstrated a dominance for racial information. These results demonstrate the powerful influence that social category information may play in the spatial organization of memory.

(425)

Visual Motion Perception and the Simon Effect. SIMONE BOSBACH, *Max Planck Institute for Psychological Research,* DIRK KERZEL, *Justus Liebig University of Giessen,* & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research*—Effects of spatial stimulus–response compatibility were explored in different experimental arrange-

ments. We conducted experiments by using dynamic stimuli in a task that followed the logic of the Simon paradigm. Depending on the task demands, we found position- and/or direction-based compatibility effects that can be explained in terms of referential coding. In addition, there was evidence that information about direction, conveyed by a moving stimulus, was recoded into position information. This recoding did not occur when motion information was presented without any reference. Further experiments showed that biological motion may convey response-relevant directional information that is independent of low-level motion processing. Finally, our experiments showed that compatibility phenomena are not restricted to static stimuli but obtain with dynamic ones as well. However, the encoding of visual motion signals and their cognitive representation are affected by the spatial or semantic context in which they are presented.

(426)

Perspective-Taking or Mental Rotation? Which One Predicts Real-Space Navigational Performance? BJÖRN H. RASCH, OLESSIA BLAJENKOVA, & MARIA KOZHEVNIKOV, *Rutgers University, Newark* (sponsored by Mary Hegarty)—Sixty participants took part in one of the two versions of a computerized pointing direction task along with the Shepard and Metzler mental rotation task and a number of large-scale navigational tasks (e.g., retracing a route, finding a shortcut). In the pointing direction task, participants were shown a map. In one version (perspective-taking), participants were asked to imagine themselves standing in one location, facing toward a second, and to point to a third. In the second version (rotation), participants were instructed to indicate the direction to the third location by imagining a vector connecting the above three locations and mentally rotating this vector. We found different patterns of responses for the two versions of the pointing direction task, supporting the distinction between rotation and perspective-taking processes. Furthermore, we found that performance in the perspective-taking version of the task reliably predicts navigational performance, whereas rotation tasks do not.

(427)

Square or Diamond? How Semantics Can Determine Spatial Reference Selection in Memory. STEFFEN WERNER & THOMAS D. SNEED, *University of Idaho*—The geometrical structure of spatial stimuli often determines the selection of a reference direction in spatial memory. The structure of the environment, the intrinsic structure of a stimulus array, or the perspective during acquisition can all be used as the basis for a spatial reference system in memory. In the present study, we manipulated the semantic interpretation of a spatial arrangement while holding the geometrical structure and learning constant. Participants learned the location of eight objects in one of two synthetic environments. The environments were displayed as part of either a soccer field or a baseball diamond. The results show that the availability of spatial knowledge differed between conditions. In the soccer condition, headings parallel to the edges were clearly preferred, whereas results in the baseball condition were less homogenous but diagonal headings were preferred overall. The semantic interpretation of a space can thus modify the effects of geometrical structure.

(428)

Spatial Learning in Virtual Reality. JOHN R. PANI, JULIA H. CHARIKER, & THOMAS E. DAWSON, *University of Louisville*—The extreme variation in the difficulty of reasoning about different types of rotation provides an excellent opportunity to study spatial learning. We have been using interactive virtual reality computer systems to study the process of learning to reason about rotations. In our presentation, we describe the course of learning in a variety of fundamental learning situations. These include the presence of insightful computer visualizations, immediate feedback and demonstration of correct answers in 3-D space, interactive simulation of target motions, simple repetition of problem types, and combinations of these.

(429)

Memory-Based Estimates of Azimuth Are Biased: Pointing Out Alternative Theories. DANIEL B. HAUN, *Max Planck Institute for Psycholinguistics,* & GARY L. ALLEN, *University of South Carolina*—Consistent with a two-system framework for spatial memory, it was predicted that memory-based motoric estimates of target azimuth would be unbiased and very accurate. Experimental manipulations designed to reduce the precision of information in temporary memory were included to see whether they would introduce graded bias in motor estimates that are characteristic of those evident in verbal estimates. Contrary to expectations, results showed that the manipulations exerted little in the way of graded influences. Yet, motor estimates of azimuth reflected systematic bias in a manner similar to that observed with verbal estimates. In agreement with a major assumption of the categorical adjustment model, findings suggest that categorical influences on spatial memory tend to be stronger the less precise the representation of the estimated spatial relation or property. These findings provide further factors to be considered in evaluating one- versus two-system accounts of spatial memory.

(430)

Spatial Updating During Imaginal Movement: When Optical Information Interferes. MARYJANE WRAGA, *Smith College*—Perky (1910) demonstrated that mental imagery can interfere with visual perception. We were interested in exploring the opposite effect. Participants performed two mental rotation tasks under different optical conditions. In the array task, participants updated the locations of objects in an array after imagining it rotating. In the viewer task, participants made similar judgments while imagining rotating themselves about the array. In the eyes-closed condition, participants performed both tasks with eyes closed. In the eyes-open condition, participants performed both tasks with eyes open in a lighted room. In the dark condition, participants performed the tasks with eyes open in a darkened room. For both tasks, updating performance was faster and more accurate in the eyes-closed condition than in the eyes-open condition. A similar result obtained with the dark condition indicated that it was the absence of optical information, rather than having one's eyes closed per se, that contributed to the improved performance.

(431)

Visual and Motor Effects in Cued Line Bisection. CATHERINE L. REED & JEFFERSON D. GRUBB, *University of Denver*—Line bisection is a task commonly used to assess biases in spatial cognition, but there is a little recognized disconnect in the literature. On the one hand, researchers have suggested that visual attention, perception, and motor biases can influence the results of uncued line bisection. However, they tend to limit their explanation of cued line bisection to scanning direction. The purpose of this study was to determine whether cuing can influence line bisection via other factors. We compared the effects of purely visual cues (line end cued by color patch) that should affect visual scanning, with positional cues (line end cued by cursor placement) that should additionally affect manual motor responses. Although left and right visual cues produced effects of equivalent magnitudes, right positional cues produced greater effects than did left positional cues. This interaction indicates that both cue types affect cued line bisection performance by affecting different perceptual–motor systems.

(432)

Mental Extrapolations as Primes for Spatial Layout Processing. CARMELA V. GOTTESMAN, *University of Oklahoma*—A prime that shows the spatial layout of a scene can facilitate distance judgments (Sanocki, 2002). This study examines whether mentally extrapolated layout, as observed in boundary extension, can prime processing of spatial relations. The prime was followed by a target, and viewers judged which of two locations in the target was closer to the camera. Experiment 1 used four primes: full picture, partial picture (not including the tested locations), full control, or partial control.

Both full and partial picture primes facilitated performance, indicating that extrapolated layout was as useful as perceived layout. Experiment 2 used two partial picture primes. One induced mental extrapolation to the tested locations; the other did not. Only the former facilitated performance. This experiment demonstrates that a simple preview of the scene is not enough to facilitate processing of spatial relations. Facilitation occurs only if the partial prime activates a mental representation of the relevant layout.

(433)

Ideal, Subideal and Human Navigation Through Large-Scale Spaces. BRIAN J. STANKIEWICZ, *University of Texas, Austin,* GORDON E. LEGGE & ERIK J. SCHLICHT, *University of Minnesota,* & J. STEPHEN MANSFIELD, *SUNY, Plattsburgh*—Spatial navigation is a task that relies on perception, memory, decision making, and planning. To understand the role of these processes in human navigation performance, we developed an ideal navigator based on a partially observable Markov decision process (Cassandra, Kaelbling, & Littman, 1994) and compared human performance with the ideal navigator. We tested humans and the ideal navigator in indoor environments, starting from a random location. The observers were instructed to go to a target location, using the fewest number of actions (translations and rotations). We investigated the effect of increasing the size of an environment (i.e., the number of hallways) on the human's action-selection efficiency (efficiency = no. of actions ideal/no. of actions human). We found that action-selection efficiency declined as the environment size increased. We investigated whether a specific suboptimal observer with limited memory, limited perceptual processing, or suboptimal decision strategy could account for the inefficiencies; we found that none of them could. Supported by NIH Grant EY 02857 to G.E.L.

• HUMAN LEARNING AND MEMORY •

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The Effects of Output Interference on Hypermnesic Recall. ROBERT L. WIDNER, *Minnesota State University,* HAJIME OTANI, *Central Michigan University,* & PHILLIP N. GOERNERT, CARRIE BRONARS, & LYNAE JOHNSEN, *Minnesota State University*—We investigated the role of output modality in hypermnesic free recall. We observed hypermnesia when the second test was written, but not when it was oral, a finding that was unaffected by Test 1 modality. In Experiment 2, we investigated whether participants' efforts to minimize repetitions from Oral Test 1 to Oral Test 2 may have reduced the likelihood of recalling additional items (e.g., reminisceable items). We failed to observe hypermnesia when participants were encouraged to repeat items but observed it when they were encouraged to refrain from repeating items. Furthermore, we observed that reminiscence occurred primarily in the fourth quartile when participants did not repeat but found that it was spread out over the last three quartiles when they repeated. In Experiment 3, we asked participants to repeat each verbally recalled item three times. Again, we failed to observe hypermnesia. We discuss these findings in light of output interference.

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Artificial Grammar Learning: Evidence for Domain Specificity. BJOERN H. RASCH, RICARDO E. CARRION, & BEN M. BLY, *Rutgers University* (sponsored by John Ceraso)—One hundred forty participants took part in two artificial grammar experiments in a randomized order, using musical chords and letters. Half of the participants listened to sequences of harmonically consistent chords; half listened to sequences of harmonically inconsistent chords. In every condition, the same finite-state machine was used, resulting in identical abstract rules or statistical properties of the sequences. Despite this similarity, performance was significantly higher for harmonically consistent chord sequences, as compared with sequences of harmonically inconsistent chords or letters. No order effects were found. In a second experiment, no increased transfer effects were observed when subjects were trained on harmonically consistent chord sequences, as com-

pared with letters. The results suggest that learning of regularities in sequences in a specific modality leads to domain-specific representations, rather than to unitary, abstract representations.

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Effects of Morningness and Time of Day on Children's Math Scores. LAURA E. WHITE & DAVID S. KREINER, *Central Missouri State University*—We investigated the effects of the time of day and morning versus afternoon preference on math test performance. Twenty-five fifth-grade students completed two computational math tests, one in the morning and one in the afternoon. Order of testing and version of the test were counterbalanced. The design was a 2 × 2 mixed factorial with morning versus afternoon preference as the between factor and time of day as the within factor. Morning versus afternoon preference was determined by using scores on Horne and Ostberg's (1976) survey. There was a significant main effect of time of day, with better performance on the afternoon test than on the morning test. There was no difference in performance for morning-preferred students, as compared with afternoon-preferred students. The time of day effect was consistent across morning-preferred and afternoon-preferred students. The results have significant implications for school performance, individual achievement, curricula, and standardized test outcomes.

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Item Learning in Cognitive Skill Training: Effects of Item Difficulty. WILLIAM J. HOYER, JOHN CERELLA, & SERGE V. ONYPER, *Syracuse University*—In some theories of cognitive skill acquisition, item learning occurs automatically, through the formation or strengthening of memory traces. Given a mixed set of items that vary in computational complexity, item difficulty should have no effect on item learning. Alternatively, harder items may be harder to memorize, if item learning is capacity demanding and the concurrent computational demand is greater. Or harder items may be learned first, if item learning is a controlled strategy, adopted to reduce the computational burden. We report three experiments in which item difficulty was manipulated through the addend value of alphabet arithmetic problems and the acquisition of individual items was tracked in young and older adults. The relationship between item learning and difficulty was curvilinear: As compared with medium items, learning of both easy and hard items was facilitated, to different degrees in young adults and older adults. This evidence supports the second and third alternatives.

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The Importance of Stimulus-Congruent Processing in Creating False Memories. JASON C. K. CHAN, KATHLEEN B. McDERMOTT, JASON M. WATSON, DAVID A. GALLO, & JANET M. DUCHEK, *Washington University*—Deep processing has been shown to enhance the likelihood of false recall and recognition in the Deese–Roediger–McDermott paradigm (e.g., Thapar & McDermott, 2001). To explore the generality of the level-of-processing effect in false recall and recognition, we presented lists of semantically associated (*bed*, *rest* . . .) and phonologically associated (*heap*, *weep*) words and asked subjects to attend to either the semantic or the phonological relations among the words. List-congruent processing (e.g., attending to phonological relations for phonologically related lists) enhanced both accurate and false recall and recognition relative to list-incongruent processing (e.g., attending to semantic relations in a phonologically related list), suggesting limitations to the conclusion that deep processing enhances both accurate and false memory. We interpret the results as suggesting that the level-of-processing effects obtained previously (with semantic lists) are an instance of the influence of relational processing on false recall and false recognition.

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Effects of Age on Prospective and Retrospective Memory in Young Children and Older Adults. LIA KVAVILASHVILI & DIANA E. KORNBROT, *University of Hertfordshire,* & DAVID J. MESSER, *South Bank University* (sponsored by Nigel Harvey)—Current research on prospective memory is concerned about the nature of prospective memory retrieval (strategic or automatic?) and its relation to retrospective memory (same or different underlying mechanisms?). In order to address these issues, we compared the age effects in prospective and retrospective memory tasks at both ends of the developmental spectrum—in young children and elderly people. In Study 1 ($N = 223$), performance on several prospective and retrospective memory tasks was compared in young and old people (18–30 and 61–80 years of age, respectively). In Study 2 ($N = 240$), prospective and retrospective memory was examined in 3-, 5-, and 7-year olds. In both studies, the age effects were smaller in prospective memory tasks. Moreover, the decline in prospective memory performance started at an older age than that in retrospective memory. Taken together, these findings provide support for the idea that the processes involved in prospective memory are largely (although not entirely) automatic.

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Mnemonic Learning of Musical Compositions: Mneme That Toon. RUSSELL N. CARNEY, *Southwest Missouri State University,* JOEL R. LEVIN, *University of Arizona,* & CARRIE E. ROBERTSON, CASSANDRA I. MASCORRO, & FRANK RAGOZZINE, *Southwest Missouri State University*—This two-part experiment was conducted as an initial effort to validate a mnemonic approach for associating composers with their compositions. On Day 1, students were randomly assigned to either an "own best method" control or a keyword mnemonic (e.g., man for Mancini; imagine the Pink Panther sneaking up on a man) condition to remember composers of familiar cartoon theme songs. Study booklets described participants' respective strategies. Then, students were paced through 20 cartoon theme song/composer pairs. This was followed by a test prompted by the 20 musical themes. Two days later, the same students applied their approach to the learning of 18 composer/ classical theme pairs. On Day 1 (cartoon themes), there was a statistically significant mnemonic advantage. On Day 2 (classical themes), however, the difference did not reach statistical significance. A rationale for the lack of a mnemonic advantage on Day 2 is provided in the discussion.

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Modality Constrained Statistical Learning of Spatial, Spatiotemporal, and Temporal Input. CHRISTOPHER M. CONWAY & MORTEN H. CHRISTIANSEN, *Cornell University*—Vision appears to process input best when the input is spatially rather than temporally distributed, whereas audition is the opposite (Mahar, Mackenzie, & McNicol, 1994). Here, we explored whether such modality constraints also affect statistical learning. Participants were exposed to statistically governed visual input sequences—distributed spatially, spatiotemporally, or temporally— and then were tested on their ability to appropriately classify novel sequences. At moderate presentation rates (four elements per second), there was little difference across the three conditions. However, at faster presentation rates (eight elements per second), performance declined such that it was worst with temporal and best with spatial input. In addition, in an auditory (temporal) version of the experiment, run at both presentation rates, performance was better than in any of the visual conditions. These results suggest that statistical learning processes are affected by modality constraints: Vision is biased toward processing spatial input, whereas audition is biased toward temporal input.

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Beauty Is Relative: Expectation, Surprise, and Aesthetic Perception. BRUCE W. WHITTLESEA & TROY CHENIER, *Simon Fraser University*—Numerous investigators have proposed that aesthetic preferences for visual stimuli arise from fluency of processing, resulting from such stimulus properties as symmetry, regularity, clarity, and good form. We investigated that hypothesis, using radially symmetric, but complex and dynamic, stimuli (constantly changing moire patterns). We observed that (1) the subjects claimed to be primarily influenced by color in making their decisions, (2) that that was an illusion, since they were actually influenced by the complexity of patterns, (3) that complex patterns were preferred over less complex patterns, even when static, but (4) that the

perception of beauty was greatest when complex patterns developed suddenly out of relatively noncomplex displays. We speculate that fluency per se contributes to a perception of pleasantness but that beauty is based on surprise. The results are discussed in terms of the SCAPE framework of memory.

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Can Implicit Learning in Music Go Beyond the Learning of Adjacent Chunks? GUSTAV KUHN & ZOLTAN DIENES, *University of Sussex* (sponsored by Brendan Stuart Weekes)—Most research in implicit learning is based on evidence from the visual modality and emphasizes the role of chunking adjacent elements in a sequence. The perception of music relies on knowledge about nonlocal dependencies, which suggests that this form of learning may go beyond recognizing adjacent chunks. The following experiments assessed whether an abstract musical rule could be learned in the absence of any chunking information. Participants were exposed to short musical tunes that followed an inversion rule. It was found that when subjects were asked to explicitly distinguish between grammatical and ungrammatical tunes, they failed to perform any better than a control group. However when subjects' knowledge was assessed using an indirect measure (liking judgments), they succeeded in doing so. These findings suggest that implicit learning may go beyond pure associative learning and may also go some way toward furthering our understanding as to why people like certain types of music.

• RECOGNITION MEMORY •

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One Source or Two? Memory For Multiple Sources. MARTIN L. BINK & DANIELLE ARVANITIS, *University of North Texas,* & ANDREW LEYNES, *College of New Jersey*—The attribution of source information is important in many types of memory decisions, such as eyewitness testimony and unconscious plagiarism. Generally, source attributions involve distinguishing the origin of an item from among possible sources present in a given episode. However, the attribution process can be complicated when any single item is encountered in more than one source. This study presents two experiments that look at the processes of ascribing source for items presented in multiple sources. In Experiment 1, items were seen as pictures, heard as words, or both seen and heard. Source recognition results indicate that items for which both sources were used were confusable with items only seen. Experiment 2 used a test-formats manipulation to show that auditory details were available for multiple-source discriminations but were not used in the decision process to the extent that visual details were used.

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The Fluency Heuristic in Recognition Memory: The Effect of Repetition. MARIANNE E. LLOYD, JEREMY K. MILLER, & DEANNE L. WESTERMAN, *SUNY, Binghamton*—Four experiments were conducted to test the idea that participants are sensitive to the amount of processing fluency that is associated with prior study. Participants studied target words either once or five times and then were given a recognition test in which the fluency of half of the test items was enhanced through priming. Results showed that participants were less likely to be influenced by the priming manipulation when targets had been presented five times than when they had been presented once. The interaction between repetition and fluency also occurred when counterfeit study lists were presented and participants were told that targets appeared one or five times (when, in reality, no targets were presented). The results suggest that participants develop expectations as to the amount of fluency that should accompany target items and that their attributions of fluency are adjusted according to these expectations.

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Phonological Neighbors Lead Not Only to False Recognition, But Also to Priming for Nonpresented Associates. AYANNA K. THOMAS & MITCHELL S. SOMMERS, *Washington University*—Roediger and

McDermott (1995) presented semantically related lists to induce false recall and recognition. Since then, a vast amount of research on false memories generated by word list associations has ensued. More recently, researchers have turned their attention to phonologically related lists to determine the overlap and divergence of proposed mechanisms that account for false memories and spoken word recognition. In several experiments, phonological neighbors were studied, followed by either a recognition or a perceptual identification test. Participants not only erroneously recognized critical lures, but also were more accurate at identifying critical lures on the perceptual identification task, as compared with other nonstudied words. Levels-of-processing manipulations minimized the false memory effect but did not affect facilitation on perceptual identification. The present findings lend support to the idea that similar mechanisms may mediate semantic and phonological false memories.

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Effects of Distraction on Unconscious Transference in Eyewitness Memory. JULIE L. EARLES, ALAN W. KERSTEN, & EILEEN CURTAYNE, *Florida Atlantic University*—In unconscious transference, people mistakenly associate an action observed in one context with an actor encountered in a different context. This would seem to be an example of a binding error, a phenomenon most strongly associated with the attention literature. Thus, one possible explanation for unconscious transference is that a failure to attend to the relevant features in one's initial perception of an event results in binding errors in perception, which in turn lead to binding errors in memory. If this were the case, then attentional manipulations taking place after encoding would not be expected to influence the rate of binding errors in memory. Contrary to this hypothesis, we demonstrate that a distraction manipulation performed at retrieval has a selective effect on the binding of actors and actions in event memory. This finding suggests that unconscious transference is not exclusively an encoding phenomenon but, rather, also reflects a retrieval problem.

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Ironic Effects of Repetition in Young and Older Adults: Multidimensional Signal Detection Theory Models. MICHAEL R. HEALY & LEAH L. LIGHT, *Pitzer College,* & WILLIAM P. BANKS, *Pomona College* (sponsored by Leah L. Light)—Repeating items at study improves younger adults' performance on inclusion, source, and exclusion tasks. Older adults, however, show an ironic effect of memory with repetition: Their false alarm rates increase when they are asked to exclude repeated items. Dual-process models of memory postulate that this effect arises from a recollective deficit in older adults, making it more difficult for them to oppose the augmented familiarity of test lures. In this study, young and older adults completed an inclusion, a source, and an exclusion test, and the ironic effect of increased exclusion errors for older adults was observed. The data were modeled using a multidimensional signal detection theory approach as an alternative to process-estimation and multinomial modeling techniques. Both groups' model fits contained old–new and source dimensions. Age differences are discussed in terms of differential reliance upon these dimensions when memory judgments are made.

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Direct Examination of Item and Source Memory Using fMRI. AVA J. SENKFOR, *Massachusetts General Hospital and Stanford University,* EVELINA BUSA, *Massachusetts General Hospital,* DAVID FRIEDMAN, *New York Psychiatric Institute,* & ERIC HALGREN, *Massachusetts General Hospital*—We examined the underlying neural substrates for item and source memory, using fMRI as participants viewed objects and conducted one of two encoding tasks at study (imagine a common action, estimate object's cost) and then made old/new item judgments (Experiment 1) and made old-encoding-tasks/new-source judgments (Experiment 2). In Experiment 1, parietal and left-frontal activations were greater for old than for new judgments, whereas activation in temporal areas was greater for new than for old judgments.

In Experiment 2, activations were also greater for old judgments in parietal areas plus bilateral frontal areas, as compared with new judgments. In addition, new judgments produced greater activation in temporal areas than did old. Successful source retrieval produced greater activation in medial temporal areas, as compared with unsuccessful retrieval; neither condition produced significantly different activity in prefrontal regions. Initial results suggest a distinction between involvement during item/source retrieval and (un)successful source retrieval that appears to be associated with medial temporal activity.

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Remembering Collaborative Choices: Groupthink in Memory? JO ANN SISON & MARA MATHER, *University of California, Santa Cruz*—Individuals, after making a decision between options, seem to remember the characteristics of the two options in a manner that favors the option they chose; for example, more positive features are attributed (and misattributed) to the chosen option than to the one not chosen (Mather, Shafir, & Johnson, 2000). The present experiment examines the differences in the way that group and individual decisions are remembered. Participants worked either in collaborating groups of three or as individuals to make a decision between two options on the basis of a list of features for each option. After a filler task, all the participants completed a recognition memory test individually. Interestingly, collaborating participants showed significantly more choice-supportive biases than the individual decision makers did, suggesting a type of "groupthink" phenomena in memory.

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Encoding of Elements and Relations in Working and Long-Term Memory. AARON S. YARLAS, *Grand Valley State University,* & VLADIMIR M. SLOUTSKY, *Ohio State University*—Previous studies (Sloutsky & Yarlas, 2002) using delayed recognition procedures indicated that encoding time differentially affected accuracy of recognition for elements of study items (e.g., colors of objects, content of propositions) and relations among elements (e.g., whether shapes were arranged symmetrically, whether arguments were valid). When encoding time for study items was ample, subjects accurately recognized both elements and relations; however, when encoding time was radically reduced, accuracy of recognition for relations (although not for elements) decreased significantly. We present two new experiments that used an immediate recognition procedure in which recognition involved comparisons with items in working memory. In these studies, relations were accurately recognized even under limited encoding time. The disparity of findings across the two procedures indicates that difficulties in processing relations does not occur at initial encoding (i.e., detection, identification, binding), but, rather, more likely occurs during the recoding of relations from working memory to long-term memory.

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Two Recognition Effects in Remembering That Sometimes Occur in Knowing. IRENE KARAYIANNI, IRA KONSTANTINOU, & JOHN M. GARDINER, *University of Sussex*—Two recognition memory effects that occur in remembering were also found in knowing, depending on the conscious resources available at encoding and retrieval. One effect was that of voice congruence. Superior recognition for same versus different voices at study and test, found only in remembering with words, was found in knowing with nonwords, especially with divided attention at study. Thus, the state of memory awareness in which the effect occurred depended on the opportunity for more meaningful, elaborative encoding and the conscious resources initially available. The other effect was that of response deadline. Superior recognition for long versus short response-signal delays, found only in remembering with novel faces, was found also in knowing with famous faces. Thus, for the more meaningful faces, but not for the less meaningful faces, both states of awareness of memory increased with slower, more consciously controlled retrieval decisions, compared with more rapid, automatic ones.

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Retrieval Phenomenology Associated With Memory for Items and Concepts. KATE E. LYNCH & JENNIFER A. MANGELS, *Columbia University*—We designed a remember–know task to investigate the retrieval phenomenology of item and concept memory. Subjects were shown a name within either one or three (massed or distributed) descriptive sentences and were asked both to encode the name and to extract an impression of that individual's personality. Massed or distributed repetition of items within varied semantic contexts enhanced remembering, but not knowing, of the person's name (item memory). In addition, whereas remembering an item was associated with selection of an appropriate personality trait (concept memory) in both distributed and massed conditions, knowing an item was associated only with accurate concept memory in the distributed condition. The phenomenology associated with accurate concept retrieval was related to the retrieval phenomenology associated with the corresponding item. These results extend previous research on the phenomenology of item retrieval to that associated with concept retrieval and demonstrate the relationship between the two.

• **DIVIDED ATTENTION** •

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Backward Motor Crosstalk in a Psychological Refractory Period Task. JEFF MILLER & MARK ALDERTON, *University of Otago*—Two experiments were conducted using the psychological refractory period paradigm. Task 1 required a response with the middle or the index finger of the left hand, and Task 2 required a hard or soft keypress response with the index finger of the right hand. Contrary to what is predicted by a simple response-selection bottleneck model, a backward force-level crosstalk effect was obtained. Specifically, Task 1 responses tended to be more forceful when the Task 2 stimulus called for a hard Task 2 response, and they tended to be less forceful when the Task 2 stimulus called for a soft Task 2 response. The effect of the Task 2 stimulus on Task 1 response force suggests that the Task 2 stimulus/response mapping was at least partially activated before Task 1 processing had reached the final stage of ballistic motor output.

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Formation of Subjective Surfaces Facilitates Change Detection in a Flicker Paradigm. JUN SAIKI, *Kyoto University*—Change blindness suggests a severe capacity limitation in scene perception. The storage of surface representations can overcome such limitation by providing efficient cues about objects in the world. A series of experiments examined whether subjective surfaces are preferentially processed in visual short-term memory (VSTM) in a change detection task, using a flicker paradigm. Even with the same amount of physical change applied to the figures, people were more accurate and rapid in detecting a change involving the presence and absence of a subjective surface than with subjective contours or rotational symmetry. The results could not be attributed to the configuration of the inducers or to the attentional set. The slope-hold analysis revealed that the advantage for the subjective surface mainly reflects the faster processing involving VSTM. Modally completed surfaces play important roles not only in visual perception and search, but also in visual cognition involving VSTM.

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Linking P3 Amplitude to the Attentional Blink. SANDER MARTENS & ADDIE JOHNSON, *University of Groningen*—The attentional blink (AB; the deficit in reporting the second of two targets when it occurs 200–500 msec after the first) reflects a limited capacity to consolidate information. In fact, the P3 component of the ERP, associated with memory consolidation, is absent for a "blinked" target. It has recently been suggested that the blink is also directly associated with the P3 response to the first target. In two experiments, we tested whether the magnitude of the P3 elicited by the first target influences the magnitude of the AB. Consistent with the hypothesis of reduced cortical excitability correlated with the P3, both manipulations of first-target

probability and cue validity influenced the AB in the expected direction. Manipulations that lead to a greater P3 for the first target also lead to a greater AB.

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Dividing Resources Between Tasks: Event-Related fMRI Study. HIDEYA KOSHINO, *Carnegie Mellon University and California State University, San Bernardino,* & JACQUELYN H. CYNKAR & MARCEL A. JUST, *Carnegie Mellon University*—The classic question of how people divide their attention between multiple tasks motivated the present fMRI study involving visual mental rotation concurrent with auditory sentence comprehension. The specific question was how attentional resources (indexed by brain activation) are reallocated when a second task starts 2 sec after a first task, as compared with both tasks starting simultaneously. In a study of 12 participants, the activation in the prefrontal region (DLPFC), associated with executive processes, was significantly higher when reallocation occurred because of an asynchrony between the presentation times of the two tasks. By contrast, in the posterior regions, primarily associated with the two respective tasks (parietal with rotation and temporal with comprehension), the activation was lower for the task that was presented first. This effect may reflect how the onset of a second task draws extra resources in the presence of an ongoing competing task.

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The Attentional Blink and Task Expectancy. JACQUELYN M. CREBOLDER & ALEXANDRA J. OSTANIEWICZ, *DRDC, Toronto*—Two experiments were conducted to explore previous work in which we observed an AB effect on the third of three targets (T1, T2, T3) presented in an AB paradigm but no such effect on the second target. In one experiment, two- and three-target trials were intermixed, and an AB effect on T2 was anticipated on trials in which two targets, rather than three, were presented. No such effect was evident for T2, and there was no difference in T2 performance as a function of whether T3 was present or absent, although an AB effect was observed for T3. In a second experiment consisting of three-target trials only, the AB effect on T3 was reduced by eliminating T3 masking. Again, no AB effect on T2 was found. The results suggest that the influence of task preparation is a factor in concealing the AB effect on T2 when more than two targets must be processed.

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Automatic Mechanisms of Parallel Response Selection. SCOTT WATTER, *University of Illinois, Urbana-Champaign* (sponsored by Gordon D. Logan)—Previous research has shown Task 1 of a dual-task pair to simultaneously prime and be influenced by response selection (RS) on Task 2, with strict *Task 1 then Task 2* performance. Such priming requires Task 2 RS to begin before Task 1 RS is complete, implying that Task 1 and Task 2 RS may operate in parallel. Using a PRP paradigm, a speeded Task 1 was performed either alone or with an unspeeded Task 2 (accuracy demand only). No effects of R2 were observed on R1. When these tasks were preceded by performance of speeded responses to both Task 1 and Task 2, compatibility effects of R2 on R1 were observed at short SOAs for Task 1, implying that R2-related information was generated prior to the completion of Task 1 RS only after subjects had practiced speeded Task 2 responding. Evidence of parallel RS where Task 2 response is unspeeded or unrequired, dependent on previous speeded Task 2 performance, suggests that the automatic nature of RS is significant.

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Electrophysiological Investigation of Stimulus Identification Delays in a Dual-Task Paradigm. KAREN M. ARNELL, *Brock University,* & BRIAN PASIEKA, *North Dakota State University*—When two attended targets are presented within half a second of each other, second-target identification is often delayed. We presented two targets (T1 and T2) separated by variable temporal intervals. Response requirements and masking of T1 varied, but T2 was always unmasked and required a speeded response. Electrophysiological recordings were time-locked to T2 to isolate the T2 P3 event-related potential. The P3 component is sensitive to categorization and identification manipulations. P3 timing can be used to indicate when these operations have been completed. T2 RTs were always delayed at short target separations. However, T2 P3s were delayed only when on-line stimulus identification of T1 was made more difficult, not when T1 response requirements were increased. Results suggest a processing limitation prior to the identification stage that is influenced by T1 on-line identification difficulty and a distinct processing limitation after the identification stage that is influenced by T1 response selection difficulty.

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Sharing the Spotlight: Can You Search While Stream-Switching? TODD S. HOROWITZ & JEREMY M. WOLFE, *Brigham & Women's Hospital and Harvard Medical School,* & JENNIFER S. DiMASE, *Brigham & Women's Hospital*—Two modes of attentional deployment can be distinguished on the basis speed: slow (e.g., endogenous cuing) and fast (e.g., visual search; Wolfe, Horowitz, & Alvarez, *Nature*, 2000). Is it possible to make fast deployments in the "dead time" between initiation and completion of slow deployments? Observers looked for a cue (a "2") in a 9.3-Hz stream of digits presented to the right of fixation, then reported the first letter in a second stream to the left. The time of the reported letter indicated the time of the attentional shift. A four-item search array centered on fixation was presented for 107 msec at various SOAs; subjects detected a T among Ls. Search performance during the cue-to-shift interval was superior to performance when the shift of attention occurred. These data suggest that rapid deployments of attention are possible between the planning and the execution of a slow deployment of attention.

• **WORKING MEMORY** •

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Strengthening the Unconscious Activation of Unconscious Memories. LEILANI B. GOODMON & DOUGLAS L. NELSON, *University of South Florida* (sponsored by Douglas L. Nelson)—Words become associated through language experience. We assume that associates are automatically activated as a set whenever a target word is experienced. Preexisting connections among associates in the target's set heighten the activation of it and its associates. Our purpose was to evaluate this assumption by testing the cuing effectiveness of two different types of associates. One type receives strong inputs, whereas the other receives weak inputs, from other associates in the set. PIER 2 predicts that associates that receive more input from other items in the set will serve as better cues for recalling the target. The experiment reported tested this prediction, along with assumptions about the importance of sustaining attention to meaning during and after study. The results supported the prediction and showed that sustained attention to meaning is essential. The findings suggest that unconsciously activated memories can be strengthened by the activation of other unconsciously activated memories.

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What One Working Memory Span Task Measures: A Reanalysis of Miyake et al. (2000). MICHAEL F. BUNTING & ANDREW R. A. CONWAY, *University of Illinois, Chicago*—Miyake, Friedman, Emerson, Witzki, & Howerter (2000) do not support the view that the operation span task (OSPAN) measures a general executive function ability. In their report, structural equation modeling revealed three semi-independent latent variables of executive function (inhibition, task-switching, and updating), and only updating predicted performance on OSPAN. The authors used this finding to argue that OSPAN does not tap a general executive ability but, rather, a more specific ability—namely, updating. We reanalyzed their data and observed that multicollinearity prohibits differentiation of the updating and inhibition functions. Controlling for multicollinearity yielded a better-fitting model in which both updating and inhibition significantly predicted performance on OSPAN.

This reanalysis suggests that OSPAN taps the ability to update information and the ability to inhibit distracting information. Thus, the essence of the task is maintenance of goal-relevant information in the face of interference.

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Working Memory Span Differences in the Psychomotor Vigilance Task. JOSEF C. SCHROCK, NASH UNSWORTH, & RANDALL W. ENGLE, *Georgia Institute of Technology*—We tested high and low working memory span participants on a 10-min version of the psychomotor vigilance task (Kribbs & Dinges, 1994). Participants began each trial by focusing on a set of zeros presented in the center of a computer screen. After an interval of between 1,000 and 10,000 msec, the zeros began counting forward in millisecond increments, similar to a stopwatch. Participants pressed the space bar as quickly as possible in order to stop the clock and check their reaction time. Reaction times for high and low spans were similar during the first few minutes of the task. The last 5 min showed an increase in reaction times for the low spans, whereas the reaction times for high spans remained flat across all 10 min of the experiment. This suggested a decrease in vigilance over the 10-min period for low working memory individuals.

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The Time Course of Response Suppression: No Evidence for a Gradual Release From Inhibition. STEPHAN LEWANDOWSKY & MATTHEW J. DUNCAN, *University of Western Australia* (sponsored by Stephan Lewandowsky)—Most models of serial recall postulate a response suppression mechanism that operates at retrieval and renders recalled items temporarily unavailable. Response suppression can explain several common observations in serial recall—for example, the small number of erroneous repetitions and people's reluctance to report repeated items. Clearly, if response suppression operates, it must wear off at some point to permit an item to be recalled again (e.g., on the next trial). We report several experiments that measured the time course of response suppression during recall. A multiple cued-retrieval response-deadline test was used on both repeated and nonrepeated lists under RSVP and Ranschburg presentation conditions. The results showed that (1) repetition inhibition can occur without requiring whole report of the list, provided multiple retrievals are required, and (2) repetition inhibition, and hence response suppression, did not change as a function of increasing retrieval time. This suggests that the release from response suppression is a global, list-wide, effect, rather than a continuous gradual release. This latter conclusion is consistent with the operation of the SOB model (Farrell & Lewandowsky, PB&R, in press).

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Speaker Variability Effect in Immediate Serial Recall. MARIE POIRIER, SADIK RAY, & PRITI RUPARELIA, *City University, London,* & JOELLE LYRETTE, *UQAM*—Four experiments examined the effects of speaker variability on immediate serial recall. In all the experiments, the recall of lists in which words were pronounced by different voices were compared with the recall of lists in which the same voice says all the words. In Experiments 1 and 2, order recall performance was superior when the to-be-remembered words were pronounced by different voices, relative to the control condition in which all the words were presented in the same voice. However, Experiments 3 and 4 controlled for proactive interference between successive trials and showed that the effect reverses. Results are discussed in terms of their implications for models of immediate memory.

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Age Differences in Semantically and Phonologically Based Intrusions in Sentence Recall. MICHELLE D. MILLER, *Northern Arizona University,* & JEFFREY S. JOHNSON, *University of Iowa*—Older and younger adults (*M* = 64.83 and 20.60 years, respectively) completed a sentence recall task based on Potter and Lombardi's (1990) paradigm, in which a "lure word" that is semantically similar to a target word in a sentence appears in a list presented after the sentence. Our materials also included a set of lure words that were phonologically and semantically similar to the target words and were systematically varied by concreteness (adapted from Martin & Katz, 1998). Intrusions were more common for abstract than for concrete words, replicating Martin and Katz's findings. Older adults showed an increased tendency to intrude lure words into sentences. Both older and younger adults were more likely to intrude lures that were phonologically and semantically similar to the target, as compared with lures that were only semantically similar, supporting the idea that phonology plays a role in sentence recall in both age groups.

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The Effects of Irrelevant Information on Age Differences in Working Memory. JULIE A. DUMAS & MARILYN HARTMAN, *University of North Carolina, Chapel Hill*—Three experiments examined age differences in working memory, using a delayed-matching-to-sample task (DMTS). On the basis of theories of working memory and aging that posit that older adults are more susceptible to interference, age differences were expected to be greater for older adults when irrelevant information was present during encoding. In all experiments, performance was equated for older and younger participants on a nodelay version of the DMTS task to control for age differences in the speed of encoding information into working memory. In Experiment 1, the presence of irrelevant information at encoding had equivalent effects on younger and older adults. In Experiments 2 and 3, the discriminability between targets and irrelevant words was made more difficult by increasing the perceptual and semantic similarity, and again no age differences were found. These results are inconsistent with theories that propose that older adults are more susceptible to interference than are younger adults.

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Representation, Retention, and Recognition of Information in Visual Working Memory. DAVID E. FENCSIK, *University of Michigan,* TRAVIS L. SEYMOUR, *University of California, Santa Cruz,* & SHANE T. MUELLER, DAVID E. KIERAS, & DAVID E. MEYER, *University of Michigan*—Previous experiments on visual working memory (VWM) have inspired the hypothesis that information about briefly displayed objects is stored in separate object files whose contents may endure for several seconds (e.g., Vogel et al., 2001). Supposedly, VWM can contain about four such files. Yet data from these experiments seem difficult to interpret and were perhaps contaminated by some artifacts. To help resolve such problems, we have conducted new VWM studies that required same–different judgments and cued recall under conditions in which successive object displays changed in various ways. Our results suggest that at least two distinct types of extra-iconic visual storage contributed to performance there. One type involved unintegrated location-independent visual features. The other involved integrated location-dependent features, consistent with the object-file hypothesis. However, it appears from our results that VWM has a capacity of only about three, rather than four, object files.

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Individual Specific Abilities for Attention-Dependent Chunking in Visual Working Memory. DANKO NIKOLIC & WOLF SINGER, *Max Planck Institute for Brain Research*—We studied the conditions under which novel combinations of features can be integrated and stored as chunks and addressed individual differences in the chunking ability in visual working memory (WM). We used a WM task that required chunking the locations of elements of the same shape into a figure. With a fixed presentation time of 1 sec, the capacity of WM was limited to locations of about 4 elements. The availability of additional presentation time revealed that locations of at least 12 elements could be integrated into chunks. However, integration of more than 4 elements required a serial process where the integration time per element varied highly between individuals and very little within individuals. These results suggest that chunking into visual WM relies on atten-

tional processes and that the individual differences in WM capacity could be due to the differences in individual rates of chunking.

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The Interaction of Surfaces and Visual Short-Term Memory Capacity. YAODA XU, *Harvard University*—To date, studies of visual short-term memory (VSTM) have presented items on the same surface. The reported VSTM capacity limitation may thus reflect an encoding limitation within a given surface. Could more items be encoded into VSTM if they were distributed on two surfaces? In a first experiment, using the change detection paradigm (Luck & Vogel, 1997), items were either presented on the same surface or evenly distributed on two surfaces separated by depth. No difference was found in performance between the two conditions. However, it was difficult to attend to two surfaces at once. This added difficulty might have erased any benefit gained from encoding items from two surfaces. In a second experiment, with sequential presentation, subjects only had to attend to one surface at a time. Preliminary results showed better performance when items were on two surfaces. The interaction of VSTM capacity and surfaces will be discussed in detail.

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Real-Time Collaboration Among Brain Regions During Working Memory for Sentence Meaning. HENK J. HAARMANN, *University of Maryland,* KATHERINE A. CAMERON, *Washington College,* & DANIEL S. RUCHKIN, *University of Maryland* (sponsored by Marius Usher)—We used electroencephalogram (EEG) coherences to investigate cortical synchronization processes during the retention of sentence meaning in working memory. Sixteen adults had their EEGs recorded while they read a sentence (processing) and retained it for 2.5 sec (retention), in order to answer a question about it. The critical sentences could contain either three semantically related or unrelated nouns. As compared with a presentence baseline, coherences in the 3- to 7-Hz range were larger during processing and smaller during retention, whereas coherences in the 9- to 15-Hz range showed the reverse pattern. During retention, sentences with unrelated nouns showed increased coherence in the 13- to 15-Hz range. Coherence changes spanned frontal and posterior sites in both hemispheres. More errors were made in the unrelated than in the related condition. Converging results came from ERP amplitudes and source analysis. The results suggest that working memory for sentence meaning is supported by a large-scale network of interdigitated brain regions interacting in real time.

• COGNITIVE CONTROL •

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Element-Level and Ensemble-Level Task Switching: The Influence of Task Organization. MEI-CHING LIEN & ERIC D. RUTHRUFF, *NASA Ames Research Center*—Two task-switching theories were tested. The element-level theory attributes switch costs to the switch in cognitive operations, perhaps requiring a task-set reconfiguration, from one task to the next (Task A to Task B). The ensemble-level theory attributes switch costs to the change in the preparatory state for a task ensemble. A task ensemble is a mental organization of multiple tasks as a unit; for example, participants might group Task 1 and Task 2 together when presented in close temporal proximity (e.g., the PRP paradigm) or spatial proximity. We have consistently found that when the ensembles of Task 1 and Task 2 switched (AB on one trial, BA on the next trial), Task 1 was slow even though it was a repetition from the previous Task 2. These findings suggest a crucial role for the preparatory state of the task ensemble and call into question the importance of element-level task repetition.

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Two Languages Are Better Than One: Bilingualism and Aging Effects on Inhibitory Control. MYTHILI VISWANATHAN, MICHELLE M. MARTIN, & ELLEN BIALYSTOK, *York University*—Research with bilingual children has revealed a consistent advantage in their ability to inhibit misleading perceptual information, compared with monolinguals. The present experiments used the Simon Task to extend this effect across the lifespan. The Simon Task requires participants to respond to the color of a stimulus and ignore the position, but in half the trials the position conflicts with the correct response. Children (5 years), younger adults (20 years), adults (40 years), and older adults (70 years) who were monolingual or bilingual completed the Simon Task. There was a bilingual advantage on incongruent trials for all groups except the younger adults. Although performance continued to decline for adults and older adults, the bilingual advantage was maintained at about the same level. Therefore, the rate of decline of the executive processes used to solve the Simon Task was not different for the two groups.

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How Two Share Space. NATALIE SEBANZ, GÜNTHER KNOBLICH, & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research*—Spatial stimuli often carry social content, as when a person points at one of two others. In a series of experiments, we investigated whether acting upon such stimuli is influenced by the presence of another agent involved in the same task. Participants carried out a variant of the Simon Task alone and together. Each participant responded to one of two colors that were presented together with an irrelevant spatial feature in the form of a finger pointing to the left, the right, or straight ahead. There was a compatibility effect in the joint condition, resulting in faster reaction times on trials in which the finger pointed at the person who should respond, but no such effect in the individual condition. In further experiments, we investigated which aspects of the context lead to the joint compatibility effect. The results demonstrate that action alternatives assigned to others become part of one's own action plan.

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Absentmindedness in Task-Set Switching: Goal Neglect or Goal Amnesia? TAKATSUNE KUMADA, *National Institute of Advanced Industrial Science and Technology*—A failure in task-set switching was examined by a cued-switch paradigm. In each trial, two objects (one red and one green; one circle and one square; one large and one small) were presented in the left and right sides, respectively, of a fixation. Before a block of 16 trials, a cue word (*red*, *circle*, or *large*) was presented for 3,000 msec to specify a feature relevant to the block. Fifteen participants responded to the location of a relevant object, while ignoring irrelevant dimensions. Ten participants made *dimensional-switch errors*: The participants absentmindedly responded to one of the irrelevant dimensions through a block. Most of the errors were perseveration errors: Participants responded to a dimension relevant to the preceding block. The errors tended to occur when a relevant dimension was switched from a difficult one (i.e., a shape dimension) to others. This suggests that the dimensional-switch error is not simply due to amnesia for a current goal but to inertia of the prior task-set's preventing reconfiguration of new task-sets.

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Does "Switch Cost" Really Index Executive Control? ERIK M. ALTMANN, *Michigan State University*—*Switch cost*, the measure of choice in the task-switching literature, suffers two validity problems when interpreted as an index of executive control. First, when derived across positions within a run, as in the alternating runs paradigm (Rogers & Monsell, 1995), switch cost is confounded with other costs that are independent of switch/stay. To be valid, switch cost must be derived across switch and stay trials on the first position of a run. Second, when thus derived, switch cost is unaffected by cue–stimulus interval (CSI). In a parametric study, CSI ranged from 100 to 800 msec by 100-msec increments between subjects in order to prevent carryover of cue-encoding strategy. CSI failed to affect switch cost ($F < 1$). The results suggest that a task-independent encoding cost measures the processes that establish a task set and that switch cost (properly measured) is a nonfunctional artifact that says little about executive control.

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Neural Network Model of a Directed-Forgetting Working Memory Task. GREG STEVENS, ROBERT G. MORRISON, & RICHARD STACK, *UCLA*—We developed a neural network model of a memory-scanning task (Bjork, Abramowitz, & Krantz, 1970) to investigate the active maintenance of task-specific information involved in action control. In the task, subjects see a stream of letters followed by a probe and must say whether the probe appeared in the preceding stream or not; on some trials, a change in letter color signals subjects to forget previous letters and remember only letters in the new color. We model this task, using standard neural network assumptions: A self-excitatory attractor network implements active memory, competitive inhibition guides response selection, and contextual cues control information flow. We evaluate the model's ability to account for classic results, describe its predictions for repetition and set size manipulations, and present new empirical data testing these predictions. We conclude by discussing the strengths and limitations of the model in the broader context of connectionist models of memory and executive control.

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Does Executive Control During Task Switching Rely on Verbal Self-Instruction? RICHARD L. BRYCK & ULRICH MAYR, *University of Oregon* (sponsored by Ulrich Mayr)—Recent task-switching work has demonstrated elevated task-switch costs with concurrent articulatory suppression (Baddeley et al., 2001, JEP:General), implicating a general role of the phonological loop during executive control. Using an alternate-runs paradigm with spatial cues of the required task sequence, we failed to replicate this result both for verbal and for nonverbal primary tasks. However, indications of interference between verbal processing and task switching were obtained in the absence of external cues regarding the sequencing of tasks. These results are consistent with a specific, rather than general, contribution of verbal processing to executive control. Verbal self-instruction may be critical whenever a sequential plan needs to be executed in an endogenous manner.

• LETTER AND WORD PROCESSING •

(480)

The Stroop Effect and Automaticity in Word Recognition. BEN A. PARRIS, *University of Sussex,* DINKAR SHARMA, *University of Kent,* & BRENDAN S. WEEKES, *University of Sussex*—The Stroop task is a classic example of the automatic nature of word reading. However, Besner, Stoltz, and Boutilier (1997) challenged the automaticity assumption. They colored in only one letter of the word and found that this manipulation reduced and, in some cases, eliminated the Stroop effect. We show that if the color carrier is at the optimal viewing location, the Stroop effect is as large in magnitude as when all the letters are colored. We argue that this is due to the fact that an initial fixation at this position minimizes the time needed for word recognition, because it decreases the probability of the need for a second fixation within the word. Since word recognition is less efficient from any other position, inhibition is facilitated. We also show that the level of control a participant has over inhibition of the irrelevant dimension is dependent on response modality.

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Recognizing Words Among Streams of Pseudowords: How Long Does it Take? MARY C. POTTER, *MIT,* & DANIEL H. O'CONNOR, *Princeton University*—Words in sentences viewed in rapid serial visual presentation (RSVP) at 100 msec/word are easy to read, and single words presented with a following noise mask reach the 50% threshold at about 40 msec. But sentences provide supportive context, and single masked words allow for postmask processing. Eye fixations last for more than 200 msec per word, but they include integration time; lexical decisions take 500 msec, but they involve sensory–motor overhead. We showed RSVP sequences in which one word was mixed with pseudowords, presented at rates of between 53 and 213 msec/item.

At a rate of 107 msec/item, 46% of the words were reported; at 213 msec, 85% were reported. (Lexical decisions on the same words mixed with pseudowords took over 400 msec; neither task showed significant frequency effects.) We conclude that identifying a word out of context takes a median exposure time of 115 msec under conditions in which a word can be detected only by being identified.

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The Time Course of Vowel and Consonant Activation in Reading. STUART E. BERNSTEIN, *Middle Tennessee State University*—An experiment examined when vowels become associated with the consonants that follow them during the encoding of briefly presented monosyllabic words. Target items were presented for 24, 36, or 48 msec and were immediately followed by a 24-msec backward mask that preserved the rime, the head, or none of the target. For the 36- and 48-msec target durations, masks that preserved the rimes of words (*gait*–BAIT) resulted in significantly higher accuracy than did control items (*gait*–BEEF). At all three target durations, masks that preserved the heads of words (*seek*–SEED) resulted in no difference in comparison with control items (*seek*–MOOD). These findings suggest that vowels are immediately associated with the consonants that follow them during the initial encoding of a printed stimulus.

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An Event-Related fMRI Study of Printed Word Recognition With Rapid Presentation Rates. STEPHEN J. FROST, *Haskins Laboratories,* W. EINAR MENCL, *Haskins Laboratories and Yale School of Medicine,* REBECCA SANDAK & STEPHANIE A. MASON, *Haskins Laboratories,* LEONARD KATZ, *Haskins Laboratories and University of Connecticut,* & KENNETH R. PUGH, *Haskins Laboratories and Yale School of Medicine*—We investigated the feasibility of using rapid presentation rates in event-related fMRI studies of word recognition. A visual lexical decision task was employed with slow and fast presentation rates, allowing for (1) comparability with designs employed in behavioral and electrophysiological studies of language and (2) comparison of the spatial overlap of activation patterns observed at the two presentation rates. Analyses of both the slow and the fast presentation rates revealed activations of the major cortical areas implicated in reading, including robust activations in inferior frontal and occipito-temporal sites. In addition, we observed a set of cortical areas that were sensitive to lexicality and frequency. The effects of lexicality and frequency across presentation rates were largely overlapping, although important differences were observed. Brain/behavior correlations were also used to explore the relation of individual differences in cortical activation patterns to individual differences in performance. Implications for methodology and theory are discussed.

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Functional Connectivity of Brain Regions in Good and Poor Readers. W. EINAR MENCL, BENNETT A. SHAYWITZ, & SALLY E. SHAYWITZ, *Yale University School of Medicine,* KENNETH R. PUGH, *Haskins Laboratories,* & ROBERT K. FULBRIGHT & JOHN C. GORE, *Yale University School of Medicine*—Previous brain imaging research has indicated altered activation patterns within localized cortical areas in dyslexics, relative to good readers, including overactivation of anterior areas (Broca's area) and underactivation of posterior areas (angular gyrus and occipito-temporal cortex). We present a complementary examination of functional connectivity across brain areas to better understand the full reading network and its disruption in reading disability. We acquired fMRI data from 144 nonimpaired and dyslexic children, 7–17 years of age, while they read real words. Correlation analysis indicated a relationship between activity in Broca's area and the occipito-temporal region in older good readers, but not in young good readers, young dyslexics, or older dyslexics. A multivariate analysis (PLS) was then employed to frame these local correlation differences within the context of the larger network. Results suggest that connectivity between Broca's area and the occipito-temporal area develops with age to support skilled reading.

(485)

ERP Studies of Verb Generation. GWENDOLYN SCHMIDT & CAROL A. SEGER, *Colorado State University*—We used event-related potentials (ERPs) to investigate the time course and scalp topography of brain activity during semantic processing in the verb generation task. We compared reaction times and ERPs for generating verbs to repeated versus novel nouns, generating the first verb to come to mind versus generating an unusual verb, generating repeated verbs to the same noun, and generating verbs to nouns with few associated verbs versus nouns with many associated verbs.

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Age, Process, and Representation in an Attractor Network. PATRICK CONLEY & CURT BURGESS, *University of California, Riverside*—Previous attractor networks have simulated semantic priming behavior. Reaction time in such networks is modeled by the cycles required for the network to achieve a steady state. This steady state is more quickly achieved for an input word when the immediately preceding word is semantically related than when it is not, replicating in the network the well-known priming effect found in humans. This study expands on these previous networks by comparing priming behavior across two networks, with one network trained on language derived from older adults and the other on language from younger adults. Whereas previous networks have used highly simplified or atheoretical semantic vectors, the vectors in this study are derived from actual language as processed by the HAL model of memory. These new networks simulate the effects of age on semantic priming and allow a more thorough examination of the interaction between representation and process in age-related memory deficits.

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Second-Language Experience and Priming With Weakly and Strongly Related Word Pairs. ZANA DEVITTO & CURT BURGESS, *University of California, Riverside,* & CATHERINE DECKER, *Chaffey College*—McKoon and Ratcliff (1979) suggested that very weakly related words may not show a semantic priming effect without prior training. An analysis using the HAL memory model showed that their weakly related items showed a reliable distance priming effect (although it was smaller in magnitude than that for strongly related pairs). Two semantic priming experiments were conducted with English-speaking subjects who varied in their second-language experience. In Experiment 1, subjects made lexical decisions to targets preceded by two types of primes (SR, strongly related, e.g., *green–grass*; WR, weakly related, e.g., *city–grass*). All subjects showed a robust SR priming effect, and only subjects who were native English speakers with no second-language experience showed a very small WR priming effect. In Experiment 2, only WR trials were presented to subjects. Again, only native English-speaking subjects with no second-language experience showed a WR priming effect; however, the priming magnitude increased.

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Mediated Priming and the Role of Language Experience in the HAL Memory Model. KAY LIVESAY, *University of San Francisco,* & CURT BURGESS, *University of California, Riverside*—Mediated priming with humans has been shown with stimuli that are contextually consistent (*bat–bounce*), but not with stimuli that are not contextually consistent (*day–dark*; Livesay & Burgess, 1997). The HAL memory model has demonstrated a wide range of semantic priming effects. However, Livesay and Burgess have not found mediated priming with contextually consistent word pairs—a major limitation of HAL, since it relies on contextual learning for developing its representations. Lowe and McDonald (2000) have criticized the robustness of the HAL model for this failure. Livesay and Burgess (1999) found that higher verbal ability subjects showed a mediated priming effect with contextually consistent items but that low verbal ability subjects did not. This led to the hypothesis that if the HAL model had additional language experience, it would reflect the mediated relatedness effect. Increasing input from 130 million words of text to 320 million words resulted in a robust priming effect.

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Semantic Ambiguity and the Process of Generating Meaning From Print. PENNY M. PEXMAN, *University of Calgary,* YASUSHI HINO, *Chukyo University,* & STEPHEN J. LUPKER, *University of Western Ontario*—A semantic ambiguity disadvantage has been reported in semantic tasks (Gottlob et al., 1999; Hino et al., 2002; Piercey & Joordens, 2000). This effect has been attributed to the one-to-many mappings between orthography and semantics presumed to exist for ambiguous words and has been taken as support for PDP models of word recognition. We tested an alternative explanation for this effect—that the ambiguity disadvantage arises during the decision-making process in semantic tasks, and not during the process of meaning activation. To do so, we examined the effects of ambiguity on unrelated trials in a semantic-relatedness decision task. These trials are free from a response bias for ambiguous words that is present in most other semantic tasks. We observed a null ambiguity effect on these trials (Experiment 2), despite the fact that the same stimuli produced the typical ambiguity advantage in LDT (Experiment 1), providing support for the decision-making explanation.

• PSYCHOLINGUISTICS •

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A Dichotic Study of Semantic Processing in the Cerebral Hemispheres. KRISTIN M. KWASNY & RUTH A. ATCHLEY, *University of Kansas,* LAURA HALDERMAN, *University of California, Riverside,* & CHRIS DOMEN, *University of Kansas*—Researchers have investigated the differential contribution of each cerebral hemisphere to semantic processing. To date, the majority of this work has focused on the visual modality, and few have investigated semantic processing across the hemispheres, using auditory lateralized stimuli. However, both behavioral and electrophysiological evidence suggests that there are separate systems responsible for auditory and visual word processing. The present study attempted to build a link between these two research domains by utilizing the dichotic listening technique in order to study semantic processing in the cerebral hemispheres. As in the visual modality, we found that the left hemisphere seems to preferentially access highly related semantic information, whereas the right hemisphere accesses a wider range of semantic associates. In addition, interesting differences were observed for our dichotic semantic processing task that may be interpreted in light of theories regarding differences in the auditory and visual lexicon.

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The Development of Lexical Ambiguity: A Corpus-Based Analysis. CLINTON SCHLENKER & PING LI, *University of Richmond*—Although lexical ambiguity has attracted enormous research attention, most previous studies have focused on the resolution of lexical ambiguity in sentence processing by normal adult speakers. In this study, we examine lexical ambiguity as a developmental phenomenon and hypothesize that children's ability to handle lexical ambiguity grows with their lexical experience. We analyzed a corpus of children's speech transcripts (about 2.7 million word tokens) from the CHILDES database (MacWhinney, 2000) and found that children start to explore the various meanings of ambiguous words from a very early age. However, children's early uses are primarily the dominant meaning of an ambiguous word, as reveal by a token frequency analysis. Implications of the results are discussed with respect to an activation-based model of lexical ambiguity processing.

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Semantic Analysis Can Overrule Syntactic Analysis: Evidence From ERPs. DOROTHEE J. CHWILLA, HERMAN H. J. KOLK, & MARIEKE VAN HERTEN, *Nijmegen University*—Commonly syntactic anomalies elicit P600 effects, whereas semantic anomalies elicit N400 effects. Experiment 1 compared the effects of semantic reversal anomalies (e.g., *the fox that on the poachers hunted* [singular] . . .) with those of syntactic subject–verb agreement anomalies in an ac-

ceptability judgment task. Unexpectedly, syntactic and semantic anomalies elicited P600 effects. Experiment 2 replicated this finding in a reading task showing that the P600 effect to semantic anomalies was not a task artifact. We propose that the P600 effect to reversal anomalies reflects a semantic bias in syntactically unambiguous sentences for the plausible scenario (*poachers hunt foxes*). This bias leads participants to expect a certain inflection (*poachers hunted* [plural]) or a certain verb (e.g., *spotted*). If this expectation is violated, reanalysis occurs that yields a P600 effect. Experiment 3 clarified that the unexpected verb elicited the P600 effect. In general, these experiments show that semantic analysis can overrule syntactic analysis.

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Individual Differences in Working Memory and Bilingual Control Processes. ERICA B. MICHAEL, *Carnegie Mellon University,* TON DIJKSTRA, *University of Nijmegen,* & JUDITH F. KROLL, *Pennsylvania State University*—When bilinguals recognize words in one language, information about words in their other language is also active. Past research suggests that language nonselectivity reflects bottom-up activation of the lexical identification system and cannot be modulated by instruction or intention to use only one language. In the present study, we investigated whether individual differences in cognitive resources influence bilinguals' ability to control activation from the nontarget language. Dutch–English bilinguals completed a working memory task and also performed translation, word naming, and English lexical decision including interlingual homographs (e.g., *room*, which means *cream* in Dutch). Higher span bilinguals were faster to translate than lower span bilinguals, but there were no span effects in the speed of naming and lexical decision. Most critically, there were no span differences in modulating the interference from the Dutch reading of the homographs. We discuss the implications for models of lexical selection and control in bilingual performance.

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Generalizing Phonotactic Regularities. KYLE E. CHAMBERS & KRISTINE H. ONISHI, *University of Illinois, Urbana-Champaign* (sponsored by Gregory L. Murphy)—Phonotactic regularities affect language processing (e.g., Mattys et al., 2001; McQueen, 1998). Novel phonotactic regularities can be learned from brief auditory experience (Chambers et al., 2002; Onishi et al., 2002). But what regularities are being learned—consonant-position restrictions or transitions between consonants and vowels? The present studies were designed to decide between these alternatives. Subjects heard consonant–vowel–consonant syllables (e.g., /kɪp/) from a miniature language that displayed consonant-position regularities (e.g., /b/s were onsets, /p/s were codas). Subjects were faster to begin repetition of unstudied syllables that were consistent with the regularity than those that violated the regularity. This advantage for "legal" syllables held even when the syllables contained a novel vowel, indicating that subjects were learning more than phoneme transitions. The studies demonstrate the ability to rapidly learn and generalize phonotactic regularities, suggesting a powerful phonological learning mechanism.

(495)

Sound Symbolism: A Possible Piece in the Puzzle of Word Learning. SUSAN J. PARAULT, *University of Maryland,* & PAULA J. SCHWANENFLUGEL, *University of Georgia* (sponsored by Paula J. Schwanenflugel)—Sound symbolism is the notion that the relationship between word sounds and word meaning is not arbitrary for all words. The present experiments examine the potential role that sound symbolism might play in vocabulary learning. In four experiments, participants were asked to guess the meaning of obsolete English words containing an initial sound symbol and obsolete words not containing a sound symbol. More correct guesses were made for sound-symbolic words than nonsound-symbolic words in each experiment. In a fifth experiment, these words were presented with and without context. There was an interaction between context and sound symbolism. The results of these studies suggest that word learners are able to use sound-symbolic in-

formation to extract initial guesses as to the meanings of unknown words and to capitalize on contextual features during word learning.

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Language Consistency Among Bilinguals in Remembering the Same Event Twice. SAMI GULGOZ, *Koc University*—Language of experiencing an event has been shown to be influential in the retrieval of events from autobiographical memory. In two experiments, we investigated the retrieval of memories by bilinguals. In the first experiment, bilinguals tended to recall events experienced in the same language as that used during the research session. This experiment also showed that events including interactions in a particular language were reported to be retrieved in the same language. In the second experiment, the participants in the first experiment were tested again 2 years later. In this testing, they were given the memories recalled in the previous experiment. They were given in same-language and different-language conditions according to the session of the previous experiment and according to reported language of retrieval. The results showed a consistency in the language the participants reported experiencing memories in.

• REASONING AND PROBLEM SOLVING •

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Verbal Processes and Symbol Manipulations During Algebra Problem Solving. MYEONG-HO SOHN, ADAM GOODE, & KENNETH R. KOEDINGER, *Carnegie Mellon University,* CAMERON S. CARTER, *University of Pittsburgh,* & JOHN R. ANDERSON, *Carnegie Mellon University*—Mathematical thinking requires both linguistic processes as well as symbol manipulations. In this fMRI study, we examined neural bases of these processes during algebra problem solving. Half of the participants received algebra problems expressed in verbal format (story problems), and the other half received problems in equation format. Behavioral results showed that problems requiring division operation were solved faster and more accurately than were problems requiring multiplication. Otherwise, the initial representation format and the problem type (start unknown or result unknown) did not affect the performance. However, neuroimaging data suggested that the symbolic (equation) representation of problems evoked greater activation in inferior parietal and visual areas, whereas the verbal representation evoked greater activation in superior parietal and prefrontal areas. These results suggest that linguistic and symbolic processes may be alternative problem-solving strategies, although their relative efficiency in problem solving may not differ.

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How do Situational and Cognitive Constraints Influence Strategy Choices? MELANIE CARY & MARSHA C. LOVETT, *Carnegie Mellon University*—This study examines the strategy choices people make during problem solving, particularly when those choices are between equally viable strategies. Participants in three experiments practiced solving several income calculation problems. Each problem could be solved by using one of two types of solution strategies: compute wage income first or compute commission first. We manipulated two between-subjects factors: The working memory demands associated with the two strategy types were either equivalent or not, and participants were provided with a subtle instructional bias toward one or the other strategy type. The results indicate that some participants in the nonequivalent condition developed a preference for the less demanding strategy. Regardless of demand condition or practice, the instructional bias had a substantial impact on participants' strategy choices, especially when the bias was toward the wage income first strategy. These effects verify that strategy choices can be influenced by situational and cognitive constraints.

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Reasoning With Realistic Material: Inducements and Advice. EYVIND OHM & VALERIE A. THOMPSON, *University of Saskatchewan*—

Performance on standard measures of logical reasoning reflects both knowledge-based and rational influences. In this experiment, we examined reasoning with inducements, such as promises and threats (e.g., *if you tidy your room, you may have ice cream*) and advice, such as tips and warnings (e.g., *if you want to make a good impression on the boss, you should come to work early*). Comprehension of these statements requires not only knowledge of the specific elements referred to in the rule, but also attributions regarding other people's intentions and goals. However, the factors underlying the interpretation of inducements and advice have not been clearly specified. In this study, we identified several such factors (e.g., how much the speaker of the rule is perceived to have at stake) and examined the relationship between these factors and performance on standard tests of conditional reasoning.

(500)

The Role of Working Memory Span in Insight Problem Solving. TRINA C. KERSHAW, IVAN K. ASH, CARA JOLLY, & JENNIFER WILEY, *University of Illinois, Chicago*—In incremental problems, once a problem representation is constructed using prior knowledge, the solver can take algorithmic steps toward solution. Working memory (WM) may be important for maintaining the representation, subgoals, and partial solutions as the solver works through the problem. For insight, the role of WM is less clear. High-WM function may help the solver to maintain and mentally manipulate a representation, but it would not guarantee the recognition of new relations or the restructuring of the problem needed for solution. In one experiment, we investigated the relation between WM executive function (O-span), algebra, and insight problem solving ability. In a second experiment, the high spans solved more insight problems than did the low spans, but with object use as a means of external representation and manipulation, differences between spans were eliminated. The role of WM span may be an additional dimension on which incremental and insight problems differ.

(501)

Retroactive Interference on Long-Term Memory for Planned Solutions. PETER F. DELANEY & MARTIN E. KNOWLES, *University of Florida*—Recent research with word lists suggests that even if items are similar between two lists, retroactive interference (RI) is greatly lessened if those items are processed differently (Burns & Gold, 1999), whereas the degree of original or interpolated learning matters relatively little (Bauml, 1996). We report some recent experiments on memory for well-learned planned solutions in the water jugs task. In each experiment, participants planned their solution to two water jugs problems, but were interrupted prior to executing the second plan to do something else. We found that plans were well-remembered even after ten or more minutes of a distractor task, even when the distractor task was difficult and attention demanding. The amount of forgetting caused by RI depended on the presence of similar elements being processed in a similar fashion, not on the distractor task's difficulty or whether the distractor task involved planning or not.

(502)

How to Put Things Together. JULIE HEISER & BARBARA TVERSKY, *Stanford University*—Instructions, for assembling objects or operating devices, are notorious. We seek to improve them by generating principles in three steps: Knowledgeable participants of varying ability produce instructions that use depictions and descriptions; new participants rate them; a third set tests them. From this, we produce an analysis of mental representations of the objects and procedures for assembling them, as well as guidelines for constructing effective instructions.

• JUDGMENT AND DECISION MAKING •

(503)

Individual Differences in Probability Judgment and Subadditivity. MICHAEL R. DOUGHERTY & JENNIFER HUNTER, *University of Maryland*—The purpose of the present research was two fold. First, we examined the extent to which subadditivity in probability judg-

ment was affected by the strength of the alternatives with which the focal was compared. Second, we examined whether individual differences in working memory (WM) capacity were related to the degree to which judgments were subadditive. In two experiments, we revealed that subadditivity was greater when the set of alternatives contained a few strong alternatives than when the alternatives were all rather weak, even though objective probability was held constant. More important, the degree to which participants were subadditive was negatively correlated with a measure of WM span. Results lend support for the idea that participants make probability judgments by comparing the focal with relevant alternatives and that participants high in WM span include more alternatives in the comparison process.

(504)

Regret Is Both a Causal and a Counterfactual Emotion. BARBARA A. SPELLMAN & STEPHEN J. STOSE, *University of Virginia*—Regret and disappointment have been characterized as counterfactual emotions: They depend on imagining alternative outcomes to the one that actually occurred. Yet regret also depends on our own decisions—what we could have done differently to affect the outcome. Thus, regret should be related to causality. To assess how much someone's actions contributed to causing an outcome, people compare the probability of the outcome before the action was taken with its probability after the action was taken (Spellman, 1997). We predicted that regret would depend on the difference between the change in probability of the (bad) outcome given the actual decision and the imagined change in probability of that outcome had an alternative decision been made. (Such probability estimates are made in hindsight.) Our experiments use these definitions to explain *action* and *inaction* effects (i.e., why people sometimes regret actions more than inactions and vice versa) and dissociations between judgments of regret and disappointment.

(505)

Search and Stopping Rules in Decision Making: Do People "Take the Best"? BEN R. NEWELL, *University College London,* TIM RAKOW, *University of Essex,* & NICOLA J. WESTON, DAVID R. SHANKS, & NIGEL HARVEY, *University College London*—The "take-the-best" heuristic (TTB; Gigerenzer & Goldstein, 1996) comprises three basic building blocks: the search rule (search cues in order of descending validity), the stopping rule (end search when a cue that discriminates between alternatives has been found), and the decision rule (choose the alternative pointed to by the first discriminating cue). We present empirical evidence that shows systematic deviations from both the search and the stopping rules. Search is determined not by validity alone, but by "success," a function of the discrimination rate and the validity of a cue. Stopping does not always occur after the discovery of a single discriminating cue; a significant proportion of participants continued to acquire information after a discriminating cue had been discovered. The results demarcate some of the boundary conditions of TTB and question the psychological reality of its fundamental components.

(506)

Effects of Sleep Loss on Team Decision Making: Social Loafing or Social Facilitation? JOSEPH V. BARANSKI, MEGAN M. THOMPSON, FREDERICK M. LICHACZ, LUIGI PASTO, CAROL McCANN, & ROSS PIGEAU, *Defence Research and Development Canada*—We examined the effects of 30 h of sleep loss and continuous cognitive work on performance in an interactive team decision-making environment. Sixteen teams participated, and each was made up of four members. Three members made independent threat assessments on a medium fidelity simulation of a naval surveillance and threat assessment task and then forwarded their judgments electronically to a team leader, who made a final assessment on behalf of the team. The performance loss associated with fatigue owing to sleep loss was mediated by being part of a team, as compared with performing the same task individually; that is, we found evidence of a social facilitation effect in sleepy teams. We compare these results with those of Hoeksema-van Orden, Gaillard, and Buunk (1998), who found clear evidence of social loaf-

ing in sleepy teams, and we reconcile the different outcomes in terms of the degree of interdependency of the team tasks.

(507)

A Comparison of Theories in Categorical Reasoning. DAVID E. COPELAND & GABRIEL A. RADVANSKY, *University of Notre Dame*—In categorical reasoning, many studies have examined which conclusions people draw from syllogisms, as well as how people reach them. These studies have resulted in a number of different theories to explain this type of reasoning. We examined theories of categorical reasoning, such as the probability heuristics model, traditional mental model theory, and a new version of mental model theory (Sultan). The predictions made by these theories were tested using an analysis that took into account the likelihood of certain processes, or steps, occurring according to these theories. This analysis examined the likelihood of specific conclusions' being drawn, both correct and incorrect, for each syllogism and how these probabilities relate to the predictions of the theories.

(508)

Temporal and Probability Discounting as Measures of Impulsivity and Risk Taking. JOEL MYERSON, LEONARD GREEN, DANIEL D. HOLT, SARA J. ESTLE, & JOHN S. HANSON, *Washington University*—Temporal and probability discounting tasks measure the subjective value of delayed and probabilistic rewards, respectively. It is commonly believed that impulsivity (i.e., inability to delay gratification) and risk taking are both manifestations of a single underlying trait. If so, one would expect there to be a negative correlation between rates of temporal and probability discounting. To test this hypothesis, we correlated measures of temporal and probability discounting obtained in three experiments (Ns = 68, 101, and 171). Contrary to the single-trait hypothesis, positive correlations were observed in all three experiments. The present results are counterintuitive: Individuals who are more impulsive appear to put a higher value on certainty of reward, whereas those who are less impulsive tend to be more risk taking. This finding may have implications for the application of discounting measures to the study of groups with behavioral problems (e.g., gamblers, substance abusers).

(509)

A Cognitive Analysis of Judgments of Group Liking. JAMES B. WORTHEN & JACQUELINE M. DILLON, *Southeastern Louisiana University* (sponsored by James B. Worthen)—Previous research has demonstrated that attitudes toward social interaction can be predicted by factors related to knowledge representation. For example, a recent study (Worthen, McGlynn, Solis, & Coats, 2002) demonstrated that judgments of social distance for both objects and people were predicted not only by judgments of similarity between the participant and the target, but also by how well the target represented its category. The present study further investigated the role of cognitive factors in determining social judgments by examining the analysis of shared features (family resemblance of behaviors, physical features, and traits), predictability, and the frequency of direct and indirect interactions as determinants of liking of social groups. The results indicated that analyses of disliked features and judgments of predictability were significant and unique predictors of group liking. The implications of the results regarding differences between common-object and social information processing are discussed.

(510)

A Power Calculator for One-Degree-of-Freedom Tests. JAMIE I. CAMPBELL & VALERIE A. THOMPSON, *University of Saskatchewan*—We have developed an easy-to-use calculator program to estimate power, effect size, or sample size for any one-degree-of-freedom test (main effect or interaction) from within-subjects, between-subjects, or mixed designs of arbitrary complexity. Effect size is estimated (or provided by the user) in the original units of measurement, rather than in less intuitive variance-based ratios or small–medium–large approx-

imations. To specify effect size, one can enter either MST or the difference in original units; to specify error variance, one can use either MS_e or the variance of the difference. Given the F ratio and MS_e provided in most research reports, one can easily compute observed power and effect size for any ANOVA effect with one degree of freedom.

(511)

Does the Law of Small Numbers Explain the Gambler's Fallacy? BRUCE D. BURNS, *Michigan State University*—Belief in the law of small numbers leads people to expect every segment of a random sequence to reflect the true proportions (Tversky & Kahneman, 1971). This has been seen as explaining the gambler's fallacy, a tendency for people to expect a streak of one event to be followed by a different event. What counts as a segment is vague, so it could be defined as the streak itself, making the gambler's fallacy and law of small numbers tautological. However, if a nontautological definition is used, then they can be contrasted. For example, the coin-flip sequence HHTHHHTT could be continued with T, owing to the imbalance of H and T, or with H, if the streak alone is considered. (Empirically, participants appear to favor H.) Thus, rather than the law of small numbers explaining gambler's fallacy, it may be in competition. Alternative accounts of the gambler's fallacy are considered.

(512)

Bayesian Network Properties and Information Format Affect Causal Reasoning Ability. ELIZABETH J. MULLIGAN & BARBARA FASOLO, *University of Colorado, Boulder,* & REID HASTIE, *University of Chicago*—Two experiments examined people's ability to make correct inferences about a simple causal structure. Intuitive judgments were compared with normative answers obtained by propagating the Bayesian network corresponding to the causal structure. In Experiment 1, performance was higher when all causes in the network increased the likelihood of their effects (positive cause condition) than when one cause decreased the likelihood of its effect (negative cause condition). In Experiment 2, positive and negative cause conditions were crossed with two information format conditions in which the causal structure was both taught and tested, either as group frequencies or as individual probabilities. In the group condition, performance was higher in the positive than in the negative cause condition, but in the individual condition, the reverse was true. These results suggest that both the direction of the cause (positive or negative) and the information format can substantially affect people's ability to make correct causal inferences.

(513)

Stroop-Based Instructional Effects and Semantic Congruity Effects in Comparative Judgments. SAMUEL SHAKI & WILLIAM M. PETRUSIC, *Carleton University*—In one experiment, the direction of a comparative judgement was defined not by the word presented (*darker* or *lighter*) but by the darkness or the lightness of the print of the word. Participants selected the darker circle in a pair on half of the trials and the lighter circle on the other half. Stroop effects occurred when selectivity failed, and the irrelevant semantic information slowed processing. Semantic congruity effects (SCEs) were obtained with Stroop-congruent instructions (e.g., the word *darker* in dark print); RTs were faster when participants selected the darker of two relatively dark pairs and faster when selecting the lighter of two relatively light pairs. However, SCEs were substantially reduced with the Stroop-incongruent instructions, contrary to almost all existing theories of comparative judgments. This pattern of findings was replicated in a second experiment requiring size discriminations with symbolic stimuli, with instructions defined by font size.

(514)

Causal Models Guide Information Seeking: A 6-Year Web Experiment. ULF-DIETRICH REIPS, *University of Zurich* (sponsored by Friedrich Wilkening)—Information-seeking processes such as looking for potential solutions in the Wason selection task may be strongly guided by causal models, if such models are activated. In an Internet-

based experiment, we manipulated causal models by direction (predictive vs. diagnostic) and added the classic version of the task as a control condition. In an attempt to estimate generalizability, we also applied a version in a different language. Results indicate a clear pattern in support of causal model theory: the "correct" solution E&5 was found about 1.5 times as often with an underlying diagnostic causal model than with an underlying predictive causal model. Detailed results for the robustness of this effect in a changing Internet environment can be derived from this Web experiment, because it was available on the Internet for more than 6 years. These results will be presented, and implications for Internet-based research will be discussed.

• BRAIN AND COGNITION •

(515)

Toward a Characterization of How the Reading Circuit Learns: An fMRI Study. REBECCA SANDAK, *Haskins Laboratories,* W. EINAR MENCL, *Haskins Laboratories and Yale School of Medicine,* STEPHEN J. FROST, *Haskins Laboratories,* JAY G. RUECKL & LEONARD KATZ, *Haskins Laboratories and University of Connecticut,* & KENNETH R. PUGH, *Haskins Laboratories and Yale School of Medicine*—Increased familiarity with words has been associated with a shift in the relative activation of the cortical systems underlying reading. This study examined the means by which practice with unfamiliar words results in this shift. Before completing the fMRI scan, participants acquired familiarity for a set of pronounceable pseudowords over eight exposures, while making orthographic, phonological, or semantic judgments (pseudowords were paired with pictures) about each item (between items) in a standard levels-of-processing manipulation. Participants then named trained pseudoword, untrained pseudoword, and real word tokens in an event-related fMRI session. Behaviorally, phonological and semantic encoding resulted in speeded naming times relative to orthographic encoding. Cortically, trained pseudowords were processed more similarly to real words than to untrained pseudowords. Each encoding condition was associated with a distinct pattern of cortical activation, with overlap in several reading-related sites critical for phonological and semantic integration. Implications for reading instruction and dyslexia are discussed.

(516)

Context Processing in Schizophrenia: When Disinhibition Helps. DEBRA A. TITONE, *Harvard Medical School and McLean Hospital,* & TALI DITMAN, *McLean Hospital*—We examined contextual processing in schizophrenia, a disorder affecting the neural substrate of language. Word triplets were presented to controls and schizophrenia patients, who were instructed to decide the semantic relatedness of the triplets' final two words. The triplets consisted of homographs preceded by neutral, dominant-biased, or subordinate-biased context words and followed by dominant- or subordinate-biased words (*taxi–bank–money, finance–bank–money, river–bank–money, taxi–bank–muddy, finance–bank–muddy, river–bank–muddy,* respectively). Both groups showed facilitated accuracy and latency for cooperating contexts and reduced accuracy for conflicting contexts. Although both groups responded more slowly to conflicting triplets when the subordinate meaning was the final word (*finance–bank–muddy*), schizophrenia patients were relatively faster than controls when the dominant meaning was the final word (*river–bank–money*). Patients' working memory spans did not correlate with the specific context conditions. The results are consistent with previous work suggesting that automatic activation and controlled inhibition are differentially impaired in schizophrenia and possibly are distinct neurally.

(517)

Detecting Novel Versus Familiar Hidden Figures in Complex Arrays: Age-Linked Versus Hippocampus-Linked Deficits. DONALD G. MacKAY, JENNIFER K. TAYLOR, & MEGHAN GOULD, *UCLA,* & LORI E. JAMES, *University of Colorado, Colorado Springs*—Most previous studies have examined detection of hidden figures with un-

specified familiarity and complexity, using number of targets traced within some time limit as the dependent measure. With these procedures, age-linked deficits may reflect general slowing in motor-tracing abilities. The present experiment examined detection, without time pressure, of targets controlled for familiarity and complexity. Relative to 30 young adults, 30 normal older adults exhibited deficits in detecting novel, but not familiar, targets. Comparing results for a *hippocampal amnesic* (H.M.) in a similar experiment, H.M. exhibited more profound deficits for novel targets than did both young adults and same-age older adults with matched background, intelligence, and education, contradicting widespread claims that H.M. has a *pure memory deficit* with intact visual cognition. These results comport with node structure theory, which predicted no deficits for familiar targets, but deficits in representing unfamiliar targets for older adults and, especially, amnesics with right-hippocampal damage.

(518)

ERP as a Measure of Alignment Between Mathematic and Semantic Relations. AMY GUTHORMSEN, MIRIAM BASSOK, LEE OSTERHOUT, & KAYO INOUE, *University of Washington*—Previous research on mathematical problem solving has shown that people tend to select mathematical operations that are structurally aligned with the semantic relations between objects in a problem. In particular, taxonomically related objects (tulips and roses) elicit addition, whereas thematically related objects (tulips and vases) elicit division. This could be a strategic, conscious process, or it could be a more automatic tendency. Psycholinguistic research using event-related potentials has established reliable differential brain responses to semantically anomalous words in a sentence—the N400 effect. If semantic alignment processes are a natural part of reading mathematical word problems, it is conceivable that misaligned mathematical expressions would elicit a similar effect. We compared ERPs elicited by semantically aligned (4 tulips + 2 roses) and semantically misaligned (4 tulips + 2 vases) math problems, to determine whether N400 amplitude can be used as an electrophysiological marker of misalignment.

(519)

Implementation of Transcranial Magnetic Stimulation in Motor and Cognitive Tasks With a Nonhuman Primate (*Macaca mulatta*): Preliminary Evidence. CLAUDIO CANTALUPO, JOHN B. GULLEDGE, & DAVID A. WASHBURN, *Georgia State University,* & WILLIAM D. HOPKINS, *Emory University* (sponsored by David A. Washburn)—Transcranial magnetic stimulation (TMS) has been increasingly used to experimentally influence the electrical activity of circumscribed cortical regions in humans. In this line, TMS is an invaluable tool for investigating the selective involvement of the two cerebral hemispheres in a variety of motor and cognitive tasks in a fully noninvasive fashion. To date, there is a remarkable lack of TMS studies with nonhuman primates. To counter this lack of data, we have developed a computer-driven system that allows the implementation of TMS with joystick-trained monkeys in motor and cognitive tasks. Two rhesus monkeys were required to bring a cursor to collision with a target, with near-threshold TMS delivered laterally just before the target appeared. In this paradigm, TMS resulted in consistently shorter reaction times when stimulation occurred contralateral to the preferred hand. To the best of our knowledge, this is the first evidence of a facilitatory effect of TMS in a nonhuman primate.

(520)

A Neural Theory of Choice on the Iowa Gambling Task. BRITAIN A. MILLS & DANIEL S. LEVINE, *University of Texas, Arlington* (sponsored by Daniel S. Levine)—We present a neural network theory of the Iowa gambling task (IGT) developed by Bechara, Damasio, Damasio, and colleagues. In this task, the subject makes multiple selections from four decks of cards that each yield different levels of reward/punishment involving play money. Normal subjects eventually learn to choose from the decks that give smaller short-term rewards but better long-term expected payoffs, whereas patients with lesions to the ventromedial pre-

frontal cortex (VMPFC) consistently select from decks with higher short-term rewards and worse long-term payoffs. Several cortical and subcortical structures contribute to goal-directed behavior, including the VMPFC, amygdala, and basal ganglia. We account for the IGT results with a neural network that characterizes the interactions between these areas, emphasizing (1) opposing roles of direct and indirect basal ganglia pathways, (2) selective involvement of dopamine in incentive salience attribution, and (3) the ventral striatum as a critical site of information convergence.

(521)

Interval Timing: A Cerebellar Model and Investigation of Temporal Production. AMY B. SANTAMARIA & RANDALL C. O'REILLY, *University of Colorado, Boulder* (sponsored by Tim Curran)—Two neural systems for timing are proposed: a small-interval system computed in the cerebellum and a large-interval system that uses the frontal cortex to concatenate small intervals. We constructed a neural network model of cerebellar timing based on Buonomano and Mauk (1994), which predicts a nonlinear increase in error as a function of interval length and no transfer between hands. We tested these predictions in a paced finger-tapping task. The results were not consistent with the model's predictions: Error increased linearly with interval length, and there was some evidence of transfer. Ongoing research using a dual-task paradigm is attempting to clarify whether reducing

the availability of frontal resources reveals error differences between the two systems.

(522)

Effects of Incongruency on Brain Activity and Memory. PASCALE G. MICHELON, *Washington University,* ABRAHAM Z. SNYDER, *Washington University School of Medicine,* & RANDY L. BUCKNER & JEFFREY M. ZACKS, *Washington University*—Memory is greater for incongruent than for ordinary information. This *bizarreness effect* has been attributed both to semantic incongruency and to novelty. To determine the contribution of each factor, we performed an fMRI experiment while subjects viewed pictures depicting ordinary and incongruent objects (e.g., head of a wrench fused onto a sheep body). Across conditions, incongruent pictures were infrequent (novel) or frequent. Increases in activation were greater for incongruent versus ordinary stimuli throughout the ventral and dorsal visual pathways bilaterally and in the lateral prefrontal cortex primarily on the right. A

subset of regions, including the right frontal operculum and the right frontal cortex, responded selectively to infrequent incongruent pictures. A second experiment demonstrated better recognition memory for the same incongruent versus ordinary pictures. The data suggest that better memory for incongruent visual information may result from bilaterally enhanced visual and semantic processing.

1:30–1:50 (523)

Electrophysiological Evidence for Selective Target Processing in Visual Search. JOHN J. McDONALD, TROY A. W. VISSER, & PHILLIP E. GANDER, *Simon Fraser University,* & VINCENT DI LOLLO, *University of British Columbia*—An important issue in visual search is whether target selection is accomplished by enhancement of the target or suppression of the surrounding distractors. Evidence from ERP recordings has suggested that visual search involves distractor suppression, but there has been little evidence to indicate that visual search involves selective processing of the target itself. We show that an ERP component that is believed to reflect distractor suppression in visual search actually reflects selective target processing. Previous research has indicated that this component, which is called the N2pc, is elicited by targets only when distractors are present. However, we found that N2pc occurred in discrimination tasks whether or not distractors were present and that it failed to occur in detection tasks whether or not distractors were present. These findings indicate that N2pc is a reflection of target discrimination, rather than of distractor suppression.

1:55–2:15 (524)

Electrophysiological Evidence for Serial Shifts of Attention in Demanding Visual Search Tasks. STEVEN J. LUCK & GEOFFREY F. WOODMAN, *University of Iowa*—Does attention shift rapidly from one item to the next in demanding visual search tasks? Or is attention focused on multiple objects at any given moment, shifting slowly if at all? This is one of the most fundamental questions about visual search, but it has received relatively little empirical investigation. Most of the existing experiments have favored parallel processing, but we will argue that these studies are actually consistent with contemporary serial accounts of visual search. We will also provide new evidence from ERP recordings, which can directly measure the time course of attentional processes during visual search. These recordings indicate that, at least in some tasks, attention is allocated serially to potential target items.

2:20–2:40 (525)

Neural Basis of Target Selection During Visual Search. JEFFREY D. SCHALL, *Vanderbilt University*—Recent research has provided new insights into the neural processes that select the target for and control the production of a shift of gaze. Being a key node in the network that subserves visual processing and saccade production, the frontal eye field has been an effective area in which to monitor these processes. Certain neurons in the frontal eye field signal the location of conspicuous or meaningful stimuli that may be the targets for saccades. Other neurons control whether and when gaze shifts. The existence of distinct neural processes for visual selection and saccade production is necessary to explain the flexibility of visually guided behavior.

2:45–3:05 (526)

Synaesthetic Color Influences the Efficiency of Visual Search. PHILIP M. MERIKLE, DANIEL SMILEK, & MIKE J. DIXON, *University of Waterloo*—Whenever alphanumeric synaesthetes see, hear, or even think about a digit or letter, they have an associated color experience (i.e., a photism). We evaluated whether these synaesthetic photisms influence the efficiency of visual search. We tested two alphanumeric synaesthetes. Both synaesthetes searched for target digits presented against backgrounds that were either congruent or incongruent with the colors of their photisms for the digits. Search was more efficient when the target digits were presented against the incongruent backgrounds than when presented against the congruent backgrounds. In contrast, search by nonsynaesthetes was unaffected by the incongruent and congruent backgrounds. The results indicate that for synaesthetes, color and form are bound together prior to a digit's being selected and recognized. Coupled with previous findings showing that

the photism elicited by a grapheme depends on the meaning of the grapheme, the findings suggest that the efficiency of visual search can be influenced by the meaning of a stimulus.

3:10–3:30 (527)

What Guides the Development of Attention in Visual Search? Old Question, New Answers. JEREMY M. WOLFE, *Brigham & Women's Hospital and Harvard Medical School*—Attention is not deployed randomly in visual search tasks. Preattentive process can prioritize objects as more or less likely to be targets, and attention can be preferentially allocated to more likely objects and/or locations. We used to think that there were two sources of preattentive guidance: Bottom-up stimulus salience (e.g., the brightest region in an image) and top-down information (e.g., knowledge that the target was "red"). In addition, memory for prior deployments guided new deployments away from previously attended objects. New evidence from several labs has changed this view. Top-down guidance can be divided into separable explicit and implicit knowledge of target identity. Bottom-up salience is modulated by top-down attentional (or inattentional) "set." Although new sorts of memory have appeared (e.g., visual marking), the overall role of memory in search has become controversial. This talk will synthesize a new understanding of the forces that govern the deployment of attention in visual search.

1:30–1:50 (528)

Grounding Through Pointing and Placing Gestures. HERBERT H. CLARK, *Stanford University,* MIJA M. VAN DER WEGE, *Carleton College,* & ANNA KATZ, *Stanford University*—Pointing is required for many demonstrative references (such as *that dog* or *there*). Data from several paradigms, however, show that it arises even when there are no demonstrative references present. It is used for grounding, at several levels of action–attention, signals, meaning, and overall projects. These data suggest that grounding is generally multimodal.

1:55–2:10 (529)

Comprehending the Pronouns *Her*, *Him*, and *His*. SHELIA M. KENNISON, *Oklahoma State University*—A series of self-paced reading experiments investigated the processing of the pronouns *her*, *him*, and *his*. In Experiments 1 and 2, readers comprehended sentences having the form subject–verb–object. The subject was a male proper name, a female proper name, or the plural pronoun *they*. The pronoun followed the verb, functioning as either a full NP (e.g., "Mark/Mary/They saw her/him yesterday . . .") or a specifier (SPEC) (e.g., "Mark/Mary/They saw her/his friend . . ."). Binding theory (Chomsky, 1981) predicted that comprehenders would consider the subject of the sentence when resolving coreference for SPEC conditions but would not for NP conditions. The results showed that an effect of subject type occurred in both NP and SPEC conditions. In Experiment 3, a context sentence provided an antecedent for the pronoun. The results indicated no effect of subject type for NP conditions. These results demonstrate that referential processing in isolated sentences can differ from those in context.

2:15–2:30 (530)

Satisficing in Language Processing: The Adaptive Theory of Language Use. BOAZ KEYSAR, *University of Chicago,* DALE J. BARR, *University of California, Riverside,* & SHUHONG LIM, *University of Chicago*—The standard theory of language use assumes that language users routinely rely on mutual belief, whereas perspective adjustment suggests that initial processing is routinely egocentric. We propose that these theories describe two extremes of what is actually a continuum of behavior and that language users adapt their use of mutual belief to experience. By tracking listeners' eye movements during referential communication, we found that listeners defaulted to egocentric processing,

except when mutual belief was a diagnostic cue for reference. In one experiment, addressees became more strongly attuned to the speaker's perspective when their egocentric behavior led to errors. Another experiment found that highlighting the discrepancy between perspectives reduces listeners' egocentrism. These experiments show that addressees satisfice: They rely on mutuality of belief to the extent that it is informative.

2:35–2:50 (531)

Negation Is Not Affirmation: Process and Product in Comprehending Negation. URI HASSON & SAM GLUCKSBERG, *Princeton University* (read by Sam Glucksberg)—Is comprehension of negative statements different from that of corresponding affirmatives? We presented participants with statements in which the predicate was either affirmed or negated (e.g., *that person is/isn't athletic*) and immediately assessed the accessibility of affirmative-related target words (e.g., *strong*). Such targets were more accessible after the affirmative form than after the negative. But does the comprehension of negation entail affirmative predication, followed by its cancellation? To address this issue, we presented participants with negated metaphors (e.g., *my lawyer is not a shark*) and assessed the accessibility of two kinds of target words over time: affirmative related (e.g., *vicious*), and negative related (e.g., *gentle*). We find that the comprehension of negation in metaphors requires initial activation of a metaphor's original meaning, followed by suppression of that meaning and inference. We conclude that negation prompts the construction of unique representations but that its comprehension may involve the transient construction of the affirmative meaning.

2:55–3:15 (532)

Second Language Syntactic Development: An Event-Related Potential Investigation. NATASHA TOKOWICZ & BRIAN MACWHINNEY, *Carnegie Mellon University* (read by Brian MacWhinney)—We used behavioral measures (reaction time and accuracy) and event-related brain potentials (ERPs), which are markers of cognitive events, to investigate the impact of first-language grammar on second-language (L2) grammatical processing (i.e., Do people use cues from their first-language, such as word order, to comprehend sentences in their L2? How does the grammaticality of a sentence in the first-language influence its comprehension in L2?). Native English speakers learning Spanish as a second language made grammaticality judgments to visually presented sentences in English and Spanish. We predicted that second-language learners would be less aware of violations in grammar that occurred in constructions that were unique to the second language or were different in the two languages. The results support this prediction and suggest that even second-language learners at relatively early stages are aware of violations of constructions that are similar in the two languages.

Brain and Perception
Chicago A, Saturday Afternoon, 1:30–3:15

Chaired by Walter Schneider, University of Pittsburgh

1:30–1:45 (533)

Cortical Analysis of Visual Context. MOSHE BAR & ELISSA AMINOFF, *Harvard Medical School*—How does the human brain represent and analyze contextual associations between visual objects? In three functional neuroimaging experiments, we revealed the cortical mechanisms that are activated when people encounter highly contextual objects (e.g., a traffic light). Our findings indicate that a region in the parahippocampal cortex and a region in the retrosplenial cortex make up a system that mediates processing of familiar contextual associations, both spatial and nonspatial. Each of these regions has been associated in the past with two functions: episodic memory and the analysis of topographic information. Attributing contextual analysis to those two areas, instead, provides a framework for reconciling these seemingly conflicting reports.

1:50–2:10 (534)

Synesthetic Colors Support Symmetry Perception, Apparent Motion, and Ambiguous Crowding. VILAYANUR S. RAMACHANDRAN, EDWARD M. HUBBARD, & PETER A. BUTCHER, *University of California, San Diego*—About 0.5% of the population has grapheme-color synesthesia: Printed numbers or letters always evoke specific colors. We showed that these induced color can lead to (1) grouping and pop-out, (2) symmetry perception, and (3) apparent motion. The synesthetic color also interferes with the perception of real colors at or near threshold. Bregman's *B*s were initially not seen colored unless *primed* earlier by the *B* fragments. Remarkably, certain bizarre fonts evoked more intense synesthesia than did a simple prototype (analogous, perhaps, to superstimuli in ethology). Lastly, an ambiguous letter (*E* or *H*) rendered indiscriminable through crowding evoked one of two colors. We conclude that some types of synesthesia are caused by a gene mutation(s) resulting in cross-activation of brain maps through either disinhibition or defective pruning of either lateral or back projections. Synesthesia may also help illuminate the evolution of language, metaphor, and abstract thought.

2:15–2:30 (535)

Configural Processing of Facial Expressions: An Expression Superiority Effect. BEATRICE DE GELDER & ILJA FRISSEN, *Tilburg University*—Traditional models of face recognition view identity and recognition of expression as implemented in separate systems, a view reinforced by the notion that prosopagnosia is a selective loss of the ability to recognize facial identity and is due to a loss of configural-processing ability. Yet, not much attention has been devoted to investigating the role of configural processing in recognition of facial expressions either in normal viewers or in prosopagnosics. We investigated the influence of facial organization on discrimination of a local facial feature, using a feature-matching task and comparing matching performance for either upright or inverted target presentation. Stimuli consisted of faces and face parts with or without expression, but task requirements were identical in both conditions. Normal viewers are equally sensitive to the face configuration whether the stimuli are neutral faces or face expressions. In contrast, prosopagnosic patients present an effect of the configuration only when there is a facial expression present.

2:35–2:50 (536)

How the Brain Represents Numerical Quantity. JOHN WHALEN & FRANK MORELLI, *University of Delaware*—Little is known about the neural instantiation of numerical quantity, which forms the foundation of arithmetic competency. Using event-related potentials (ERPs), we characterize the nature of neural representations of both small (0–9) and larger (10–99) quantities, as well as the mapping of multidigit numerals to neural quantity representations. Participants passively viewed a sample of Arabic digits ranging from 0 to 99 that automatically activated magnitude representations. Periodically, participants compared the relative numerical magnitude of two sequentially presented numbers, ensuring both magnitude activation and vigilance. ERPs were recorded using a 128-channel EGI Sensor Net. We show functionally distinct neural representations for the overall numerical magnitude and the magnitudes of the individual numerals that compose a multidigit number (e.g., the "3" and "4" of the multidigit numeral "34"). Whereas overall magnitude was represented bilaterally in inferior parietal regions, representations of tens and units appear to be localized to the right superior parietal gyrus.

2:55–3:10 (537)

Hippocampal Function in Auditory Discrimination Learning. ITZEL ORDUNA, *Rutgers University,* EDUARDO MERCADO III, *SUNY, Buffalo,* & MARK A. GLUCK, *Rutgers University* (read by Eduardo Mercado III)—Hippocampal involvement in discrimination learning depends on the stimulus properties to be discriminated. Animals with hippocampal damage often have problems learning discriminations that involve configural cues. In simple discrimination tasks, animals

with hippocampal lesions appear to acquire the discrimination normally but may show abnormal transfer when tested on novel comparisons. To examine how the hippocampus mediates learning about complex stimuli, we trained intact and hippocampal-lesioned rats to discriminate broadband, time-varying sounds, using a two-alternative, operant task. We then tested rats' ability to classify novel sounds with acoustic features similar to those they experienced during training. Our results show that rats with hippocampal damage can learn to discriminate complex sounds and associate them with spatial responses but that they learn the task in ways that differ from intact rats. These findings suggest that the hippocampus is involved in the adaptive processing of complex sensory events.

Human Learning and Memory III
Chicago BC, Saturday Afternoon, 1:30–3:25

Chaired by Alice F. Healy, University of Colorado

1:30–1:45 (538)
Old and New Estimates of Total Information in Human Memory. THOMAS K. LANDAUER, *University of Colorado, Boulder*—Around 1666, Robert Hooke counted how fast he could think "ideas," multiplied appropriately, and calculated that he would be able to store 2×10^9 memories in his lifetime. (He thought the average person could probably manage only 10^8.) Three hundred years later (1986), and unfortunately unaware of Hooke's work, I took a similar approach. I modeled the rate of gain of information from recognition memory and reading, posited a principle of constancy of memorial information accumulation, and estimated the total information in a typical adult human's memory to be around 10^9 bits. This year I report yet another estimate, by an entirely different approach. It is based on the information needed to capture a typical adult human's word knowledge in a latent semantic analysis (LSA) semantic space. The new number is 4×10^8 bits for this one component of acquired knowledge.

1:50–2:10 (539)
Interfering With Consolidation. JOHN T. WIXTED, *University of California, San Diego*—The notion that memories consolidate over time drives a significant fraction of contemporary research concerned with the neurobiology of memory. Research concerned with the psychology of memory, by contrast, is virtually devoid of this notion. The best evidence for a consolidation process in the neuroscience literature comes from studies showing that damage to the medial temporal lobes disrupts recently formed memories to a greater extent than memories that were formed long ago (i.e., retrograde amnesia exhibits a temporal gradient). In the psychology literature, memories are often disrupted in less dramatic fashion by using retroactive interference procedures. Does retroactive interference exhibit the same temporal gradient that retrograde amnesia does? One might imagine that it would, but the old evidence bearing on this question is inconclusive and warrants another look.

2:15–2:30 (540)
Knowledge Restructuring and Cue Validity. MICHAEL L. KALISH & STEPHAN LEWANDOWSKY, *University of Western Australia*—Lewandowsky, Kalish, and Griffiths (2000) showed that people often learn to rely on an expedient, one-dimensional predictor and that this reliance persists even when a more valid, albeit complex, predictor is revealed. However, in their studies, participants could memorize exceptions to the expedient rule, producing a strategy with higher validity than the complex alternative. In a series of experiments, we manipulate validity directly and demonstrate that participants do restructure under some conditions. Further, we show that this change in behavior is not the result of componential associative learning, since knowledge about the validity of the expedient predictor does not change when utilization changes and since neither of the two alternative dimensions that make up the complex rule acquire associate strength individually. Instead, our results support the view that knowledge restructuring

comes from the error-driven redirection of attention among competing response strategies.

2:35–2:55 (541)
Executive Control and the Mechanisms of Encoding. BENJAMIN J. LEVY & MICHAEL C. ANDERSON, *University of Oregon* (read by Michael C. Anderson)—Both behavioral and neuroimaging studies strongly indicate a role for attention in encoding new experiences. However, the precise functions of attention during encoding remain unclear. The present experiments sought to determine whether one role of attention may be to resolve interference from semantic knowledge that arises in forming new associations. After studying word pairs (e.g., *Thorn Ghost*) 0, 1, 6, or 12 times, subjects were given an apparently unrelated semantic generation task where some of the possible responses were strong associates to words studied earlier (e.g., *flower* r___ for *Rose*). The more often these word pairs had been studied, the less often the related words were generated on the free association test, showing that these semantic associates were inhibited during the previous encoding session. These findings indicate that episodic encoding recruits mechanisms that suppress interfering semantic knowledge, suggesting that the role of attention during encoding may be partly inhibitory in nature.

3:00–3:20 (542)
Modes of Presentation and the Processing of Positive and Negative Integers. JOSEPH TZELGOV & GUY PINKU, *Ben Gurion University of the Negev*—Participants performed numerical size comparisons of positive and negative integers and physical comparisons of integers differing in physical and numerical size. In some of the experiments, numbers were presented using a ± sign; in others, polarity was coded by color; and in still others, we trained subjects to use arbitrary symbols as numbers. The results show that although intentional processing depends on the mode of presentation, automatic processing indicates that polarity is not part of the internal representation of integers.

Animal Cognition and Memory
Chouteau, Saturday Afternoon, 1:30–3:25

Chaired by Thomas R. Zentall, University of Kentucky

1:30–1:45 (543)
Species Differences in Executive Attention: Ability or Skill? DAVID A. WASHBURN, *Georgia State University*—Environmental, experiential, and executive constraints vie for the control of attention. Rhesus monkeys and human adults were tested on a series of tasks that involved specific competition between two or more of these sources of response information. Visual search, sustained attention, and cuing paradigms were used, and all participants regardless of species responded to computer-generated stimuli by manipulating a joystick. Across tasks, executive attention was more characteristic of humans than of monkeys, whereas the nonhuman animals were more susceptible to environmental cues. That is, the monkeys appeared to be relatively unable to bias attention endogenously and to inhibit prepotent and associative responses. It appears that this difference reflects a difference in both skill (in that the monkeys improved in executive attention with training) and ability (in that differences remained, particularly on transfer tests, even after the training).

1:50–2:00 (544)
Elements of Consciousness in Reptiles but Not in Amphibians. SEBASTIEN PARADIS & MICHEL CABANAC, *Laval University* (read by Michel Cabanac)—Taste aversion learning occurs when digestive illness follows ingestion of a novel food. Such learning has been shown to exist in mammals and birds. In this experiment, we looked for taste aversion learning in amphibians (*Bufo paracnemis, Pachytriton breviceps*) and reptiles (*Basiliscus vitattus, B. basiliscus, Eumeces schneideri, Mabuya multifasciata*). After intake of the novel food, the animals received i.p. injections of either lithium chloride (LiCl), an effective ill-

ness inducer, or a saline solution. A week later, the LiCl injection had not affected the food intake of the amphibians, whereas in the lizards, it had produced a strong aversion to the taste of the novel food. These results are consistent with the hypothesis that basic consciousness emerged with reptiles.

2:05–2:20 (545)

The Numerical Abilities of a Socially Housed Hamadryas Baboon and Squirrel Monkey. BRIAN R. SMITH, ALEXANDER K. PIEL, & DOUGLAS K. CANDLAND, *Bucknell University* (sponsored by Douglas K. Candland)—To extend a study conducted by E. M. Brannon and H. S. Terrace (1998, 2000) with rhesus monkeys (*Macaca mulatta*), one hamadryas baboon (*Papio hamadryas*) and one squirrel monkey (*Saimiri sciureus*) were trained to respond to stimuli representing the numerosities 1, 2, 3, and 4 in ascending order. When tested with novel stimuli of the same numerosities, both subjects' performance appeared to be based on the numerical attributes of stimuli. Subjects were then tested on their ability to order pairs of numerosities derived from the values 1 through 9. Both subjects successfully ordered pairs that included the untrained numerosities 5 through 9. Accuracy and latency of responding also showed numerical distance and magnitude effects similar to those found by E. M. Brannon and H. S. Terrace. The results indicate that numerosity was a salient cue to both subjects and that two families of primates may represent ordinal relations between numerosities.

2:25–2:40 (546)

Pigeons' Memory for Filled and Empty Time Intervals Marked by Visual Stimuli. ANGELO SANTI & STEPHANIE HORNYAK, *Wilfrid Laurier University,* & ANDREW MIKI, *York University*—Pigeons were trained within sessions to discriminate filled intervals (2 and 8 sec of light) and empty intervals (2 and 8 sec bound by two 500-msec light markers). Filled intervals required a response to one set of comparisons (e.g., blue vs. yellow), whereas empty intervals required a response to a different set of comparisons (e.g., red vs. green). Delay testing and sample stimulus omission tests both produced a choose-short bias on filled interval trials and a choose-long bias on empty interval trials. The results of additional testing ruled out an explanation of the response biases in terms of asymmetrical coding and default responding. Additional tests also indicated that the pigeons were not timing the markers themselves on empty interval trials. Overall, the findings provide additional evidence that pigeons process filled and empty intervals differently.

2:45–3:00 (547)

Memory for Unique Events in a Gorilla. BENNETT L. SCHWARTZ & CHRISTIAN A. MEISSNER, *Florida International University,* SIAN EVANS, *DuMond Conservancy,* & LESLIE D. FRAZIER, *Florida International University*—Episodic memory is a human cognitive system that encodes, stores, and retrieves memories of unique events. Researchers have begun to pose the question: Do animals have episodic memory? We tested King, a 32-year-old male western lowland gorilla. King witnessed an event lasting about 1 min involving a familiar person doing a unique activity (e.g., jumping rope). Following a minimum retention interval of 5 min, King was shown photographs of faces, one of which was the person involved in the event and at least one of the other two was a familiar person. King chose the correct answer 65% of the time, greater than chance. Preliminary results suggest weaker performance with unfamiliar people. Although a response based on relative familiarity cannot be eliminated, the data are consistent with episodic memory. We claim that the gorilla's responses are palinscopic, because they refer to past events rather than to current states of the world.

3:05–3:20 (548)

An Evolved Spatial Memory Bias in a Nectar Feeding Bird. DARREN BURKE, *Macquarie University,* & BENJAMIN J. FULHAM, *University of Wollongong*—In support of the proposition that spatial memory mechanisms have been precisely shaped by evolution, previous investigators have shown that the tendency to avoid or return to previ-

ously rewarding locations reflects the spatiotemporal distribution of prey. However, attributing these differences to evolved spatial memory adaptations requires ruling out the possibility that they are a consequence of the experience of individual animals and is much more compelling if performance in the memory task reveals sensitivity to complex features of the animal's natural environment. In the present experiment, Regent honeyeaters (*Xanthomyza phrygia*), a species of nectar-feeding birds, show behavior that closely reflects the spatiotemporal distribution of nectar in the natural environment, despite being born and raised in captivity.

Decision Processes III
Empire, Saturday Afternoon, 1:30–3:30

Chaired by Linda Buyer, Governors State University

1:30–1:50 (549)

Dynamic Understanding and Simulation of Hindsight Bias. TOM TRABASSO, *University of Chicago*—A dynamic understanding account of *hindsight bias* is tested by a simulation of the Wasserman, Lampert, and Hastie (1991) study. Causal discourse analysis (Trabasso, van den Broek, & Suh, 1989) and a connectionist model (Langston & Trabasso, 1998) operate together in simulation in which readers access and infer causes that integrate clauses and update memory accessibility (connection strength) of all processed clauses as each new clause is understood. When an outcome is given, explanatory conditions are accessed, and their connection strengths are increased. The strengths for conditions necessary to the outcome's alternative are decreased. When participants have to predict an outcome, they access both sets of conditions. Across seven story versions, participant likelihood estimates are accurately predicted by a ratio of connection strengths of favorable conditions to the sum of connection strengths for both favorable and unfavorable conditions. The hindsight bias is thus a consequence of memory updating through normal, dynamic understanding.

1:55–2:15 (550)

Modeling Participant Skepticism as a Means of Explaining Purportedly Irrational Behavior. CRAIG R. M. McKENZIE & JOHN T. WIXTED, *University of California, San Diego,* & DAVID C. NOELLE, *Vanderbilt University*—Surprisingly, many purported demonstrations of irrational behavior hinge on the assumption that participants believe key task parameters that are merely asserted by experimenters. For example, in our own previous research, we found that participants who first reported confidence in items presented in a yes/no format did not change confidence to the degree prescribed by the normative model when those same items were later presented in a forced-choice format. A crucial assumption, however, was that participants fully believed the assertion that the forced-choice items were mutually exclusive and exhaustive. We have derived and tested a new normative model of this task that does not assume that participants fully believe this assertion; the model's free parameter corresponds to the degree of belief that the forced-choice items are mutually exclusive and exhaustive. Two visual identification experiments show that this new normative model predicted participants' confidence reports better than did several alternative models.

2:20–2:40 (551)

Using Advice in Judgment and Attitude Change: Policies for Weighting Others' Opinions. ILAN YANIV, *Hebrew University of Jerusalem*—Using advice is a basic practice in making real-life decisions, although, until recently, relatively little attention has been given to it in either empirical studies or theories of decision making. Studies were conducted to investigate people's weighting policies for advice and whether using it leads to gains in accuracy. Respondents were asked to provide final judgments on the basis of their initial opinions and advice presented to them. The respondents' weighting policies were inferred. Analysis of the advice-weighting policies show that (1) respondents tended to discount the advisor's opinion, (2) more knowledgeable individuals

discounted the advice more, (3) the weight of advice decreased as its distance from the initial opinion increased, and finally, (4) the consequences for accuracy were evaluated. The findings on advice use are connected with theories of attitude change, and the ties between the two fields are discussed.

2:45–3:00 (552)
Memory Dynamics in Hindsight Biases. SARA APPLETON-KNAPP, ROBERT A. BJORK, & THOMAS D. WICKENS, *UCLA* (read by Robert A. Bjork)—When individuals are asked general-knowledge questions and later provide answers to those questions, they frequently exhibit a hindsight bias when asked to recall their earlier answers: They misreport their earlier answers in ways that the reduce the discrepancy between those answers and the correct answers. The present findings demonstrate that participants' recall of provided (i.e., correct) answers are also biased—as much or more—by the initial answers they generated. The findings also demonstrate that the prior effort to generate an answer to a given question influences, in a positive way, the encoding of and memory for the correct answer when it is subsequently provided. Overall, the findings suggest that the role of memory dynamics, such as retrieval as a learning event and the potent effects of activating non-recallable but preexisting knowledge, has been underappreciated in the interpretation of hindsight biases, and that the role of decision making and reconstruction has been overappreciated.

3:05–3:25 (553)
The Role of Random Error in Producing Subadditive Judgments. J. NEIL BEARDEN, *University of North Carolina,* Chapel Hill, THOMAS S. WALLSTEN, *University of Maryland,* & CRAIG FOX, *Duke University* (read by Thomas S. Wallsten)—Subadditivity (SA) is a well-established fact in probability judgment, for which support theory (Tversky & Koehler, 1994) is the accepted explanation. However, SA also occurs in contexts for which support theory seems inappropriate. One possible mechanism that may contribute to observed SA is random error that is bounded by the unit interval so that it is regressively skewed. We derived expected results, assuming covert judgments that are either nonextensional (and therefore SA) or extensional (and therefore additive) but perturbed by symmetrically ordinal regressive random error, and tested them in two experiments using domains to which support theory is unlikely to apply. Both studies involved repeated judgments, and one also included choices. Analyses at the level of individual respondents yield results consistent with our predictions and suggest that random error enters at both the formation of covert judgment and the mapping of the judgment to an overt response.

Recognition Memory II
Atlanta, Saturday Afternoon, 3:40–5:30

Chaired by Robert West, University of Notre Dame

3:40–4:00 (554)
How Are Recency Judgments Related to Recognition Memory? DOUGLAS L. HINTZMAN, *University of Oregon*—Experiments were done exploring the relation between judgments of recency (JOR) and recognition memory. To eliminate the confounding of JORs by temporal landmarks and recognition failures, a continuous recognition task with a small range of test lags was used, in which each *old* response was followed by a numerical JOR. Manipulations found to affect both JOR and recognition were test lag, the match between study context and test context, and the mirror-effect variables of word frequency and concreteness. Despite these functional similarities, a direct comparison of JORs and recognition confidence ratings shows important differences between the two tasks. The pattern of similarities and differences provides a challenge for theorists to address.

4:05–4:25 (555)
Item and Associative Recognition With Precuing and Postcuing. BENNET MURDOCK, *University of Toronto,* & DUNCAN MATTHEW,

University of Western Australia—A previous study comparing precued and postcued item recognition and serial recall showed precued–postcued differences for item recognition, but not for serial recall (Duncan & Murdock, 2000). This methodology was extended here to a paired-associate task. Two experiments will be reported where short lists of paired associates were presented followed by single-item old–new or intact–rearranged pair recognition tests and test type was precued or postcued. A fast (Experiment 1) or slow (Experiment 2) presentation rate was used to discourage or encourage mediators. TODAM2 (a theory of distributed associative memory) predicts that there should be little or no cuing differences whether or not subjects use mediators to remember the pairs, and in fact, contrary to the previous study, the recognition data were essentially identical for the precued and postcued conditions. Theoretical implications of these findings are discussed.

4:30–4:45 (556)
Accuracy in Recognition: The Role of Distinctive Processing in Correct Identification and Correct Rejection. R. REED HUNT, *University of North Carolina, Greensboro*—Accurate memory requires both correct identification and correct rejection. The concept of distinctive processing often is invoked to meet these demands. The relationship between distinctive processing and correct identification is straightforward, but the role of distinctive processing in correct rejection of an incorrect item is less clear. Logically, prior processing can have no direct effect on incorrect items, because those items were not processed, distinctively or otherwise. Indirect effects of distinctive processing on correct rejection of highly familiar distractors has been shown in two important papers: Dobbins, Kroll, Yonelinas, and Liu (1998) and Gruppuso, Lindsay, and Kelley (1996). In neither case did distinctive processing affect correct identification. These results obviously imply some difference between distinctive processing of a prior experience that facilitates correct identification and processing that facilitates correct rejection. Research will be presented that shows what the difference is.

4:50–5:05 (557)
Age Declines on Recognition and Free Recall Tests are Comparable. BOB UTTL, *Oregon State University*—Older adults often perform as well as younger adults when their memory is tested by old/new recognition tests, rather then by free recall tests. One explanation for this pattern of findings is that old/new recognition tests are less resource demanding than are free recall tests, taxing diminished resources of older adults less. To examine the alternative possibility that the differential age declines may be artifacts of ceiling effects, we administered a modified Rey Auditory Verbal Learning Test (M–RAVLT) to 351 healthy adults, 18–91 years of age. Our results showed that when performance was not limited by ceiling effects, age declines on old/new recognition and free recall indexes were comparable.

5:10–5:25 (558)
Effect of Delay on Recognition Decisions: Evidence for a Criterion Shift. MURRAY SINGER, *University of Manitoba,* & JOHN T. WIXTED, *University of California, San Diego*—There is mixed evidence about customizing signal detection answering criteria to intermixed test classes. Different criteria were measured for intermixed immediate and delayed story questions (Singer et al., 2002, *Canadian Journal of Experimental Psychology*), but not for conspicuously different word classes (red and blue words, respectively encountered five times or once during learning; Stretch and Wixted, 1999, *JEP:LMC*). Here, Singer's procedure was applied to single-word stimuli. Participants made semantic judgements about items (blocked) from five categories. After delays of 20 min, 40 min, or 2 days (Experiments 1–3, respectively), five lists from different categories were presented. After each one, participants recognized intermixed targets and foils from that category and one of the earlier ones. At the 2-day delay, different answering criteria were detected for immediate and delayed categories, reflecting false alarm rates of 16% and 31%, respectively. This outcome raises the challenge of characterizing those variables that promote distinct answering criteria.

Lexical Access
New York, Saturday Afternoon, 3:30–5:30

Chaired by Leonard Katz, Haskins Laboratories

3:30–3:50 (559)

DRC Doesn't Read Correctly. MARK S. SEIDENBERG, *University of Wisconsin, Madison,* JASON D. ZEVIN, *University of Southern California,* & MICHAEL W. HARM, *Carnegie Mellon University*— Coltheart et al. (2001) described a computational version of the dual-route model of reading said to account for a broad range of behavioral data, providing strong support for the model and setting the bar quite high for the competing triangle (connectionist) model. Close examination of DRC's performance indicates that (1) it does not correctly account for consistency and nonword naming data that have been the focus of attention since Seidenberg and McClelland (1989), and (2) the coverage of the data is shallow insofar as the model fits the results of individual studies of a given phenomenon but not others; thus, the model overfits the data, resulting in a lack of generality. These problems are difficult to fix because changing model parameters to improve the fit in one place creates problems elsewhere. Thus, the attempt to extend the DRC model to a broader range of phenomena reveals intrinsic limitations of this approach.

3:55–4:15 (560)

A Whammy for Dual-Route Models? The Effects of Digraphs, Regularity and Consistency on Lexical Retrieval. SALLY ANDREWS, *University of Sydney,* & RACHEL BOND, *University of New South Wales*—Two experiments investigated the effects of the presence of digraphs in word stimuli varying in regularity and consistency and in nonword stimuli varying in consistency and body frequency. Experiment 1 compared performance for the same items in lexical decision, naming, contingent naming, and delayed naming tasks. The results showed no evidence of the slower overall naming performance for words containing digraphs that is predicted by the dual-route model. However, variability in the item data suggested that this may have reflected constraints on stimulus selection. A second experiment using a more tightly controlled set of items did reveal an effect of digraphs on naming of both words and nonwords but also showed that regularity and consistency effects were confined to items containing digraphs. These data have important implications for accounts of the locus of effects of orthographic–phonological mapping on visual word recognition.

4:20–4:40 (561)

Grain-Size Effects in Word Naming. JAY G. RUECKL & AMMANCIS WRIGHT, *University of Connecticut and Haskins Laboratories*—In English, the mapping between orthography and phonology contains regularities at several grain sizes, including grapheme–phoneme and body–rime correspondences. In an experiment in which regularities at each of these grain sizes were independently manipulated, Cortese and Simpson (2000) found that consistency at the larger (body–rime) grain size had a larger effect on naming latencies. In our first experiment, we replicated Cortese and Simpson's results. In two subsequent experiments, we found that presenting the stimuli in aLtErNaTiNg CaSe reduced the effect of body–rime consistency but had no impact on the effect of grapheme–phoneme consistency. In contrast, when the stimuli were presented in a vertical orientation (and in uniform case), body–rime consistency again had a larger effect than did grapheme–phoneme consistency. These results suggest the need for a richer treatment of the notion of *orthographic representation* than is found in many current models of word processing.

4:45–5:00 (562)

Effects of Consonantal Context on Pronunciation of Vowels by Humans and Models. REBECCA TREIMAN & BRETT KESSLER, *Washington University,* & SUZANNE BICK, *Wayne State University*— In two experiments, we found that college students' pronunciations of vowels in nonwords are systematically influenced both by the preceding and the following consonants. The predominance of rimes in previous studies of reading does not appear to arise because readers are unable to pick up associations that cross the onset–rime boundary but, rather, because English has relatively few such associations. Comparisons between people's vowel pronunciations and those produced by several computational models of reading revealed that none of the models provided a good account of human performance on nonwords for which the vowel shows contextual conditioning. Possible directions for improved models are suggested.

5:05–5:25 (563)

Phonological and Visual Attentional Disorders in Developmental Dyslexia. MARIE-LINE BOSSE, *UPMF, Grenoble,* SYLVIANE VALDOIS, *CNRS,* SERGE CARBONNEL, *UPMF, Grenoble,* BERNARD ARIS, *CNRS, Grenoble,* & MARIE-JOSEPHE TAINTURIER, *University of Wales, Bangor* (sponsored by Marie-Josephe Tainturier)—The connectionist MTM model (Ans, Carbonnel, & Valdois, 1998) postulates the existence of two distinct reading procedures that differ only in the kind of visual attentional (VA) processing involved. Within this framework, developmental dyslexia is interpreted as resulting from either a phonological disorder or a visual processing deficit. Our aim was to demonstrate the existence of a dissociation between phonological and VA disorders in developmental dyslexia. One hundred fifty-four participants (68 dyslexics, 55 chronological-age, and 31 reading-age matched controls) were submitted to metaphonological and VA tasks. A principal component analysis extracted three factors (VA, phonological, age). Four subgroups of children emerged, characterized by (1) a phonological disorder in the absence of VA deficit, (2) a VA deficit in the absence of phonological trouble, (3) both disorders, and (4) neither of these two disorders. The VA performance was predictive of the reading level even when the influence of metaphonological skills was partialled out.

Visual Perception II
Chicago A, Saturday Afternoon, 3:25–5:30

Chaired by Joseph Cataliotti, Ramapo College of New Jersey

3:25–3:45 (564)

Several Strange Effects Arising From Perceptual Grouping in Vision. JAMES R. POMERANTZ, *Rice University*—Experimental reports on human visual perception and attention typically describe their stimuli in sufficient detail for readers to reconstruct close approximations. Despite their accuracy, however, these descriptions sometimes fail to depict the stimuli as they are experienced by the perceiver. Here, I describe several effects, some of them seemingly anomalous, that can arise when perceptual processes regroup the stimuli employed in common performance tasks, such as search, matching, and speeded classification requiring selective or divided attention. These unusual results include (1) steeply negative search slopes, (2) strong facilitation from irrelevant information, (3) false pop out, (4) erroneous perception of sameness, (5) missing incongruity effects, (6) better dual- than single-task performance, and (7) dimensional blindness. The apparent peculiarity of these results is reduced when the stimuli are redescribed in terms more closely matching the observer's perceptual experience. These results can function as diagnostics to solve the elusive problem of detecting grouping.

3:50–4:05 (565)

Perceptual Grouping and Contrast Polarity. JOHAN WAGEMANS & PETER CLAESSENS, *University of Leuven*—Mechanisms mediating contour representation are able to integrate information from nonadjoining locations. Previous research has shown that contrast polarity is not an impediment to illusory contour formation (Dresp & Fisher, 2001, *Perception & Psychophysics,* **63**, 1262–1270) or snake detection (Field et al., 2000, *Spatial Vision,* **13**, 51–66). Participants reported the orientation of spontaneous grouping in Gabor patch lattices with different conditions of polarity alternation. We compared

the grouping odds for these oriented Gabor lattices with grouping in lattices with elements without local orientation: Gauss blobs and Gabor patches with a luminance profile extending radially from the midpoint. A slight polarity effect for Gabor lattices was evident only for short distances. This influence was negligible, as compared with the two cases in which the elements lack orientation information. This finding indicates a functional difference in the way the visual system treats information supporting contours in these two stimulus classes.

4:10–4:25 (566)

Subitizing in Dot Cluster and Bargraph Enumeration. DAVID B. BOLES & JEFFREY B. PHILLIPS, *University of Alabama*—The enumeration of dot clusters and bargraphs with values of 1 to 8 appears to share a common process based on factor-analytic, dual-task interference, and transfer-of-training evidence. But what process? Here, factor analytic evidence is produced consistent with separate processes, underlying the enumeration of 1–3 and 6–8 dots, and a blend of the two processes for 4–5 dots. In contrast, bargraphs use a homogeneous process for values of 1–8, and it appears to be the same subitizing process used for small numbers of dots. Because bargraphs vary only in the position of a single element, these outcomes appear inconsistent with subitizing hypotheses based on multiple elements, such as those emphasizing the learning of canonical patterns, the preattentive tagging of item locations, or *precise estimation*. However, they may be consistent with the *fast-counting* model of subitizing.

4:30–4:50 (567)

The Mysteries of the Diagonal. JUDITH AVRAHAMI, TALY ARGAMAN, & DVORA WEISS-CHASUM, *Hebrew University of Jerusalem*—Orientation is known to be an important determinant of perception, and evidence for perceptual asymmetries owing to orientation is ubiquitous in the psychological literature. However, although the vertical is often compared with the horizontal and both of these with the diagonal, comparison of one diagonal with another is rare, since perceptual processing of both diagonals is assumed to be similar. Our series of experiments questions this assumption: Using displays with a clear diagonal structure—paintings, sets of short diagonal lines, or line drawings that are cued in one of their corners—we find that speed of detection, accuracy, and aesthetic preference are sensitive to the direction of the diagonal in the display. What is more, we find the advantage of one diagonal over another to be related to gender.

4:55–5:05 (568)

Testing Laws of Backward Masking: Support for an ISI Law. GREGORY FRANCIS & MARK ROTHMAYER, *Purdue University*—In backward visual masking, it is common to find that the mask has its biggest effect when it follows the target by several tens of milliseconds. Research in the 1960s and 1970s suggested that masking effects are best characterized by the stimulus onset asynchrony (SOA) between the target and the mask. In particular, one claim has been that the SOA for which masking is optimal is fixed, even as target and mask durations vary. Experimental evidence supported this claim, and it has been accepted as an SOA law. However, recent modeling (Francis, 1997) and experimental (Macknik & Livingston, 1998) studies argued for an interstimulus interval (ISI) law and a stimulus termination asynchrony (STA) law, respectively. We measured masking effects for various target and mask durations and compared the predictions of the SOA, ISI, and STA laws. We found that the data best support the ISI law.

5:10–5:25 (569)

Gender, Race, Similarity, and Distinctiveness in Social Change Blindness. SHEENA ROGERS, SUSAN DAVIS, JENNIFER RICHARDSON, & JEFFREY ANDRE, *James Madison University*—Unfamiliar conversation partners can be switched during a brief social interaction without notice by many participants. The outgroup homogeneity effect predicts more change blindness when participants are of a different sex or race from their conversation partners'. We staged interactions between same-sex and opposite-sex and same-race and other-race par-

ticipants and actors. During conversation, actors were switched behind a passing occluder. Participants saw mug-shot lineups (Wells's procedure) and gave confidence ratings for their identification of actors' and foils' faces. Change blindness rates were substantial, yet both actors were usually identified with some confidence. Associations between gender/race and change blindness were weak. Higher rates of change blindness were found when actors were rated more similar to each other in appearance. Also, more distinctive faces were more confidently recognized whether they were the first or the second actor met. Implications for eyewitness testimony and for perceptual theory are considered.

Divided Attention
Chicago BC, Saturday Afternoon, 3:40–5:30

Chaired by Raymond M. Klein, Dalhousie University

3:40–3:55 (570)

Effect of Divided Attention on Eyewitness Memory. MARILYN C. SMITH, *University of Toronto, Scarborough,* CHRISTINE WICKENS, *York University,* & PEARL BEHL, *University of Toronto, Scarborough*—Eyewitness identification is typically tested in the laboratory, where attention may be fully focused on the on-going event. In contrast, an eyewitness in the real world is most likely distracted by many things. This study investigated the effects of such divided attention on eyewitness accuracy, susceptibility to suggestion, and line-up identification. We also examined correlations of performance on the eyewitness task with performance on the DRM paradigm and the Ruff 2&7 task (a measure of attention).

4:00–4:15 (571)

Attentional Capture Triggers an Attentional Blink. WILLIAM S. MAKI & MICHAEL MEBANE, *Texas Tech University*—Participants viewed RSVP streams (10/sec) of strings printed in black. Most strings were distractors consisting of unfamiliar characters (a false font). Two of the strings (S1 and S2) were critical stimuli. S1 was a black or red false-font string, a red consonant string, or a red word. S2 was a word printed in black and followed S1 after 1–5 distractors. Participants were instructed to report only S2 and to ignore all other stimuli. Nevertheless, recall of S2 was impaired at short S1–S2 lags, but only when S1 was a red word or a red consonant string. Thus, consistent with results of Folk, Leber, and Egeth (*Abstracts of the Psychonomic Society*, 2000), a to-be-ignored stimulus produced an attentional blink (AB). Perhaps attention was drawn to the colored singleton, but the additional processing of S1 necessary to produce an AB was contingent on the resemblance of S1 to task-relevant stimuli.

4:20–4:35 (572)

Polysensory Convergence Onto Processes Associated With Selecting Verbal Name Codes. KESTUTIS KVERAGA, LISA E. WEBB, & HOWARD C. HUGHES, *Dartmouth College* (read by Howard C. Hughes)—Reaction times typically increase logarithmically with increasing stimulus–response (S–R) entropy—a relationship known as Hick's law. Kveraga et al. (*Abstracts of the Psychonomic Society*, 2001; *Experimental Brain Research*, in press) reported that the latencies of visually guided saccades are independent of response uncertainty, suggesting automatic selection of saccadic response parameters. To assess whether saccades are unique in this regard, we reevaluated earlier reports that latencies to name visually presented digits are also independent of the number of S–R alternatives. Our results indicate that latencies to name visually presented digits do indeed follow Hick's law, as do the naming latencies to digits presented aurally. We also find strong evidence of channel summation in the naming latencies of digits presented polymodally (visually and aurally). We conclude that accessing highly over-learned name codes does require a time-consuming process of response selection. We also suggest that this (presumably premotor) process receives convergent (coactive) visual and auditory inputs.

4:40–5:00 (573)

Central Capacity Demands of Visual and Memory Search. CHRIS ORIET & PIERRE JOLICŒUR, *University of Waterloo* (read by Pierre Jolicœur)—Central capacity demands of visual search and short-term memory search were studied by embedding visual and memory search operations in Task 2 of a psychological refractory period paradigm under varied and consistent mapping conditions. Partial underadditivity of display size with decreasing SOA was observed in visual search with varied mapping, and near complete underadditivity was observed with consistent mapping. For search of short-term memory, we found additive effects of increasing memory set size with SOA with varied mapping, but underadditive effects with consistent mapping. The results suggest that memory search makes greater demands on central mechanisms than does visual search, but only with varied mapping. Consistent mapping reduces demands on central mechanisms.

5:05–5:25 (574)

Using Incentives to Foster Parallel Central Processing at Low Practice Levels. ERIC D. RUTHRUFF, JAMES C. JOHNSTON, & ROGER W. REMINGTON, *NASA Ames Research Center*—Can central operations such as response selection be performed on more than one task at a time? A negative answer has come from numerous dual-task studies showing that substantial time delays occur on one or both tasks. A few recent studies have yielded a positive answer, but only after extensive amounts of practice. Unfortunately, single-task RTs after practice were very short (<300 msec), which means that little dual-task interference would be expected even if a central bottleneck remained. In addition, high practice levels might represent a special case. We investigated whether multitasking is possible even without extensive practice, using a new paradigm that provides clear feedback and unusually strong inducements for parallel processing. Surprisingly, we found multitasking with very little interference even on the 1st day of testing. We investigated whether successful multitasking depends on the use of "natural" S–R mappings that permit response activation via automatic pathways.

Animal Learning II
Chouteau, Saturday Afternoon, 3:40–5:20

Chaired by Kimberly K. Kirkpatrick, University of York

3:40–4:00 (575)

The Wings of Time: Representing Stimulus Duration as a Distributed Pattern. CATALIN V. BUHUSI & WARREN H. MECK, *Duke University*—Time flies. But does it fly with one or with multiple wings—that is, underlying processes? To address this question, we examined a paradigm in which rats have to filter out the gaps that (sometimes) interrupt timing. Previous theoretical accounts of this paradigm have proposed that the accumulated time decays passively during the gap. In our present experiments, the hypothetical decay of accumulated time was evaluated experimentally against the predictions of two models of time accumulation. A model based on a unique representation of accumulated time predicts that the effect of the gap would depend on the duration of the gap, but not on the to-be-timed interval. In contrast, a model based on multiple processes predicts that the effect of the gap decreases with an increase in the to-be-timed interval. The latter prediction was confirmed experimentally, supporting the possibility that stimulus duration is represented as a distributed pattern.

4:05–4:20 (576)

Discriminative Conditioned Inhibition and Search Modes. WILLIAM D. TIMBERLAKE, *Indiana University,* & MATTHEW R. TINSLEY, *UCLA*—Like other accounts of conditioned inhibition, the behavior systems view predicts (and Experiment 1 shows) that during summation and retardation tests, presentation of a CS− created by discriminative Pavlovian food conditioning will interfere with a focal search response, like rats nosing in the food tray. Unlike most other views, the behavior systems account predicts (and Experiment 2 shows) that the same CS− can potentiate a general search response, like attending to a moving artificial prey stimulus. Contacting the prey stimulus in extinction increased over baseline levels when a CS− but not a CS Novel preceded the prey stimulus. It appears that the effects of a discriminative CS− depend on the interaction of the training contingency with US-related search modes, their perceptual–motor repertoires and environmental support, and the choice of response measure.

4:25–4:40 (577)

Some Examinations of Within-Session Changes in Free-Operant Responding by Pigeons. MARC N. BRANCH, KATHRYN A. SAULSGIVER, & JONATHAN W. PINKSTON, *University of Florida*—Pigeons keypecked under a variable interval schedule of food presentation, and within-session response rates were measured. In different parts of the study, each food presentation lasted either 3 or 5 sec. When pigeons were kept at 80% of their free-feeding weight, rates changed little within sessions. In probe sessions in which food-presentation length varied, either increasing or decreasing, rates remained generally constant. In the 5-sec access condition, when body weight was allowed to increase, within-session changes were observed. Observation of within-session rate changes thus depended on deprivation level.

4:45–5:00 (578)

Inhibitory Conditioning in Honeybees. P. A. COUVILLON, A. V. BUMANGLAG, & M. E. BITTERMAN, *University of Hawaii*—Honeybees were rewarded with sucrose solution for choosing AX rather than ABX (gray targets, X, labeled with distinctive stimuli, A and B). Subsequent tests of independent groups showed a clear preference for AX over ABX, for ABX over BX, and for X over BX. All three preferences can be accounted for on the assumption that the B acquires inhibitory properties. If afferent interaction is assumed, the first two preferences can be accounted for without reference to inhibition, but the third cannot be. The consistent preference for X over BX in four experiments with different stimuli provides the first persuasive evidence of inhibitory conditioning, which now can be added to the already substantial list of what may well be fundamental similarities in the learning of honeybees and vertebrates.

5:05–5:15 (579)

Discrimination Learning in Paramecia. HARVARD L. ARMUS & AMBER R. MONTGOMERY, *University of Toledo*—Previous research, using the apparatus of the present study, showed that paramecia (*P. caudatum*) responded differently to DC electrical stimulation depending on whether they were in the area of the anode or the cathode. Anode stimulation was aversive, whereas cathode stimulation was attractive, relative to anode stimulation. The present study was designed to determine whether paramecia could learn a simple brightness discrimination task on the basis of reinforcement provided by cathode stimulation. The data indicate that they did just that.

Decision Processes IV
Empire, Saturday Afternoon, 3:45–5:15

Chaired by Tom Trabasso, University of Chicago

3:45–4:00 (580)

Is a Rose by No Name Still a Rose? MAYA BAR-HILLEL & AVITAL MOSHINSKY, *Hebrew University of Jerusalem*—Everyday experience suggests that people rate the products of reputable sources higher than those of anonymous sources. This paper shows, in the context of judging a poem with or without the name of its highly regarded author, that the enhancement occurs not just in the reporting, but apparently in the experience itself. Even though people are aware of the fact that the poet's name makes a difference, they overestimate its magnitude and do so in a manner asymmetrical with respect to whether they have to "add" the poet's name or to "subtract" it. When asked to "enter the shoes" of someone who read it under different conditions than themselves, they are unable to do so and, instead, substitute their "theory" of the name's impact.

4:05–4:25 (581)

Fuzzy Probabilities in Medical Decision Making. VALERIE F. REY-NA, *University of Arizona,* FARRELL LLOYD, *Mayo Clinic,* & ALLAN HAMILTON, *University of Arizona*—Fuzzy-trace theory predicts systematic distortions in probability judgments owing to processing interference (that contrast with predictions based on frequency). These predictions are tested in medical decision making—specifically, for genetic counseling, informed consent for risky surgery, and risk estimation for patients at risk of myocardial infarction (heart attack). Judgment errors are attributable to two sources: salient gist representations of event categories and neglect of denominators when categories overlap. Error rates range from 22% for disjunctive judgments to 68% for conditional probabilities and are present in highly trained medical specialists, such as cardiologists. Similar results are obtained for physicians' judgments of both hypothetical and actual patients. Simple interventions that reduce processing interference significantly reduce error rates, consistent with theoretical interpretations.

4:30–4:50 (582)

The Effect of Race on the Diagnosis of Oppositional Defiant Disorder (ODD). JOSEPH DAY & LINDA BUYER, *Governor State University* (read by Linda Buyer)—This study examined complex decision-making (making a diagnosis) by psychiatric clinicians. Two hundred twenty-five clinicians (psychiatrists, psychologists, and social workers) were sent a vignette of a white, a black, or a racially unspecified child. The child was depicted as having clear symptoms of oppositional defiant disorder (ODD), possible symptoms of ODD, or no symptoms of ODD. These clinicians were asked to give a differential diagnosis of the child in the vignette and, using a 0–5 Likert scale, to rate how confident they were in their diagnosis. Results demonstrated that the black child got significantly more diagnoses than did the other two groups. In addition, although not statically significant, the black child got the diagnosis of ODD more often than did the white or the racially unspecified child, with higher clinician confidence rating. Results were discussed in relation to the use of heuristics to arrive at judgments.

4:55–5:10 (583)

Temporal Discounting by Pigeons and Rats. LEONARD GREEN, JOEL MYERSON, DANIEL D. HOLT, & JOHN R. SLEVIN, *Washington University*—Temporal discounting refers to the decrease in the present, subjective value of a reward as the time to its receipt increases. Results from humans have shown that a hyperbola-like function describes the form of the discounting function when choices involve hypothetical monetary rewards. The present research examines the cross-species generality of this finding, using real rewards—namely, food pellets—with both pigeons and rats. An adjusting amount procedure was used to estimate the amount of an immediate food reward judged equal in value to a delayed food reward. Different amounts of delayed food rewards (ranging from 5 to 32 pellets) were studied at delays ranging from 1 to 32 sec. The same hyperbolic function that described the discounting of rewards in humans also described the discounting of food rewards in both pigeons and rats, thus extending the generality of the mathematical model.

POSTER SESSION IV
Crown Hall, Saturday Evening, 6:00–7:30

• VISUAL PERCEPTION •

(584)

Configuration Is More Important Than Parts in Object Recognition. SIMONE K. KEANE & DARREN BURKE, *University of Wollongong,* WILLIAM G. HAYWARD, *Chinese University of Hong Kong,* & STEVEN ROODENRYS, *University of Wollongong*—Research has shown that we are sensitive to different kinds of object information. We are more sensitive to changes to the configuration of object parts than to the identity of parts, and categorical changes to parts are detected more accurately than coordinate changes (Keane, Hayward, & Burke, in press). In this series of experiments, we explored this sensitivity across a range of tasks and object sets. An advantage for detecting changes to part configuration over those to part identity was found across rotations of objects in depth and for objects of different sizes in sequential matching tasks and also in visual search and old/new tasks. The configuration of an object's parts is information more accessible, more important, and more useful for object recognition than is the identity of an object's parts.

(585)

Surface-Based Shape Representations Mediate Object Recognition: Further Evidence From Part–Whole Priming. E. CHARLES LEEK & IRENE REPPA, *University of Wales,* & MARTIN ARGUIN, *Université de Montreal*—Leek and Arguin (2000, Psychonomic Society, New Orleans) proposed that 3-D object recognition is mediated by surface-based shape descriptions, rather than by representations based on low-level image features or higher order volumetric components (e.g., geons). We present evidence from a part–whole priming paradigm that provides support for this hypothesis. In Experiment 1, we show that two adjacent surfaces from the same geon produce as much priming as two surfaces from different geons in the same object. This result shows that priming derives from surface properties of objects, and not from geon-based components. In Experiment 2, we show that this effect obtains with both geometrically regular and irregular 3-D object forms. The results challenge models of object representation such as RBC (Biederman, 1987), which do not posit a level of surface-based shape description. Instead, the data are interpreted in terms of a surface-based approach to recognition.

(586)

The Face in the Crowd: Yet Another Confound. DEAN G. PURCELL, *Oakland University,* & ALAN L. STEWART, *Stevens Institute of Technology*—Various experiments have concluded that a face with an angry expression is easy to locate when surrounded by happy faces. But experiments reporting this angry-superiority effect (ASE) have confounded angry expression with low-level visual cues such as high-contrast blobs. Recent experiments by Ohman et al. eliminated contrast cues but introduced a new low-level feature: The mouths and eyebrows of angry faces point outward. Faces with neutral expressions and outwardly pointing mouths and eyebrows produced results identical to those for angry faces. As yet, there is no clear evidence for an ASE.

(587)

Foreshortening and "Forelengthening": Overestimated and Underestimated? JOHN M. KENNEDY & IGOR JURICEVIC, *University of Toronto* (sponsored by John M. Kennedy)—Polar projection, vision's major geometry, produces "forelengthening" as well as foreshortening. Inspect a wide-angle picture from afar (farther than the correct viewing distance) and the forelengthening is evident, Pirenne and Kubovy noted. Result? From afar, forelengthened quadrilaterals that depict squares at the correct viewing distance look especially long in the *z*-dimension. But the length judgment is not at all as perspective predicts. It is markedly underestimated. Also, apparent length of the lines on the page depicting the squares is affected: Foreshortened lines are overestimated, forelengthened lines are underestimated. We point out implications for theories of *tolerance* of incorrect projection and for subjects making panoramic drawings.

(588)

Does Endogenous Planning Modulate Effects of a Spatial Illusion on Reflexive Saccades? JASON S. McCARLEY & ARTHUR F. KRAMER, *Beckman Institute, University of Illinois, Urbana-Champaign,* & GREGORY J. DiGIROLAMO, *University of Cambridge*—Evidence suggests that reflexive saccade programming integrates signals from retinotopic and subjective spatial frames (DiGirolamo, McCarley, & Kramer, 2001). Here, we asked whether endogenous saccade preparation modulates the relative strength of these signals. Subjects made prosaccades toward flashed go-signals that appeared at the left or the right endpoint of a horizontal Müller-Lyer (M-L) figure. To encourage endogenous saccade preparation, go-signals appeared 80% of the time on one side of the display and 20% on the opposite side. Saccade latencies were reliably faster for movements toward the high-probability location, confirming that the probability manipulation was effective. Effects of the M-L illusion on saccade amplitudes, however, were independent of target probability; movements toward high- and low-probability targets were biased to the same extent by illusory changes in target distance. Results demonstrate that the effects of a spatial illusion on reflexive saccade amplitudes are not modulated by endogenous saccade preparation.

(589)

Perception During Perceptual Filling-In. ALEJANDRO LLERAS, *University of British Columbia,* & CATHLEEN M. MOORE, *Pennsylvania State University*—The phenomenon of perceptual filling-in, also known as Troxler fading, is a dramatic fading and filling-in of the background over a peripherally attended stimulus. A dual-task methodology was used to investigate the nature and extent of perceptual processing inside the faded area. The dual-task method consisted of asking participants to simultaneously perform two tasks: (1) a fading-report task, which had participants attend to a peripherally presented target and report the target's presence/absence from visual awareness over an extended period of time, and (2) a dot-detection task, which had participants report the brief onset of small dots that were repeatedly presented inside the target. The results showed that, during target-faded intervals, participants (1) rarely detected background-colored dots and (2) detected nonbackground-colored dots at a reduced rate than during target-visible intervals. We concluded that the perception of new events inside the faded area is possible, although perceptual abilities are somewhat suppressed.

(590)

Illusory Line Motion in the Retinal Periphery. WILLIAM C. SCHMIDT & MICAH GEER, *SUNY, Buffalo*—Experiments are presented that systematically examined the effects of the peripheral presentation of illusory line motion (ILM; motion within a probe line that is presented subsequent to a cuing contour). A motion asymmetry was observed as a function of the combination of presentation distance from the fovea and relative position of the cue and the probe. The illusion proceeds normally when the cue is more peripheral than the line but is split or completely reversed when the line is more peripheral than the cue. This phenomenology suggests that stimulus mislocalization or the misalignment of disparate retinotopic maps can act as the source of a spatial mismatch producing an illusory motion effect, further demonstrating how early processing in the visual system can drive perceptual outcomes.

(591)

Signal Detection Analysis of Size Perception in Static Pictorial Arrays. KIMBERLY R. RADDATZ & JOHN UHLARIK, *Kansas State University*—Pictorial depth cues and instructional set are two factors that influence size constancy in pictorial arrays. However, the degree to which these factors influence sensitivity to perceived size differences (d') versus the subjective criteria (bias) for making discriminative responses has not been systematically studied. The present research

seeks to examine the effects of pictorial depth cues and instructional set, using a signal detection analysis. Two objects were presented at different relative distances in static pictorial displays. Observers were required to make same–different judgments regarding their apparent (phenomenal instructions) or objective (objective instructions) distal size. Judgments were made in arrays that varied the amount of pictorial depth cues. Sensitivity was influenced by the relative distance separating the stimulus objects and by relative distal size. Surprisingly, number of available depth cues did not influence sensitivity but, instead, affected response bias. Also, instructions had no effect on response bias but did influence sensitivity.

(592)

Visual Hindsight Bias in Object and Face Recognition. ERIN M. HARLEY, DANIEL M. BERNSTEIN, & GEOFFREY R. LOFTUS, *University of Washington* (sponsored by Geoffrey R. Loftus)—We investigated hindsight bias in visual recognition. In an object recognition experiment (E1) and a celebrity face recognition experiment (E2), participants viewed degraded images that resolved to full clarity. Participants stopped the resolution process when they recognized the object or the face. E1 participants viewed half of the objects in full clarity a priori, and then stopped the resolution process when they thought a naive peer would recognize the object. E2 participants were given a surprise memory test in which they adjusted the clarity of the face until it looked as it did when recognized in the first part of the experiment. In both experiments, participants showed visual hindsight bias. These results suggest that once the contents of a visual image are known, observers are unable to discount this information. As a result, they overestimate their ability (and the ability of others) to identify the image at a more degraded state.

(593)

Perceived Separation, Perceived Size, and Perceived Distance of Virtual Images in Mirrors. ATSUKI HIGASHIYAMA, *Ritsumeikan University,* & KOICHI SHIMONO, *Tokyo University of Mercantile Marine*—We investigated spatial perception of virtual images in convex and plane mirrors. In Experiment 1, 20 subjects reproduced lateral separation between virtual images by adjusting lateral separation between real objects. The subjects based their judgments on objective separation, not on optical separation of virtual images in mirrors. In Experiment 2, 36 subjects reproduced perceived size and perceived distance of virtual images in mirrors. In Experiment 3, 30 subjects verbally judged perceived size and perceived distance in a more extensive physical setting. Both experiments showed that (1) size constancy was achieved over distance ranging from 2.5 to 45 m and (2) distance was readily discriminated within this range, but virtual images in the mirror of strong curvature were judged to be farther away than those in the mirror of less curvature. In addition, the ratio of perceived size to perceived distance was represented as a power function of visual angle, but for a given visual angle, the ratio for the convex mirror was generally larger than that for the plane mirror.

(594)

Ambiguous Figures: A Case for Differentiation Between Graphical and Semantic Figures. ILSE VERSTIJNEN, *University of Utrecht,* & JOHAN WAGEMANS, *University of Leuven* (sponsored by Johan Wagemans)—A normative study was undertaken to establish perceptual ambiguity for a set of 11 ambiguous figures with seven levels of ambiguity each. Triplets of figures were presented consisting of a more or less ambiguous figure in the middle (one of five levels) flanked by its two possible interpretations. In the first experiment, subjects had to draw an arrow to indicate whether the ambiguous figure resembled most the interpretation to the left or to the right. In the second experiment, subjects had to indicate which one of the extremes resembled the middle figure most. In a third experiment, subjects had to encircle the extremes. Results showed that the interpretation of the five semantically ambiguous figures tended to be more influenced by the interpretation to the right; this influence increased with the middle figure's ambi-

guity. The six graphical figures showed a different pattern; their interpretation tended to be influenced by rightward comparisons.

• **VISUAL IMAGERY/PICTURE PROCESSING** •

(595)

Two Types of Visual Imagers: The New Self-Report Questionnaire. MARIJA PETKOVIC, MARIA KOZHEVNIKOV, & OLESSIA BLAJENKOVA, *Rutgers University*—Recent theories of mental imagery distinguish between two types of mental imagery, visual-object and spatial. The same dissociation is confirmed in the domain of individual differences. Some people are better in constructing vivid, detailed images (object imagers), whereas others prefer to construct schematic images of spatial relations among objects (spatial imagers). The goal of this study was to design and validate a new self-report cognitive style questionnaire that distinguishes between the two types of imagers. One hundred and sixty-five subjects were administered the new questionnaire, verbal ability tests, Raven matrices, and different object and spatial imagery tasks. The questionnaire reliably distinguishes between visual-object and spatial imagers. Assessed by this instrument, object imagers are found to be significantly better than spatial imagers on object imagery tasks, and vice versa for spatial imagers on spatial imagery tasks. Factor analysis performed on the questionnaire's items reveals two underlying imagery factors (visual-object and spatial).

(596)

Multiple Memory–Percept Integration. JAMES R. BROCKMOLE, RANXIAO FRANCES WANG, & DAVID E. IRWIN, *University of Illinois, Urbana-Champaign*—If 1,000–1,500 msec separate two visual stimuli, a VSTM representation of the first stimulus can be integrated with the second to form a single representation (memory–percept integration). The present research investigated the nature of the integrated representation by testing how additional information is added to it. Subjects were shown three dot arrays that filled all but one space in a grid, which they identified. Arrays 1 and 2 were separated by 1,500 msec, allowing integration to occur. Array 3 was presented 0–3,000 msec after Array 2. When the delay was 0 msec, performance was high and dropped significantly at 100 msec as Array 3 masked Array 2. However, performance recovered within 300–500 msec and did not vary thereafter. This suggests that the initial integrated representation is in a format that can accept additional information immediately, as well as at longer delays as long as no masking occurs.

(597)

Left-Hemisphere Viewpoint-Independent Recognition Depends on Semantic Information. KIM M. CURBY, *Vanderbilt University,* WILLIAM G. HAYWARD, *Chinese University of Hong Kong,* & ISABEL GAUTHIER, *Vanderbilt University*—The dissociable neural subsystems (DNS) theory (Marsolek, 1999) proposes that the left hemisphere (LH) uses a viewpoint-invariant (V-I) object recognition subsystem, whereas the right hemisphere (RH) uses a viewpoint-dependent (V-D) subsystem. Studies supporting this theory have used familiar objects, for which nonperceptual information could support V-I recognition. Experiment 1 tested this possibility with a lateralized sequential-matching task using novel objects; V-D recognition performance was found in both hemispheres. In Experiment 2, subjects learned semantic associations for four novel objects, whereas participants in the control condition were exposed to the same novel objects without the semantic associations. Both groups later performed a depth-rotated lateralized sequential-matching task. Although both groups of subjects showed V-D performance in the RH, only subjects who learned semantic information showed V-I performance in the LH. Thus, V-I performance may be facilitated by LH use of semantic information.

(598)

Age-of-Acquisition Effects on Two Picture Categorization Tasks. ROBERT A. JOHNSTON, *University of Birmingham,* & CHRIS BARRY, *University of Kent*—Age of Acquisition (AoA) seems to predict the time

needed to name pictures but not categorize them (Morrison et al., 1992). This reflects Brown and Watson's (1987) suggestion that early-acquired words are represented in a more "complete" form than later-acquired words. However, Ellis and Lambon Ralph (2000) propose that AoA effects arise owing to the order in which items are learned and so need not be restricted to naming tasks. Learning later items becomes more difficult as the maturing system loses plasticity. Two experiments examined AoA in categorization tasks. In Experiment 1, objects were categorized as being found inside/outside of the house. Early items were categorized faster than late items, but only for the "outside" decision. In Experiment 2, objects were categorized as being smaller/larger than a loaf. AoA effects were present for both "smaller" and "larger" decisions. These findings are discussed in terms of a learning account of AoA.

(599)

Early Extraction of Scene Gist Facilitates Eye Movement Guidance During Visual Search. MONICA S. CASTELHANO & JOHN M. HENDERSON, *Michigan State University*—Gist is acquired during the initial fixation on a scene. The nature of initial scene gist was investigated using an eye-contingent moving-window/visual-search paradigm. Participants searched for a prespecified target object in scene photographs while their eye movements were recorded. In each of three conditions, participants were shown a preview photograph (the search picture, a different picture, or a mask) for 250 msec before they began the visual search. During search, the search scene was restricted to a 2° window region surrounding the fovea. This window region moved with the eyes. Results showed that there was a benefit for eye movement guidance and search efficiency in the search picture preview condition versus the different picture or mask preview conditions. Experiments exploring the source of this facilitation (e.g., extraction of scene category vs. spatial layout) will be reported.

(600)

Minimal Memory in a Scene Comparison Task. DANIEL A. GAJEWSKI & JOHN M. HENDERSON, *Michigan State University* (sponsored by John M. Henderson)—Does the amount of information stored in visual short-term memory (VSTM) reflect the specific demands of the ongoing task, or does the system routinely make full use of its capacity? Eye movement behavior in multimodal tasks suggests a preference for a "just in time" processing strategy that minimizes the use of memory. A scene comparison paradigm was introduced to determine whether the preference holds when the task is primarily visual and when more complex naturalistic scenes are used as stimuli. Participants made same or different judgments in response to simultaneously presented pairs of scenes that were identical or differed by one object. The number of objects fixated during each glance to a scene and the number of fixations intervening between glances to corresponding objects were fewer than would be predicted by current estimates of VSTM capacity. These results suggest that frequently only a single object is stored.

(601)

Effects of Stimulus Properties and Intentionality on the Bizarreness Effect. SHEILA R. BLACK, RYAN C. LEONARD, & MATTHEW KELLY, *University of Alabama,* & REGAN LOOKADOO, *Georgetown College* (sponsored by David B. Boles)—The bizarreness effect refers to the finding that bizarre information is better remembered than common information. In the present study, bizarreness was conceptualized as occurring on a continuum. We examined the possibility that stimuli that were more extreme on the bizarreness continuum would yield larger bizarreness effects than would stimuli that were less extreme. We also examined the extent to which intentionality might modulate the bizarreness effects. The present study yielded evidence that items on the extreme end of the bizarreness continuum were more likely to yield bizarreness effects, relative to items that were less extreme. Furthermore, the present study yielded evidence that the bizarreness effect was less robust under intentional conditions, relative to incidental learning conditions.

(602)

Inattentional Blindness: What Makes Noticers Different Than Nonnoticers? JOHN G. JEWELL, *Ursinus College*—The present study attempted to reexamine the role of attention in the perception of unexpected events. Participants viewed a dynamic scene containing an unexpected event while engaging in a monitoring task (counting) similar to that in Simons and Chabris (1999). Eye movement data were recorded from participants while they viewed the scene and performed the counting task. The eye movement technique revealed that "noticers" of the unexpected event made several fixations to the unexpected event or made extended scanning fixations of the unexpected event. A more surprising result emerged from the eye movement data for participants who did not notice the unexpected event ("nonnoticers"). A number of these participants made extremely brief fixations to the unexpected event but failed to report the unexpected event. The present findings confirm earlier research on inattentional blindness but call into question the notion that we perceive items or events only if they receive our focused attention.

(603)

The Thatcher Illusion Turns Hemispheric Specialization Upside Down. GLENN E. CASNER, BRIAN E. BROOKS, & ERIC E. COOPER, *Iowa State University*—The fact that Thatcherized faces look grotesque only when upright is thought to reflect the fact that configural/holistic representational mechanisms operate only on upright faces. Furthermore, it is widely believed that the right cerebral hemisphere (RH) is superior to the left cerebral hemisphere (LH) at mediating configural/holistic representations. If these widely held views are correct, there should be an RH advantage for deciding whether a face is Thatcherized only when faces are upright. However, we found a right-hemisphere advantage for deciding whether a face is Thatcherized when faces were inverted, but not when faces were upright. These results suggest a need to rethink the cognitive and neural basis of the Thacher illusion. The results suggest either that configural/holistic representations can sometimes operate more effectively on upside down faces than upright faces or that configural/holistic coding is not responsible for the Thatcher illusion.

(604)

Context-Related Facilitation and Interference From Distractors in Object Recognition. MARK AUCKLAND, KYLE R. CAVE, & NICK DONNELLY, *University of Southampton*—Most current theories of object recognition implicitly assume that only one object is selected at a time and that object recognition cannot function if input from multiple objects is given simultaneously. We combined object naming with another task designed to spread the focus of attention to include the distractors with the target. The addition of distractor objects produced no additional naming errors and even lowered the error rate when the distractors were semantically related to the target. Object recognition is thus surprisingly resistant to distractor interference. This experiment demonstrates that even a simple context, made up of a collection of separate objects rather than a coherent scene, can influence object recognition. The effect arises even though the target and the context are presented very briefly (80 msec, no mask) and the target can be located without searching. This experiment does not indicate whether the context is affecting early perceptual processes or later decision processes.

• HUMAN LEARNING AND MEMORY •

(605)

Does the Generation Effect Occur in Short-Term Memory? YVONNE WAKEFORD, RICHARD A. CHECHILE, & SAL A. SORACI, *Tufts University*—Robust generation effects have been documented in a wide range of experimental contexts, typically with list-learning testing procedures that require the utilization of long-term memory. The present series of experiments, involving categorical word-fragment completion tasks, examine whether generative effects occur in short-term memory. Experiments 1 and 2, utilizing the Brown–Peterson task and a modeling framework, indicated retention interval main effects,

but no generation advantages over read conditions. Experiment 3 employed a modified continuous recall short-term memory paradigm and found the same pattern as that instantiated in the first two experiments. Experiment 4 also utilized a categorical word-fragment completion acquisition task and a delayed free recall test. In the latter experiment, a generation advantage was demonstrated. In conjunction, these studies indicate that generative processing involves complex cognitive processes that influence long-term memory but are not evident in highly time-constrained memory methodologies.

(606)

Individual Differences in Time Needed for Mastering 1,000 Words in a Second Language. TAKAFUMI TERASAWA, *Okayama University,* TETSUYA YOSHIDA, *Tokoha Gakuen University,* NOBUO OHTA, *University of Tsukuba,* MIWA KAJIKAMI, *Okayama University,* KEIKO SUGIYAMA, *Namiki High School,* & YUKIO SHIMAUCHI, *Benesse Educational Research Center*—We conducted a 6-month learning study on second-language (English) acquisition by using a new experimental design. The experimental design was developed specially to measure the effect of long-term learning. Throughout the experiment, the learning tasks, the test conditions, and the schedule of learning were controlled. One-month-interval tests were given in all experimental conditions. The results showed that even the effect of long term learning for less frequently learned words accumulated unconsciously. Furthermore, from the analyses of results, we can provide a precise prediction of the time needed for each learner to master 1,000 words in English. In addition, the new experimental design enables the researchers to (1) examine the exact effects of long-term learning for the vast content and (2) measure substantial implicit lexical ability for learning words in a second language.

(607)

Examining the Long-Lasting Font Size Effects in Contingent Recognition Task by Using Japanese Kanji Words. TETSUYA YOSHIDA, *Tokoha Gakuen University,* NOBUO OHTA, *University of Tsukuba,* TAKAFUMI TERASAWA, MIWA KAJIKAMI, & YUKA FUSA-MUNE, *Okayama University,* & TAMON NAKATSUKA, *Okayama Asahi Senior High School* (sponsored by Nobuo Ohta)—This study examined the font size effect in a contingent recognition task by using Japanese Kanji words. The experiment was conducted in two sessions. Both sessions were carried out with the same procedure, with a 16-week interval between the two sessions. The recognition task was employed as the test task in the second session by means of asking the subjects to decide whether each stimulus item had appeared in the contingent learning task in the second session. Each stimulus for the contingent learning task was presented twice in the same or different size fonts. Half of the items in the first session had appeared both in the first session and in the second session, whereas the other half had appeared only in the first session. The results showed that false alarms for the items displayed twice in different font sizes were lower than those for the items displayed in the same font size.

(608)

The Effects of Sleep on Perceptual Skill Acquisition. KIMBERLY M. FENN, HOWARD C. NUSBAUM, & DANIEL MARGOLIASH, *University of Chicago*—Studies of memory consolidation during sleep have found that performance in verbal and spatial memory tasks improves with sleep; some tasks even require sleep for learning. We used perceptual learning of synthetic speech to investigate how sleep affects generalization learning. Listeners were trained and tested on all novel words. Listeners who were trained at 9:00 p.m. one day and tested at 9:00 a.m. (after sleeping) performed better than listeners who were trained at 9:00 a.m. and tested at 9:00 p.m. after 12 h awake. When tested directly after training, listeners do learn, but a significant amount of this information is lost after 12 waking hours. If permitted to sleep before this intervening wake period, listeners do not show this loss. We suggest that sleep helps consolidate and facilitate generalization learning of speech. This study further suggests that sleep may help to inoculate memories against interference.

(609)

The Costs of Performing a Prospective Memory Task: Support for the Multiprocess View. GILLES O. EINSTEIN, *Furman University,* MARK A. McDANIEL, *University of New Mexico,* & HILARY SHANK & SARA MAYFIELD, *Furman University*—In contrast to typically studied retrospective memory tasks, prospective memory requires that, at some point in the future, an individual remembers to perform an action without being put in a retrieval mode by an external agent. One view on how this is accomplished is that participants strategically monitor the environment for the target event. Another view is that participants rely on a relatively automatic associative process to retrieve the intention when the target event is encountered. A third view, the multiprocess view (McDaniel & Einstein, 2000), assumes that the particular approach that participants adopt in a prospective memory task depends on the characteristics of the task. We examined these views by evaluating whether or not performing a prospective memory task produced costs on the performance of the cover activities. The results supported the multiprocess view by showing that the presence of costs depended on several factors.

(610)

Anchoring Memory to the Environment: Testing Models of Contextual Drift. LAEL J. SCHOOLER, *Max Planck Institute for Human Development*—Estes's (1955) stimulus fluctuation theory proposed that behaviors are encoded in contexts that consist of myriads of internal and external elements. These elements have the potential to act as cues to memory. Over time, the context gradually drifts as cues enter and leave the context, with recall dependent on the cues shared between the encoding and the retrieval contexts. Variants of the mathematical model of the environment Estes constructed have been a central component of memory models for nearly 50 years. Although this basic idea has been the subject of detailed mathematical analysis and behavioral tests, environmental predictions of Estes's theory have gone untested. Here, we will report the first such environmental tests. These tests involve analyses of word use in linguistic corpora.

• RECOGNITION MEMORY •

(611)

The Effect of Distinctive Visual Information on False Recognition. JASON ARNDT, *Middlebury College,* & LYNNE M. REDER, *Carnegie Mellon University*—We examined the effect of presenting study items in unusual looking fonts on semantic false recognition. In one condition, each font was associated with a single study item. In a second condition, each font was presented 12 times per study list, randomly distributed across several themes. In a third condition, each font was presented 12 times in the study list and was associated with a particular studied theme. False recognition levels were lowest when there was a unique association between a font and a single study item, whereas false recognition levels were highest when all items from a theme were presented in the same font. Furthermore, the effects of font condition on false recognition maintained when font condition was manipulated within participants and lists. Taken together, these results are inconsistent with theories proposing that false recognition reduction is the product of response strategy shifts across experimental conditions.

(612)

False Recognition Following Explicit Warnings in Young and Older Adults. DAVID P. McCABE & ANDERSON D. SMITH, *Georgia Institute of Technology*—Previous research with young adults has indicated that warning participants about the DRM false memory effect prior to study (study warnings) results in large false recognition reductions but that warnings after study but before test (retrieval warnings) are less effective. The present experiment compared young and older adults' ability to use study or retrieval warnings to reduce false recognition (as compared with an unwarned control group). Corrected recognition scores revealed reductions in false recognition for both age groups following study warnings, and both age groups reported using

a similar rehearsal strategy to reduce false recognition in this group. Only young adults were able to reduce false recognition following retrieval warnings. Furthermore, performance on a measure of working memory capacity was inversely related to false recognition in the retrieval warning group. We conclude that discriminating between similar sources of activation (studied words and related lures) is dependent on attentional control, which declines with age.

(613)

A Dual-Process View of Associative Interference in Recognition. MICHAEL F. VERDE, *University of Massachusetts, Amherst*—According to dual-process theory, two retrieval processes contribute to recognition. Familiarity describes a global match to memory, whereas recollection discriminates among competing memories. These characteristics suggest that each process is differently affected by A–B, A–D interference. Changes in the relative contribution of processes across tasks may explain the inconsistent effects of interference on recognition memory. The remember–know procedure was used to measure the contribution of different retrieval processes. Under conditions of interference, remember hit rates (tied to recollection) were predicted to decrease, whereas know hit rates (tied to familiarity) were predicted to increase. In three experiments, the relative contributions of familiarity and recollection were manipulated by varying type of test lures (new vs. rearranged pairs) and study materials (sentence vs. noun pairs). Depending on conditions, recognition hits sometimes increased and sometimes decreased with interference. However, the predicted pattern of remember and know hits was constantly observed.

(614)

Random Verbal Associates Enhance Recognition of Abstract Visual Stimuli. PAUL VERHAEGHEN & TIBOR PALFAI, *Syracuse University*—Four experiments establish and examine the effect that presenting a verbal stimulus (viz., an English noun) alongside an abstract visual stimulus (viz., a Chinese character) enhances recognition for the visual stimulus. Experiment 1 demonstrates that the character-plus-word combination results in better recognition than does a character-alone presentation. Recognition is further enhanced when the word is presented at both encoding and retrieval. Experiment 2 demonstrates that presenting the word first and then the character results in higher performance than using the opposite order. Experiment 3 shows that the concreteness value of the word, not familiarity, is the crucial factor. In Experiment 4, presentation time was varied. More time was needed for lift-off from chance level for the word–character combination than for the character-alone combination, and the rise to asymptote proceeded more slowly. Together, the results suggest that participants build asymmetric effortful imagery associations, going from English word to Chinese character.

(615)

The Ring of Familiarity: False Familiarity in Item and Associative Recognition. MATTHEW G. RHODES & COLLEEN M. KELLEY, *Florida State University*—The present study investigated false recognition within a paradigm (Whittlesea & Williams, 2001a) that manipulates fluency of target processing by presenting targets at recognition in the context of a rhyming or nonrhyming nonword prime. Experiment 1 attempted to background the role of the primes by presenting items with primes at study as well as at test and found a large increase in the false alarms to rhyming pairs. Subsequent experiments demonstrated that the effect is not due to backgrounding per se but is, instead, partially due to cohort activation and partially due to people's use of associative familiarity on the item recognition test. Rhyming pairs on an associative recognition test also produce high levels of false alarms. The data illustrate how relations between elements in the test context can be mistaken for episodic familiarity.

(616)

Effects of Presentation Frequency and Response Deadline on Associative Recognition in Young and Older Adults. LEAH L. LIGHT, *Pitzer*

College, MEREDITH PATTERSON & CHRISTIE CHUNG, *Claremont Graduate University,* & MICHAEL R. HEALY, *Pitzer College and Claremont Graduate University*—The effect of presentation frequency on associative recognition was investigated in two experiments using a dual-process framework. In Experiment 1, young and older participants studied word pairs one or four times and made old/new judgments on intact, rearranged, and new pairs in short and long deadline conditions. Young adults showed an increase in false-alarm rate with repetition when pressured to respond quickly but a decrease in false alarm rates with repetition when given a long deadline. However, older adults showed an increase in false alarm rates with both short and long deadlines. In Experiment 2, responses were self-paced. Results were similar to those with the long deadline in Experiment 1. Therefore, young, but not older, adults could oppose increased familiarity with recollection when given sufficient time to respond. These results also suggest that recollection declines with age, whereas familiarity remains relatively unchanged.

(617)

Remember–Know and Source Monitoring in Social Contagion of Memory. JUN KAWAGUCHI, KEISUKE OGURA, HAMA WATANABE, & ERINA SAEKI, *Nagoya University*—This study examined the influence of response by another person on false recognition memory for visual objects. Subjects were presented with seven common scenes for 15 sec, followed by a collaborative recall phase, in which 2 subjects each recalled seven items from the scenes but a confederate made mistakes by reporting items not from the scene. Finally, in a recognition phase, subjects were asked to decide whether an object presented on a screen had been included in the studied scene or not. Subjects recognized the critical item suggested by the confederate better than in a control condition. Their recognition of the critical item belonged to a *know* rather than to a *remember* response. Moreover, many of the sources of false recognition of the critical item were attributed to the confederate. These results suggest that false memory implanted by a confederate can be made by inferences based on the experience of a collaborative recall phase.

(618)

Simulating Recognition Memory Using Abstract Features, Acoustic-Phonetic Features, and Features of Real Speech Production. DEBORAH K. EAKIN, TRAVIS WADE, THOMAS A. SCHREIBER, ALLARD JONGMAN, & JOAN SERENO, *University of Kansas*—Many formal models of memory assume that memories are represented as ordered patterns of features, but in simulations these features are left undefined. The purpose of the present study was to examine whether MINERVA2 (Hintzman, 1984, 1988) can accurately model recognition memory when features are defined instead by tenable representations of real-world information. Using abstract features, MINERVA2 simulated findings from behavioral data regarding category frequency and relatedness. In Experiment 1, we accurately simulated the category frequency and relatedness effects, using our implementation of MINERVA2. Experiment 2 demonstrates the same effects using CVC words represented by features consisting of linguistically relevant characteristics of phonemes. In Experiment 3, we obtain identical effects with actual vowel sound productions, using spectral properties of the productions as features. The findings will be discussed in terms of a long-term goal of developing a cognitive-robotics platform to provide a more realistic way to test theories of cognition.

(619)

Relative Sparing of Retrieval in Older Adults in an Associative Recognition Task. GAIL C. O'KANE, ANTHONY D. WAGNER, & SUZANNE CORKIN, *Massachusetts Institute of Technology*—Older adults are typically impaired on episodic recognition tasks that depend on recollection, such as associative recognition. At present, it is unclear whether this deficit reflects impairment at encoding or at retrieval. We explored whether older adults can succeed at recollection-based recognition when material is learned through deep, incidental

encoding. Young and older adults were trained to generate associative images from word pairs and to rate the quality of the generated image. Participants then received a surprise associative recognition test. Results revealed that, at encoding, older adults were slower to generate images and rated fewer images as being highly interactive. On items for which participants generated a highly interactive image during encoding, however, young and older adults were equally accurate in associative recognition. These results build on prior findings (Glisky et al., 2001), suggesting that age-related deficits in recollection reflect ineffective encoding.

(620)

Prototype Formation of Normal and Distorted Faces. JOANNA SALAPSKA-GELLERI, KIMBERLY A. LENZI, & ROBERT SOLSO, *University of Nevada, Reno*—Two experiments examined whether prototype formation for faces occurs because of the holistic or the featural characteristics of faces. In Experiment 1, 10 Identikit faces used by Solso and McCarthy (1981) were presented to participants who were later asked to rate, for familiarity, a series of faces that resembled, were different from, or were a prototype of ones they had seen. The face stimuli in Experiment 2 were distorted where four features (eyes, mouth, nose, and hair) were randomly positioned. In both experiments, the faces were presented in four different orientation combinations: upright study/ upright test, upright/inverted, inverted/upright, and inverted/inverted. Participants tended to rate the prototype as being more familiar than new and similar-to-old items for both intact and distorted faces. This was most evident for conditions in which the orientation of the stimuli matched during study and test.

(621)

Conversational Influence on Recognition Memory. YASUHIRO OZURU & WILLIAM C. HIRST, *New School University*—This study explored contributions of conversational interactions to an increase of mnemonic consensus and, hence, to the formation of collective memories. Members of small groups of four each read slightly different versions of stories containing discrepant details. After recounting the stories in a group (experimental) or individually (control), members performed forced-choice recognition, choosing one text version of the information among the four options, some of which they might have encountered during group recounting. Participants were more likely to falsely choose other member's version as their own when it was mentioned than when it was not mentioned, thereby increasing the consensus. Two follow-up experiments adopting source-monitoring techniques indicated that such false recognitions may occur in part because of source confusions between text and conversational items. Combined together, the experiments demonstrate that one of the ways in which collective memories emerge is through conversational interactions that induce source confusions.

(622)

Not All False Memories Are Created Equal. GIULIANA MAZZONI, LISA GONCALVES, & MICHAEL GENTZEL, *Seton Hall University*— In two experiments, we examined the relationship between two types of memory errors, those in which associated words are mistakenly remembered as being on a word list (the Deese/Roediger/McDermott [DRM] paradigm) and those produced by having participants imagine false autobiographical events. Experiment 1 assessed the effect of imagination in both paradigms. Having participants imagine words decreased memory errors in the DRM paradigm, whereas having them imagine autobiographical events increased them. Experiment 2 was a correlational study, in which participants studied three word lists and imagined three events. Increases in false memories of the three events were significantly correlated with each other, but not with false memories of words in the DRM paradigm. These data suggest that DRM memory errors and false memories of autobiographical events produced by imagination inflation involve disparate processes.

• **METAMEMORY** •

(623)

Everyday Memory 101: Designing a Course in Applied Cognition. SHARLENE D. WALBAUM, *Quinnipiac University*—Research and theory in applied cognition provide the bases for a new, substantive interdisciplinary course. In designing such a course, emphasis was placed on the way knowledge about cognition can enlighten us about human endeavors as varied as writing a poem or making a bet in poker. In a the same vein, topics such as the psychology of writing, the role of overconfidence in studying, and gist versus verbatim memory were related to actual behaviors and cognitions of student in the course. As a capstone activity, participants created original applications of cognitive psychology, along with related assessment tools. The applied projects were designed to enhance the accuracy and effectiveness of cognition in contexts ranging from the workplace to police precincts.

(624)

Self-Generated Feedback and Strategy Change in Directed Forgetting Benefits. LILI SAHAKYAN, *Florida State University,* PETER F. DELANEY, *University of Florida,* & COLLEEN M. KELLEY, *Florida State University*—Our recent study on directed forgetting proposed that the benefits of directed forgetting result from participants in the forget condition employing more effective encoding strategies on List 2, as compared with the remember group participants (Sahakyan & Delaney, in press). We report two experiments showing that participants in the remember condition, given an opportunity to evaluate their own memory for List 1, subsequently remembered more from List 2. This improvement in performance was comparable to that observed in the forget group. In Experiment 1, feedback was prompted by having participants recall each list immediately following the encoding of each list. In Experiment 2, participants were asked to give a quick estimate of how many items from List 1 they would be able to recall at the end of the experiment. In both experiments, performance on List 2 in the remember group showed an improvement equivalent to that in the forget group.

(625)

The Role of Attention in the Hypercorrection Effect. BRADY BUTTERFIELD & JANET METCALFE, *Columbia University* (sponsored by Janet Metcalfe)—We investigated the role of attention in the *hypercorrection effect*—the finding that erroneous responses endorsed with high-confidence are more likely to be corrected at retest (Butterfield & Metcalfe, 2001). In two experiments, participants engaged in a tone-detection task as they gave responses to general information questions and rated their confidence in the accuracy of those responses. Feedback was given in green if it the response was correct, or in red if the response was an error. A surprise retest was given. We replicated the hypercorrection effect, since high-confidence errors were more likely to be corrected at retest than were low-confidence errors. Feedback to high-confidence errors also captured more attention (as measured by a decrement in tone detection performance) than did feedback to low-confidence errors. It is possible that the increased attention to the correction of high-confidence errors enhanced retest performance.

(626)

Metacognitively Controlled Spacing of Study. LISA K. SON, *Columbia University*—In the literature, it has been found that as the delay between repeated information is increased, later memory performance also increases (Glenberg, 1979; Hintzman, 1974; Melton, 1970; Underwood, 1970)—known as the spacing effect. These results suggest that people should space their study to some extent, in order to maximize learning. How people control their spacing strategies, using metacognitive judgments of learning (JOLs), was investigated. Participants were presented with cue–target pairs. After each pair was presented, JOLs were recorded. Then, participants were given a choice to study the pair again now (massed) or to study the pair again after the entire list had

been presented (spaced). Results showed that there was a systematic spacing strategy: The higher people's JOLs were, the more often they chose to space their study.

(627)

Global and Specific Strategies in Item Selection and Persistence During Study. NATE KORNELL & JANET METCALFE, *Columbia University* (sponsored by Peter Balsam)—In a free choice, nine-alternative study-time allocation experiment, people did not extensively use their metacognitive judgments about particular items when choosing items to study but did use this knowledge to guide their study persistence once an item was chosen. People initially relied on global (shallow) strategies, such as choosing words from the easy and medium columns more than from the difficult column and cycling through all the words in a consistent order. Once a word was selected for study, however, they appeared to monitor their level of learning to determine persistence, spending more time on the more difficult words. We suggest that the metacognitively shallow choices might have been effective in allowing participants to avoid wasting time making decisions. Instead, they could simply open the items without wasting cognitive effort and then engage the monitoring mechanism to determine study time.

(628)

Sunk Cost in Memory. PETRA SCHECK & JOHNNY HSU, *University of Maryland* (sponsored by Thomas O. Nelson)—In the decision-making literature, the *sunk costs* phenomenon is one in which resources continue to be allocated toward a goal that is no longer desirable or no longer attainable. This experiment was designed to explore whether a similar phenomenon exists in the field of learning and memory. Participants were asked to study a list of English noun–noun pairs, 40 of which were presented in an initial study phase. Judgments of learning (JOLs) were made for each item, after which participants were informed of the point value of the item (1 or 5 points) to be awarded if the item was correctly recalled at test. They were then asked to choose between allocating a second study trial to that item or studying a new item with an expected value of 3 points, with a goal of maximizing their score on the final recall test. *Sunk costs in memory* was operationalized as selecting for restudy items that were assigned a JOL of 0% and worth only 1 point. Results showed that a significant proportion of these items were selected for restudy, suggesting that learners do fall prey to sunk costs in memory.

• SELECTIVE ATTENTION •

(629)

Visual Marking: Old Items Can Be Prioritized for Search. SYBIL E. JONES, PAUL ATCHLEY, & LESA HOFFMAN, *University of Kansas*— In visual marking, a benefit is seen for searching through the newest set of items, owing to inhibition of old items or prioritization of the new items. In the present two experiments, we used a procedure to eliminate the prioritization of the new items, to determine whether observers could selectively search old items. A 230-msec blank screen was added between the 1,000-msec preview of the first set of items and the simultaneous reappearance of those items (in their original locations) with the abrupt onset of the new items. On separate blocks of trials, the target occurred at old locations either 50% or 100% of the time. Observers were more efficient detecting the presence of a target at an old location when it was completely predictable, indicating that (1) visual marking is not simply due to a prioritization of new items and (2) visual marking is subject to top-down control.

(630)

Inhibition of Return Interacts With S–R Probability: Evidence for Decision-Level Effects of IOR. JASON IVANOFF & RAYMOND M. KLEIN, *Dalhousie University* (sponsored by Raymond M. Klein)— Inhibition of return (IOR) refers to the slower response time to targets presented at a cued location, as compared with uncued targets. One long-standing issue concerns whether IOR is better conceptualized as attention's being inhibited from returning to the cued location or as an increase in the criterion for responding to cued targets. Klein (1994) found that S–R probability interacts with endogenous orienting of attention (the cuing effect was larger with the likely S–R pair than with the unlikely S–R pair), whereas it is additive with exogenous orienting. This pattern suggests that endogenous, but not exogenous, attention has effects at late, decision stages of processing. Here, we report that S–R probability interacts with IOR, showing a pattern like that seen with endogenous orienting. This finding, which suggests that IOR affects a late, decision stage of processing, provides converging evidence for a criterion-shift interpretation of the IOR effect (Klein & Taylor, 1994).

(631)

Motor Preparation and Perceptual Processing: A Potential Solution to an Existing Conflict. MARC GROSJEAN, *Max Planck Institute for Psychological Research,* & J. TOBY MORDKOFF, *Pennsylvania State University*—There is currently an existing conflict concerning how preparing a response is thought to specifically influence the perceptual processing of a stimulus that is consistent (i.e., shares attributes) with that response. Namely, under unspeeded (masked accuracy) conditions, accuracy consistency effects indicative of interference have been reported (e.g., Müsseler & Hommel, 1997), whereas under speeded conditions, response time (RT) consistency effects indicative of facilitation have been reported (e.g., Craighero, Fadiga, Rizzolatti, & Umiltà, 1999). In the present work, we replicate and extend these findings by showing that (1) these two types of effects can be obtained for the same group of participants and (2) both the size and the time course of these effects are independent. On the basis of these results, it is argued that the present and previously reported RT consistency effects are actually postperceptual in origin and, therefore, should not be considered as (motor–) perceptual effects.

(632)

Repetition Blindness: Bug or Feature? ALISON L. MORRIS, *Iowa State University,* & CATHERINE L. HARRIS, *Boston University*— Repetition blindness (RB) is thought to arise from a difficulty in tokenizing two separate occurrences of a visual event within a short time window (Kanwisher, 1987). Is RB best characterized as a bug in the visual system, or does it reflect the workings of a mechanism designed to direct attention to novel objects? Participants monitored brief simultaneous displays of 3–4 letters for a vowel target. Target detection was more accurate when the display contained repeated letters. In contrast, when no target was present, participants made more errors on trials with repeated letters, and correct responses were slower. These results are consistent with the idea that (1) attention is directed to novel objects prior to repeated objects and (2) repeated objects require more processing time for conscious perception.

(633)

Letter Probe Detection in Rapid Serial Visual Presentation: Not All Letters Are Created Equally. PAUL HAERICH, *Loma Linda University*—The attentional blink (AB) has been observed as the reduction of probe detection accuracy when the probe is presented within 500 msec of a previous to-be-identified target. In Experiment 1, this effect was replicated using standard stimulus parameters, including a 20-item stream of black letters with the target presented in white and the probe task being detection of the (black) letter X. The AB was almost completely attenuated in Experiments 2 and 3, which, using two different presentation rates, employed a probe task in which participants indicated which of two letters, H or S, appeared in the stream. Experiment 4, employing a speeded version of the 2AFC H/S task, demonstrated an AB-like attentional cost in RT, despite the lack of an AB itself. Experiment 5 demonstrated that even with the standard probe detection task, the AB is attenuated when the probe is H or S, as compared with X.

(634)

Quartering the Spotlight of Selective Attention. EDWARD K. VOGEL, *University of Oregon,* & STEVEN J. LUCK, *University of Iowa*—Can spatial attention be split to multiple noncontiguous locations? Some studies have found evidence for a unitary focus, whereas others have shown that attention can be split. One possibility for this discrepancy is that these studies may be examining different levels of selective attention. To test this, we compared the spatial distribution of attention in a working memory task with that in a perceptual task by using spatial precues that directed attention to either contiguous or noncontiguous locations. In the working memory task, performance was equivalent for both the contiguous and the noncontiguous cues, indicating that working memory level attention can be divided among noncontiguous locations with no cost. However, in the perceptual task, accuracy was significantly lower for noncontiguous cues than for contiguous cues, indicating that perceptual level attention cannot be easily divided among noncontiguous locations. These results indicate that the spatial properties of attention are different for perceptual tasks versus working memory tasks.

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Sitting and Waiting for the Target: A Strategy for Searching Dynamic Displays. CHRISTOPHER A. DICKINSON & GREGORY J. ZELINSKY, *SUNY, Stony Brook*—Contrary to Horowitz and Wolfe (1998), we present behavioral and modeling data to support the use of a "sit-and-wait" strategy in a dynamic search task. Relative to static search, observers searching dynamic displays tended to restrict their gaze to the display center, a strategy producing high miss rates for peripherally located targets. In modeling this strategy, we assumed that observers monitor a small number of locations surrounding fixation. The model input the observers' actual fixation positions and output an estimate of the number of items that would need to be monitored to produce the obtained error rates. We also used the model to obtain the optimal display positions in which to sit and wait for the target, then conducted another behavioral experiment that prepositioned fixation at these locations. Supporting a sit-and-wait search strategy, we found higher levels of accuracy at these optimal locations, as compared with fixation at the display center.

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Distractor-Feature Preview Effects in Visual Search. BRIAN A. GOOLSBY, MARCIA GRABOWECKY, & SATORU SUZUKI, *Northwestern University*—In a color-singleton search task, observers located an odd-colored target (e.g., a red diamond among greens) and discriminated its shape (whether the diamond was "chipped" on its left or right corner). Homogeneously colored arrays were randomly intermixed with the search trials and were passively viewed (30–600 msec). When the distractor color of a search trial was repeated from a prior passively viewed trial, search RT was speeded relative to the case in which the target color was repeated (OPAM, 2001; VSS, 2002). We proposed that this RT facilitation resulted from increased target salience owing to adaptation to the previewed color. This adaptation was not due to color energy or color contrast. Instead, it exhibited evidence of tuning for noncolor item features (e.g., shape, size, and configuration), indicating contextually modulated adaptation. In the present work, we extended this distractor-color preview effect to other temporal parameters (e.g., ITI) and features (e.g., motion direction).

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How Specific Are Attentional Control Settings For Motion? CHARLES L. FOLK, JESSICA HACKMAN, & DONNA BRADY, *Villanova University*—A growing body of research indicates that the ability of salient stimuli to capture spatial attention depends heavily on whether the stimulus matches goal-related, top-down attentional control settings. Previous work in the color domain suggests that attentional control settings are quite flexible, ranging from a set for color "singletons" in general to a set for specific feature properties, such as the color *red*. The present experiments explored the nature of attentional control settings in the motion domain. Using the contingent capture paradigm developed by Folk, Remington, and Johnston (1992), uninformative spatial cues defined by translational, rotational, or looming motion were crossed with targets defined by these same motion types. Evidence of contingent capture was obtained, but only when the task forced subjects to adopt control settings for specific motion types. The results provide converging evidence for the specificity and flexibility of attentional control.

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Positive and Negative Priming of Location and Categorical Information in RSVP Search. ERIC J. WILLETTE, SYBIL E. JONES, J. DEVIN LAND, ALICIA MacKAY, BINDI PAREKH, REBECCA STONE, IMAD UDDIN, & JAMES F. JUOLA, *University of Kansas*—Participants searched for a single red vowel in successive RSVP frames, each containing four black consonant distractors. On some trials, a special distractor was presented one or more frames before the one containing the red vowel target. These distractors were either a single red consonant, shown at any of the four letter positions, or a single black vowel, shown at the target's position. The special distractors thus provided either valid or invalid location information or valid or invalid identity information about the vowel target. As was expected, invalid information effected a cost in target vowel identification time, and valid information showed a benefit at short lags but a cost (negative priming) at longer lags before the target. The costs and benefit functions were remarkably similar for location and identity information.

• LETTER AND WORD PROCESSING •

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Multiple Constraints on Sino-Japanese Character Recognition: A Model of a First-Grade Japanese Reader. RICK DALE, *Cornell University,* & ROBERT NELSON, *Southern Illinois University, Carbondale* (sponsored by Michael E. Young)—We explored how different properties of Sino-Japanese characters, such as initial stroke sequence and global character shape, facilitate character recognition by Japanese and Chinese college students. Participants classified characters and pseudocharacters after being presented with a prime stimulus (either initial stroke sequence or global shape). Results reveal that both stroke sequence and global shape reduce reaction time when they prime the appropriate character. Given these results, we argue that integration of multiple sources of information governs recognition and present a neural network model of this process. We trained a simple recurrent network to read a corpus of 76 kanji characters (learned by first-grade children in Japan). Following training, network performance on recognition was measured on trials that followed a prime stimulus (either initial stroke sequence or global shape). Results indicate that recognition by the network model can be facilitated by both properties.

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Disyllabic Word Naming: A Large-Scale Study. MURIELE BRAND, ARNAUD REY, & RONALD PEEREMAN, *LEAD–CNRS,* & DANIEL H. SPIELER, *Georgia Institute of Technology* (sponsored by Arnaud Rey)—Recent studies have reported item level performance by asking a group of participants to read aloud a large number of words (e.g., Spieler & Balota, 1997). These item databases have been used to evaluate computational models of reading and to determine which psycholinguistic factors are the best predictors of item performance. These studies were restricted to English monosyllabic words. The present work is an extension of the large-scale study approach and addresses the issue of disyllabic word naming, in both French and English. Naming latencies of 600 disyllabic words were collected from 100 participants for each language. Various psycholinguistic factors were used to predict item level performance. The results provide strong empirical constraints to construct computational models of polysyllabic word processing.

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Morphological Decomposition in Hebrew: Converging Evidence From Masked Priming and Parafoveal Preview Benefit. AVITAL DEUTSCH & RAM FROST, *Hebrew University of Jerusalem,* & ALEXANDER POLLATSEK & KEITH RAYNER, *University of Massachusetts*—Previous studies in Hebrew, using the masked priming paradigm for single-word recognition, revealed that complex words are automatically decomposed into their derivational morphemes: the root and the verbal pattern. On the basis of these results, a model of lexical organization and lexical access in Hebrew was offered, in which subword morphological units, such as roots and verbal patterns, mediate early stages of word recognition. The ecological validity of this model was probed by measuring the benefit of a parafoveal preview of a morphemically related word to a morphologically complex word during the reading of Hebrew sentences. Since the obtained results are similar to earlier results obtained in masked priming, they suggest that masked priming and parafoveal preview presentation tap similar cognitive processes in word recognition and support the claim that early morphological decomposition of Hebrew words occurs while coherent text is read.

(642)

Familiarity, Semantic Priming, and the Multistability of Pseudohomophone Perception. DAVID V. BECKER, STEPHEN D. GOLDINGER, & GREGORY O. STONE, *Arizona State University*—Two experiments examined associative priming of words and pseudohomophones of those words in lexical decision. In addition to frequency effects for words, reliable base-word frequency effects were observed for pseudohomophones: Those based on higher frequency words elicited faster and more accurate correct rejections. Associative priming had distinct effects on high- and low-frequency items. Whereas priming improved performance to high-frequency pseudohomophones, it impaired performance to low-frequency pseudohomophones. (All words showed priming benefits.) The results suggest a resonance process, wherein phonologic identity and semantic priming combine to undermine the veridical perception of infrequent items. This was tested in a third experiment by administering a surprise recognition memory test after lexical decision. When asked to identify words that were spelled correctly during lexical decision, participants most often misremembered low-frequency pseudohomophones as correctly spelled items. Taken together, the results suggest multistability in word recognition, wherein bottom-up and top-down information sources coalesce into correct, and sometimes illusory, perception.

(643)

Grammatical Context Effects in Automatic Priming. JASON M. SULLIVAN, *University of Illinois, Urbana-Champaign* (sponsored by Gary S. Dell)—Automatic priming effects can arise from both associative prime–target relations (PHANTOM–OPERA) and semantic similarity (CONCERT–|OPERA), although it is unclear whether associative priming results only from strategic processes in the absence of any semantic similarity (e.g., Shelton & Martin, 1992). Similarity priming, by all accounts, should be unaffected by grammatical context, as long as stimulus onset asynchrony (SOA) remains within the temporal window in which automatic processes dominate (<250 msec). Associative priming, however, depends on linear word order and represents predictions from the activation of one lexical item to likely subsequent items. Grammar makes similar predictions (determiners are always followed by nouns or adjectives, rarely by verbs). In the present experiments, lexical decision times for associative targets were affected by grammatical context in the 250-msec SOA condition, whereas pure similarity priming was not. The results support dissociable automatic processes underlying the two types of priming.

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Effects of Neighborhood Size Across Subsyllabic Units in Lexical Decision. MELVIN J.-M. YAP & SUSAN J. RICKARD LIOW, *National University of Singapore*—Consistency and neighborhood size exhibit different effects across paradigms. For naming tasks, consistent words are typically named faster than inconsistent words, whereas words with large neighborhood sizes usually show an advantage in lexical decision. As a rule, consistency and neighborhood size are both computed with respect to the orthographic rime, but Treiman et al.'s (1995) database allowed us to look simultaneously at the processing of rimes and other subsyllabic units. We examined consistency and neighborhood size effects in lexical decision across five types of word segment (C1, C1V, V, VC2, and C2). Regression analyses (with 81 participants and over 900 words) established that decision latencies are predicted from C1 (onset), C1V (oncleus), and VC2 (rime) neighborhood size, but there were no effects of neighborhood consistency for any of the subsyllabic units. The implications of these findings are discussed with reference to extant models of word recognition.

(645)

Dreaming About Semantics in False Recall: The Influence of Lexical Associative Information. KEITH A. HUTCHISON & DAVID A. BALOTA, *Washington University*—Veridical and false recall were examined in lists that contained 12 words that all converged onto the same meaning of a critical nonpresented word (e.g., SNOOZE, WAKE, BED, SLUMBER . . . for SLEEP) and lists that contained 6 words that converged onto one meaning and 6 words that converged onto a different meaning of a homograph (e.g., STUMBLE, SEASON, TRIP, AUTUMN . . . for FALL). Associative strength from the list items to the critical item was equated across the two types of lists. The results indicated that the likelihood of recalling the critical item did not differ across the two types of lists. This pattern occurred regardless of whether the words diverging onto the two meanings of the homograph were presented blocked or intermixed and also whether each list item was presented for 200 or 1,200 msec during encoding. These results suggest that false recall in the DRM paradigm largely reflects lexical/associative activation, rather than the formation of a semantic gist-based representation.

(646)

Individual Differences in Working Memory and Vocabulary Acquisition in Reading. RIHANA S. WILLIAMS & ROBIN K. MORRIS, *University of South Carolina*—Recent reports have demonstrated that skilled readers are able to acquire the meaning of an unfamiliar word from the context in which it occurs. This experiment examined the effect of individual differences in working memory, as assessed by the reading span task, on this process. Readers' eye movements were monitored as they read pairs of sentences that contained a high familiar (*violin*), a low familiar (*lute*), or a novel (*asdor*) target word. Readers' initial processing of the target, processing of informative context, and inference of word meaning were assessed. In addition, memory for the target word and quality of the meaning representation were evaluated with vocabulary tests administered after the reading session was completed. Individual differences in working memory had little effect on initial encoding processes. Effects of working memory emerged in measures of text integration and comprehension.

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Evidence for a General Relationship Between Task Difficulty and the Size of Individual Differences in Response Times. JING CHEN, *Grand Valley State University,* & SANDRA HALE & JOEL MYERSON, *Washington University*—Participants ($n = 103$) performed three speeded verbal tasks (lexical decision, category judgment, and rhyme judgment) and three speeded visuospatial tasks (shape judgment, visual search, and abstract matching). Each task included three experimental conditions. Principal component analysis of the RTs revealed a two-factor solution: The first, general speed component accounted for 54% of the variance, and a second, bipolar component (whose loadings mapped onto the verbal vs. visuospatial distinction) accounted for an additional 12% of the variance. In addition, there was a strong linear relationship between mean RT and *SD* at the group level (slope = 0.373; intercept = -138 msec; $r^2 = .961$). Tests for separate regressions failed to reveal any difference either between the slopes or between the intercepts for verbal and visuospatial tasks. Taken together, these

findings support the predictions of the difference engine (Myerson et al., in press), a mathematical model of diversity in speeded performance.

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The Effects of Semantic Distance in Word Naming. PAUL D. SIAK-ALUK, *University of Alberta,* LORI BUCHANAN, *University of Windsor,* & CHRIS WESTBURY, *University of Alberta*—The effects of semantic distance have been observed in lexical decision and semantic categorization (Siakaluk, Buchanan, & Westbury, 2001). In the present study, the effects of semantic distance were examined in two word-naming conditions. In a pure condition, the critical items, which were all regular and consistent in their orthographic-to-phonological properties, were presented alone. In a mixed condition, the identical items were intermixed with irregular and inconsistent items. Two interesting findings were observed. First, responses to the critical items were slower in the mixed condition than in the pure condition. Second, there was a semantic distance × condition interaction, in that a semantic distance effect was observed in only the mixed condition. These findings, in addition to those of Siakaluk et al. (2001), demonstrate that semantic distance exerts larger effects in conditions requiring more extensive processing. Implications of these findings for visual word recognition are discussed.

• PSYCHOLINGUISTICS •

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Contextual Bias and Hyperinhibition in Mild Cognitive Impairment. JULIET DAVIE & TAMIKO AZUMA, *Arizona State University,* DONALD J. CONNOR, MARWAN N. SABBAGH, & NINA B. SILVERBERG, *Sun Health Research Institute,* & STEPHEN D. GOLDINGER, *Arizona State University*—In mild cognitive impairment (MCI), memory is often impaired in a manner similar to that observed in early Alzheimer's disease, while other cognitive functions remain intact. The present study evaluated the ability of young adults, older adults, and individuals with MCI to utilize strategic processing in a relatedness decision task. The proportion of category–exemplar pairs (*banana–fruit*) to coordinate pairs (*nickel–penny*), or CP, of the stimulus set was varied to induce a strategic expectancy bias. It was expected that healthy controls would demonstrate facilitated priming for category–exemplar pairs when the CP was high and for coordinate pairs when the CP was low. All groups showed a significant inhibitory priming effect for coordinate pairs when the CP was high. MCI participants showed a much larger inhibitory priming effect than did the other groups. This pattern could be attributed to the effects of expectancy bias and possible lexical retrieval deficits in MCI.

(650)

The Dissociation of Input and Output Orthographic Lexicons. DENISE H. WU & RANDI C. MARTIN, *Rice University*—Evidence from brain-damaged subjects suggests that there are separate input and output orthographic lexicons involved in reading and spelling, respectively. We investigated this hypothesis with normal subjects, using a repetition priming paradigm. Undergraduates performed tasks involving either input orthographic processing (i.e., lexical decision and word naming) or output orthographic processing (letter search, writing, and typing). Priming between different tasks was assessed. When an input task was the test task, performance was facilitated by prior exposure to the word in other input tasks (word naming and lexical decision), but not from exposure in output tasks (letter search and writing). When an output task was the test task, results differed, depending on the output task. Letter search and writing were primed following output tasks but not input tasks, but typing was primed by all input and output tasks. The results support a model of separate but linked input and output orthographic lexicons.

(651)

Experiments on Picture–Multiple-Word Interference. RASHA ABDEL RAHMAN & ALISSA MELINGER, *Max Planck Institute for Psycholinguistics* (sponsored by Werner Sommer)—In a modified version of the picture–word interference paradigm we examined whether transmission of information between lexical items (lemmas) and word forms is discrete or continuous. If transmission is discrete phonological processing can begin only after lemma selection and is therefore restricted to the selected lemma. If transmission is continuous, phonological processing begins on the basis of partial information and is not restricted to the selected lemma. So far, evidence for phonological co-activation has been obtained only for extreme semantic relations (e.g., SOFA and COUCH), but not for simple competitors (e.g., SOFA and CHAIR) or semantic associates (e.g., MOUSE and CHEESE). In three experiments, we presented pictures with multiple distractor words that were phonologically related to the picture name, a semantic competitor, or a semantic associate or were unrelated. Results suggest that multiple distractor words boost the typical picture–word interference effects and provide a tool for examining phonological co-activation in picture naming.

(652)

Effects of Global Context on the Interpretation of Adjective–Noun Combinations. STEVEN FRISSON, *University of Massachusetts, Amherst,* MARTIN J. PICKERING, *University of Edinburgh,* & BRIAN McELREE, *New York University*—Many adjective–noun modifications involve simple predicate conjunctions in which the denotation of the adjective is intersected with the denotation of the noun (*strong fireman*). This interpretation is called intersective. However, the interpretation of a large subset of adjective–noun combinations cannot be described by this simple rule (*strong applicant*). Their preferred interpretation involves picking out a subset of a set denoted by the noun and is therefore called subsective. Using eye-tracking, we studied whether contextual information determines interpretation or whether the preferred interpretation is computed first and then overridden by context. Unambiguous intersective predicate conjunctions were contrasted with ambiguous adjective–noun modifications that have a preferred subsective interpretation. Preceding context biased the ambiguous conjunction toward the preferred subsective or the dispreferred intersective interpretation. The results showed early processing difficulties only for the dispreferred intersective. This suggests that even a strong biasing context could not override the computation of the preferred subsective interpretation.

(653)

A Simulation of the Activation-Selection Model of Meaning. DAVID S. GORFEIN, *University of Texas, Arlington,* & VINCENT R. BROWN, *Hofstra University*—The activation-selection model of determining the meaning of an ambiguous word or phrase (Gorfein, 2001) is unique in that it does not require an explicit mechanism for suppressing the representation of the nonselected meaning. The model assumes that a meaning is selected when a threshold number of attributes associated with that particular meaning are activated. The interpretation of ambiguous words is directed by the *set principle*, which states that processing an ambiguous word in the context of currently active attributes will influence the meaning of the word toward the meaning most strongly associated with the currently active attributes. This provides a mechanism by which meaning selection at one time can affect meaning selection at a later time. Computer simulations of the activation-selection model demonstrate the viability of the approach in helping understand both short- and long-term effects of prior meaning selection on the selection of meaning in a new context.

(654)

Orientational Metaphors and the Use of Controls. WILLIAM LANGSTON, *Middle Tennessee State University,* & JEFF KUBAN, *University of Illinois*—Will users' interactions with a device be influenced by orientational metaphors? In the first experiment, participants were asked to use controls on a box to indicate more or less (using an up–down or left–right control) and earlier or later (using a front–back or left–right control). For more–less, participants were very consistent in their choices, and they were consistent with Lakoff and Johnson's (1980)

more-is-up metaphor. Users were less consistent in their choices for earlier–later. Experiment 2 demonstrated that the results were not affected by having participants actually touch the controls to make their judgments. For Experiment 3, participants used alarm clocks and radios to make their judgments. The results were consistent with the previous two experiments. Interestingly, participants' choices were different from the way the controls actually operated on the devices. The results are discussed in terms of metaphor and embodiment.

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Tracking Speakers' Use of Internal and External Information During Referential Communication. WILLIAM S. HORTON, CHARLES A. METZING, & RICHARD J. GERRIG, *SUNY, Stony Brook*—What sources of information constrain the referring expressions that speakers produce? Previous research has shown that speakers can use knowledge about their conversational partners to shape referring expressions. What is unknown is how such partner-specific information interacts with information available to speakers in their visual environment. To address this question, we monitored the eye movements of speakers as they carried out a referential communication task either with a single addressee or with two addressees who switched off halfway through the experiment. Speakers repeatedly described arrays of picture cards that contained multiple cards of the same type in early rounds but only unique cards in later rounds. Of particular interest was to degree to which speakers carried out a visual survey of possible competitor objects after this change in referential context. Through our analysis, we demonstrate a trade-off between internal (knowledge of the partner) and external (visual) cues in language production.

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The Production and Use of Eye Gaze During Referring. JOY E. HANNA & SUSAN E. BRENNAN, *SUNY, Stony Brook*—Studies of conversation typically prevent visual contact between interlocutors. However, eye gaze is an important source of information in face-to-face conversation. Previous research indicates that eye movements to objects often accompany reference production. Can addressees use eye gaze as a cue during reference resolution? We monitored interlocutors' eye movements in a referential communication task. Speakers and addressees could see each other over a barrier, which hid their horizontal displays. The speaker's display was either informative, a mirror image of the addressee's, or noninformative, a circular rather than horizontal arrangement. Speakers' object descriptions were accompanied by eye movements to the target, which was next to or far away from a competitor. Of interest was the degree to which eye movements in informative displays speeded addressees' target identification when the competitor was far away. Our analyses explore the coordination of mutual and object-oriented gaze, and the degree to which addressees can use this visual cue.

• LANGUAGE PRODUCTION/WRITING •

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Frequency and Aging Effects on Naming Pictures of Homophones. GABRIELLE L. OSBORNE, *Claremont Graduate University*, & DEBORAH M. BURKE, *Pomona College*—When homophones (e.g., *nun*) are produced, does production latency reflect the combined frequency of all homophones (e.g., *nun* plus *none*), or the frequency of only the relevant word (e.g., *nun*)? The answer to this question has important implications for models of word production, but the answer is disputed. Jescheniak and Levelt (1994) reported homophone production latencies compatible with combined frequency, but Caramazza, Costa, Miozzo, and Bi (2001) reported homophone picture naming latencies compatible with frequency of only the relevant word. We measured young and older adults' naming latencies for pictures of homophones and for control pictures of objects matched to either the combined homophone frequency or the relevant word frequency. Homophone picture-naming latency matched the combined frequency control, and both were faster than the relevant word control latency. This suggests that

homophones share sublexical phonological representations. The contribution of practice and picture–name agreement to diverging results is discussed.

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Sentence Production and Working Memory in Older Adults. LORI J. ALTMANN & SUSAN KEMPER, *University of Kansas*—There is some controversy over whether language tasks require the same type of working memory (WM) as that measured by typical span tasks, owing to equivocal findings in comparisons of language comprehension abilities and typical WM span tasks (Caplan & Waters, 1999). The present study asked whether a different language task, sentence production, partakes of the same WM ability as that measured by these span tasks. We compared the speed and accuracy of sentence production in groups of older adults with higher, average, and lower WM ability. Higher and lower WM participants differed significantly in both speed and accuracy of production. Participants with average WM showed a speed–accuracy tradeoff: Their accuracy was similar to that of the higher WM group, but their speed of response was similar to that of the lower WM group. These findings suggest that WM as measured by typical span tasks may be a crucial resource for accurate, timely sentence production.

(659)

Contextual and Cognitive Factors in the Asymmetry of Verbal Irony Production. JEFFREY T. HANCOCK, *Cornell University*, & PHILIP J. DUNHAM, *Dalhousie University*—Previous research indicates that ironic criticisms are more readily understood and are produced more frequently than ironic compliments. Both contextual factors (i.e., a speaker's expectations and verbal politeness objectives) and cognitive factors (i.e., the cognitive constraints associated with negation) have been hypothesized to underlie this *asymmetry of affect*. The present study employed a novel procedure to control contextual factors by forcing participants to discuss positive and negative conversational stimuli either ironically or literally, in an effort to isolate the role of cognitive factors in the asymmetry. The results revealed that forced irony production was symmetrical in (1) absolute frequency, (2) rates of production, and (3) time required to produce an utterance, suggesting that cognitive constraints do not play a role in the asymmetry. A comparison across ironic and literal conditions, however, indicated that ironic utterances contain more adverbs and adjectives than do literal utterances, suggesting that the syntactic structure of irony is modified relative to literal statements.

(660)

Unconscious Plagiarism in a Generative Linguistic Task. KAREN A. HUSSEY & ALBERT N. KATZ, *University of Western Ontario* (sponsored by Albert N. Katz)—Marsh, Ward, and Landau (1999) demonstrated that participants asked to create novel words to replace English nouns use elements of nonword examples they are given, even when instructed to avoid use of the examples. In two experiments, we replicated the effect of this *unconscious plagiarism* and, moreover, found that we could increase the proportion of plagiarism by adding the constraint of memory load, particularly when the English words are presented in category groupings. It is proposed that the presence of the nonword examples, presented in groups with the same word rules, creates a syntactic category used unconsciously by participants in the word creation task. These findings suggest both external and internal pressures on inadequate source monitoring in generative cognition tasks.

(661)

Effects of Native Language on Bilinguals' Formation of English Comparative Adjectives. BRIAN M. FRIEL & RICHARD J. HARRIS, *Kansas State University*, & SHELIA M. KENNISON, *Oklahoma State University*—Aspects of one's native language can intrude on second-language use, even for highly fluent bilinguals. The present study examined the formation of English comparative adjectives. In English, comparatives are sometimes formed by adding the suffix *-er* (*happier,*

older) and sometimes by adding the adverb *more* (*more upset, more intense*). Which morphological form is preferable is not always clear but is heavily influenced by the etymology of the adjective, with Germanic forms using *-er* and Romance forms using *more*. The present study asked German–English and Spanish–English bilinguals to select the preferred comparative form (*-er* or *more*) for 36 English adjectives previously normed to cover a range of relative native-speaker preference for the *-er* and *more* forms. Results showed that, compared with control English monolinguals, German speakers more often preferred English comparatives with *-er* and Spanish speakers those with *more*, thus both showing the influence of their native language.

(662)
Working Memory in Written Sentence Production. RONALD T. KELLOGG, *Saint Louis University,* THIERRY OLIVE, *University of Paris VIII and CNRS,* & ANNIE PIOLAT, *University of Provence*—During written sentence production, semantic content is planned and then grammatically encoded. Verbal working memory may enable these required computations by temporarily storing word representations. By contrast, visual working memory may be needed only when the semantic content activates imaginal as well as prepositional codes. College students ($N = 60$) wrote in longhand definitions of either concrete or abstract nouns, while currently performing a task demanding either visual or verbal working memory. We predicted that defining both concrete and abstract nouns would disrupt the verbal task but that only concrete nouns would disrupt the visual task. The definitions were richer in detail for the concrete words, suggesting that imagery was involved, as compared with the abstract words. As was predicted, only these image-evoking words slowed reaction times on the visual working memory task, as compared with baseline, control measurements. Both high- and low-imagery words interfered equally with the verbal working memory task.

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Verb Generation: Component Processes and Cerebral Asymmetries. CHRISTINE CHIARELLO, *University of California, Riverside,* STELLA LIU, *University of Pennsylvania,* & CONNIE SHEARS, NATALIE KACINIK, CATHY ROBINSON, & LAURA HALDERMAN, *University of California, Riverside*—Verb generation (producing a semantically related verb from a concrete noun stimulus) is one of the most frequently used tasks in fMRI investigations, yet there is very little behavioral research to inform our understanding of the psycholinguistic processes involved. We examined variations in cerebral asymmetries to tease apart component processes involved in verb generation. In all experiments, concrete nouns were presented to the left or right visual fields. Subjects responded to each stimulus by generating a verb, producing a free association or a category name, generating a rhyming word, or pronouncing the stimulus (immediately or after a delay). Across experiments, we were able to investigate the roles of number of competing responses, response repetition, constrained versus unconstrained retrieval, and priming of potential responses. The results suggest bilateral competence in some aspects of semantic retrieval and imply a heretofore unsuspected role for the right hemisphere in semantically guided word production.

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Production of Subject–Verb Agreement in Second-Language Learners and Proficient Bilinguals. NORIKO HOSHINO, PAOLA DUSSIAS, & JUDITH F. KROLL, *Pennsylvania State University*—The present study examines the way in which English–Spanish speakers access grammatical and semantic information when computing subject–verb agreement in each of their languages. Cross-linguistic research suggests that native speakers of English and Spanish utilize different strategies to produce subject–verb agreement, with Spanish speakers sensitive to the conceptual representation of the subject of the sentence and English speakers more sensitive to syntactic variables. What happens when an individual acquires some degree of proficiency in both languages? In this study, we tested the hypothesis that more proficient

Spanish speakers will use the conceptually mediated strategy in both languages, whereas less proficient speakers will use a syntactic strategy in both languages. Individual difference measures on reading span and verbal fluency were assessed in English, the participants' native language, to see whether the flexible use of language-processing strategies depends on available cognitive resources.

(665)
Lexical Bias and Feedback in Language Production. KARIN R. HUMPHREYS, *University of Illinois, Urbana-Champaign* (sponsored by Kathryn Bock)—Lexical bias is the tendency for phonological speech errors to be more likely when the outcomes form words rather than nonwords. This can be accounted for either by feedback from phonological to lexical levels or, in models that prohibit feedback, by an editor that prevents nonword utterances. The lexical bias effect was shown in experimentally elicited phoneme exchanges to be asymmetrical, because the first word of an error showed a greater lexical bias than did the second. This is not predicted a priori by an editor but is predicted by feedback, with the additional assumption (which was also experimentally supported) that the second part of an exchange is a default error. Finally, consistent with feedback, the lexical bias effect was shown even in a context of nonword stimuli, contra the original editor study of Baars, Motley, and MacKay (1975).

(666)
Formulating *wh*-Questions. DOUGLAS J. DAVIDSON, *University of Illinois, Urbana-Champaign* (sponsored by Susan M. Garnsey)—Existing research has shown that speakers fixate objects shortly before producing referring expressions in picture description tasks. However, *wh*-questions involve the production of pronouns rather than full referring expressions and also involve dependencies across a sentence. In this study, participants heard scene descriptions and saw simple scenes in a matching task. Participants questioned the description with an agent or a patient question if the description mismatched the scene, or repeated the description if it matched. Within 1 sec of display onset, there were more fixations to agents for agent questions, as compared with patient questions, and conversely, more fixations to patients for patient questions. Likewise, relative to speech onset, there were earlier peaks in the fixation distributions to agents and patients for the corresponding question types. These results suggest that a close linkage between eye and voice can be observed during the formulation of *wh*-questions.

• CATEGORIZATION •

(667)
Inferring Unobserved Category Features With Causal Knowledge. BOB REHDER, *New York University,* & RUSSELL C. BURNETT, *Northwestern University*—One central function of categories is to allow people to infer the presence of features that cannot be directly observed. Although the effect of observing past category members on such inferences has been considered, the effect of theoretical or causal knowledge about the category has not. We compared the effects of causal laws on feature prediction with the effects of the interfeature correlations that are produced by those laws and with the effect of exemplar typicality or similarity. Feature predictions were strongly influenced by causal knowledge. However, they were also influenced by similarity, in violation of normative behavior as defined by a Bayesian network view of causal reasoning. Finally, feature predictions were not influenced by the presence of correlations among features in observed category members, indicating that causal relations versus correlations lead to different inferences regarding the presence of unobserved features.

(668)
Biasing in Categorization: The Importance of the Familiarity of Feature Manifestations. SAMUEL HANNAH & LEE R. BROOKS, *McMaster University* (sponsored by Lee R. Brooks)—Several studies have shown that the diagnoses made by medical personnel are susceptible to suggestions about possible diagnoses (Leblanc et al., 2000). The

present experiments show that this biasing effect is not dependent on the complexity and ambiguity of medical stimuli or on the extensive training acquired in medical school. Using a small number of simple, artificial categories, we were able to show that the effect can emerge with less than an hour of training on stimuli consisting of features that are not individually ambiguous. We showed that the effect is sensitive to the perceptual similarity between individual features of test items and individual features of training items and to overall similarity between training and test items, and is weakly sensitive to the presence of a taxonomic organization structuring the categories. In all of these experiments, the effects of feature familiarity was assessed against the effect of features that had the same informational value.

(669)

Are Odor Categories Organized Around Perceptual Prototypes? KRYSTEL CHREA, DOMINIQUE VALENTIN, CECILE BOURRY, & RENAULT BROCHARD, *University of Bourgogne*, & HERVÉ ABDI, *University of Texas, Dallas*—We investigated the hypothesis that odors are structured in categories around perceptually salient prototypes. We used two categories: fruits and flowers. In Experiment 1, we asked a first group of participants to perform a speeded categorical decision task. In Experiment 2, a second group of participants evaluated the similarity of pairs of odors of fruits and pairs of odors of flowers. In Experiment 3, a third group of participants rated the typicality of all odors for fruit and flower categories. Results showed that some smells seem to be more typical and, therefore, are categorized better and faster in the right category and are closer to all other members of the category. Also, interestingly, similarity alone predicts reaction times.

(670)

Category Learning and Recognition When Instances Do Not Repeat. MARK BLAIR, DON HOMA, & LAMISTA JOHNSON, *Arizona State University*—The learnability of ill-defined categories, where instances were either repeated or not, was investigated. The learning sets contained instances derived from different prototypes, where the patterns either were repeated (repeating) or were novel (nonrepeating) in each block. A replication with different prototypes was used in Experiment 2, with learning followed by a classification or recognition transfer test. Our expectation that learning would be severely retarded in the nonrepeating condition was not supported—in each experiment, learning rates were slightly, but not significantly, better in the nonrepeating conditions. Furthermore, classification of novel instances on the transfer test was superior in the nonrepeating conditions (Experiments 1 and 2). On the recognition test (Experiment 2), a d' analysis for the nonrepeating condition revealed that subjects had little specific memory for the training instances, with similar hit and false alarm rates for the category members. These results have interesting implications for models of classification.

(671)

A Model of Prototype and Exemplar Learning. JOHN P. MINDA, *Beckman Institute, University of Illinois*—Categorization has often been described by models that assume that people represent categories either as prototypes or as exemplars. Recent research has challenged single-system prototype and exemplar models and has suggested that both processes operate during category learning. The present research introduces a new model that learns prototype and exemplar information. Prototypes can accumulate quickly, since successive exemplars can reinforce the same prototype. As a result, the system can make prototype-based decisions early in learning. Specific exemplars accumulate more slowly and exert most of their influence later in learning. Several simulations are described that illustrate how the model can predict early prototype effects, late exemplar effects, category size effects, and category structure effects. Thus, this model not only provides a reasonable account for data that could previously be accounted for by two separate models, but also makes testable predictions about when each representation is most influential in categorization.

(672)

Possible Predictors of Performance and Generalization Within an Implicit Categorization Task. KRISTIN CHRISTY, MARK D. HAMMERLY, JOHN L. PARKER, ROBIN D. THOMAS, MELISSA A. LEA, & KATE KARELINA, *Miami University*—This study explores generalization within an implicit categorization task and its relation to measures of cognitive style. All participants completed several inventories of cognitive style (field independence/dependence, impulsivity/reflexivity, visual/verbal, etc.). One group trained on an information integration categorization task, whereas a control group performed a dimensional judgment task using the same stimuli. Both groups performed another information integration task that used a different set of stimuli; however, the task had the same underlying category structure as did the training task of the experimental group. It was found that some measures of participants' cognitive style were related to categorization accuracy in the training task and that these participants tended to learn the transfer task faster.

(673)

Verifying Properties From Different Modalities for Concepts Produces Switching Costs. DIANE PECHER, *Erasmus University, Rotterdam,* RENÉ ZEELENBERG, *Indiana University,* & LAWRENCE W. BARSALOU, *Emory University*—According to Barsalou (1999), conceptual representations consist of perceptual symbols. Perceptual symbols are records of the neural states that underlie perception. The neural systems that are used in perception are also used for conceptual knowledge. Perceptual symbols can have any aspect of perceived experience, such as vision, audition, touch, smell, taste, and proprioception. In perception, there is a cost associated to modality shifts. We investigated whether this also holds for conceptual representations. In a property verification task in which all stimuli were words, a critical trial (e.g., *eggplant–purple*) was preceded by a trial in the same modality (*gemstone–glittering*) or a different modality (*marble–cool*). The results showed that responses were slower after a modality shift. These results provide evidence for embodied theories of cognition.

(674)

Prior Knowledge and Category Structure in Unsupervised Learning. JOHN P. CLAPPER, *California State University, San Bernardino*—This experiment explored the role of prior knowledge in unsupervised category learning. A *study time* paradigm was used to track unsupervised learning as participants viewed a series of unlabeled training instances (descriptions of fictitious persons) from two categories. In the *consistent* condition, the correlated features that defined the categories were consistent with a familiar real-world distinction (e.g., young vs. old), whereas in the *neutral* condition, the categories were defined by correlated features neutral with respect to such distinctions. The categories were learned rapidly in the *consistent* condition, but no significant learning occurred in the *neutral* condition. Learning the categories caused people to focus more on the idiosyncratic, noncorrelated features of individual instances and less on their predictable correlated features, resulting in better memory for both. Thus, prior knowledge aided unsupervised learning by facilitating the discovery of separate categories, as well as by enhancing memory for individual instances within those categories.

(675)

Force Vectors and Causal Relations. PHILLIP WOLFF & DEREK WONG, *University of Memphis*—This research proposes a new model of causal meaning, the vector model, which formalizes a model of causation based on Talmy's (1988) notions of force dynamics. In the vector model, the concepts of *cause*, *enable*, and *prevent* are distinguished from one another in terms of force vectors, their resultant, and the relationship of each force vector to a goal vector. The predictions of the model were tested in a series of experiments in which participants saw realistic 3-D animations of an inflatable boat moving through a pool of water. The boat's movements were completely determined by the force vectors entered into a physics simulator. Participants' linguistic descriptions of the animations were closely matched by those predicted

by the model and its computer implementation, given the same force vectors as those used to produce the animations. The model also has implications for the induction of causal relations from a single instance.

(676)

Inductive Reasoning With Familiar Properties. SERGEY V. BLOK & DOUGLAS L. MEDIN, *Northwestern University,* & DANIEL N. OSHERSON, *Rice University* (sponsored by Douglas L. Medin)— Current models of induction employ the similarity between premise and conclusion categories as a main predictor of inductive judgments (e.g., Osherson et al., 1990; Sloman, 1993). These similarity-based approaches predict several reasoning phenomena that have been robust when tested under conditions in which the properties to be reasoned about are unfamiliar (e.g., novel enzymes or diseases). However, recent studies with college adults, as well as with cross-cultural and expert populations, have shown that when richer property information is brought to bear on the reasoning task, inductive judgments are poorly predicted by premise– conclusion similarity (Medin et al., 1997; Smith et al., 1993). We describe and test a model of induction with familiar properties on the basis of informativeness of premise statements. The model exhibits a good quantitative fit to a variety of task structures, including reasoning from single and multiple premises, reasoning about specific and general conclusions and reasoning from positive and negative evidence.

• ANIMAL LEARNING AND COGNITION •

(677)

Memory for Empty and Filled Time Intervals in Pigeons. DOUGLAS S. GRANT & DIANE C. TALARICO, *University of Alberta*— Pigeons were trained with 2- and 8-sec samples that were either empty (dark) or filled by keylight. In both groups, intervals were bounded by 1-sec start and stop signals presented on the pecking keys. During retention testing, a robust choose-long effect was obtained with empty intervals and a moderate choose-short effect was obtained with filled intervals. Manipulation of sample duration and start- and stop-signal duration provided evidence that animals trained with filled intervals, but not those trained with empty intervals, incorporated the duration of the start and stop signals into the sample durations. It was concluded that use of start and stop signals with filled intervals may reduce the magnitude of the choose-short effect.

(678)

An Investigation of a Conditional Discrimination With Memory and Ordinal Position Cues. RICHARD A. BURNS, BRIAN A. HARRIS, & SARAH E. WRIGHT, *Southeast Missouri State University*—Rats were runway trained on three series of reward events that required the use of specific reward memories, but not ordinal position cues. In a different runway, the animals received training with series that required the use of ordinal position cues, but not reward memories. Position cues overshadowed reward memory and prevented the development of a conditional discrimination. There followed training with only reward memory until appropriate discrimination developed. A return to the conditional discrimination procedure then produced blocking of learning with position cues by reward memory.

(679)

Arousal, Changeover Rate, and Preference in Concurrent Schedules. MARGARET A. McDEVITT, *McDaniel College,* & BEN A. WILLIAMS, *University of California, San Diego*—Pigeons were trained on multiple schedules that provided concurrent reinforcement in each of two components. In one component, a variable-interval (VI) 40-sec schedule was presented with a VI 20-sec schedule. In the second component, a VI 40-sec schedule was presented with a VI 80-sec schedule. After extended training, probe tests measured preference between the stimuli associated with the two 40-sec schedules. In Experiment 1, probe tests replicated the results of Belke (1992), which showed preference for the 40-sec schedule that had been paired with the 80-sec schedule. In Experiment 2, the overall rate of reinforcement provided

by the two components was equated by adding a signaled VI schedule to the component with the lower rate of reinforcement. Probe results were unchanged, challenging the notion that preference was due to differential changeover patterns produced by differences in the overall rates of reinforcement provided in the two choice contexts.

(680)

US Preexposure Effect on Taste Avoidance Caused by Voluntary Wheel Running. SADAHIKO NAKAJIMA, *Kwansei Gakuin University*—Confinement of a rat in a running wheel yields the rat's subsequent avoidance of the taste consumed before the confinement. An account of this relatively new finding is that voluntary wheel running works as an unconditioned stimulus (US) for establishing taste aversion (Lett & Grant, 1996). In a series of experiments (Hayashi, Nakajima, Urushihara, & Imada, in press), we have explored two US parameters (i.e., intensity and delay of wheel confinement) and obtained results congruent with traditional Pavlovian conditioning. As a further step toward clarification of the underlying mechanism of the running-induced taste avoidance, we are examining another US parameter, familiarity of wheel running. An experiment clearly demonstrated that prior experience of wheel running results in retarded development of taste avoidance, suggesting a US preexposure effect in the framework of Pavlovian conditioning. Preliminary research on crossover US preexposure effect between wheel running and LiCl poisoning will also be presented.

(681)

Dynamically Changing Concurrent VI Schedules. MATTHEW BOWERS, BEN Y. ZIMMERMAN, & WILLIAM L. PALYA, *Jacksonville State University*—Previous work on the matching law has predominantly focused on the molar effects of the contingency by examining only one reinforcer ratio for extended periods. The present study implemented concurrent variable interval (VI) schedules that were reciprocally interlocked and that continuously changed across a fixed 5-min trial (VI 15-sec to VI 480-sec and VI 480-sec to VI 15-sec). The dynamical concurrent VI schedules shifted behavior in the direction of matching response ratios to reinforcer ratios. Sensitivities derived from the generalized matching law were approximately .62, the mean absolute bias was approximately .11, and r^2s were approximately .86. It was concluded that choice behavior can come to adapt to reinforcer ratios that change continuously over a relatively short time and that this change does not require extensive experience with a fixed reinforcer ratio.

(682)

Landmark Encoding in Humans and Pigeons. DEBBIE KELLY, *University of Nebraska, Lincoln,* & WALTER F. BISCHOF, *University of Alberta*—Studies have shown that pigeons and humans encode both metric and featural landmark information for encoding spatial locations. However, reliance on this information may differ between the species. We investigated how humans encode 3-D environmental information presented on a computer monitor. Subjects were presented with views of a rectangular room and were asked to locate a consistently reinforced corner(s). For half the subjects, the room initially did not contain any distinct featural information. The subjects were later presented with the same images, but now distinct featural information was presented in each corner. The remaining subjects received the conditions in the opposite order. All subjects showed a strong reliance on featural information, and only a subset of subjects was able to successfully use metric landmark information. These results suggest that even when 3-D cues are presented to enhance metric properties of a table-top environment, humans rely more on featural than metric information.

(683)

Recognition of Partly Occluded Ecologically Significant Stimuli by Pigeons. TOMOKAZU USHITANI & KAZUO FUJITA, *Kyoto University* (sponsored by Kazuo Fujita)—Humans can perceptually complete the portion of objects occluded by others. However, several studies showed that pigeons failed to do so for geometrical figures. We used more natural stimuli in the present research. Namely, we trained pi-

geons to peck at photos of foods and not to peck at photos of nonfood objects presented on the monitor. Subsequently, we presented simultaneously foods and nonfoods and required pigeons to peck only at the former. At the test, we presented both photos of food partly occluded by pigeon feathers and those truncated at the same part. If the pigeons completed the occluded portion, they would have pecked at photos of occluded food and would not have pecked at truncated photos, or would have pecked at the former prior to the latter. However, the pigeons pecked at both test stimuli equally in both frequency and order. Pigeons' perceptual completion was not demonstrated even for the ecologically significant stimuli.

(684)

Transposition in Pigeons and People? OLGA F. LAZAREVA & EDWARD A. WASSERMAN, *University of Iowa*—We studied transposition in both adult people and pigeons. We trained subjects to discriminate pairs of circles of different diameters. First, they were trained with two end pairs: 1+ 2− and 5+ 6− or 2+ 1− and 6+ 5− (where the plus and minus indicate that the stimulus was reinforced or nonreinforced and the larger number corresponds with the larger diameter of a circle). In later testing, new pairs were presented, such as 34 (middle pair), 16 and 26 (both stimuli had been either reinforced or nonreinforced in training), or 23 and 45 (in each pair, one stimulus had been neutral and the other had been either reinforced or nonreinforced in training). For nearly all pairs, Spence's theory predicts performance to be at or slightly above chance. Our data suggest that neither humans nor pigeons selected the stimuli in the novel pairs according to gradients of generalization.

(685)

Spatial Navigation on the Radial Maze. STEPHANIE J. BABB & JONATHON D. CRYSTAL, *University of Georgia*—We investigated the use of global and local cues on the eight-arm radial maze. The rats received daily training consisting of forced-choice visits to four baited arms, a 1-h retention interval, and the availability of all eight arms with baits available at arms that did not appear in the forced-choice phase. The radial maze was placed in a featureless octagonal enclosure to minimize the availability of global environmental cues. Local cues were provided at the distal end of each arm by placing a small object in front of the food trough; unique objects were randomly sampled from a large pool of objects to minimize the buildup of proactive interference. The use of global and local cues was assessed by rotating the objects, after the retention interval, on occasional nonrewarded probes, thereby dissociating the location of global and local cues. The rats used global rather than local cues.

(686)

Set Size Controls for Abstract Concept Learning by Pigeons and Rhesus Monkeys. JEFFREY S. KATZ, *Auburn University,* & ANTHONY A. WRIGHT, *University of Texas Medical School, Houston*—A series of experiments with pigeons (*Columba livia*) and rhesus monkeys (*Macaca mulatta*) controlled for the amount of training time in an expanding set size procedure. Both species were trained in a virtually identical same/different task to discriminate (simultaneously) pairs of pictures as same or different. In control and experimental groups, initial training with a stimulus set size of eight pictures resulted in no transfer to novel stimuli. Further training and testing of the control groups with the set size fixed at eight items did not produce increases in transfer, in comparison with the experimental groups in which an expanding set size (16, 32, 64, and 128 stimuli) resulted in successive increases in transfer to novel stimuli. These results confirmed that abstract concept learning varied as a function of the size of the stimulus training set.

(687)

Searching in the Center: Pigeons Encode Relative and Absolute Distance From Walls of an Enclosure. MARCIA L. SPETCH, EMILY GRAY, & ANGELA NGUYEN, *University of Alberta*—When pigeons are trained to find a goal in the center of an array of identical landmarks, they appear to encode absolute, rather than relative, spatial information: On expansion tests (landmarks moved farther apart), pigeons maintain their distance from individual landmarks and do not search in the center (e.g., Spetch et al., 1997). By contrast, chicks that are trained to find a goal in the middle of an enclosure show both relative and absolute encoding: In expanded enclosures, chicks search in the center and at the absolute distance from walls (e.g., Tommasi et al., 2000). To explore whether species or apparatus factors underlie this difference, we tested pigeons in an enclosure similar to that used with chicks. On expansion tests, pigeons showed both relative and absolute encoding. It appears that encoding of spatial information based on walls of an enclosure differs from encoding of spatial information based on discrete landmarks.

(688)

Metacognitive Judgments in Rhesus Macaques. LISA K. SON, NATE KORNELL, & HERBERT S. TERRACE, *Columbia University* (sponsored by Herbert S. Terrace)—The ability to make confidence judgments was investigated in two rhesus macaques. Subjects were presented with a psychophysical task in which they had to press the longest of nine lines, after which they made confidence judgments about the certainty of their response. Subjects were more likely to choose *high confidence* following easy trials and *low confidence* following hard trials. To address concerns that the monkeys made the judgments on the basis of patterns specific to the task, they were then given two new psychophysical tasks and were asked to make confidence judgments. Results suggest that rhesus macaques could make fairly accurate judgments on the basis of uncertainty.

(689)

How Rhesus Macaques Represent Order in a Transitive Inference Task. DUSTIN J. MERRITT & HERBERT S. TERRACE, *Columbia University*—Monkeys trained on a transitive inference task (A > B, B > C, C > D, etc.) can infer the order of nonadjacent items (B > D, C > E, etc.). Although it has been suggested that the monkeys' relative order judgments reflect an internal representation of the list (Chen, Swartz, & Terrace, 1991), the nature of that representation is unclear. Accuracy and reaction time patterns suggest three potential mechanisms: (1) a positional comparison process, (2) an ends-inward scan mediated by associative relationships, or (3) an ends-inward scan mediated by ordinal position. To adjudicate between these mechanisms, monkeys were first trained on adjacent pairs and were tested with novel nonadjacent items both within (Experiment 1) and between (Experiment 2) lists. Experiments currently in progress will further test the viability of the associative scan account (Experiment 3) under conditions of associative interference and will test the viability of the ordinal scan and positional comparison accounts (Experiment 4) by removing absolute versus relative position confounds.

(690)

The Effects of Food Pilfering on Food Hoarding and Retrieval in Rats. TAMMY McKENZIE, LEANNE BIRD, JASON RICE, & WILLIAM A. ROBERTS, *University of Western Ontario*—One group of rats (Group Hoard) carried food from the center of an eight-arm radial maze to hoard it in boxes at the end of four arms. A second group (Group Encounter) encountered food in each of four boxes. After a 45-min delay, both groups were returned to the maze to retrieve food. Accuracy of food retrieval was indicated by visits to boxes where food was hoarded before visits to boxes where food was not hoarded. Group Hoard learned to retrieve food accurately faster than did Group Encounter. After each group had reached a high level of accuracy at food retrieval, rats were given 30 trials in which food was pilfered before retrieval on each trial. Group Hoard rats continued to hoard and accurately return to boxes where food had been hoarded, but Group Encounter's accuracy dropped to chance. These findings suggest that hoarding food improves rats' memory for its location but that rats do not anticipate food retrieval when hoarding food.

Metacognition
Atlanta, Sunday Morning, 8:30–10:00

Chaired by Barbara H. Basden, California State University

8:30–8:45 (691)

Metacomprehension Accuracy Can Improve With Practice. GARY E. RANEY, *University of Illinois, Chicago,* & JOHN D. MURRAY, *Georgia Southern University* (read by John D. Murray)—We evaluated whether students' ability to accurately predict performance on a test over material just read would improve if they were given practice making these predictions. Students read 16 expository texts (approximately 550 words in length) distributed across four sessions. After reading each text, they predicted their performance on a six-question quiz. Students were given the answers after finishing the quizzes and were asked to develop reasons why their predictions were accurate or inaccurate (i.e., underestimated or overestimated performance). Students completed several questionnaires, including a vocabulary test that is correlated with reading ability. Metacomprehension judgment accuracy improved across sessions for readers with above-average vocabulary scores, but not for readers with below-average vocabulary scores. High scorers tended to slightly underestimate their performance, whereas low scorers slightly overestimated their performance. These results demonstrate that practice alone may improve judgment accuracy and that judgment accuracy might be related to reading ability.

8:50–9:05 (692)

Overconfidence Relates to Verbal Ability in Metacomprehension Judgments. RUTH H. MAKI & N. MELISSA CHAVEZ, *Texas Tech University*—Kelemen, Frost, and Weaver (2000) showed that the accuracy of metacomprehension judgments (measured by gamma correlations) is unstable and does not relate to other measures of metacognitive accuracy. Our previous inability to find relationships between individual differences and metacomprehension accuracy may be the result of the instability of gamma as a measure of accuracy. Kelemen et al. also noted that over- or underconfidence (measured by bias) was stable and interrelated across metacognitive tasks. In the present metacomprehension studies, we used both gamma and bias. Consistent with the results of Keleman et al., we found that bias on a general knowledge judgment task was correlated with bias on the metacomprehension task, but gamma was not. Verbal ability (measured by SAT scores) related to bias, but not to gamma. Students with higher verbal abilities showed less overconfidence, particularly with difficult texts.

9:10–9:30 (693)

Intentional Theory of Mind Combined With Mischaracterizations of Visual Attention Produce Drastic Errors of Visual Metacognition in Adults. DANIEL T. LEVIN & MELISSA R. BECK, *Kent State University*—Recent research demonstrating that people fail to detect large between-view visual changes often contradicts the strong intuition that the changes should be easily detectable. Consistent with this, we have repeatedly observed that adults make radical overestimates of their ability to detect changes. Here we show that subjects who believe in a broad attentional spotlight and who believe that they typically look at a large percentage of objects in a scene predict that they would see a large number of visual changes. In addition, we tested whether overestimates of change detection occur for a nonhuman representational system (a computer program) that was described in mechanistic or intentional/anthropomorphic terms. We found that describing the program as an intentional agent did increase the degree to which subjects believed it would detect changes. Accordingly, these errors may arise from a misapplication of an intentional level of analysis, combined with mischaracterizations of visual attention.

9:35–9:55 (694)

Re-Representing Consciousness: Dissociations Between Experience and Meta-Consciousness. JONATHAN W. SCHOOLER, *University of Pittsburgh*—A distinction is drawn between conscious experience and the explicit awareness (meta-consciousness) of that experience. Whereas experience is continuous, meta-consciousness is hypothesized to occur only intermittently in response to goal failures, self-reflection, or requests for self-reports. Two types of dissociations follow from the notion that meta-consciousness involves the intermittent re-representation of the contents of consciousness. Temporal dissociations occur when an individual, who previously lacked meta-consciousness about the contents of consciousness, directs meta-consciousness toward those contents. The case of catching one's mind wandering during reading illustrates a temporal dissociation. Once meta-consciousness is triggered, translation dissociations may occur if the re-representation process misrepresents the original experience. Such translation dissociations are particularly likely when one verbally reflects on nonverbal experiences or attempts to takes stock of subtle/ambiguous experiences. This talk reviews empirical evidence for temporal and translation dissociations and explores their implications for conceptualizing consciousness.

Word Processing
New York, Sunday Morning, 9:00–11:25

Chaired by Kathleen Rastle, Royal Holloway University of London

9:00–9:15 (695)

Cross-Task Strategic Effects. KATHLEEN RASTLE, *Royal Holloway University of London,* SACHIKO KINOSHITA & MAX COLTHEART, *Macquarie University,* & STEPHEN J. LUPKER, *University of Western Ontario*—Reading-aloud latencies depend not only on particular characteristics of the target stimuli themselves, but also on characteristics of other stimuli in the experiment: when easy and difficult items are mixed together, their reading-aloud latencies become more homogeneous, relative to their presentation in unmixed conditions (Lupker, Brown, & Colombo, 1997). Two experiments were conducted to investigate the nature of the mechanism that underlies this list composition effect. Experiment 1 produced latency homogenization effects in both reading-aloud and visual lexical decision tasks. Experiment 2 produced latency homogenization effects across tasks: Characteristics of stimuli in a visual lexical decision task influenced reading-aloud latencies, and vice versa, when visual lexical decision and reading-aloud trials were presented alternately in the same experiment. We believe that these results may implicate a general strategic mechanism—and discuss one potential candidate—that could influence a range of RT tasks, linguistic or otherwise.

9:20–9:40 (696)

Differential Length Effects for Words and Pseudowords in Reading and Lexical Decision. SYLVIANE VALDOIS, *CNRS, Grenoble,* SERGE CARBONNEL, MONICA BACIU, & ALEXANDRA JUPHARD, *UPMF, Grenoble,* BERNARD ANS, *CNRS, Grenoble,* & MARIE-JOSEPHE TAINTURIER, *University of Psychology, Bangor* (sponsored by Marie-Josephe Tainturier)—The connectionist MTM model (Ans, Carbonnel, & Valdois, 1998) postulates the existence of two distinct reading procedures that work successively during processing. The model predicts the absence of any length effect (on words and pseudowords) in lexical decision (LD). In reading, a length effect is expected on pseudowords, not on words. The performance (RTs) of skilled readers engaged in two LD and reading tasks involving items of different syllable length was analyzed. Results showed that the item × length interaction is significant in reading, but not in LD. An fMRI study further demonstrated that the same cortical regions were activated in LD for words and pseudowords. In contrast, the regions involved in pseudoword reading were all the more extended that pseudowords were longer. No difference was observed between short and long words. Long pseudowords activated Broca's area (phonological processing) and visual attentional regions (parietal lobule) more strongly than did short pseudowords or long words.

9:45–10:00 (697)

Brain Imaging in Lexical Decision and Naming. LEONARD KATZ, STEPHEN J. FROST, W. EINAR MENCL, REBECCA SANDAK,

STEPHANIE A. MASON, & KENNETH R. PUGH, *Haskins Laboratories*—Repeating a word has a different effect in a lexical decision task than in a naming task. Repeated exposures removed the RT advantage for regular words, as compared with irregular words, in lexical decision, but not in naming. Functional MRI showed a decreased involvement in the inferior frontal gyrus (Broca's area and related structures), with repetition for lexical decision, but not for naming. This region has been implicated in previous studies as being involved in discriminating irregular from regular words. These and other data suggest that word recognition in the lexical decision task shifts from an algorithmic process on single letters to a more simple process involving larger aggregates of letters. For naming, such a shift to large grain size occurs more slowly, if at all.

10:05–10:20 (698)
Foveal and Nonfoveal Processing Difficulty Influence Saccade Amplitude. SARAH J. WHITE & SIMON P. LIVERSEDGE, *University of Durham* (read by Simon P. Liversedge)—White and Liversedge (2002) found that orthography influences where words are first fixated in reading of English sentences. One explanation for this effect is that processing difficulty reduces nonfoveal preprocessing (Henderson & Ferreira, 1990) and, consequently, shortens saccades (Hyvnd & Pollatsek, 1998). This experiment tested this hypothesis by investigating the relationship between foveal and nonfoveal processing difficulty on saccade lengths. Results showed that landing positions were nearer the beginning of the critical word if the previous word was low frequency than if it was high frequency. Also, landing positions were nearer the beginning of the critical word if it was misspelled than if it was spelled correctly. No interaction occurred. The results suggest independent influences of foveal and nonfoveal information on the computation of saccade amplitude. The results will be discussed in terms of current models of eye movement control in reading.

10:25–10:35 (699)
Auditory Processing of Low-Frequency Prefixed Words. LEE H. WURM & JOANNA AYCOCK, *Wayne State University*—According to some models of word recognition, morphologically complex words are processed simultaneously as whole units and as decomposed constituents. Alegre and Gordon (1999; Gordon & Alegre, 1999) identified a frequency threshold of six occurrences per million, above which visually presented suffixed inflections appear to be stored as whole units, and below which they appear to be stored as constituent morphemes. The present study extends this work to the auditory domain and uses prefixed derivations instead of suffixed inflections. Spoken prefixed words were presented to participants in a naming experiment. The words carried high-frequency roots but had low overall frequencies. The effect of root frequency on naming times depended on semantic transparency. Furthermore, although there was a whole-word frequency effect for prefixed words, it was much weaker than that for monomorphemic adjectives from the same frequency range. Results are discussed within the framework of two influential dual-route models of word recognition.

10:40–10:55 (700)
Evaluating Computational Models of Reading With Highly Reliable Data ($r > .95$). ARNAUD REY, *LEAD-CNRS,* ARTHUR M. JACOBS, *Katholische Universität Eichstätt,* & FLORIAN SCHMIDT-WEIGAND, *Justus Liebig Universität Giessen*—Several studies have reported naming latencies for a small number of participants (30) and a large number of words ($N > 1,000$). These databases have been used to "bring computational models of word naming down to the item level" (Spieler & Balota, 1997). In the present study, we examine the reliability of such databases and their adequacy for model evaluation. Response times to a small number of items (120 monosyllabic English words), but from a large number of participants (140), were collected in a perceptual identification task. We show that, with few participants (30), correlations on mean item latencies for different participant groups are relatively low (between .5 and .6). In order to reduce error variance, a grouping procedure derived from Vincentizing was used. This resulted in

higher correlations between participant groups ($r > .95$), thus yielding a more reliable database for evaluating computational models of reading.

11:00–11:20 (701)
The Vowel-Length Effect in Visual Word Recognition. GEORGIJE L. LUKATELA & MICHAEL T. TURVEY, *Haskins Laboratories* (sponsored by Carol A. Fowler)—We evaluated the hypothesis that the phonology mediating visual word recognition represents the physical dynamics of the word's pronunciation. Specifically, we compared words such as PLEAD and PLEAT. Temporal aspects of the pronunciation of EA differ between the two words; relative to voiceless consonants, voiced consonants prolong preceding vowels. In Experiment 1, visual lexical decision was faster for PLEAT than for PLEAD. In Experiment 2, in visual masked priming, the magnitude of identity priming was larger for PLEAD than for PLEAT. Apparently, visual processing reflects a word's physical time-evolution. In Experiment 3, naming latencies for PLEAT and PLEAD were not reliably different, suggesting that the PLEAT versus PLEAD difference originated from the phonological lexicon. A phonologically oriented dual-route model was implemented. Simulation data were in full agreement with behavioral data.

Movement Perception II
Chicago A, Sunday Morning, 8:00–9:25

Chaired by Dennis R. Proffitt, University of Virginia

8:00–8:15 (702)
Catching Baseball Pop Flies: Individual Differences in Aggressiveness and Handedness. MICHAEL K. McBEATH, DENNIS M. SHAFFER, & THOMAS G. SUGAR, *Arizona State University*—We examined the behavior and control heuristics used by baseball fielders navigating to catch infield pop flies. We both reanalyzed data of McLeod, Reed, and Dienes (*JEP:HPP*, 2001) and collected a new set of trials in which fielders moved only 2–5 m. When fielders repeat the same catching conditions, they exhibit variance in optical control behavior both within and between players. We confirmed that fielders generally maintain a linear optical trajectory with constant optical ball speed even when they take only a few steps. We also found systematic differences in the optical ball slopes that the fielders maintained under identical conditions, with some slopes as much as twice that of others. Finally, gloved handedness impacted the optical curvature, with more curvature observed at termination for balls caught on the gloved-hand side. The findings further support the use of invariant viewer-based control heuristics during interception, despite notable individual differences.

8:20–8:40 (703)
Organization of Human Locomotion: Recalibration Transfers From Foot to Hand. JOHN J. RIESER, *Vanderbilt University,* & HERBERT L. PICK, JR., *University of Minnesota*—People are sensitive to the coupling of their actions and resulting environmental events, and they learn to fine-tune actions to fit changing circumstances. For locomotion, turning results in rotational flow in perspective, and forward walking results in radially expanding flow, but the gain depends on the specific circumstance (e.g., walking through sand boosts the dynamic forces coupled with a given flow rate, and skating boosts the stride kinematics coupled with optic flow). We induce people to recalibrate their walking and turning, by manipulating the gain linking environmental flow to the kinematics and/or dynamics of the actions, and then assess how the learned recalibrations transfer to other forms of walking and turning. The results fit a functional organization, such that recalibrations learned while forward walking transfer to side-stepping and recalibrations learned while "stepping" by foot transfer to "stepping" by hand. Might this functional organization reflect sensitivity to changes in an action's kinematics, dynamics, or both?

8:45–9:00 (704)
Perceptuomotor Adaptation: More Than Meets the Eye. FRANK H. DURGIN, LAURA F. FOX, JED LEWIS, & KATHERINE A. WALLEY,

Swarthmore College—Running on a treadmill with eyes closed produces three aftereffects: forward *drift* when attempting to run in place (Anstis, 1995), exaggerated apparent optical *flow* when walking (Pelah & Barlow, 1996), and *overshoot* when attempting to walk to a previewed target with eyes closed (Durgin et al., 1999; cf. Rieser et al., 1995). We have found that all three aftereffects are expressions of adaptation to sensory conflict. Moreover, although these aftereffects are often labeled *visuomotor*, the conflict need not involve vision. Careful measurement of these aftereffects demonstrates an inconsistency in their expression. Although *drift* and *flow* are of a constant velocity that increases with adaptation speed and/or adaptation time, *overshoot* shows evidence of a ceiling at about 15%–18% across a number of experimental manipulations. Here we report our attempts to smash through that ceiling, using VR, and suggest a new way of conceptualizing these locomotor aftereffects.

9:05–9:20 (705)

Behavioral Dynamics of Intercepting a Moving Target. WILLIAM H. WARREN, *Brown University,* & BRETT R. FAJEN, *Rensselaer Polytechnic Institute*—How do people walk to a moving target? Previously, we found that participants head in front of the target (an interception strategy), rather than directly toward it, as they do with a stationary goal (pursuit strategy). However, they do not maintain a constant angle in front of the target, as expected, and turn toward the target during the final approach. Here, we show that these data can be reproduced by a simple extension of our earlier steering dynamics model. Specifically, the attractor of heading is shifted from the target itself to a constant angle in front of the target, which is determined from the target's tangential velocity and walking speed. The final turn toward the target is a consequence of decreasing walking speed near contact. The model thus accounts for steering to both stationary and moving targets with a single unified control strategy.

Visual Search
Chicago BC, Sunday Morning, 9:00–11:00

Chaired by Howard C. Hughes, Dartmouth College

9:00–9:15 (706)

Searching for the Inhibition That Guides Search. RAYMOND M. KLEIN, *Dalhousie University,* & JIYE SHEN & EYAL M. REINGOLD, *University of Toronto*—Conjunction search is typified by a serial self-terminating strategy wherein each displayed item is inspected until the target is found. However, under some circumstances, search is guided (Wolfe, Cave, & Franzel, 1989) or selective (Williams & Reingold, 2001) such that some distractors are not inspected. Using a dual-task, probe procedure, we sought direct evidence for the proposal (Treisman & Sato, 1990) that guidance is mediated by inhibition of features inconsistent with the target. Subjects searched for conjunction targets (e.g., a red+blue cross) among distractors made from nontarget features (e.g., green+yellow) and mixed distractors made from one target and one nontarget feature (e.g., red+green). Consistent with an inhibitory account, when single-colored probes were delivered during search, observers were slower to process nontarget-colored probes. Probe color did not affect performance when probes were delivered immediately after the search response, suggesting that, when no longer required, the differential treatment is rapidly removed.

9:20–9:40 (707)

Linguistic Control of Visual Search. BRADLEY S. GIBSON & KATHLEEN M. EBERHARD, *University of Notre Dame*—Spivey, Tyler, Eberhard, and Tanenhaus (2001) recently showed that visual search could become twice as efficient when a spoken instruction ("Is there a red vertical?") is presented simultaneously with (as opposed to just before) a standard conjunction search display. This remarkable improvement in search efficiency was attributed to interactions that can occur between the incremental processing of spoken language and top-down attentional control processes. According to this account, attention is first allocated to all the items sharing the first spoken feature (e.g.,

red) and then subsequently to the single item within this subset that shares the second spoken feature (e.g., vertical). The present series of experiments provided stronger empirical support for the operation of these incremental, top-down control processes and further showed that their successful operation depends critically on speech rate. In particular, linguistic input does not appear to benefit visual search when it is spoken at a normal rate.

9:45–9:55 (708)

Is *Intersection* a Basic Feature for Visual Search? JEREMY M. WOLFE, *Brigham & Women's Hospital and Harvard Medical School,* & JENNIFER S. DiMASE, *Brigham & Women's Hospital*—One of the criteria for identifying a property as a basic feature in visual search is a near zero slope of the RT × set size function. That is, the time to find targets defined by the feature should be independent of the number of distractors. Although it is clear that some aspects of object form can support efficient search of this sort, the list of form features has remained controversial. Here we revisit the status of *intersection*. Intersection has been proposed as a basic feature on the basis of efficient search for a + among Ls, However, plusses are radially symmetric and have four line terminators. Ls are not radially symmetric and have two terminators. When we controlled for these factors, search for intersection among T-junction distractors became very inefficient. Intersection does not appear to be a *basic feature* in visual search.

10:00–10:15 (709)

Comparing Visual Search Mechanisms for Mirror Image Symmetry and Search Asymmetry. ELIZABETH T. DAVIS, RACHEL K. MICHEL, & TERRY SHIKANO, *Georgia Institute of Technology,* & KRISH SATHIAN, *Emory University School of Medicine*—Visual search can be affected by mirror image symmetry between target and nontargets and by switching the roles of target and nontarget. However, it is not clear what level of processing is affected or whether different mechanisms are involved. We tested 15 participants in a study that decomposed visual processing into component parts. Search for a tilted target among vertical nontargets served as a baseline condition. When the target was a mirror image of the homogeneous, tilted, nontarget stimuli, it was perceptually more difficult to distinguish the target from irrelevant stimuli, but search performance was unimpaired once discriminability was balanced across conditions. In contrast, search asymmetry affected performance at a higher processing level. Even when the target was detected, there was more spatial confusion about the location of a prototypical target (vertical line) among deviant nontargets (tilted lines) than vice versa, suggesting that deviant stimuli attract attention away from prototypical stimuli.

10:20–10:35 (710)

Motion Onset Captures Attention. SHAWN E. CHRIST & RICHARD A. ABRAMS, *Washington University* (read by Richard A. Abrams)—Subjects identified target letters in displays that contained targets and distractors, some of which were moving. There was no overall advantage for moving letters among static ones, but there was an advantage for items that had recently started to move, despite the fact that the motion was uninformative. We conclude that the motion onset attracted attention automatically. Consistent with this interpretation, if some additional time was allowed to elapse after motion onset, inhibition of return slowed responding to the item that had started to move. Also, detection of target letters was found to be independent of the number of distractors in the display if the target had undergone motion onset, also indicative of attentional capture. Finally, the effects of motion onset persisted under circumstances in which the moving objects were never the targets and, hence, could be ignored. Motion per se does not attract attention, but the onset of motion does.

10:40–10:55 (711)

Perceptual Grouping Reduces Feature Encoding Time in Visual Extinction. LYNN C. ROBERTSON, JOSEPH L. BROOKS, & YUTING WONG, *University of California, Berkeley, and Veterans Administration*

Medical Center—A central finding in research on visual attention, both in normal perceivers and in neurological patients, is that grouping can modulate spatial attention. Using an adaptive psychophysical procedure, we varied presentation times of feature search displays and determined the duration that was necessary for 70% correct detection of a target under grouped and ungrouped conditions. The participants were patients with left extinction owing to right-hemisphere stroke. Detection thresholds for features on the left were significantly longer than for those on the right. Consistent with parallel feature search, the number of distractors did not affect performance. More important, grouping decreased feature registration on the left, as well as reducing the temporal discrepancy between left- and right-sided thresholds. Grouping across the midline may benefit attentional search in hemineglect by decreasing temporal asynchrony between left and right encoding of features. Implications of these findings for normal perception will also be discussed.

Brain and Cognition
Chouteau, Sunday Morning, 8:30–10:00

Chaired by Eduardo Mercado III, Rutgers University

8:30–8:45 (712)
Neural Development of Selective Attention and Response Inhibition. JAMES R. BOOTH & DOUGLAS D. BURMAN, *Northwestern University,* JOEL R. MEYER & BARBARA L. TROMMER, *Evanston Northwestern Healthcare,* & DARREN R. GITELMAN & MARSEL M. MESULAM, *Northwestern University*—Twelve children (9–12 year olds) and 12 adults were administered a selective attention and response inhibition task during functional magnetic resonance imaging. Both tasks involved conjunction search of red triangle targets in a field (nine stimuli) of blue triangle and red trapezoid distractors. However, the attention task required the selection of a yes/no response to the presence/absence of the target, whereas the no-go task required the inhibition of a response to the target. The selective attention task revealed small developmental differences in extrastriate regions, whereas the response inhibition task revealed large developmental differences including the anterior cingulate, posterior cingulate, medial prefrontal, caudate nucleus, thalamus, and amygdala. These results are consistent with the slower development of large-scale neuro-cognitive networks involving the frontal cortex.

8:50–9:10 (713)
Automaticity and Domain General Learning Cortical Network. WALTER SCHNEIDER & JASON CHEIN, *University of Pittsburgh*—There are dramatic reductions in cortical activation as participants become more automatic. An fMRI experiment was used to look at activation in a verbal and nonverbal paired associate learning paradigm with well-practiced and novice materials. Common regions that decrease activation with learning include medial frontal (BA 32), left inferior frontal (BA 44), bilateral middle frontal (BA 9,46), left anterior insular, bilateral intraparietal (BA 7,40), medial parietal (BA 7), bilateral fusiform (BA 37), and right inferior occipital regions. A common (overlapping) practice-related increase was present in the precuneus (BA 7). With practice, most of the regions in this network exhibit reduced levels of activity, suggesting that they support processes that are less critical for performance once the associations are learned well. Although alternative interpretations are reasonable, we believe that these practice-related changes reflect the varying contributions of executive control, monitoring, and working memory processes of a domain general learning network.

9:15–9:30 (714)
Processing of Meaning and Structure in Action Comprehension. GÜNTHER KNOBLICH & PATRIC BACH, *Max Planck Institute for Psychological Research,* ANGELA D. FRIEDERICI & THOMAS GUNTHER, *Max Planck Institute for Cognitive Neuroscience,* & WOLF-GANG PRINZ, *Max Planck Institute for Psychological Research*—In order to understand the actions of others, one needs to understand the meaning and the structure of the action sequences they produce. In several experiments, we addressed the question of how these two different aspects of action sequences are processed, using action sequences of the game "Paper, Scissors, Rock." The results suggest that the meaning and structure of action sequences are processed in parallel and cannot be ignored. In a subsequent study recording evoked potentials, we found that semantic violations in action sequences elicited an N400 component and that structural violations elicited a P600 component. These components are regularly found in studies of language comprehension for semantic and syntactic violations. These results might suggest that similar processes are involved in language and action comprehension.

9:35–9:55 (715)
Brain-Based Correlates Underlying Causal Cognition. KEVIN N. DUNBAR & JONATHAN A. FUGELSANG, *Dartmouth College*—The ways in which knowledge of causal mechanisms and covariation information are used in causal thinking have been hotly debated, resulting in a number of different models of causal thinking. Here, we report a study in which we measured the functional brain correlates of causal thinking, using fMRI, and collected reaction times while participants observed data regarding potential causal candidates. Participants rated how likely it was that a given cause produced a particular effect. Both the plausibility of the causal mechanism and the degree of covariation were manipulated. Key sites associated with numerical competency, semantic knowledge, and the integration of information were activated. We propose that these three sites are key areas involved in causal cognition and suggest important constraints on models of causal thinking.

Reasoning and Problem Solving
Empire, Sunday Morning, 9:00–11:05

Chaired by James A. Hampton, The City University, London

9:00–9:15 (716)
The "Fast" and the "Slow" Systems in Conditional Reasoning. JOHN BEST, *Eastern Illinois University*—Stanovich (1999) has suggested that humans possess two systems of reasoning, an adaptive, "fast" system, grounded in a Bayesian, *frequency-counting* analysis (Gigerenzer & Hoffrage, 1995), and a "slow" deductive system. It is currently unclear what happens when the two systems produce contradictory answers. Participants solved a series of Mastermind problems in which deductively able and less able people were explicitly cued regarding the importance of using logical processes. Each problem contained a salient deduction that could be correctly solved by the "fast" Bayesian system or a deduction requiring an analysis by the "slow" analytic/rules-based system, whose correct conclusion was in opposition to that produced by the "fast" system. As was expected, deductively able people outperformed less able people, and these differences were particularly marked when the deductively able people were cued to use logic. Inconsistent with the theory however, even deductively able people still endorsed as "logical" erroneous conclusions deduced by the "fast" system.

9:20–9:30 (717)
Does the Complexity of Relations Affect Reasoning? GEOFFREY P. GOODWIN & PHILIP N. JOHNSON-LAIRD, *Princeton University* (sponsored by Philip N. Johnson-Laird)—The theory of relational complexity predicts that the number of arguments in a relation should affect cognitive performance. We report two experiments testing this prediction for reasoning about relations between relations—for example, *Tom is taller than Bob to a greater extent than Dave is taller than Mike; Dave is taller than Mike to a greater extent than Dave is taller than Tom.* The task was to determine the order of the four individuals. Experiment 1 showed that the more information to be integrated, the longer inference took and the greater the chance of error. Experiment 2 examined the participants' *think-aloud* protocols as they

solved such problems. It replicated the results of the previous experiment and also showed that different participants developed different strategies for tackling the problems.

9:35–9:50 (718)

Discovering a Mathematical Relation: Repeated Activation Leads to Representational Change. JAMES A. DIXON, *University of Connecticut,* & ASHLEY S. BANGERT, *University of Michigan*—How do people spontaneously generate mathematical representations during problem solving? Current theories suggest that new representations are constructed to increase efficiency or in response to error. In the present study, participants solved a series of gear-system problems (i.e., predict the direction a specified gear would turn given the direction of a driving gear). The majority of participants first solved the problem by representing the physical forces in the system. However, most of the participants spontaneously discovered the appropriate mathematical relation, parity. Performance on previous problems and problem characteristics were used to predict discovery of the parity relation in an event-history analysis. Results showed that neither previous errors nor response times predicted discovery. Rather, repeated exposure to a particular type of problem that contrasted number and parity predicted the discovery of parity. The results bear on accounts of representational change that emphasize structural alignment, redescription, and activation.

9:55–10:10 (719)

Examples That Illustrate Subgoals Help Generalization More Than Do Examples That Illustrate Multiple Methods. RICHARD CATRAMBONE, *Georgia Institute of Technology*—Learning from examples was examined. Two factors were manipulated: (1) whether or not relevant subgoals were highlighted in the examples, and (2) whether or not both examples illustrated the same method for achieving a particular subgoal. Participants studied two examples dealing with mechanics (e.g., blocks on inclined planes) and then solved isomorphs and far transfer problems. Transfer performance was affected by whether or not subgoals were highlighted in the examples, but not by whether or not multiple methods (for achieving a particular subgoal) were illustrated in the examples. These results suggest that learners can more effectively generalize methods if they are taught subgoals but are less successful trying to generalize from multiple methods if the subgoals are not also learned.

10:15–10:35 (720)

Direction and Distance in Human Problem Solving. ZYGMUNT PIZLO & ZHENG LI, *Purdue University*—According to the traditional view, solving a problem involves a recursive process of reducing the distance to the goal (hill-climbing, means–ends methods). Because the distances among the states of a difficult problem are very rarely known precisely, solving a problem must (seemingly) result in a search through at least some part of the problem space. We tested, in a sequence of experiments, human ability to solve one class of difficult combinatorial problems, as well as to judge distances among the states and directions. We found that the judgments of distances were very unreliable. Judgments of directions, on the other hand, were very reliable and consistent across subjects. We also found that solving the problems did not involve substantial, if any, search. We conclude that direction is an important aspect of human problem solving, at least in the case of difficult problems, which are solved efficiently by humans.

10:40–11:00 (721)

fMRI Signal at the Moment of Insight, During Insight-Like Verbal Problems. MARK JUNG BEEMAN, JASON HABERMAN, & EDWARD M. BOWDEN, *Northwestern University*—Functional magnetic resonance imaging (fMRI) assessed neural activity while participants worked on and solved insight-like verbal problems. An event-related fMRI design allowed comparison of neural activity at different time points during solving effort, including the moment at which problems were solved. In addition, participants judged each solved problem as either an insight or a noninsight experience. The fMRI signal increased

in several areas when participants worked on problems and, specifically, when they solved problems. In 4 of the first 5 participants, one of these activated areas, in and near the anterior superior temporal sulcus of the right hemisphere, was also more active when participants solved problems accompanied by feelings of insight (Aha!) than when they solved problems without an insight experience. This area has been proposed to be involved in lexical–semantic integration when inputs are distantly related, as is often the case with insight problems.

Retrieval Processes
Atlanta, Sunday Morning, 10:10–11:55

Chaired by Ruth H. Maki, Texas Tech University

10:10–10:20 (722)

The Emergence of Distinctiveness at Retrieval. MARK A. McDANIEL & COURTNEY C. DORNBURG, *University of New Mexico,* & MELISSA J. GUYNN, *New Mexico State University*—Recall effects attributed to distinctiveness have been explained by both encoding and retrieval accounts. Resolution of this theoretical controversy has been clouded because the typical methodology confounds the encoding and the retrieval contexts. Using bizarre and common sentences as materials, we introduce a paradigm that decouples the nature of the encoding context (mixed vs. unmixed lists of items) from the retrieval set (mixed vs. unmixed retrieval sets). Experiment 1 presented unmixed lists for study, and Experiment 2 presented mixed lists for study. In both experiments, significant bizarreness effects were obtained in free recall when the retrieval set intermixed items, but not when the retrieval set consisted of only one item type. The results support the idea that retrieval dynamics mediate the bizarreness effect and, perhaps more generally, distinctiveness effects. Such retrieval effects appear to be consistent with recent theoretical models (the feature model; SIMPLE).

10:25–10:40 (723)

Releasing Retrieval Inhibition in Directed Forgetting. BARBARA H. BASDEN, DAVID R. BASDEN, & EDWARD T. COKELY, *California State University, Fresno*—With categorized lists, directed forgetting was tested when category names were provided as retrieval cues. Release of retrieval inhibition—that is, equivalent recall of Lists 1 and 2—was observed when each list contained a relatively large number of categories, but not when each list contained few categories. These results contradict the notion that list method directed forgetting may result from differential storage.

10:45–11:05 (724)

Hypermnesia, Total Retrieval Time, and Delayed Recall. NEIL W. MULLIGAN, *University of North Carolina*—Hypermnesia is an increase in recall over repeated tests. A core issue is whether hypermnesia is due to repeated testing per se or to increased retrieval time. Prior research implies an equivalence between multiple and single recall tests of equal total duration, but theoretical analyses suggest otherwise. Three experiments investigated this issue, using different study materials (unrelated word lists, related word lists, and a short story). In the first experimental session, the study materials were followed by a series of short recall tests or by a single, long test of equal total duration. Two days later, participants took a final recall test. The multiple and single test conditions produced equal performance in the first session, but the multiple test group exhibited less forgetting on the final test. Thus, single and repeated recall tests of equal total duration are not functionally equivalent but, rather, produce differences observable at a delay.

11:10–11:30 (725)

A Hierarchical Model for Estimating Group and Individual RT Distributions. JEFFREY N. ROUDER, DONGCHU SUN, PAUL L. SPECKMAN, JUN LU, & YI JIANG, *University of Missouri*—We present a new model for estimating response time distributions aggregated across groups of individuals. The model is hierarchical; it assumes that each individual's RT varies as a three-parameter Weibull

distribution, with unique parameters of location, scale, and shape. But the parameters themselves are sampled from a master distribution that represents group-level effects. Bayesian estimation of this hierarchical model is conceptually straightforward. The behavior of the model's estimates are compared with maximum likelihood (ML) estimates. For small sample size, there is an occasional tendency for the ML estimates of Weibull distributions to be unreasonably extreme. In contrast, by borrowing strength across subjects, Bayes estimation "shrinks" these extreme cases. The results are that the Bayes estimators in the hierarchical model are far more accurate than the corresponding ML estimators. The advantages of this model over the Vincentizing procedure are presented.

11:35–11:50 (726)
Benchmarking the Accuracy of Commonly Used Experiment Generators. RICHARD R. PLANT, NICK HAMMOND, & TOM WHITEHOUSE, *University of York* (sponsored by Jonathan Vaughan)—With the backing of national research funding, we have established the Experimental Timing Standards Lab (ETSL) in the U.K. to examine the issues inherent in using computers for millisecond precise behavioral research. Under the guise of ETSL, we have developed a set of component-based benchmarks and built a bespoke test rig for administering them. We have concentrated on producing a set of recognizable benchmarks that can be used to assess the absolute accuracy of the building blocks of typical studies. For example, one benchmark is a simple visual stimulus response paradigm (RSVP) where absolute presentation accuracy and response registration are examined at the submillisecond level. Initially, we have focused on applying these benchmarks against the leading three commercial experiment generators, E-Prime, ERTS, and SuperLab. This paper outlines the benchmarks and the performance of the three experiment generators in terms of absolute accuracy when running on standard hardware and operating systems.

Visual Perception III
Chicago A, Sunday Morning, 9:40–11:35

Chaired by Judith Avrahami, Hebrew University of Jerusalem

9:40–9:55 (727)
Developing a Dynamic Model for Holistic and Analytic Perception. MICHAEL J. WENGER & ANGELINA M. COPELAND, *University of Notre Dame*—The perception of meaningful, organized visual forms, such as human faces, has been hypothesized to result in an encoded representation that possesses a high degree of dependence among the constituent elements. In contrast, the perception of forms such as common objects is thought to produce encoded representations that possess much less dependence. However, to date, there have been few, if any, attempts to provide a comprehensive treatment of the manner in which such forms are perceived and encoded. We present data from an experiment involving the perception of two visual forms (faces and doors). Both reaction time and response probability measures are used to constrain the specification of a dynamic model, capable of making simultaneous predictions for both types of measures. We show how a comprehensive account of performance can be provided, while still allowing for model falsification.

10:00–10:15 (728)
Linking Brain Response and Behavior Reveals Top-Down (and Inside-Out) Influences on Face Perception. HEATHER A. WILD & THOMAS A. BUSEY, *Indiana University* (read by Thomas A. Busey)—In two electrophysiological experiments, we investigated top-down contextual influences on face and word recognition. An event-related potential component previously identified with face processing (the N170) was shown to be modulated by top-down influences produced by task differences. Subjects viewed faces and words embedded in fixed visual noise and produced a larger N170 to noise-alone trials when they expected a face. In a second experiment, we found a larger N170 on noise-alone trials when observers thought they saw a face relative to word response trials. Thus, the N170 is related to the behavioral re-

sponse for an ambiguous stimulus, even in the absence of face-like features. The results point to the intriguing suggestion that the illusion of a face in an ambiguous display may result from greater activity in the temporal lobe face region, which we term *inside-out* influences. Extensions to classification images produced with resampled noise are explored.

10:20–10:30 (729)
Effect of Cortical Arousal on Varieties of Visual-Geometric Illusions. STANLEY COREN, *University of British Columbia*—Many visual-geometric illusions containing intersecting line elements may, in part, be due to the interaction among orientation-tuned neurons in the visual cortex. Caffeine has been shown to reduce cortical inhibition and augment lateral cortical interactions; hence, one might predict that caffeine should also increase the magnitude of illusions involving intersecting line elements but would have little effect on illusions without such elements. Using doses of 0, 100, and 200 mg of caffeine, in a counterbalanced design involving testing over three sessions, these predictions were confirmed. Specifically caffeine increased the magnitude of the Wundt–Hering curvature illusion but had no effect on the Ebbinghaus size contrast illusion. For the Poggendorff illusion, caffeine increased the angular alignment illusion but had no effect on the parallel line contraction component of the illusion.

10:35–10:50 (730)
Unconscious Color Priming Occurs at Stimulus- Not Percept-Dependent Levels of Cortical Processing. BRUNO G. BREITMEYER, *University of Houston,* TONY RO, *Rice University,* HALUK OGMEN, *University of Houston,* NEEL S. SINGHAL, *Rice University,* & JIAN CHEN, *University of Houston*—Using a metacontrast paradigm, we show that unconscious color priming is better explained in terms of physical, wavelength-dependent processes, rather than perceptual, color-dependent processes. Moreover, when an additional paracontrast mask is used, the color-priming effect is greatly reduced. Together, these studies indicate that unconscious color priming (1) occurs at lower (V1 or V2), rather than higher (V4 or V8), levels of cortical processing and (2) is due to the early component of neuronal responses.

10:55–11:10 (731)
Perceiving Sequential Constraint in Sequences of Categorical Events. JOHN H. FLOWERS & LAURA E. WHITWER, *University of Nebraska, Lincoln*—Biased judgment heuristics such as *local representativeness* can affect the ability to detect patterns of sequential constraint in event streams and the ability to discriminate between "random" and constrained sequences. We describe a set of experiments demonstrating that choice of display format can modulate the impact of such biases and the ability to perceive weak to moderate constraint per se. For example, use of colored symbol streams to represent sequential categorical data (e.g., protein sequences) may be an especially poor choice for illustrating sequential structure, since that format encourages concentration of visual attention on local similarity groupings of events.

11:15–11:30 (732)
Audiovisual Temporal Order Judgments. CHARLES SPENCE & MASSIMILIANO ZAMPINI, *University of Oxford,* & DAVID I. SHORE, *McMaster University*—All previous multisensory research using temporal order judgments (TOJs) have presented stimuli from different locations. We assessed whether people can use spatial cues when making multisensory TOJs. Auditory and visual stimuli were presented from the left and/or the right of fixation at varying SOAs. Participants made an unspeeded TOJ regarding either which modality (E1) or which side (E2) was presented first. Other observers made a simultaneous/successive judgment (E3). Observers were more precise in multisensory TOJs when stimuli came from different locations, rather than from the same location, thus highlighting one important methodological confound present in previous research. Observers were more precise when making a modality judgment than when making a spatial judgment. Finally, observers were more likely to judge pairs of auditory and visual stim-

uli as being simultaneous if they come from the same rather than from different positions, supporting the important status of space in multi-modal binding.

Animal Cognition
Chouteau, Sunday Morning, 10:15–12:00

Chaired by Richard A. Burns, Southeast Missouri State University

10:15–10:30 (733)
Imitative Learning in Japanese Quail, Using the Bidirectional Control Procedure. THOMAS R. ZENTALL, CHANA K. AKINS, & EMILY D. KLEIN, *University of Kentucky*—In the presence of an observer, demonstrator quail pushed a feeder-blocking screen in a particular direction (either left or right) to obtain food. Following observation, the observers showed a strong tendency to push the screen in the direction they had observed it pushed by the demonstrator, although for the observers, pushes in either direction were reinforced. Control observers saw the screen move in a particular direction in the presence of a demonstrator trained to wait for the screen to move before it ate (the screen was moved by the experimenter from outside the chamber). These observers showed no inclination to push the screen in the direction they had observed it pushed. Thus, there was no evidence of *object movement reenactment*. Overall, these results support the findings of experiments that have used the two-action method (e.g., stepping on a treadle vs. pecking at a treadle) to demonstrate imitative learning in animals.

10:35–10:55 (734)
Development of and Conditional Control by "Unsignaled" Differential Sample Responding. KAREN M. LIONELLO-DᴇNOLF, *Eunice Kennedy Shriver Center,* & PETER J. URCUIOLI, *Purdue University* (read by Peter J. Urcuioli)—Sidman (2000) hypothesized that responses, as well as stimuli, can become members of equivalence classes. His idea is difficult to test because differential responding usually requires different occasioning stimuli, creating an obvious confound. In an effort to avoid this confound, we describe a procedure in which pigeons learn to emit different response patterns to a common visual stimulus. We also show that differential behavior to this mixed-schedule stimulus serves as an effective cue for comparison choice in a matching task. Furthermore, when substituted for similar behavior conditioned to visually distinct samples, these *unsignaled* differential responses support transfer of control.

11:00–11:20 (735)
Same/Different Abstract Concept Learning by Two Monkey Species and Pigeons. ANTHONY A. WRIGHT, *University of Texas Medical School, Houston,* & JEFFREY S. KATZ, *Auburn University*—Same/different abstract concept learning was shown, for the first time, to vary as a function of the stimulus training set size for rhesus monkeys, capuchin monkeys, and pigeons. The different species were trained in similar same/different tasks with the same stimuli. There was no abstract concept learning with the initial 8-item set. Concept learning increased with set size, and all species obtained complete concept learning, indicating qualitatively similar concept learning processes. There were quantitative differences in the training set size for complete concept learning (up to 1,024 items) and differences in the observing response requirements for initial task learning.

11:25–11:35 (736)
Pigeons Use Specific and Consistent Features to Discriminate Human Faces. BRETT M. GIBSON, *University of Iowa,* FRÉDÉRIC GOSSELIN, *University of Montreal,* EDWARD A. WASSERMAN, *University of Iowa,* & PHILIPPE G. SCHYNS, *University of Glasgow* (sponsored by Gregg C. Oden)—Four feral pigeons were trained to discriminate 32 pictures of human faces on a computer display. Two of the birds were trained to discriminate between faces that were either expressive or neutral (emotion discrimination), whereas the other 2 birds were trained to discriminate between faces that were either female or male (gender discrimination). The birds then were presented with bubbled images of the training stimuli that sampled the features of the faces. Choices during testing were considered indicative of what features of the face the birds were using to make the discrimination. The early results indicate that pigeons, like humans and ideal observers trained with the same images (Gosselin & Schyns, in press), consistently use specific regions of the face when discriminating either emotion or gender. Furthermore, the regions of the face that pigeons use overlap somewhat with the regions that people and ideal observers use.

11:40–11:55 (737)
Inherent Versus Acquired Rules in Rats' Serial Pattern Learning. JEROME S. COHEN, WESTLAKE J. KIMBERLY, & IZABELA SZEL-EST, *University of Windsor*—When required to learn two three-trial serial patterns of RNR and RRN sequences in a T-maze, rats acquired these patterns more easily when they conformed to an inherent *win–shift* than an acquired *win–stay* rule for pairs of trials. Under either rule condition, however, rats were able to integrate both series to always choose a baited arm under free-choice conditions. These findings were derived from an experiment consisting of two independent groups of rats. The question arises whether a rat can acquire serial patterns that are consistent and inconsistent with the win–shift rule on the basis of conditional context cues of food type and lighting of the apparatus. Evidence for such higher order acquisition and integration of aspects of each type of serial pattern will be presented and discussed.