

Papers and Posters Presented at the 41st Annual Meeting of the Psychonomic Society  
Hyatt Regency Hotel, New Orleans, Louisiana  
November 16–19, 2000

POSTER SESSION I

French Market Exhibit Hall, Thursday Evening, 7:00–8:30

• PERCEPTION •

(1)

**Ventriloquism: Implications for an Auditory/Visual Spatial Map.** POPPY A. C. CRUM, ERVIN R. HAFTER, & WESLEY K. NURSS, *University of California, Berkeley*—This study explores the lingering effects of visual capture as defined by Recanzone (*Proc. Nat. Acad. Sci.*, 1998, **95**, 869-75) who showed an influence of visual stimuli on the perceived location of an auditory target after the visual signal was removed. Our subjects first responded to the location of 700-Hz tones presented without visual stimuli from a number of locations in anechoic space. They then performed a 25-min, nonspatial task in which tones were presented from a subset of locations simultaneously with spatially mismatched lights. Finally, a repetition of the auditory task alone provided support for a more global visual influence, with the effects of the spatial mismatching being found regardless of whether the individual exemplars had or had not been paired with a light.

(2)

**When Apparent Depth Affects Perceived Lightness Contrast.** FREDERICK BONATO, *Saint Peter's College*, & JOSEPH CATALIOTTI, *Lafayette College*—Some investigators have claimed that lightness illusions, such as simultaneous lightness contrast, are perceptual by-products of retinal processing (lateral inhibition). Other investigators have stressed the importance of perceptual organization processes that must occur higher up the visual pathway. We will present examples of lightness contrast illusions that may be influenced by apparent depth relationships. Factors that will be addressed include border junctions, shape from shading, and texture similarity. Results indicate that when targets and backgrounds are perceptually separated in depth, lightness contrast is sometimes reduced. More specifically, T-junctions significantly affect perceived depth separation and lightness contrast, shape from shading affects perceived depth separation but does not affect lightness contrast, and texture similarity by itself affects neither perceived depth separation or lightness contrast. Results strongly suggest that contrast effects can be affected by depth processing that occurs beyond the retinal level.

(3)

**Retrospective and Prospective Influences on Performance During a Visuomotor Search Task.** IAN M. THORNTON, *Max Planck Institute for Biological Cybernetics, Tübingen*, & TODD S. HOROWITZ, *Brigham and Women's Hospital*—We used a simple visuomotor task to explore retrospective and prospective aspects of search. Observers sequentially clicked through a series of target items (e.g., letters A–J), randomly distributed within a  $12^\circ \times 12^\circ$  viewing area. In Experiment 1, all target items were initially visible and we varied whether they remained visible or vanished after selection. Reaction time decreases, as a function of target position, were identical in both conditions. In Experiment 2, we isolated the retrospective component. Here, only one target item was initially present while the remaining locations contained distractor items. As each target was selected, the next target appeared, replacing one of the distractor items. Again, reaction time decreased roughly linearly in both vanish and remain conditions, however, the efficiency of remain trials was substantially reduced compared with that of vanish trials. These findings suggest that both *what you did* and *what you intend to do* can influence search performance.

(4)

**Discrepancy Between Perception and Cognition of Effects of Gravity and Inertia on Object Motion.** IN-KYEONG KIM, *La Sierra University*—This study examined college students' common sense knowledge of effects of gravity and inertia on object motion. Participants were presented with a ramp and two kinds of balls (heavy and light) and asked to judge the final position of the ball if it was placed on top of the ramp (cognition task). They were then asked to perceive 18 actual motions of heavy and light balls (natural and unnatural) on video and asked to compare the naturalness of motions (perception task). Half of the participants did vice versa. The results showed they judged the heavy ball closer to the ramp than the light ball and the light ball closer than the actual position, suggesting dominant effects of gravity, consistent with Spelke's Core knowledge thesis. Discrepancy was found between perception and cognition, and perception of the motion prior to cognition task didn't improve the judgment, suggesting possible two knowledge systems.

(5)

**Distortions in Body Orientation Follow Egocentric Rather Than World-Based Coordinate System.** JOHN G. JEWELL, *Ursinus College*, MICHAEL K. McBEATH, *Arizona State University*, & DIANE J. SCHIANO, *Stanford University*—We previously showed that perception of body orientation is dramatically distorted when people estimate being at a  $45^\circ$  tilt. People typically experience that they are tilted nearly twice as much as actual, with little effect due to whether their eyes are open or closed. In the present study we examined whether this distortion is principally based on egocentric or world coordinates. We tilted subjects  $45^\circ$  from both vertical and horizontal starting orientations. To the extent that the coordinate system is egocentric, overestimation of tilt should be relative to the starting orientation. To the extent that it is world based, judgments should converge, independent of starting orientation. We found that both coordinate systems have some impact, but that judgments of body tilt are primarily based on egocentric coordinates. The findings confirm how position perception can change as a function of somatosensory information and further strengthen the notion of a multisensory representation of space and body orientation.

(6)

**Plasticity in Somatosensory Representation Subsequent to Cortical Damage.** SHARMA K. HENDEL, BRENDA RAPP, FRANCISCO VEGA-BERMUDEZ, & STEVEN HSIAO, *Johns Hopkins University*—Issues of neuronal plasticity in the somatosensory system have been examined primarily in the context of amputation and extensive practice. This work considers data from cortical damage. We report on two individuals with parietal lobe damage who exhibit intact abilities in detecting the presence/absence of brief stimuli to the contralesional hand. Their good detection abilities are in striking contrast with their impaired localization of stimuli presented to certain locations. Mislocalization responses are distributed in a systematic manner such that locations are systematically shifted proximally. Additionally, for one of the subjects, thresholds for vertical/horizontal grating discrimination were evaluated. He displayed normal thresholds despite poor localization. These data indicate that correct identification of stimulus attributes may take place without correct knowledge of stimulus location. We discuss these findings in the context of hypotheses of cortical remapping and unmasking.

(7)

**Mental Rotation of Facial Components and Configurations.** ADRIAN SCHWANINGER, *University of Zurich*, FRED MAST,

*Harvard University*, & HEIKO HECHT, *MIT*—We investigated the effect of orientation upon the visual processing of faces. Experiment 1 revealed that participants could detect changed components (eyes and mouth) independent of orientation. In contrast, when configural changes had to be detected (increased distances between components, Experiment 2), orientation had a detrimental effect upon accuracy. Both experiments yielded a linear increase in response time. The results support the view that rotated faces overtax an orientation normalization mechanism and therefore have to be processed by mentally rotating facial features individually. The analysis of transfer effects (Experiment 1 followed by Experiment 2, and vice versa) revealed that error scores were generally reduced in the second experiment. This finding is not compatible with the assumption that two separate mechanisms are responsible for processing components and configurations and thus gives further support for mental rotation's being involved in both experiments.

(8)

**Effect of Break Frequency in Interrupted Time Production.**

CLAUDETTE FORTIN & CINTHIA CARON, *Université Laval*—We showed in previous experiments that expecting a break, during a time interval production, lengthens produced intervals proportionally to the duration for which the break is anticipated. In this experiment, we tested whether the effect varied with the proportion of interrupted intervals. Two groups of participants were tested in two conditions of high and low proportion of trials with breaks. In both conditions, produced intervals were linearly related to the duration for which the break was expected. The proportion of trials with breaks interacted with the expectation duration: The slope of produced intervals as a function of expectation duration was weaker when breaks were rare than when they were frequent. We conclude that attentional shifts between time estimation and expecting its interruption are influenced by the proportion of interrupted intervals.

(9)

**Temporal Integration Between Visual Memory and Perception.**

JAMES R. BROCKMOLE, RANXIAO FRANCES WANG, & DAVID E. IRWIN, *University of Illinois*—Previous studies on visual processing have shown that serially presented stimuli are perceptually integrated when the delay between them is short (<100 msec). To study whether integration can occur between visual memory and percepts, we systematically varied the temporal separation between two sequentially presented dot arrays in a grid, which filled all but one position. As in previous studies, accuracy at identifying the missing dot decreased sharply from 0 to 100 msec, suggesting a very small temporal window for integration between percepts. However, with delays longer than 500 msec accuracy improved and nearly reached the original level when the two arrays were separated by 1,500 msec. This level of performance was maintained through delays of 5,000 msec. These results suggest images in memory can be combined with ongoing perceptual information. Given time to create and access what is in memory, we can improve our ability to construct complete visual representations.

• ATTENTION •

(10)

**Incidental Learning of Task Shifts.**

IRING KOCH, *Max Planck Institute for Psychological Research, Munich*—Switching tasks is typically associated with a performance cost. Intentional preparation can reduce such switch costs when the interval between the explicit instructional cue and the stimulus is long enough. The question addressed in the present study was whether task preparation can be based on incidental learning. In the experiments, subjects performed a complex repeating sequence of precued tasks, but stimuli and responses were unpredictable. At the end of training, the repeating task sequence was replaced with a random sequence. With short cue–stimulus interval (CSI), RTs indicated task sequence learning, that, however, did

not affect switch costs but only general RT level. This incidental learning effect disappeared with long CSI, that is, when intentional advance preparation was possible. Together, the results suggest that incidental learning leads to nonspecific, automatic priming of task sets, whereas intentional processes can specifically prepare for a task shift.

(11)

**Attention During Adaptation Weakens Negative Afterimages.**

SATORU SUZUKI & MARCIA GRABOWECKY, *Northwestern University*—Can selective attention during adaptation modulate the strength of subsequent negative afterimages? We investigated this question in a series of experiments in which observers voluntarily directed their attention to one of two geometric figures during an adaptation period. Across a series of different stimulus conditions, afterimages were generally weaker for the previously attended figure. We manipulated ease of attentional selection by varying color and relative motion of the two stimuli. When selection was subjectively easier, the effect of attention was more pronounced. If afterimages are produced only by cells that are sensitive to stimulus contrast polarity, and if we assume that attention enhances neural activity of those cells and thereby accelerates adaptation, attention to a stimulus should produce a stronger afterimage. The fact that attention during adaptation weakens (rather than strengthens) negative afterimages suggests that attention facilitates adaptation of neurons at a contrast-polarity invariant level of processing.

(12)

**Attentional Momentum Does not Underlie the Inhibition of Return Effect.**

JANICE J. SNYDER, *University of Pennsylvania*, WILLIAM C. SCHMIDT, *SUNY, Buffalo*, & ALAN KINGSTONE, *University of British Columbia*—Inhibition of return (IOR) is characterized by longer response time (RT) for a target rather than at a cued than at an uncued location. Pratt, Spalek, and Bradshaw (1999, *JEP:HPP*) reported that an inhibitory effect at the cued location co-occurs with a facilitatory effect at the uncued location opposite the cued location. They suggested that *attentional momentum* away from a cued location and toward an uncued opposite location is primarily responsible for IOR. Three experiments plus a re-analysis of the Pratt et al. data indicate that RT can be facilitated at an uncued opposite location; however, this momentum effect occurs for only a small minority of participants, in only a small subset of possible cue–target directions, and is uncorrelated with the occurrence or magnitude of IOR. Hence, the attentional momentum effect does not underlie the robust and reliable IOR effect.

(13)

**The Effect of Color Temperature on Color-Naming Latencies.**

MARILYN K. HOFFMAN & ROBERT J. CRUTCHER, *Metropolitan State College of Denver*—Artistic theories of color “temperature” assert that color can create the illusion of space, with warm colors (red, yellow, and orange) appearing to advance toward the viewer while cool colors (green, blue, and violet) appear to retreat (Sargent, 1964). Psychological studies have used physiological measures (e.g., galvanic skin response) to show that red and yellow are more arousing than blue and green (Valdez & Mehrabian, 1994). The current study investigated the psychological validity of the color temperature construct from an attention resource perspective, hypothesizing that warm colors would grab greater attentional resources than cool colors, thereby producing faster color-naming times. In addition, this perspective predicted a moderation of the typical Stroop interference effect for warm versus cool colors. The results revealed the predicted main effects of color temperature and the Stroop task on color-naming times but no interaction of the two factors.

(14)

**Reducing Costs of Switching Between Well-Learned Response Sets.**

FRANCES J. FRIEDRICH, KHENA M. SWALLOW, & JAMISON D. FARGO, *University of Utah*—An executive control system or

anterior attention network (AAN) is commonly thought to be required when novel responses are generated or attention is switched between tasks. However, once a response becomes well learned, such a system appears no longer to be needed (e.g., Posner & Petersen, 1990). These experiments investigated whether the switching process itself can be made sufficiently routine such that the AAN is not required and switch costs are eliminated. Participants switched between two response sets associated with a given target; the appropriate response set was cued at a short (600-msec) or long (1,200-msec) SOA prior to the target onset. In some cases a longer SOA or predictable trial sequence reduced switch costs, but even when the response was completely predictable, costs were not eliminated. These findings are consistent with previous suggestions that task set reconfiguration cannot be completed prior to target presentation (Rogers & Monsell, 1995).

(15)

**Desperately Seeking Memory in Visual Search.** TODD S. HOROWITZ, GEORGE A. ALVAREZ, & JEREMY M. WOLFE, *Harvard Medical School*—A standard assumption of visual search models has been that the visual system avoids devoting resources to nontargets by marking rejected distractors. In several experiments, we have found no evidence for this sort of memory in visual search. Here we used a new paradigm measuring detection time rather than reaction time. Subjects searched for a mirror-reversed S or P, with other letters as distractors. Each letter was randomly red, green, blue, or yellow. At some transition time, all letters changed color. Subjects reported the color of the target when they found it. We measured the probability of not finding the target as a function of transition times. This function should decrease linearly if there is memory, and exponentially if there is no memory. Over 130 to 1,300 msec, there is no evidence for memory. However, there is a hint of a limited-capacity (i.e., 2-back) memory in the first 130 msec.

(16)

**Distractor Interference in the Absence of Awareness.** TONY RO & NEEL SINGHAL, *Rice University*—When a target is flanked by irrelevant distractors, responses to the target may be facilitated or delayed based on the congruency of the target with the distractors. This flanker interference effect has been previously shown to occur even in the absence of attention to or awareness of the distractors. We used a variant of this interference paradigm to further explore the effects produced by stimuli that are and are not consciously registered by an observer. A series of experiments employed a metacontrast masking paradigm where a target stimulus masked the distractor. Although thresholds for conscious perception of the distractors were measured in different ways across these experiments, the results always demonstrated an interference generated by the unconscious distractors. However, the magnitude of the interference effect was dependent on a number of different factors that will be discussed.

(17)

**Selective Attention and the Size of the Cued Region.** MIGUEL MORENO, HEATHER M. KLEIDER, & DON HOMA, *Arizona State University*—The present study investigated how an exogenous cue (momentary brightening) impacts attention to probes that occur briefly within spatial regions of varying size. The procedure of Bohnsack and Homa (1996) was adopted, but with a couple of refinements. In general, a single probe usually appeared between 2 vertical lines of varying length, and the task was to make a speeded discrimination to the target (< or >) that appeared there. On valid trials, the target appeared within the region of vertical bars that was momentarily brightened. On invalid trials (20%), the target appeared on the side contralateral to the cue. Unlike Bohnsack and Homa, three levels of brightening of the cue were used, and the target was not always centered on the horizontal meridian. The results generally reaffirmed the previous findings of speeded responses to cued-valid versus cued-invalid trials, with RT systematically increased by the size of the cued region.

(18)

**Effects of Geometric Structure of Objects on Attentional Selection.** JUN SAIKI, *Kyoto University*—The effect of geometric structure of objects on attentional selection was investigated by a speeded feature comparison task. Subjects were presented two sets of sticks attached to an object, and judged the number of sticks. When the distance between features was constant, there were effects of object's geometric properties. Feature comparison was facilitated when the object is composed of homogeneous texture elements and when the object is composed of a single connected region. These results were consistent with the notion of uniform connectedness as a unit to which visual attention is directed. However, some properties such as closure, local branching structure, and the consistency of curvature produced significant differences among uniform connected regions in the efficiency of attentional selection, suggesting that a uniform connected region is decomposed into parts quickly, or that uniform connected regions are not really the unit to which attention is directed.

(19)

**Do Worry, Be Happy: Stress Improves the Ability to Ignore Irrelevant Information.** DANIEL ALGOM, *Tel-Aviv University*, & ERAN CHAJUT, *Israel Open University*—Traditional approaches hold that attention is narrowed under stress, whereas a recent influential approach holds that attention is rendered less oriented and vulnerable to distraction under stress. To decide between the competing theories, the ability to focus on the task-relevant dimension of complex stimuli and the complementary ability to ignore irrelevant variation was tested under high and low stress conditions. The selectivity of attention was gauged through Stroop and Garner interference. Results supported the prediction based on the traditional approach: The selectivity of attention improves under stress. By the same token, the influence of stress on psychological functioning is not inevitably harmful.

(20)

**Guidance of the Eyes by Contextual Cues and Abrupt Onsets.** MATTHEW S. PETERSON & ARTHUR F. KRAMER, *Beckman Institute, University of Illinois, Urbana-Champaign*—Contextual cuing is a memory-based phenomenon in which previously encountered global pattern information in a display can automatically guide attention to the location of a target (Chun and Jiang, 1998), leading to rapid and accurate responses. By monitoring eye movements, we investigated the roles that recognition and guidance play in contextual cuing. Recognition does not appear to occur on every trial and sometimes does not have its effects until later in the search process. In Experiment 2, we investigated the interaction between memory-driven search (contextual cuing) and stimulus-driven attentional capture by abrupt onsets. Contextual cuing was able to override capture by abrupt onsets. In contrast, onsets had almost no effect on the degree of contextual cuing. These data are discussed in terms of the role of top-down and bottom-up factors in the guidance of attention in visual search.

(21)

**Switching Costs for Different Cognitive Operations on the Same Stimulus Set.** PADMANABHAN SUDEVAN, JOHN HOLMES, NATASHA RUETH, PATRICK BLOOM, & GARY HARDCASTLE, *University of Wisconsin, Stevens Point*—We compared task switching costs using two classification operations on the same set of letter stimuli, using the same response keys, in a new switching paradigm involving performance in pairs of tasks repeated or switched within a trial with a long intertrial interval. In contrast to previous experiments using different stimuli, operations and responses, we found that (1) using the same stimulus set produced reaction times (RTs) that were substantially slower than in previous experiments using different stimulus sets and responses, in the conditions where the two tasks were repeated within a pair but varied across pairs, relative to task repetition; and (2) RTs in the condition where tasks were switched within

a trial were slowest and displayed switching costs relative to task repetition that were greater than in previous experiments using different stimulus sets. We discuss the implications of these results.

(22)

**Perceptual Versus Attentional Sources of Dual-Task Costs.** KAREN M. ARNELL, HEATHER B. TRANGSRUD, JASON HAMMES, & JULIE M. LARSON, *North Dakota State University*—Duncan, Martens, and Ward (1997) found dual-task costs when two targets were presented closely in time in the same sensory modality, but not when presented in different modalities. They suggested that the limitations that underlie the attentional blink (AB) were attentional, but within modality in nature. We largely replicate Duncan et al. using their program and stimuli; however, we find the same pattern of results even when all filler masking stimuli are removed from the visual and auditory displays. This suggests a perceptual locus of interference for the within modality dual-task costs, given that previous research has found true AB to be present only when the second target is backward pattern masked. In follow-up experiments, the presentation conditions are changed, and the AB presence in each of the modality conditions is investigated. Results reinforce the need for removing the possibility of perceptual interference before positing modality specificity of attentional resources.

(23)

**Towards Unification of Inhibitory Processes: Latent Inhibition of Stimulus Dimensions.** HENNING GIBBONS & THOMAS H. RAMMSAYER, *University of Göttingen*—Latent inhibition (LI) refers to the finding that performance on a learning task is poorer for a preexposed irrelevant stimulus than for a novel stimulus. Recently, analogs of LI have also been demonstrated with nonlearning tasks. The present experiment aimed, for the first time, at investigating the effect of preexposure on the processing of stimulus dimensions, such as color or size, rather than specific stimuli. A LI-like effect for stimulus dimensions could be established as indicated by a decrease in processing speed of stimulus dimensions that were previously introduced as irrelevant compared with a control condition. This finding not only provides converging experimental evidence for attention-based explanations of LI but is also consistent with the notion of a general concept of inhibitory cognitive processes.

(24)

**A Reverse Task Switching Effect in a Dual Task: Importance of Response–Response Spatial Correspondence.** MEI-CHING LIEN, RICHARD SCHWEICKERT, & ROBERT W. PROCTOR, *Purdue University*—Three psychological refractory period experiments were conducted to examine the effects of task switching and response–response correspondence. The letter and digit tasks of Rogers and Monsell's (1995) study were used to form four dual-task pair types: letter and letter, letter and digit, digit and digit, and digit and letter. The predictability of a switch was varied across experiments. In Experiment 1, each block contained all task pairs. In Experiment 2, switching condition was blocked, and the types of the two tasks were unknown until the onset of S1. In Experiment 3, the uncertainty of switch and task type was eliminated by presenting one task pair in each block. A large reverse task-switching effect was obtained (1) when the task switch was known in advance and (2) when the response locations did not correspond. Possible models and explanations are discussed.

(25)

**An Attentional Dwell Time Account of Auditory Interference in a Visual Detection Task.** MELANIE BUCKING & PHILIP SERVOS, *Wilfrid Laurier University*, & KEITH HUMPHREY, *University of Western Ontario*—Attentional dwell time theory states that the first of two successive stimulus events will interfere with the processing of the second event. In a detection task, following a two-cycle tone, observers were presented with a suprathreshold sinusoidal grating at one of three contrasts. Stimulus onset asynchrony (SOA), the interval be-

tween the auditory and visual event, was varied in three experiments. Reaction times (RTs) were used to measure the interference of the auditory signal on the visual detection task. Although observers were not required to respond to the auditory cue, processing of the tone interfered with detection of the visual stimulus. In all three experiments the shortest SOA produced the slowest RTs—consistent with the dwell time theory of attention. Previous work has not documented such interference effects using accuracy. Thus, RT may be a more sensitive measure of interference when observers must detect the second of two stimulus events in a task requiring cross-modal shifts of attention.

(26)

**Task and Location Switching Effects on the Attentional Blink.** JAMES F. JUOLA, *University of Kansas and Universidad Autónoma de Madrid*, & JUAN BOTELLA & ANTONIO PALACIOS, *Universidad Autónoma de Madrid*—A stream of 14 characters (100 msec each) was presented in Experiment 1, and a pair of streams on either side of fixation was presented in Experiment 2. On each trial, two targets appeared (either white letters, black digits, or one each) at six different lags among black letter distractors. Experiment 1 found that report of the first target was lowest if it immediately preceded the second target, but report of the second target was lowest if one or two distractors intervened between the two targets (the attentional blink). These effects interacted with both target type and whether or not participants knew which targets to expect. Experiment 2 added location uncertainty as a factor and found similar effects as Experiment 1 with one exception. Lag 1 sparing was observed for task switching between target type, but not for switching across locations, in agreement with Visser, Bischof, and Di Lollo (1999).

(27)

**Asynchronous Presentation and Capacity Issue: The ABC of Visual Search.** DENIS COUSINEAU & RICHARD M. SHIFFRIN, *Indiana University*—Visual search is generally seen as a superposition of three processes: (1) a scanning process, which allows attention to move from one object to the other; (2) a stopping rule, which specifies how a search is terminated in the case no match is found; and (3) a recognition mechanism. Using more elaborate analyses, we provide evidence that the scanning process is serial and the stopping rule is close to exhaustive. We also show (through the lack of a FIFO effect and a look at the distributions of reaction times [RT]) that the beginning of the search also has important implications for understanding of the RT. We introduced two variations in the tasks, manipulating the asynchrony between objects and between features of the objects. Finally, a complementary feature detection task, performed in parallel with the search task, permits a description of the capacity limits of the subjects, the recognition mechanism, and the binding-of-features problem.

(28)

**A New Object Reduces, Not Eliminates, Masking Effects.** PATRICIA O'NEILL & ZHE CHEN, *University of Mississippi*—Can the appearance of a new object reduce masking effects? Observers searched for an upright C among rotated and inverted Cs ("non-pop-out" search) or for an upright C among Os ("pop-out" search). Set sizes of 2 and 4 were used. At the start of each trial, three placeholders were presented followed by the search display. On every trial, one of the search items appeared in a location previously unoccupied by a placeholder. A mask was presented at varying stimulus onset asynchronies. The target, if presented, was always masked. The target could be either a new object or an old object. For the pop-out search, the object effect was significant. For the non-pop-out search, both the object effect and the set size effect were significant. These results suggest that a new object does not completely capture attention on every trial.

(29)

**The Reliability of Object-Based Attention Following Peripheral and Central Cues.** CATHERINE M. ARRINGTON, *Michigan State University*, DALE DAGENBACH, *Wake Forest University*, &

MAURA K. McCARTAN & THOMAS H. CARR, *Michigan State University*—Recent studies of object-based attention using the Egly, Driver, and Rafal (1994) rectangles task with either peripheral or central cues have reported conflicting results. All studies have found object-based attention following peripheral cues, but the findings are mixed for central cues. We investigated the test–retest reliability of this task. In a completely within-subjects design, participants completed two sessions where data were collected for a peripheral cue and a central cue version of the rectangles task in which all other task variables were held constant. Analysis of mean RTs showed object-based attention following peripheral but not central cues. Across sessions, there was a significant correlation of cuing effects following peripheral but not central cues. The lack of correlation across sessions for central cues indicates that the task with central cuing is less reliable. This may explain the mixed results in past reports. Possible sources of the observed unreliability will be discussed.

• COGNITION •

(30)

**An Eye Movement Examination of Mental Box Folding.** BRETT MILLER, DONALD FISHER, IBRAHIM HAKKI, ALEXANDER POLLATSEK, & KEITH RAYNER, *University of Massachusetts, Amherst*—The role of visualization was investigated using the paper folding task developed by Shepard and Feng (1972). Eye movements were recorded while participants were asked to mentally fold a depiction of an unfolded strip of paper into a cube-like object. Each person was asked to indicate the position of the terminal square that possessed a bar in reference to the constructed object and report which side the bar would appear on after all of the folds had been completed. Differences due to gender, spatial ability, whether or not the unfolded strip was actually derived from a cube, and the number of folds was investigated. A processing account for the paper folding task will be discussed.

(31)

**Processing of Signed and Unsigned Numbers.** STACEY A. FRIEL & BRUCE W. CARLSON, *Ohio University*—Although an abundance of research addresses the psychological processing of positive numbers, research investigating the processing of negative numbers is nonexistent. Findings in numerical comparison research with positive numbers have uncovered three robust effects: the symbolic distance effect, the magnitude effect, and the semantic congruity effect. The present research investigated the processing of negative numbers using a numerical comparison task. Participants compared both positive and negative target numbers to both positive and negative standards. The symbolic distance effect was observed for both kinds of numbers, suggesting that few differences exist in the processing of positive and negative numbers.

(32)

**The Relation Between Visual–Spatial Processing and Arithmetic Performance.** PATRICIA TRBOVICH, DIANA DESTEFANO, MARCIE PENNER-WILGER, & JO-ANNE LEFEVRE, *Carleton University*—The relation between visual–spatial processing and arithmetic performance was examined using a dual-task methodology. Participants solved addition problems while performing a visual–spatial memory task at three levels of difficulty. Addition problems were presented at two levels of difficulty: carry (e.g., 23+8) and no carry (e.g., 23+4). On carry problems, increasing the difficulty of a visual memory load resulted in a decrease in latencies. In contrast, no-carry problems showed a small increase in latencies as memory load increased. These findings suggest that taxing spatial processing resources enhanced performance on the carry problems by influencing the strategy used to solve the arithmetic problem. The results will be discussed with respect to how the strategies used to solve addition problems may vary with the structural characteristics of the problem.

(33)

**Police and Citizen Expectations About Robberies of Convenience Stores.** CLAUDIA J. STANNY, CYNTHIA BENAVIDES, KIMBERLY GASTON, & PATRICK MALLOY, *University of West Florida*—Scripts describing events expected during a convenience store robbery were obtained from 45 police officers and 39 university students. Participants were asked to describe 20 events they would expect to witness during a robbery when the robber was overtly violent (46 scripts) or when the robber only made threats (38 scripts). Responses were coded as actions, descriptive details (such as physical characteristics of the perpetrator), or evaluative comments (thoughts and intentions). Police and students reported more actions ( $M = 20.6$ ) than descriptions ( $M = 4.0$ ) or evaluative comments ( $M = 2.3$ ) and reported significantly more descriptive details when the robbery was explicitly violent. Rates of reporting actions and evaluative comments did not vary with level of robbery violence. Qualitative comparison of the content of scripts written by police and students will be discussed.

(34)

**Semantic Satiation Effects and Long-Term Memory.** MAURA PILOTTI & AYESHA KHURSHID, *Washington University*—The present study examined the effect of semantic satiation on long-term memory. Subjects first performed a semantic relatedness task on prime-target pairs with the prime words repeated 2, 15, or 30 times. In this task, massed repetition yielded semantic satiation effects. Subsequently, subjects performed a surprise recognition memory task involving the prime words of the earlier satiation phase intermixed with novel words. Recognition memory of the prime words varied as a function of the number of times these words had been repeated in the earlier phase. The results are discussed in terms of current models of semantic satiation.

(35)

**Speech and Action Control: On the Dynamics of Verbal–Manual Response–Response Compatibility Effects.** DORIT WENKE & PETER A. FRENCH, *Humbolt University, Berlin*—In three experiments, the hypothesis has been tested that verbal self-instructions mediate stimulus–response translation in the initial phase of performing a new task with arbitrary S–R mappings. To this end, research participants concurrently performed a verbal and a manual task that required activation of the same or different codes (“left” and “right”), according to arbitrary S–R mappings. To study the dynamics of verbally induced response conflict, we investigated the influence of SOA, practice, the change of S–R mappings on one dimension, and the requirement to discriminate between two stimuli and responses. Results will be discussed as they relate to current research on response–response compatibility. The implications of the findings for current models of action control will be assessed.

• HUMAN LEARNING/MEMORY •

(36)

**Effects of Triazolam on Brain Activity During Episodic Memory Encoding.** MIRIAM Z. MINTZER, *Johns Hopkins University School of Medicine*, MONIQUE ERNST, *National Institute on Drug Abuse/IRP*, ROLAND R. GRIFFITHS, *Johns Hopkins University School of Medicine*, & CARLO CONTOREGGI, VARUGHESE KURIAN, ALANE KIMES, & EDYTHE D. LONDON, *National Institute on Drug Abuse/IRP*—It is well documented that acute administration of the benzodiazepine sedative/hypnotic triazolam (Halcion®) impairs episodic memory encoding. We examined the neuroanatomical substrates of this effect in a two-session, double-blind, within-subject design in healthy volunteers. Following oral drug administration (0.25 mg/70 kg triazolam or placebo), regional cerebral blood flow (rCBF) was measured using positron emission tomography (PET) with  $^{15}\text{O}$ -H $_2$ O during the performance of semantic categorization (encoding), orthographic categorization (control), and visual

fixation (resting) tasks. While results in the placebo condition replicated those of previous nondrug encoding studies (activation of the left prefrontal cortex; Brodmann areas 9, 10, 11, 46, 47), triazolam significantly decreased activation relative to placebo during encoding. Results are discussed in relation to triazolam's effects on mnemonic versus attentional processes.

(37)

**Effects of Implicit Versus Explicit Grammar Learning on Generativity and Fluency of Acquired Knowledge.** THOMAS J. DOMANGUE & ROBERT C. MATHEWS, *Louisiana State University*—Participants were trained to recognize instances of an artificial grammar either by bubbling-in the letters in each string on an answer sheet (implicit training) or tracing the path of letters in each string through a diagram of the grammar (explicit training). Performance was measured using a computer-assisted cued generate task that provided a template for a string with two letters filled in and the rest represented by dashes. Participants attempted to generate a string that fit the template. The computer assisted participants in correcting their generated string when it was close (70% correct or better). It was found that explicit training with the grammar led to greater fluency, defined as generating higher quality strings. However, implicit training was just as effective for generativity, defined as the ability to generate reasonably good strings to fit into a wide variety of contextual cues.

(38)

**Modeling the Role of Perceptual Features in Word Recognition and Fragment Completion.** MELANIE CARY & LYNNE M. REDER, *Carnegie Mellon University*—Reder, Donavos, and Erickson (1999) showed that recognition memory for target words was better when words were presented in the same unusual font at study and test rather than in different unusual fonts. Moreover, they found that this benefit was larger when the matching font had been seen with only 1 word during study rather than with 12 different words. We replicated both of these effects in an implicit memory task: Participants completed more word fragments for previously studied items when the fragment and target solution word were presented in the same font rather than different fonts, and this effect was larger when the font had been seen with only 1 word (vs. 12) at study. We provide an account of these effects based on the source of activation confusion (SAC) theory of memory (Reder et al., 2000) and present SAC model fits to both data sets.

(39)

**Learning Location and Color Sequences for Relevant and Irrelevant Stimulus Dimensions.** ANNEMIE MELIS & ERIC SOETENS, *Vrije Universiteit Brussel* (sponsored by Eric Soetens)—To investigate whether sequence learning in serial reaction time tasks is restricted to a particular relevant or irrelevant stimulus dimension, we compared learning measures across conditions in which the same sequence structure was imposed on the relevant, on the irrelevant, or on both dimensions. Participants responded left or right to color or location in experiments with either two orthogonal location dimensions, or a color and a location dimension. Color sequence learning occurred only for the relevant dimension in the presence of a parallel structured location sequence. Learning of the relevant location sequence, however, was independent of an irrelevant color sequence, and took place in combination with an orthogonal location sequence. We argue that the location sequence is learned preferentially because this dimension always has to be processed prior to stimulus identification. In general, sequence learning involves the association of all stimulus properties required for the task.

(40)

**Spatial Knowledge Acquired From Virtual Reality: Transfer and Flexibility.** MICHAEL S. MILLER, DEBORAH M. CLAWSON, & MARC M. SEBRECHTS, *Catholic University of America*—Is there a

trade-off between how well spatial knowledge transfers from maps or virtual reality (VR) to the real world and the flexibility of that transfer? Participants practiced one or three sets of route segments through a building using VR or a map. They were tested in a real building whose front half was analogous to the training materials but whose back half had interior structural differences. During testing in the real building, participants were asked to find the shortest paths between landmarks. In the front half of the building, trained segments were the shortest routes, but in the back half the trained segments were impossible due to the structural differences. At intervals during this wayfinding, participants were also asked to point to occluded landmarks, demonstrating their survey-level knowledge of the building. Findings address spatial learning from VR and, more generally, the effect of practice variability.

(41)

**Learning Facts From Fiction.** ELIZABETH J. MARSH, MICHELLE L. MEADE, & HENRY L. ROEDIGER III, *Washington University*—People's knowledge about the world comes from many sources, which may include fictional ones such as movies and books. The current research investigates how people learn and integrate information from fictional sources with their general world knowledge. In two experiments, participants read a series of short stories that contained information about the real world. After a short delay, all participants took a general knowledge test. Of interest was whether participants would use facts from the stories to answer general knowledge questions and would be aware of doing so. Prior reading of facts boosted participants' abilities to answer both obscure and better-known trivia questions. Repeated reading of the stories increased the effect. Participants seemed generally aware of using story information, although this effect depended on the particular source test used to measure awareness. Of additional interest is the duration of the effect and whether knowledge seems permanently altered.

(42)

**Self-Reference and Like–Dislike Processing in Memory for Traits.** TAKASHI HORIUCHI, *Nagoya University*—This study examined the explanation that self-reference effect occurs because self-reference is equivalent to like–dislike processing. In Experiment 1, subjects were asked to rate each trait words in one of five conditions: self-reference, like–dislike, desirability, semantic, and physical. Then they were given the surprised-recall task. Only memory for like–dislike condition was as good as memory for self-referent condition. In Experiment 2, in order to estimate degree of overlap of processing between self-reference and like–dislike, the task facilitation paradigm (Klein, Loftus, & Burton, 1989) was used. When the initial task was self-referent judgment or ideal-self judgment, time for like–dislike judgment in the target task was faster than when the initial task was semantic judgment. These results suggest that self-reference is one of evaluative processing such as like–dislike, which produces better memory performance than semantic processing.

(43)

**Implicit and Explicit Learning of the Middle Concept: Different Transfer Functions.** F. MICHAEL RABINOWITZ & MATTHEW HERDER, *Memorial University of Newfoundland*—The relationship between learning and transfer of the middle concept and verbal awareness was of interest. Third- and fifth-graders were trained to choose the items representing the middle concept in two different stimulus sets. Following training to criterion, 24 transfer trials were presented using four new stimulus sets selected from both training and new dimensions. Verbal awareness was assessed by first asking children how they solved the transfer problems and then by asking children why they chose a particular stimulus following each of three probes. Children who were verbally aware of the middle rule chose the middle stimulus more often and the absolute stimulus less often during transfer than did children who were unaware of the middle rule. The children answered the four awareness questions consistently. The

findings are generally concordant with the hypothesis that if criterion is reached implicitly then transfer is associatively based, whereas if criterion is reached explicitly then transfer is conceptually based.

(44)

**Effects of Item Familiarity on Associative Recognition.** AUDREY A. TUSSING, *Knox College*—In an associative recognition task, participants are given pairs of words at study. At test they also receive pairs of words; some of these pairs were presented on the study list (the intact pairs), other pairs consist of words that appeared on the study list, but not with each other (the rearranged pairs). Participants are required to discriminate between these intact and rearranged pairs. Three experiments examined the influence of familiarity on associative recognition by manipulating the familiarity of the individual words in a test pair. The familiarity of the words in a pair was manipulated by presenting the words varying amounts of times and by varying level of processing. In general, associative recognition was shown to be highly sensitive to the familiarity of the individual items that make up a test pair.

(45)

**Analog Representation in Memory-Based Sequence Smoothing.** NEIL BERG & RICHARD ANDERSON, *Bowling Green State University*—Previous studies have shown that recalled versions of Arabic number sequences are smoothed versions of the originally studied sequences. That is, memory errors for numbers at Sequential Position I tend to gravitate toward the values of previous (I–1) and subsequent (I+1) numbers in the sequence. The present study was designed to explore the extent to which such smoothing depends on subjects' mentally converting the Arabic number sequence into a sequence of analog representations. Subjects studied either numbers only, numbers with corresponding analog graphics (bars), or bars only. The results suggested a possible role for analog representation in Arabic-number sequence smoothing.

(46)

**Presentation Modality Effects in Text Recall.** RONALD T. KELLOGG, DAENA COOPER, & JULIE LEE, *University of Missouri, Rolla*—It has been established that visual presentation of lists of semantically associated words can reduce the rate of false memory of critical intrusions relative to aural presentation. The generality of this presentation modality effect was examined here in text recall. Participants listened to or read Bartlett's (1932) "The War of the Ghosts" and attempted to recall it verbatim in writing after a filled retention interval of 15 min. Veridical recall was the same for both modalities, but, as expected, distortions in recall were more likely following aural presentation. Minor distortions in surface structure were easier to avoid following visual presentation. However, major distortions such as schema-based normalization and inference did not differ by modality, and intrusions of novel propositions were more frequent following visual compared with aural presentation. The use of distinctive orthography to edit false memories in written recall is discussed.

(47)

**Reports of the Demise of Short-Term Memory Are Much Exaggerated.** YONATAN GOSHEN-GOTTSTEIN, AMIR ASHKENAZI, & MARIUS USHER, *Tel-Aviv University*—Many researchers argue that there is no evidence for a short-term memory store. One of their primary arguments is based on the compatibility between the recency effect in free recall (FR), where memory is tested *immediately* after list presentation, and the long-term recency effect that is found in the continuous-distractor (CD) task, where each item is followed by distractor activity, and memory is tested *after a long retention interval*. Our experiment shows that these two recency effects are affected differently by a proactive-interference manipulation. In FR, recency items were remembered equally well for the second and first lists of items. In the CD task, however, recency items were remembered more poorly in the second list than in the first. These results

suggest that the recency effect in the CD task is based on the discriminability of items, while it is based, in the FR task, on a short-term memory store.

(48)

**Are False Memories More Difficult to Forget Than Accurate Memories?** JOHN G. SEAMON, CHUN LUO, JONATHON KOPECKY, CATHERINE PRICE, LEEATT ROTHSCCHILD, MICHAEL SCHWARTZ, & NICHOLAS FUNG, *Wesleyan University*—Some research suggests that retention interval can have different effects on accurate and false recollection in the Deese, Roediger, and McDermott procedure. Accurate memory can decrease over retention interval, whereas false memory can remain stable or even increase over short intervals. We conducted two parametric studies in which we examined accurate and false recollection in the DRM procedure by tests of recognition memory and free recall. Over retention intervals that included no delay, a 2-day delay, a 2-week delay, or a 2-month delay, we found that accurate and false recognition decreased at the same rate over all retention intervals, whereas false recall decreased more slowly than accurate recall over these same intervals. False memories may or may not be more difficult to forget than accurate memories in the DRM procedure, depending on the type of test. These findings are discussed in terms of fuzzy-trace theory.

(49)

**Phenomenal Characteristics of Guided Imagery Experiences and Autobiographical Memories.** KATHERINE D. ARBUTHNOTT & CARLA B. GEELEN, *University of Regina*—Guided imagery experiences can be mistaken for actual events, resulting in effects such as imagination inflation. One possible cause of such misattribution is that the phenomenal characteristics of guided images are more similar to memories of actual events in sensory and contextual detail than they are to thoughts and fantasies. Using Johnson et al.'s (1988) MCQ, participants rated memory characteristics of guided imagery, actual, and imagined events. For both childhood and adult conditions, guided images and actual events were similar in contextual detail (e.g., location), but differed in sensory detail for most modalities. Visual and auditory detail were the most salient and did not differ across conditions. However, touch was more salient for guided imagery than for actual or imagined memories. Thus, misattributions of guided imagery experiences are not likely attributable to sensory characteristics in general, but may be influenced by the contextual and sensory content of the imagery script.

(50)

**Output Order and Encoding Processes in Short-Term Order Recall.** THOMAS F. CUNNINGHAM, *St. Lawrence University*, & ALICE F. HEALY & JAMES T. PARKER, *University of Colorado*—We examined short-term recall of order information in adults using a partial report paradigm in which subjects recalled one of two four-letter segments. A variable length distractor task involving digit shadowing preceded recall. Subjects knew in advance the identity of the letters in each segment. On some trials a single letter was replaced with a red dash, which inhibited overall recall as well as specific recall of the absent letter. When constrained to recall the letters in their serial order, the disadvantage for absent letters was eliminated. When recall order was unconstrained, subjects were less likely to respond in serial order if a dash replaced a letter than if no letter was absent. These effects are explained in terms of output order processes, but encoding processes are also implicated by finding depressed overall performance when subjects were informed in advance that a trial would contain a missing letter.

(51)

**The Modality Effect on False Recall as a Function of Working Memory Span.** REBEKAH E. SMITH, TABITHA PAYNE, & RANDALL W. ENGLE, *Georgia Institute of Technology*—Presentation of high associates of nonpresented critical items can lead to high levels of

false recall of the critical items (Deese, 1959/Roediger & McDermott, 1995). Visual presentation reduces the level of false recall (Smith & Hunt, 1998; Kellogg, 1999; Gallo, McDermott, & Roediger, 2000). The size of the modality effect can vary and does not occur with visually presented words for older adults (Smith, 2000). In the present experiment individual differences in working memory span influence the modality effect: Only high-span subjects demonstrated the modality effect on false recall.

(52)

**Spacing and List-Strength Effects for Direct and Indirect Memory Tasks.** KENNETH J. MALMBERG & RICHARD M. SHIFFRIN, *Indiana University*—Direct tests of memory improve with massed or spaced repetitions, but indirect tests of memory are only affected by spaced repetitions. In the REMI theory applied to indirect memory, study adds current context (but not content information) to the lexical/semantic trace for an item; the item's subsequent enhanced accessibility is due to increased overlap of the stored context and the test context. We propose a "one-shot hypothesis" asserting that context information is given just one "shot" at being stored when repetitions are massed, but multiple "shots" when repetitions are spaced, whereas content information in episodic traces increases for either massed or spaced presentations. These assumptions explain the interaction of spacing effects with direct versus indirect tasks. If these assumptions are incorporated in the SAM (or REM) model's account of free recall, a list-strength effect is predicted for spaced but not for massed repetitions. This prediction is demonstrated empirically.

(53)

**Enhancing the Accuracy of the Cognitive Interview.** PHILIP A. HIGHAM, *University of Southampton*, & WAYNE ROBERTS, *University of Northern British Columbia*—Participants viewed a videotape of a simulated murder and later were interviewed using the enhanced cognitive interview (ECI). Following recall of each statement, participants were asked whether they "remembered" or "knew" the statement and their level of confidence. The results showed that *remember* statements were more accurate than either (1) statements assigned *know* judgments or (2) the set of all statements. Also, the highest confidence statements were more accurate than all statements combined. Furthermore, ECI procedures that decreased the accuracy of the full set of interview statements by inducing a more liberal report criterion did not decrease the accuracy of *remember*, or high confidence statements. Post-interview questioning indicated, however, that several participants misunderstood the remember/know distinction. Based on these results, we advise that confidence measures be taken during the ECI and that, if accuracy is of paramount importance, interviewers should examine only high confidence statements.

• RECOGNITION MEMORY •

(54)

**Evidence for a Criterion Change Account of the Revelation Effect.** MARTY W. NIEWIADOMSKI, *University of Toronto*, & WILLIAM E. HOCKLEY, *Wilfrid Laurier University*—In the revelation effect, recognition probes that are preceded by an unrelated task are classified more often as old. We present five experiments that were designed to distinguish between increment-in-familiarity and criterion change accounts of this phenomenon. These studies show that the revelation effect is (1) the same for two preceding tasks as for one, (2) the same for addition problems as for anagram solutions, (3) attenuated for speeded responses, (4) eliminated for nonwords when they are tested with words, and is (5) associated with reduced processing of the test probe. These results are problematic for familiarity accounts of the revelation effect, but are consistent with a decision-based interpretation in which it is assumed that the interrupting task causes a temporary loss of the study list context, leading subjects to adopt a more liberal recognition decision criterion.

(55)

**Stereotyping Ricochet: Effects of Race on Identification Accuracy.** HEATHER M. KLEIDER & STEPHEN D. GOLDINGER, *Arizona State University*—Studies show that (e.g., attractive) people are better remembered and identified than average people (Cutler & Penrod, 1995). We investigated the effect of an African-American's presence on recognition memory for surrounding Caucasian targets. Regarding eyewitness accuracy for an event, we expected more errors for Caucasian targets accompanied by African-American confederates (experimental condition) than by Caucasian confederates (control). A staged accident was witnessed by students, followed by a lineup. In two experiments, identification accuracy decreased in the experimental condition, relative to control. We suggest that attention is guided to the African-American confederate, reducing memory for other actors in events. Substituting hair color for race, in Experiment 3 we investigated race in particular, rather than general distinctiveness, to explain these findings. The resulting null effects suggest race is a component of attentional draw and impacts recognition accuracy.

(56)

**Differential Effects of List Strength on Recollection and Familiarity.** KENNETH A. NORMAN, *University of Colorado, Boulder*—The list strength effect (LSE) for recognition memory has been the subject of intense scrutiny over the past decade: Does strengthening some items' memory traces impair recognition of other, nonstrengthened list items? A recently developed, biologically based dual process network model of recognition memory (Norman & O'Reilly, in preparation) predicts that an LSE should be present for one process that contributes to recognition (hippocampally driven *recollection* of specific studied details), but not for the other (neocortically driven feelings of *familiarity*). This prediction was confirmed in several experiments that used the "independence remember/know" technique to estimate recollection and familiarity-based discrimination. Furthermore, analysis of ROC data collected in one experiment revealed an LSE for overall recognition sensitivity. Additional predictions and tests of the model are discussed, as well as ways of reconciling our results with other studies' failure to find an LSE for recognition (e.g., Ratcliff, Clark, & Shiffrin, 1990).

(57)

**When False Recognition Meets Metacognition: The Distinctiveness Heuristic.** CHAD S. DODSON & DANIEL L. SCHACTER, *Harvard University*—We examined the contribution of a distinctiveness heuristic to rejecting false memories. Individuals studied words, pictures, or both types of items and then completed a recognition test on which studied items appeared once but new words appeared twice. Participants who studied pictures falsely recognized fewer repeated new words than did participants who studied words. Studying pictures, we argue, provides a basis for using the distinctiveness heuristic: A response mode in which individuals infer that test items are novel when they fail to elicit memory for expected distinctive information. By varying the proportion of studied items that appeared as pictures, we show that the distinctive information need not be perfectly predictive of an item's oldness for participants to use the heuristic. We also show that the distinctiveness heuristic is under metacognitive control. It can be turned on or off depending on participants' expectations about its usefulness for reducing memory errors.

(58)

**True and False Recognition Without Perceptual Identification.** ANNE M. CLEARY & ROBERT L. GREENE, *Case Western Reserve University*—Participants can give accurate recognition judgments to word fragments that they are unable to complete. In several experiments, we show that this ability to recognize items that cannot be identified extends to perceptual-identification tasks. Even when participants were unable to identify briefly flashed test words, they were able to give accurate recognition judgments. False recognition without identification was also found. However, the effect disappeared when participants were asked to make associative-recognition judgments.

These results support the claim that recognition without identification reflects the use of abstractly represented orthographic information in judging familiarity.

(59)

**Manipulating When Outburst and Downcast Become Outcast: Conjunction Errors and Source Monitoring.** RICHARD L. MARSH, *University of Georgia*, JASON L. HICKS, *Louisiana State University*, & THOMAS W. HANCOCK, *University of Georgia*—We investigated conjunction errors of the type that are produced when participants studied parent words such as “pinwheel” and “endpoint” but later believed they had experienced “pinpoint.” Although our hypothesis was that these errors are primarily familiarity-based, we found some conditions in which parent words experienced in different contexts (i.e., from different sources) reduced the probability of claiming the conjunction was studied. This reduction occurred only under source-monitoring instructions at test and did not occur with old-new recognition instructions. The reduction also only occurred under reality monitoring conditions and not when the two sources were more similar to one another.

(60)

**Orthographic and Phonetic Embeddedness Affects False Recognition.** MARTHA D. AMBERG, JOHN P. TAYLOR, SUSAN HAMBRICK, & WILLIAM P. WALLACE, *University of Nevada, Reno*—A new word on a memory test is likely to be incorrectly recognized if its initial component corresponds orthographically and/or phonetically to a studied word (or if it corresponds to the studied word’s initial component). Normal correspondence between phonetic and orthographic embedded words was *dissociated* in order to evaluate the separate contributions in producing false recognition with *visual* stimulus presentations. Results demonstrated that both phonetic and orthographic factors were relevant for producing false recognition. For example, *trip* and *messenger* produced more false recognitions of *triple* and *mess* (phonetic and orthographic characteristics covary), compared with control words. However, it was also true that study words like *plea* and *maneuver* (orthographic examples) produced more false recognition to *pleasant* and *mane*; and *sill* and *kerosene* (phonetic examples) produced more false recognition to *cylinder* and *care*. The results suggest that phonetic factors are involved in cognitive processing when to-be-remembered words are presented visually.

• REPETITION/PRIMING EFFECTS •

(61)

**An Integrated Representation Model of Text Repetition Effects.** GARY E. RANEY, DAVID THERRIault, TIMOTHY MIURA, & SHARON OBEIDALLAH, *University of Illinois, Chicago*—Past research has explained text repetition effects using the concepts of abstract and episodic representation. We describe a new model called the integrated representation model. The basic assumption of the model is that the surface form and textbase are represented in a context-independent manner, whereas the situation model is represented in a context-specific manner. When the situation model is well developed it acts as a conceptual boundary around surface features and the textbase, and limits repetition effects to semantically or contextually similar texts. Context-dependent representations produce episodic-like repetition effects. When the situation model is not well developed or not task relevant, repetition benefits are not limited to contextually similar texts. Context-independent representations produce abstract-like repetition effects that result from overlapping surface features and textbases. Describing text representations in terms of context dependency provides a single mechanism for explaining repetition effects that appear to be abstract or episodic in nature.

(62)

**Why Semantic Relationships Are More Reliable Than Associations: Human and Computational Results.** STEVE BUENO & CHERYL FRENCK-MESTRE, *Université de Provence*, & CURT BURGESS &

KEVIN LUND, *University of California, Riverside*—Recent empirical work has clearly shown a distinction between semantic and associative priming (Frenck-Mestre & Bueno, 1999; Livesay & Burgess, 1998; Lund, Burgess, & Atchley, 1995; Lund, Burgess, & Audet, 1996; McRae & Boisvert, 1998). Priming occurs earlier in RT studies for semantically related than for associated word pairs. Moreover, priming is inherently less reliable for associative (and mediated) pairs than for semantic pairs. The experiments reported herein extend existing results, showing a more reliable pattern of priming facilitation in French for synonyms (e.g., *bateau–navire*) than for first associates (*bateau–mer*). These results are supported, furthermore, by statistics produced by a recent extension of HAL (Burgess, 2000; Lund & Burgess, 1996), in which global co-occurrence matrices have been derived based on French corpus data.

(63)

**Awareness and Evaluative Priming: Exploring the Limits of Bias and Correction.** KAREN A. DANIELS & JEFFREY P. TOTH, *Georgia Institute of Technology*—Last year, we (Toth & Daniels, 1999) examined repetition priming effects on judgments of normative word frequency. Results revealed that such priming was restricted to subjects’ fastest responses; slower responses showed no priming, suggesting a bias-correction process. This year, we examined whether such bias-correction depends on awareness. Subjects judged the normative frequency of words preceded by matching or nonmatching primes, presented for either 43 or 499 msec. Experiment 1, using a between-subject manipulation of prime duration, showed that bias effects were restricted to 43-msec primes. Experiment 2, using a within-subject manipulation of prime duration, showed the same pattern, suggesting that bias-correction is item-specific. Experiment 3 presented a study list prior to the primed judgment task and found evidence for an additive relation between perceptual- and memory-based priming, and revealed limitations in bias correction. The experiments help elucidate the complex relationship between conscious and unconscious influences on judgments.

(64)

**Preference for Prime-Related Words in Short-Term Priming: The Effects of Target Duration and Prime Similarity.** DAVID E. HUBER, *University of Colorado, Boulder*, RICHARD M. SHIFFRIN, *Indiana University*, RAUSHANNA QUACH, *University of Colorado, Boulder*, & KEITH B. LYLE, *Yale University*—In one form of short-term priming, presenting a prime word just before a trial increases the ability to name a briefly flashed and masked target word related to the prime. Using 2-alternative forced choice to separate “perceptual” and “preferential” components of priming, Huber, Shiffrin, Lyle, and Ruys (in press), found a preference for prime-related words when primes are passively viewed and a preference against prime-related words when participants actively respond to prime words. The proposed theory, responding optimally with unknown sources of evidence (ROUSE), relies on two critical factors: (1) source confusion between primes and targets; (2) discounting of prime information. We present new experiments testing nonintuitive a priori predictions of the theory when target flash duration and similarity between prime and test word are parametrically varied.

(65)

**Individual Differences in Naming Speeds for Aggressive Verbs.** ROBERT J. MADIGAN, TARIK BEL-BAHAR, PATRICK MOSHER, & RANDY WILD, *University of Alaska, Anchorage*—Anderson, Benjamin, and Bartholow (1998) showed that the speed required to name an aggressive verb is faster when it is primed by a weapon name. In this experiment, individual differences in this effect were examined. Participants were 22 male and 49 female college students who saw pairs of stimuli in which a prime word was followed by degraded target word. Subjects read the prime word silently and the target word aloud. Prime stimuli were 12 names of weapons and 12 names of household objects. Target stimuli were 24 aggressive verbs and 72

nonaggressive verbs. Results indicated that males but not females showed a significant priming effect. In addition, scores on the anger dimension of the Buss-Perry (1992) Aggression inventory predicted a portion of the priming effect. Low-anger participants, regardless of sex, tended to show the priming effect while high-anger participants did not.

(66)

**Analytic and Nonanalytic Influences on Same/Different Judgments.**

JASON P. LEBOE & BRUCE MILLIKEN, *McMaster University*—One possible consequence of encountering a small number of stimuli multiple times in an experiment is that the mental representations associated with those items become highly activated. Alternatively, the overlapping stimulus displays between trials could cause prior trials to produce considerable proactive interference, hindering subject's efforts to respond to the current trial. Using a same/different judgment task, we investigated priming influences on both *same* and *different* decisions under large and small stimulus set size conditions. Our results provide support for the latter notion that limiting the stimulus set size alters the basis upon which subjects generate their responses, requiring that responses rely on more extensive perceptual analysis. More generally, we offer evidence that encountering repeated stimuli in the prime and probe display impedes efforts to engage in analytic perceptual processing upon onset of the probe, yet exerts a facilitory influence when experimental conditions allow more nonanalytic, memorial influences to guide responding.

• PICTURE MEMORY/PROCESSING •

(67)

**Naming and Categorizing Famous Faces.** ROBERT A. JOHNSTON, *University of Birmingham, England*—Three experiments examined how the time required to categorize and name famous faces related to the rated typicality of their owners within their occupational category. Experiment 1 showed celebrities who had been previously rated as more typical of their occupational category were judged to belong to that category more rapidly than celebrities rated as less typical. However, in Experiment 2, these ratings were also shown to influence the time required to name these celebrities, a task which does not require access to occupation semantics. Familiarity is known to affect naming latencies; to eliminate this factor as the source of the typicality effects, a third experiment examined face processing using a face familiarity decision. Familiarity decisions were influenced by prior familiarity ratings, but not typicality ratings showing that the latter operate at a later stage within the face recognition process. These findings are used to explore existing models of face recognition.

(68)

**Perceptions of Facial Gender and Emotion: Selective- and Divided-Attention Tasks.**

ELISHEVA BEN-ARTZI & EVA GILBOA-SCHECHTMAN, *Bar-Ilan University* (sponsored by Elisheva Ben-Artzi)—Six studies examined the relationships between perceptions of facial gender and emotion using selective- and divided-attention tasks. In the selective-attention tasks, the irrelevant dimension—gender or emotion—was constant or orthogonal to the relevant one. Results indicated that irrelevant variation in gender interfered with classification of emotion, whereas irrelevant variation in emotion had no effect on judgments of gender. In the probed-decision tasks, pairs of photograph faces were simultaneously presented followed by an arrow indicating the face to be judged, whereas in the divided-attention tasks, participants made identical/different judgments based on gender or emotion. Results indicated that decision latencies were affected only by congruence on gender, whether as the relevant or irrelevant dimension, and not by congruence on emotion. Together the results suggest that gender is perceived independently, but may influence emotion analysis. The relevance of the present findings to task-related theories of face perception is discussed.

(69)

**Eye Movement Measures of the Misinformation Effect.**

FRANK M. MARCHAK, *Veridical Research and Design*, & E. FREDRICK PRUSSACK & SHAWN QUINLAN, *Montana State University*—The misinformation effect (Loftus & Hoffman, 1989) predicts that new information presented after subjects witness an event leads to changes in recollection of that event. Typically these studies are conducted in three stages: Subjects view a slide presentation of a complex event, read a narrative containing false information about the event, and then complete a cued recall memory test. Test questions focus on critical items from the event, some of which were presented falsely in the narrative. In place of cued recall, the current work employs an eye movement-based memory measure (Althoff & Cohen, 1999) that predicts modifications in memory processing as a result of previous exposure to a stimulus are reflected by changes in eye movements. The goal is an attempt to better understand whether the same processes are employed in implicit recall of both misinformation and factual information and to provide an objective method to differentiate false and true memories.

(70)

**Neither Change Blindness Nor Amnesia: Accurate Memory for Previously Attended Objects in Natural Scenes.**

ANDREW HOLLINGWORTH & JOHN M. HENDERSON, *Michigan State University*—Change blindness effects have been interpreted as indicating that visual scene representation is both local and transient, limited almost exclusively to the currently attended object. We present evidence to the contrary in two experiments that investigated visual memory for previously attended objects in natural scenes. In the first, participants detected token and orientation changes to a target object when the object had been fixated previously but was no longer within the focus of attention. In addition, participants demonstrated accurate memory for the visual form of target objects on a subsequent long-term memory test. In the second experiment, after having fixated and withdrawn attention from a target object, visual memory for that object was tested using a forced-choice procedure. Participants accurately discriminated the targets from different-token and different-orientation distractors. These results suggest that detailed visual representations are retained in long-term memory after attention is withdrawn from an object.

(71)

**Computing Representations for Object Recognition in Visual Search: An Eye-Movement Analysis.**

GARY CHON-WEN SHYI, H.-H. CHUANG, & C.-M. LIN, *National Chung-Cheng University*—Searching for a target entry-level object among other entry-level objects appears to be a capacity-demanding task. However, it is not clear what the basis is for the capacity limitation. Given the multi-part nature of entry-level objects, it would be difficult to locate a principled answer to that question. Here, we report findings from two experiments in which observers were asked to search for a target geon defined by a single attribute (Experiment 1) or by a combination of two attributes (Experiment 2), while their eye movements were recorded. The results indicate that observers were quite adept at realizing the hemifield of display within which all geons shared the same and single attribute that defined the target, and directed their subsequent gazes to that hemifield. However, observers were not as efficient in extracting the dual-attribute combination that defined the target.

(72)

**The Roles of Scene Characteristics, Memory, and Attentional Breadth on Scene Representation.**

HEATHER L. PRINGLE, *U.S. Air Force Academy*, & ARTHUR F. KRAMER & DAVID E. IRWIN, *University of Illinois*—When change in the environment coincides with an interruption in ongoing visual processing (e.g., eye movement, flicker) observers are surprisingly slow to detect the change, if it is detected at all (*change blindness*). We investigated several in-

trinsic and extrinsic factors that might play a role in the ability to detect scene changes in a flickering display. Change detection performance was best characterized by a convergence of attentional breadth and visuospatial working memory measures. Change meaningfulness had a smaller impact on performance than did change salience, especially for older observers. Examination of eye movement behaviors suggested that fixating the change did not ensure detection, rather the duration of processing in the change area increased the likelihood of detecting the change (especially for older observers). Change detection is influenced not only by the number of attentional samples required to scan the scene, but also by memory for what was sampled.

(73)

**False Memories for Cartoon Characters: “I Tawt I Taw a Puddy Tat.”** JEFFREY S. NEUSCHATZ, *University of Alabama, Huntsville*, MICHAEL P. TOGLIA, *SUNY, Cortland*, & JAMES M. LAMPINEN, *University of Arkansas*—In two experiments, we examined the role of stimulus distinctiveness in creating false memories. Subjects studied pictures of cartoon characters from popular animated television series. In a variation of the DRM paradigm, the main character (e.g., Bugs Bunny) of a show (e.g., Looney Tunes) was omitted while eight other characters appeared in order of centrality. To manipulate distinctiveness, black and white (B/W) or color slides were studied. In Experiment 1, recognition of targets exceeded that of critical lures for both B/W and color pictures. However, fewer false memories occurred with color slides. Experiment 2 involved recall and a 48-hour delay. Correct recall decreased, while false recall increased over time, with subjects recalling more targets than critical items at both intervals. Contrary to the first study, false recall did not vary as a function of slide color. Results are discussed in terms of fuzzy trace theory and Schacter’s distinctiveness heuristic.

(74)

**The Role of Surface Properties in Memory for 3-D Objects.** QUOC VUONG & MICHAEL J. TARR, *Brown University*—Surface properties of objects (e.g., color, texture, shading) are features that can be encoded and subsequently used to facilitate recognition. The present study investigated the role of such properties in recognizing both novel and familiar objects. In an old–new recognition paradigm, observers saw visually similar novel “YUFOs,” visually similar chairs, or visually distinct animals and objects, all of which were presented at different orientations in the picture plane or different rotations in depth. Critically, the stimuli were either grayscale images, including surface information, or line drawings without such information. Across changes in viewpoint, the presence of surface information interacted with the difficulty of the visual discrimination, such that view dependency was diminished by the availability of surface information, but only for visually similar object classes. Thus, surface properties provide additional “evidence” as to the identity of an object—such evidence may be encoded automatically and plays a progressively more critical role as shape information becomes less useful.

• LETTER/WORD PROCESSING •

(75)

**Familiar Text and the Missing-Letter Effect.** SETH GREENBERG & JOANNA TAI, *Union College*—The structural model interprets a reader’s tendency to miss target letters in some words more than others (the missing-letter effect) as an indication that a word’s role in a sentence affects its availability for analysis. The unitization position, in contrast, hypothesizes that the orthographic familiarity of a word and word groups affects access to target letters within units. Essentially the more familiar a word or phrase the more difficult letter detection becomes. The present research examined letter detection for highly familiar texts (nursery rhymes) as well as for unfamiliar texts. Previous letter detection work used only unfamiliar texts. Interestingly, the letter detection disadvantage for familiar function words was signifi-

cantly suppressed in the familiar passages. The results indicate that rather than familiar word sequences making letter detection generally more difficult (unitization position), such text familiarity makes letter detection less different between words playing different roles (function/content) in a sentence (structural position).

(76)

**The Development of Automatic Brain Systems in Reading and Oral Language.** JAMES R. BOOTH, DOUGLAS D. BURMAN, FRANK W. VAN SATEN, YASUAKI HARASAKI, DARREN R. GITELMAN, TODD B. PARRISH, & M. MARSEL MESULAM, *Northwestern University* (sponsored by Brian MacWhinney)—Functional magnetic resonance imaging (fMRI) was used to examine differences between children (9–12 years) and adults (21–31 years) in the distribution of brain activation during word processing. Orthographic, phonological, semantic, and syntactic tasks were used in both the auditory and visual modalities. Our four principal results were consistent with the hypothesis that development is characterized by increasing automaticity. First, children showed less activation than adults in unimodal association areas (fusiform gyrus during visual tasks and superior temporal gyrus during auditory tasks), but more activation in heteromodal Wernicke’s area. Second, children had larger areas of correlated activation between brain regions than adults. Third, an analysis of the correlation of behavior with activation levels showed overlap of *fast* reaction time with high accuracy for adults, but *slow* reaction time with high accuracy for children. Fourth, activation during visual and auditory tasks overlapped substantially less in adults than in children.

(77)

**Preconscious Processing of Visual Information in a Duration Judgment Task.** BART A. VANVOORHIS, *University of Wisconsin, La Crosse*, & LLOYD L. AVANT, *Iowa State University*—VanVoorhis and Avant (1999) reported that participants distinguished between verb and noun stimuli in a brightness judgment task. Specifically, nonwords (unpronounceable) and pseudowords (pronounceable) were created from high- and low-image nouns and verbs. Two 15-msec pre- and postmasked presentations occurred on each trial. Each presentation contained either the word, pseudoword, or nonword stimulus. Participants reliably indicated that “flashes” containing nonwords were brightest and those containing words were dimmest when the stimuli were nouns. This pattern was reversed for verbs, however. This task was replicated using duration, rather than brightness judgments. Participants continued to discriminate between words, pseudowords, and nonwords, indicating that the word “flashes” appeared to last longer than the pseudo- and nonword flashes. This pattern was consistent across word type, however, contrary to the findings with brightness judgments. The data are discussed in relationship to preconscious processing of visual information.

(78)

**The Role of Meaning Frequency in Processing Lexically Ambiguous Words.** SARA C. SERENO, *University of Glasgow*, & CAMERON C. BREWER, *University of Hartford*—Most ambiguous words are biased, having one dominant sense and one or more subordinate senses. Ambiguity studies generally compare responses to ambiguous versus unambiguous control words across different conditions in order to determine the time course of contextual selection (early vs. late). These control words, however, are typically matched to an ambiguous word’s overall word form frequency, not to the frequency of its contextually instantiated sense. For example, a biased ambiguous word whose word form is of high frequency (*bank*) will have a subordinate sense that is of low frequency (*bank*, river’s edge). Event-related brain potentials were obtained on sentence-final ambiguous and control words that occurred in neutral and biasing contexts. Control words were matched either to the overall frequency of the ambiguous word or to the frequency of its contextually instantiated, subordinate sense. Results are discussed in terms of a time course of meaning activation.

(79)

**Exposure to Print and Neighborhood Size Effects in Lexical Decision.** PAUL D. SIAKALUK, *University of Alberta*, VERNA CHOW, *University of Calgary*, LORI BUCHANAN, *University of Alberta*, & CHRISTOPHER R. SEARS, *University of Calgary*—Neighborhood size effects in lexical decision were examined as a function of exposure to print, which was assessed using the Author Recognition Test (Stanovich & West, 1989). When the word/nonword discriminations were relatively easy (i.e., when the nonwords had no neighbors), both the High and the Low print exposure groups exhibited a facilitatory neighborhood size effect, although the effect was restricted to low-frequency words for the High print exposure group. When the word/nonword discriminations were more difficult (i.e., when the nonwords had large neighborhoods or when they were matched to the words on neighborhood size), only the Low print exposure group exhibited a facilitatory neighborhood size effect. The implications for current accounts of the neighborhood size effect are discussed.

(80)

**Hemispheric Equivalence for the Recognition of Familiar Proper Nouns.** CLARK G. OHNESORGE, *Gustavus Adolphus College*, & DIANA VAN LANCKER, *New York University*—Observations from the language abilities of persons with aphasia following damage to the left hemisphere suggest that proper nouns are better preserved than common nouns in both production and comprehension. We hypothesize that the right hemisphere, intact in these patients, can process uniquely meaningful or familiar stimuli, although poorer at most language function. We explored this issue in six experiments with normal persons using lateralized presentation of stimuli and varying attributes both of the stimuli and of the question used to index processing. Stimulus attributes included grammatical class (proper, common) and familiarity (familiar, unknown). We queried subjects about (1) the grammatical class of presented stimuli (proper, common), (2) attributes of the stimuli (male, female for proper and naturally occurring, artificial for common) or (3) subject's relationship to the referent (familiar, unfamiliar). Results show equivalent recognition across hemispheres of familiar proper nouns for class and relationship, but not for stimulus attributes.

(81)

**Simulating the Tempo Naming Task in a Connectionist Model of Word Reading.** CHRISTOPHER KELLO, *House Ear Institute*, & DAVID PLAUT, *Carnegie Mellon University*—Kello and Plaut (2000) introduced the tempo naming task in which naming latencies were entrained to an audiovisual rhythmic cue. As tempo increased, naming latencies and durations decreased, and the occurrence of all error types except regularizations increased. To address these results, we present simulations of word reading in which the parameter input gain is used to alter the rate of processing. The simulations support the use of input gain to account for the influence that pressure for speed has on word reading. The simulations show also that input gain can account for the observed pattern of errors by virtue of its effect on the influence of sublexical spelling–sound correspondences. The simulations are consistent with the general view of reading as a skill that fundamentally engages a prelearned spoken language system.

(82)

**Processing of Inflected Morphology in Silent Reading.** ROBIN K. MORRIS & SACHIKO MATSUMOTO, *University of South Carolina* (sponsored by Robin K. Morris)—This study examines morphological processing in silent reading. Readers' eye movements were monitored as they read sentences that contained a homophone or a non-homophonic control word. We compared processing of homophone pairs like *bale/bale* which consisted of only monomorphemic words with processing of homophone pairs like *towed/toad* in which one member of the pair was polymorphemic. Target words were always monomorphemic (e.g., *bale* and *toad*), and readers always saw the

context appropriate spelling of the word. Homophone ambiguity effects were observed in initial processing time for both types of homophone pairs. This demonstrates that the whole-word lexical entries of morphologically complex words are accessed via shared phonology with morphologically unrelated monomorphemic homophones. Processing difficulty in later processing measures was observed for morphologically complex homophone pairs, but not for monomorphemic homophone pairs, demonstrating that further processing of the monomorphemic words was influenced by the morphological complexity of their homophonic partners.

(83)

**Effects of Imageability and Polysemy on Naming and Lexical Decision.** ANNA WOOLLAMS & SACHIKO KINOSHITA, *Macquarie University*—The interactive nature of the word identification process was explored in a series of experiments that assessed the impact of imageability and polysemy upon performance for words possessing consistent or inconsistent body-rime mappings. Individual differences in nonword reading ability were also considered. The speeded-naming tasks involved either words alone or words mixed with nonwords. Although reliable effects of imageability were not found in the speeded-naming tasks, effects of polysemy on error rates to inconsistent words were observed. The lexical decision tasks involved either legal nonwords or pseudohomophones. In contrast to speeded naming, effects of both imageability and polysemy on error rates to inconsistent words were apparent in the lexical decision tasks. These results suggest that the influence of polysemy is more robust than that of imageability and concur with previous research demonstrating that the contribution of semantic information to isolated word recognition is primarily compensatory.

(84)

**What Can FBI and NATO Tell Us About Lexical Identification?** S. P. LIVERSEGE, V. BROWN, & S. J. WHITE, *University of Durham*—Liversege, Gilchrist, and Brown (1998) reported three experiments investigating the effects of target eccentricity and distractor similarity on identification of letter strings. Three types of target string were used (words, legal nonwords, and illegal nonwords). Interactive effects were obtained for orthographically legal strings and additive effects for illegal strings. We concluded that orthographic legality dictates initiation of word identification. The current experiments extend this work. We used orthographically illegal initialisms like FBI and orthographically legal acronyms like NATO as target strings. Both NATO and FBI are strings that have meaning but whose constituent letters are not arbitrary. If orthographic status dictates initiation of identification, then initialisms should show additive effects, whereas acronyms should show interactive effects. We found interactive effects for the acronyms and importantly for the orthographically illegal initialisms. These results indicate that orthographic legality cannot dictate initiation of lexical identification. Instead, we provide an account for our data in terms of an interactive activation model.

• PSYCHOLINGUISTICS •

(85)

**Speech Planning in Younger and Older Adults.** ZENZI M. GRIFFIN & DANIEL H. SPIELER, *Stanford University*—Under two response deadlines, college-age and older (65+) adults were asked to name pictured objects using sentence frames that placed names early (The object was seen) or late (They saw the object). Pictured objects differed orthogonally in codability (name selection difficulty) and word frequency (phonological encoding difficulty). Although older adults took more time to initiate and complete their sentences than younger adults did, they were no more disfluent. Different effects of word frequency on response latencies and durations under short deadlines suggest that older adults were more likely to delay speaking until they retrieved a name while younger adults were more likely to phonologically encode names while speaking. We will discuss decreasing in-

crementality in language production as a potential strategy for dealing with age-related changes in information processing speed.

(86)

**Domato and Paprika Prime “Paprika” Differently. Phonological and Semantic Priming With Pseudowords.** JENS BÖLTE & ELSE COENEN, *University of Münster*—Spoken word recognition models agree that mismatching information affects lexical activation. It may be reduced directly (e.g., shortlist or cohort or indirectly via lateral inhibition as in trace). The question of what counts mismatch has been addressed by cross-modal priming with pseudowords phonologically related to a semantic associate of the targets (e.g., *domato*–PAPRIKA). The assumption is that mismatch effects at the word-form level are reflected at the semantic level. We show that this assumption is unjustified reporting two cross-modal lexical decision experiments. Primes were either pseudowords phonologically related to the target (e.g., *domato*–TOMATO) or pseudowords phonologically related to a semantic associate of the target (e.g., *domato*–PAPRIKA). Word and pseudoword primes facilitated lexical decisions in phonological but not in semantic priming. Semantic information can become available independent of form information.

(87)

**Microconventions: Coordinating Repeated Acts of Reference in Conversation.** DALE J. BARR, *Beckman Institute*, & BOAZ KEYSAR, *University of Chicago*—When people refer to the same referent on multiple occasions, they establish conversational precedents, or *microconventions*. A production and a comprehension experiment investigated the role of frequency in establishing precedents for using scalar adjectives. According to the principles of cooperative conversation, scalar adjectives such as *small* or *dark* typically presuppose the existence of a relevant contextual contrast. Nonetheless, as participants repeatedly used a scalar adjective to describe the same referent, they tended to use it even when a contrast was absent, indicating the existence of a microconvention. Furthermore, although microconventions seem to presuppose shared knowledge, participants continued using them when talking with interlocutors that were unaware of the conventions. A strong association was observed between the use of microconventions and the reduction of participants’ own efforts in speaking and understanding. Taken together, these results suggest that microconventions are largely partner-independent strategies related to effort reduction in language processing.

(88)

**Lexical Versus Segmental Deficits in Phonological Retrieval: Implications for Models of Naming.** MARY R. NEWSOME & RANDI C. MARTIN, *Rice University*—Foygel and Dell (in press) hypothesized that aphasic naming deficits can be modeled by adjusting connection weights between semantic and lexical representations and between lexical and phonemic representations. However, phonological representations for words include additional components such as syllable and stress patterns (Dell, 1986; McKay, 1987). The present study contrasted picture-naming patterns of two aphasic patients with phonological retrieval deficits. One patient appeared to have a lexical phonological deficit as he showed good nonword repetition, a large frequency effect in naming, and a poor ability to provide any phonological information about picture names he could not produce. The other appeared to have a segmental deficit as he showed poor nonword repetition, no frequency effect in naming, and very often produced a nonword response in picture naming that preserved number of syllables and stress pattern of the target (e.g., “calibusta” for helicopter). Elaborations of the production model are suggested.

(89)

**Interaction Between Sentence and Text in Syntactic Ambiguity Resolution.** MOHAMED TAHA MOHAMED & CHARLES E. CLIFTON, JR., *University of Massachusetts, Amherst*—Two experiments measured the time to read sentences that are temporarily am-

biguous between the normally preferred direct object (DO) and the normally unpreferred sentence complement (SC) interpretations. These sentences were read in long contexts whose content favored the DO interpretation, or favored the SC interpretation, or were equally biased. All experimental sentences were resolved to the DO interpretation (“They proved the theory under discussion and their results were confirmed by many other researchers”). These sentences were compared with unambiguous control sentences whose verb forced the DO interpretation (“They validated the theory”) Reading times in the ambiguous region and in the disambiguating region were not adequately described by either a parallel competitive parsing model or a serial garden-path model. They were best described by a model in which the difficulty of integrating a single DO interpretation with the context affects reading times.

(90)

**Tracking the Time Course of Subcategorical Mismatches on Lexical Access.** DELPHINE DAHAN, *Max Planck Institute for Psycholinguistics, Nijmegen*, & JAMES S. MAGNUSON, MICHAEL K. TANENHAUS, & ELLEN M. HOGAN, *University of Rochester*—Participants’ eye movements were monitored as they followed spoken instructions to click on one of four pictured objects with a computer mouse (e.g., “click on the net”). Latency to fixate the target picture (i.e., latency in identifying the referent picture) was slower when the stimulus’ initial CV originated from another existing word (e.g., *ne(ck)+(ne)t*) than when it originated from a nonword (e.g., *ne(p)+(ne)t*), reflecting lexical competition. This was found when the competitor picture (e.g., neck) was present on the display, but also when it was not present. Furthermore, simulations with the TRACE model of spoken-word recognition (McClelland & Elman, 1986) captured the major trends of fixation functions of the target and its competitor. We argue that the fixation functions provide a fine-grained measure of underlying activations and can reveal lexical-competition effects that are concealed in lexical-decision data (Marslen-Wilson & Warren, 1994; McQueen, Norris, & Cutler, 1999).

(91)

**The Time Course of Script Activation in Verbal Humor Processing.** JYOTSNA VAID & RACHEL HULL, *Texas A&M University*, & ROBERTO R. HEREDIA, *Texas A&M International University*—What is the temporal course of activation for the meanings elicited by the premise and punchline of a joke text? This question was addressed by examining the relative pattern of priming for target words related to the favored meaning or script and to the alternative script uncovered at the punchline. Theoretical analyses of humor processing present two competing hypotheses regarding the time course of script activation during joke text comprehension. The first hypothesis calls for concurrent activation of the favored and surprising scripts upon presentation of the punchline; the second asserts that the surprising script replaces or cancels that of the favored script at punchline. The present study was designed to provide an empirical test of these differing predictions using a semantic priming paradigm in which target items related to each of the joke scripts were presented at different temporal points in the joke text.

(92)

**Eye Movements in the Production of Different Sentence Structures.** FEMKE F. VAN DER MEULEN, *Max Planck Institute for Psycholinguistics, Nijmegen*, & ANTJE S. MEYER, *University of Birmingham*—Speakers’ eye movements were recorded while they described arrays of objects in sentences such as *The fork and the pen are above a cup* or *The fork is above a cup and the pen is above a key*. The experiment yielded two main results. First, the speakers’ gaze patterns showed that they often engaged in a preview of the array in order to select the appropriate sentence structure. The preview phase could be clearly discriminated from the main pass, accompanying the speech. Second, even when the speakers had engaged in a preview, they tended to fixate upon each object again before naming it and the shift

of gaze from one object to the next was tightly coordinated in time with the accompanying speech.

(93)

**ERP and RT Evidence of Priming for Script Relationships.** DOROTHEE J. CHWILLA, HERMAN H. J. KOLK, & HERBERT J. SCHRIEFERS, *Nijmegen University NCI*—We examined the range of visual priming by investigating whether priming occurs for word triplets that described a conceptual script (e.g., *director–bribe–dismissal*) but were not associatively related. We assumed that priming for these scripts requires access to general world knowledge not represented at lower levels. In Experiment 1, participants made lexical decisions. In Experiment 2, participants indicated whether the three words presented a plausible scenario. RT and ERP priming occurred for script relationships. These priming effects were larger in the relatedness judgment task than in lexical decision. The ERP script priming effect in both tasks showed a more frontal distribution and was larger over the left hemisphere than associative priming (Chwilla & Kolk, 1999). The demonstration of script priming is problematic for spreading activation and several other priming models. This finding suggests the operation of a higher-level integration process with a high flexibility with respect to the kinds of information exploited.

(94)

**Reading Proverbs in Context: The Role of Explicit Markers.** ALBERT N. KATZ & TODD R. FERRETTI, *University of Western Ontario*—A self-paced moving-window procedure was employed to examine moment-by-moment processing of familiar and unfamiliar proverbs placed in contexts that were biased toward either their literal or proverbial senses. In past research, we demonstrated that reading times of familiar proverbs generally were read at the same rate regardless of context. However, for unfamiliar proverbs, a large integration effect was noted for the last word of the proverb and the first few words that followed the proverb: Reading times for unfamiliar proverbs used figuratively were much longer than the same items used literally. In the present work, we show that when an explicit marker foreshadowing the upcoming unfamiliar proverb is presented in the discourse context (e.g., *proverbially speaking*), the differences in reading times for unfamiliar proverbs are reduced at the last word of the proverbs and eliminated thereafter. Theoretical implications will be discussed.

• LANGUAGE/DISOURSE PROCESSING •

(95)

**Violating Metaphors for Time Also Slows Reading.** WILLIAM LANGSTON & LEIGH ANNE DEMPSEY, *Middle Tennessee State University*—Langston and Terzo (1998) showed that violating an orientational metaphor (*more is up*) slowed reading time. The conclusion from those experiments was that readers expected an arrangement to be spatially consistent with the metaphor. Arranging the items in the text upside down with respect to the metaphor slowed comprehension. A potential problem for this conclusion was that a linguistic explanation could also account for the results. The experiment reported here was designed to rule out the linguistic explanation. Another goal of the experiment was to extend the results to a new metaphorical domain. Participants read texts describing an arrangement of the steps of a procedure along the front/back dimension. Some texts described an arrangement that was consistent with orientational metaphors for time, some described an arrangement that was inconsistent. Reading time was slower for inconsistent arrangements. More important, the linguistic hypothesis did not account for the results.

(96)

**The Influence of Thematic Role Filters and Agent Filler Likelihood on Lexical Ambiguity Resolution.** HOANG VU, *Saint Mary's College, Kansas*—Agent/patient thematic roles and agent typicality have been

demonstrated to influence parsing preferences and the resolution of syntactic ambiguity. Constraint-based models of language processing assume that ambiguities that exist at different levels of linguistic representations are tightly linked and may be resolved by the same mechanism(s). Under this assumption, the variables that affect syntactic ambiguity resolution should also influence lexical ambiguity resolution. Two naming experiments examined thematic role fillers (Experiment 1) and agent filler likelihood (Experiment 2) as potential sources of constraint on the resolution of lexically ambiguous words. Results demonstrated that lexical ambiguity could be resolved by either source of constraint, with the activation pattern determined by the context strength. It is proposed that the resolution of lexical ambiguity was achieved via featural overlap between the emerging contextual features and those features representing the alternate meanings of an ambiguous word. A feature-based context-sensitive model of language processing is discussed.

(97)

**Additional Consequences Reduce the Likelihood of Predictive Inferences.** REBECCA FINCHER-KIEFER & PAUL R. D'AGOSTINO, *Gettysburg College*—Klin, Guzman, and Levine (1999) discovered that when a text suggests additional consequences of a predictive sentence, no evidence for the activation of the predictive inference was found. The present study extended this research by using another dependent measure—the contradiction effect. Readers given texts that implied multiple consequences of predictive sentences did not show slow reading times for later sentences that contradicted the predictive inferences whereas readers given texts that did not suggest multiple consequences showed the typical contradiction effect. These results support the Klin et al. conclusion that additional consequences reduce the likelihood that predictive inferences are activated or encoded into the situation model.

(98)

**The Effect of Working Memory Span on the Activation of Predictive Inferences.** DESIREE BUDD & CHERYL BECKER, *University of Wisconsin, Stout*, & ALLEN KENISTON, LAURIE DOEPLI, KRISTIN PROCK, & SARAH STRUDLE, *University of Wisconsin, Eau Claire*—A lexical decision task was used to trace differences between high and low spans in the sustained activation of predictive inferences. Participants read foregrounded, backgrounded, coherence, and control versions of predictive inference passages. Each passage consisted of four sentences. The first two sentences contained setting information. The third sentence primed a particular predictive inference. The fourth sentence varied by version. In the foregrounded version, the fourth sentence kept the concept critical to the predictive inference as the focus of processing. In the backgrounded version, the fourth sentence omitted the concept critical to the predictive inference. In the coherence condition, the fourth sentence required the participant to make the inference to understand the passage. Results should shed light on the how working memory span and reading context interact to influence sustained activation of inference relevant concepts.

(99)

**Memory for Multiple Texts Depends on Issue or Source Information.** KATHERINE A. RAWSON & WALTER KINTSCH, *University of Colorado, Boulder*—What influence does background information about sources (i.e., text authors) or issues (i.e., topics the sources discuss) have on memory for multiple, related texts? In Experiment 1, participants read either source information, issue information, or no information prior to reading four related texts. All were then tested for free recall and cued recall of text content. Individuals who read issue information had higher free recall than individuals who received no information, whereas free recall for individuals who read source information did not differ from the no-information group. Secondary analyses suggested that increased recall in the issue-information group resulted from better organization of text

content in memory. Experiment 2 demonstrated that the influence of issue information on content memory depended upon the coherence of the texts. Experiment 3 demonstrated that source information could facilitate free recall of text content if the semantic relationship between source information and text content was improved.

## (100)

**Does Working Memory Span Influence the Ability to Suppress Bridging Inferences?** MARK A. CASTEEL, *Pennsylvania State University, York*—This study examines the relationship between working memory (WM) capacity and discourse processing, specifically examining a theoretical claim of Rosen and Engle's (1997, 1998). Specifically, Rosen and Engle propose that WM span differences should only appear on tasks that rely on controlled attention because high-span readers can more successfully inhibit inappropriate activations. The present study therefore presented both high- and low-span readers with context-rich stories, which strongly suggested a bridging inference. Following each story, participants were required to make recognition judgments to a series of words, one of which was the inference word. All participants were warned beforehand about the nature of the stories and were told to try to ignore the inference word. Results will be interpreted and discussed in terms of Rosen and Engle's theoretical perspective.

## (101)

**Bilingual Sentence Processing and Language Dominance.** ROBERTO R. HEREDIA, MONICA E. MUNOZ, & ORANI PALOMO, *Texas A&M International University*—Most bilingual models and general accounts of bilingualism assume that the bilingual's L1 has special status (e.g., the L1 is bigger than the L2 lexicon). We present data from two experiments that suggest that after a certain level of fluency and frequent use of an L2, a language shift occurs in which the L2 behaves as if it was the bilingual's L1. Spanish–English bilinguals listened to English sentences (e.g., *It is difficult to admit that a WAR brings profits*) and their Spanish translations. For each sentence condition, bilinguals named English/Spanish related/unrelated targets at prime offset. In general, bilinguals were slower to name Spanish targets as they listened to Spanish sentences and faster to name English targets as they listened to English sentences. Moreover, bilinguals were faster to name English words as they listened to Spanish sentences than when they named a Spanish target word in the English sentence condition.

## (102)

**Homograph Processing in Single-Word Context.** GUY DENHIÈRE, *CNRS and Université de Provence*, & PIERRE THÉROUANNE, *Université de Provence*—Contextual constraints on the processing of homophonic homographs were investigated in a series of lexical decision experiments. The context was a word related or not to the dominant or subordinate meaning. In three experiments, meaning access was assessed by target words related to either meaning of the homographs compared with unrelated targets. Results show a context-dependent access in the dominant context and an exhaustive access in subordinate and neutral contexts. In two additional experiments, lexical decisions were made on the homographs. Reaction times were shorter on homographs than on unambiguous control words, whatever the nature of the context word. Moreover, homographs' processing was facilitated in contexts related to either meaning and no subordinate bias effect (see Binder & Rayner, 1998) was observed. The findings suggest that lexical context can influence homographs' meaning access, whereas it cannot provide sufficient constraints to elicit a strictly selective access.

## (103)

**Effects of Sentence Context on Word Naming Latencies: Amount of Semantic/Schematic Association or Ease of Integration With Evolving Discourse Model?** BARBARA KAUP & DONALD J. FOSS, *Florida State University*, & MATTHEW J. TRAXLER, *University of*

*South Carolina*—Two cross-modal naming experiments investigated alternative accounts of priming in sentence comprehension. Subjects listened to sentences and named visual targets. The targets were either plausible or implausible continuations of the auditory sentence. Additionally, the sentence context preceding the targets contained either strong associates or unrelated words. Naming latencies were not affected by whether or not the sentence context contained a strong associate of the target word. However, at least for the associated conditions, plausible target words were named faster than implausible ones. These results are more compatible with the facilitated integration hypothesis (Foss, 1982; Hess, Foss, & Carroll, 1995) than with spreading activation (e.g., Meyer & Schwanefeldt, 1976) or schema-based priming (e.g., Schank & Abelson, 1977; cf. Morris, 1994).

## (104)

**Processing Negative Expressions When Comprehending a Narrative: Propositional Versus Perceptual Symbol Theories of Comprehension.** BARBARA KAUP & ROLF A. ZWAAN, *Florida State University*—In two experiments subjects read stories containing a color word in the last sentence. The color word was either mentioned within the scope of an explicit negation or not. Orthogonally to this, the corresponding color was either present in or absent from the described situation. An example is: *She [was glad]/[wished] that the bike was (not) blue*. Availability of the color word was measured by means of a probe recognition task after the end of each narrative. After a 500-msec delay, latencies were longer for the negated versions than for the nonnegated versions, independent of situational content. After 1,500 msec, however, latencies were only influenced by the content of the situation with present colors leading to shorter latencies than absent colors. These results will be discussed in the context of propositional and perceptual symbol theories of comprehension.

## (105)

**Accessing Information During Reading.** ROBERT F. LORCH, JR., LISA SHANNON, CLARESE LEMBERGER, KRISTIN RITCHEY, & SCOTT JOHNSTON, *University of Kentucky*—Two experiments examined how adult readers access previous text information when trying to understand a sentence in an expository text. In Experiment 1, readers were slower to read target sentences that were inconsistent rather than consistent with a previous context sentence. This inconsistency effect varied with the number of sentences intervening between the context and target. In Experiment 2, context and target sentences were always consistent but the surface distance between them varied and the number of changes of discourse topic varied. These two factors interacted: When the context and target were adjacent, there was no effect of number of discourse topics; when the context and target were separated by 10 sentences, targets were read more slowly if there were three topic changes than if the superordinate topic remained constant. The findings are consistent with spreading activation models of memory access, but inconsistent with resonance models.

## • NEUROPSYCHOLOGY •

## (106)

**Intact Artificial Grammar Learning in Alzheimer's Disease.** PAUL J. REBER, LUCY A. MARTINEZ, NANCY JOHNSON, & SANDRA WEINTRAUB, *Northwestern University*—The onset of Alzheimer's disease (AD) is marked by a disruption in memory function arising from progressive neuropathology in the medial temporal lobe (MTL). Damage to the MTL produces anterograde amnesia (i.e., impaired declarative memory), but leaves nondeclarative memory intact. The widespread neuropathology of AD leads to impairments in some forms of nondeclarative memory (e.g., perceptual priming is intact in patients with mild AD, but conceptual priming is impaired). Studies of amnesic patients with damage selective to the MTL find that nondeclarative memory supports complex conceptual tasks such as learning an artificial grammar. Patients diagnosed with early Alzheimer's disease (i.e., mild dementia, MMSE > 24) were tested on

artificial grammar learning and recognition memory. The AD patients exhibited normal learning of the artificial grammar although their recognition memory for letter strings was impaired. This result demonstrates that AD patients exhibit intact nondeclarative memory on a conceptual test and reinforces the idea that artificial grammar learning is independent of declarative memory.

(107)

**Semantic and Phonological False Memories in Young, Healthy Old, and Alzheimer's Disease.** JASON M. WATSON, DAVID A. BALOTA, SUSAN D. SERGENT-MARSHALL, & JANET M. DUCHEK, *Washington University*—Young, healthy old, and individuals with dementia of the Alzheimer's type studied and were tested on associative lists of words selected from a hybrid cue false memory paradigm where the words converge either semantically (e.g., *hound, puppy, lassie, mutt*), phonologically (e.g., *log, doll, dug, frog*), or semantically and phonologically (e.g., *hound, doll, lassie, frog*) on a nonpresented critical item (e.g., *dog*). The results of the study indicated that veridical recall decreased with age and with dementia and that false recall of the highly related but nonpresented critical items increased with age and remained fairly stable with dementia. Super-additive rates of false recall were observed with the hybrid lists. When false memory was considered as a proportion of veridical memory, there was a clear increase in false recall with age and with dementia. The results are discussed in terms of age- and dementia-related changes in attentional control processes.

(108)

**The Psychological Refractory Period in Parkinson's Disease.** SHULAN HSIEH, *National Chung Cheng University*—The psychological refractory period paradigm was used to investigate whether patients with Parkinson's disease suffered from disproportional deficits in regulating responses to two sequentially presented stimuli. The first task required a speeded key-press response to an auditory stimulus and the second task required a speeded key-press response to a visual stimulus. The stimulus onset asynchronies (SOAs) between Task 1 and Task 2 were 50, 150, and 650 msec. According to the bottleneck model, the SOA manipulation should not affect Task 1 performance, but that reaction time (RT) for Task 2 should increase as the SOA between the two tasks decreased. The increase in RT for Task 2 was referred to as the psychological refractory period (PRP). In this study, both patients with Parkinson's disease and normal controls showed classical PRP effects. More importantly, although patients with Parkinson's disease took longer to respond to both Task 1 and Task 2 than normal controls did, the two groups had the same magnitude of the PRP effects. The results suggest that Parkinson's disease affects only the perceptual and/or response execution stages rather than the response-selection stage based on the central bottleneck model.

(109)

**The Effects of Lexical Neighborhood Density in Schizophrenia.** DEBRA A. TITONE & DEBORAH L. LEVY, *McLean Hospital and Harvard Medical School*, & PHILIP S. HOLZMAN, *McLean Hospital and Harvard University*—According to the neighborhood activation model (NAM) of spoken word recognition (Luce, 1986; Sommers, 1996), words differ from one another in the number of phonetically similar lexical competitors, and in their relative frequency within lex-

ical neighborhoods. Words that come from high-frequency, high-density neighborhoods are predicted to be more difficult to identify than words that come from low-frequency, low-density neighborhoods. This difference in identification has been termed the *lexical neighborhood density effect*. This study extends that work to a clinical population known to demonstrate cognitive inhibitory dysfunction but few speech perception abnormalities: schizophrenia patients. The results showed that schizophrenia patients ( $n = 20$ ) exhibited significantly larger neighborhood density effects than individuals from a nonpsychiatric control group ( $n = 38$ ). We conclude that inhibitory dysfunction characteristic of schizophrenia makes it more difficult for patients to suppress activation of a large number of high-frequency lexical competitors during spoken word recognition.

(110)

**Initiation Difficulties in Schizophrenia: The Role of Explicit Instruction.** STEPHANIE L. CAISSIE, TODD S. WOODWARD, PETER GRAF, & PETER F. LIDDLE, *University of British Columbia*—Difficulty with initiating thought and behavior is a cardinal feature of schizophrenia. These symptoms are usually difficult to treat and contribute to poor social and occupational outcome. The present study sought to elucidate factors that mediate initiation ability in a choice reaction time (RT) task. Subjects were required to press a key in response to a stimulus in two different conditions: when the stimulus was expected and subjects were prepared with a response versus when subjects had to infer how to respond to a novel stimulus. Control subjects were slower to respond in the latter condition. This difference in RT between the two conditions was greater in stable schizophrenia outpatients. These results suggest that schizophrenics may have particular difficulty initiating behavior in the absence of explicit instruction.

(111)

**H.M.'s Word Comprehension and Production: Aging Interacts With Hippocampal System Damage.** LORI E. JAMES & DONALD G. MACKAY, *UCLA*—Node Structure theory (NST) predicts specific interactions between aging and H.M.'s hippocampal system damage that present experiments test with lexical decision tasks (comprehension) and reading tasks (production). For lexical decisions, H.M. exhibited comprehension deficits relative to same-age, memory-normal controls at age 57 and 71 for low-frequency (LF) but not high-frequency (HF) words. However, lexical decision scores for LF words declined reliably over that period for H.M., but remained stable with aging for controls. For reading aloud, H.M. exhibited deficits for both LF words and pseudo-words at both ages, but only his deficits for LF words increased with aging. These findings fit NST, where H.M.'s progressive deficits in comprehending and reading LF words reflect relatively recent interactions between cognitive aging and his connection formation deficits. However, H.M.'s connection formation deficits have (in theory) rendered representation of novel (pseudo-) words difficult for H.M. ever since his 1953 operation.

(112)

**Research Support From the National Science Foundation.** JOSEPH L. YOUNG, RODNEY R. COCKING, ANN H. BOSTROM, & FRED STOLLNITZ, *National Science Foundation*—Information about the various programs of the NSF will be available.

**Autobiographical and Real-World Memory**  
**Coronado H, Friday Morning, 8:00–10:00**

*Chaired by James S. Nairne, Purdue University*

**8:00–8:15 (121)**

**The Retention of Happy, Sad, Traumatic, and Involuntary Autobiographical Memories.** DORTHE BERNTSEN, *University of Aarhus*, & DAVID C. RUBIN, *Duke University* (read by David C. Rubin)—One thousand two hundred forty-one respondents between the ages of 20 and 93 were asked about their age during their most important, happiest, saddest, and most traumatic memories and their most recent involuntary memory. For respondents over 40, there was a clear peak in responding in the 20s for most important and happiest memories; in contrast, there was a monotonically decreasing retention function for participants of all ages for their saddest and most traumatic memories. Involuntary memories showed a recency effect for the most recent year similar to word-cued autobiographical memories and a peak between the ages of 0 and 20. Overall, the results are inconsistent with predictions made about the retention of autobiographical memories from the biological, narrative, aversive learning, and dissociation literatures but are consistent with assumptions that, compared with positive events, negative events are less rehearsed and central in organization due to more subsequent life change and more social censorship.

**8:20–8:40 (122)**

**True and False Autobiographical Memories and Beliefs: A Theoretical Model.** GIULIANA MAZZONI, *Seton Hall University*, & IRVING KIRSCH, *University of Connecticut*—A distinction is made between autobiographical memories and autobiographical beliefs, and a model is presented in which the two are posited to interact. Both memory reports and beliefs are hypothesized to depend on processes involving metacognitive beliefs and decisional criteria. Questions about whether an autobiographical event has occurred trigger a memory search, the results of which are matched against the decisional criteria. If the content resulting from the search is not judged to be a memory, a decision is made concerning the diagnostic implications of the failure. If the absence of a memory is not judged to indicate that the event did not happen, inferences about the occurrence or nonoccurrence of the event are derived from normative information, personal information, and additional metacognitive beliefs.

**8:45–9:05 (123)**

**Consistency of Knowledge Across Cohorts by Decades.** S. DAVID LEONARD, *University of Georgia*—Examination of recall over extended time periods is difficult, because of the problem of retaining the respondents. Many items are common across time, because they were learned in school and/or as a function of publicity about events occurring, but over different cohorts changes may occur in the emphasis given to topics in schools, and common experiences may differ for different cohorts. This report will examine the differences and commonalities of recall by college students taken at three 10-year intervals. It is assumed that those items recalled equally well by different cohorts and different sexes will be suitable for use in examining factors involved in recall of individuals at different ages both now and in the future. Differences between groups will be discussed in terms of possible sources. Ability of respondents to evaluate their ability to recall items will also be discussed.

**9:10–9:30 (124)**

**A Meta-Analysis of 250 Studies of Eyewitness Accuracy of Lineup IDs.** RALPH N. HABER & LYN HABER, *University of California, Santa Cruz and University of California, Riverside*—Cognitive scientists have conducted over 1,000 experiments on eyewitness accuracy, many requiring eyewitnesses exposed to a real or simulated crime to make an identification of the perpetrator in a lineup. These experiments have provided accuracy data that range from 90% to 10% correct. We performed an accuracy meta-analysis of 250 of these studies, limited to those that used a photo-spread or an in-person lineup

to elicit the ID response. Independent variables included factors of observation, reporting, time, interrogation, postevent exposure, lineup, race, weapon, and subject. The independent variables potentially controllable in real life by investigators, prosecutors, and the courts (e.g., line variables, postevent variables, and interrogation variables) produced large and usually interactive effects, as compared with the smaller and additive effects of the typically uncontrollable variables. The results of this meta-analysis indicate that eyewitness identification of strangers grossly fails to meet the current Supreme Court's accuracy criteria required for other kinds of evidentiary-based testimony.

**9:35–9:55 (125)**

**Recollection Rejection.** VALERIE F. REYNA, CHARLES J. BRAINERD, & RON WRIGHT, *University of Arizona*, & AMBROCIO H. MOJARDIN, *Universidad Autónoma de Sinaloa*—Procedures used to edit false events out of memory reports have fundamental implications for theories of false memory and for best practice in applied domains (e.g., forensic interviews). A false-memory editing operation posited in fuzzy-trace theory, recollection rejection, is presented, which assumes that false-but-gist-consistent events (e.g., SOFA, when COUCH was experienced) sometimes cue the retrieval of verbatim traces of the corresponding true events (COUCH), generating mismatches that override the high familiarity of false-but-gist-consistent events. Converging empirical support comes from two qualitative phenomena: recollective suppression of semantic false memory and nonmonotonic relations between retrieval time and semantic false memory. Further converging support comes from experiments in which two quantitative methodologies (conjoint recognition and receiver operating characteristics) are used to measure levels of recollection rejection on memory tests. The analysis also predicts a novel false-memory phenomenon (erroneous recollection rejection) in which certain true events are inappropriately edited out of memory reports.

**Morphological Processing**

**Coronado L, Friday Morning, 8:00–9:55**

*Chaired by Catherine L. Harris, Boston University*

**8:00–8:20 (126)**

**Orthographic Structure Versus Morphological Structure: Principles of Lexical Organization in a Given Language.** RAM FROST, TAMAR KUGLER, & AVITAL DEUTSCH, *Hebrew University of Jerusalem*, & KENNETH I. FORSTER, *University of Arizona*—Form masked priming occurs when primes and targets share most of their letters in similar positions. It is one of the more robust effects in visual word recognition and has been demonstrated repeatedly across many languages. Form priming occurs when the result of processing the prime can be transferred to the target. This transfer is possible when primes and targets share orthographically contiguous sublexical processing units. Such units are often claimed to be fundamental to lexical organization. Our study explored form-priming effects in Hebrew or Arabic—Semitic languages with a nonconcatenated morphology in which morphemes are noncontiguous orthographic units. Our experiments repeatedly failed to find form-priming effects even with maximal letter overlap. In contrast, morphological priming effects with minimal letter overlap were always obtained. These results suggest that the principle of organization and processing of words in alphabetic orthographies are not universal but are determined primarily by the languages' morphological characteristics.

**8:25–8:45 (127)**

**Does Morphological Structure in Hebrew Reduce to Surface Structure?** DAVID C. PLAUT, *Carnegie Mellon University*, & RAM FROST, *Hebrew University of Jerusalem*—Hebrew has a rich morphology in which most words are formed by interdigitating a three-consonant root into a vowel- and consonant-based word pattern. Morphological priming in Hebrew can occur in the absence of semantic similarity, supporting claims that explicit morphemic units mediate word recog-

dition. From a distributed connectionist perspective, however, such priming effects can arise due to the pervasive morphological organization of the entire language (Plaut & Gonnerman, 1999, LCP). In addition, morphological priming in languages with rich morphologies may reflect learned sensitivity to the distributional characteristics among surface forms alone, irrespective of their meanings. Results from simulations trained on a 100-million-word corpus of written Hebrew suggest, however, that surface structure alone is insufficient to induce the necessary sensitivity to morphological structure. Rather, exposure to rich surface structure combined with broad distinctions in how such structure relates to meaning may be necessary for the system to learn the relevant morphological relationships among words.

#### 8:50–9:05 (128)

**Partial Semantic Compositionality Modulates Morphological Facilitation.** LAURIE BETH FELDMAN & MATTHEW J. PASTIZZO, *SUNY, Albany & Haskins Laboratories*—Morphologically related words typically share a base morpheme whose meaning contributes to that of its morphologically complex relatives so that complex word forms composed from the same base have overlapping meanings. In a series of experiments with varying SOAs, we explore the contribution to morphological facilitation of overlapping semantics among forms that share a base morpheme. We contrast target (LATE, ALLOW) facilitation after complex forms whose meaning can be composed in full (LATENESS, ALLOWABLE) or in part (LATELY, ALLOWANCE) from that of its base morpheme and its affix (full vs. partial semantic compositionality). Finally, we contrast the time course of semantic compositionality with that of semantic association.

#### 9:10–9:30 (129)

**Parafoveal Versus Foveal Processing of Morphologically Complex (Prefixed) Words.** GRETCHEN KAMBE, *University of Nevada, Las Vegas*, & KEITH RAYNER, *University of Massachusetts, Amherst* (read by Keith Rayner)—We investigated whether morphological constituents influence word processing during reading. Participants read sentences containing free stem, bound stem, and pseudo-prefixed words. In Experiments 1 and 2, a parafoveal display change manipulation indicated that the morphological constituents of a prefixed word are not available for preprocessing in the parafovea. Reading times on the target word did not differ for prefixed versus pseudo-prefixed words. Interestingly, parafoveal preview of word-initial and word-final letters resulted in an equivalent amount of orthographic facilitation for all word types. In Experiment 3, a fast priming manipulation indicated that morphological priming effects for prefixed words are obscured during sentence processing. However, the form of the prime did facilitate subsequent word processing for all three word types. The results suggest that English prefixed words are generally accessed via their whole word form, since there was no evidence of morphological decomposition for prefixed words during sentence reading.

#### 9:35–9:50 (130)

**The Effect of Word Length on Morphological Processing.** RAYMOND BERTRAM & JUKKA HYÖNÄ, *University of Turku* (sponsored by Jukka Hyönä)—A central topic in reading research is the role of morphology in accessing complex words. Do Finnish natives, for instance, access compound words like TEATTERI/SALI (theatre hall) via their constituent morphemes or not? Earlier eye movement studies in our lab suggest that this is indeed the case. However, all compound words employed had a length of 12 letters and typically elicited more than one fixation. Consequently, readers might have started with accessing TEATTERI in TEATTERI/SALI simply because the latter part of the word was not clearly visible at the first fixation. In this study, we presented very short compound words like APU/RAHA (grant money) (typically eliciting one fixation only) to Finnish readers alongside longer words like TEATTERI/SALI, to find out whether the effects found earlier were purely structural or whether they were enhanced by word length. Our present experiments indicate that word length can indeed modify the role of morphology.

### Attention Capture Monterrey, Friday Morning, 8:00–10:00

Chaired by Joel S. Warm, *University of Cincinnati*

#### 8:00–8:10 (131)

**Semantic Oddities Draw Early Saccades.** MARK BECKER & HAL PASHLER, *University of California, San Diego*, & JEFFREY LUBIN, *Sarnoff Laboratories* (read by Hal Pashler)—We investigated whether semantically anomalous information in peripheral vision attracts saccades when the anomaly is consistent with the scene's low-level visual properties. Subjects viewed color photographs for 8 sec while their eye movements were monitored. Each subject saw two photographs of different scenes. One image was a control (e.g., a portrait of four people), and the other image was altered so that one object was semantically anomalous (e.g., one of the heads was flipped upside down in the portrait). In other photographs, the color of the items was altered in a way that was either semantically reasonable or anomalous (e.g., a green shirt or a green stop sign). Subjects fixated semantically anomalous items much earlier (both in time and number of prior fixations), as compared with semantically reasonable objects. The mean distance of saccades (~80°) suggests that the anomaly was identified in peripheral vision and attracted attention to that location.

#### 8:15–8:25 (132)

**Unexpected Oddball Images in Picture RSVP Induce an Attentional Blink.** JANE RAYMOND & STEPH TARN, *University of Wales, Bangor*—The attentional blink (AB) is a temporary deficit in perception of brief stimuli that occurs immediately after visual engagement with a brief, masked, prespecified target. Can an AB be provoked by the brief appearance of an unexpected but interesting stimulus? Might this affect long-term memory for subsequently presented images? We presented color pictures in RSVP (5/sec or 2.5/sec) and asked participants to visually memorize them. All items within each series belonged to a single category (e.g., boats) except one oddball (e.g., butterfly). One group was uninformed about the oddballs; another was told to report their categories. After viewing 12 series, visual recognition for previously seen images was measured. Both groups showed severe dips in recognition for items presented 0.5 sec after the oddball (AB effect) even though the uninformed group had poor oddball recognition. Natural types of visual engagement probably limit visual memory in some situations (e.g., video).

#### 8:30–8:50 (133)

**Attention Without Selection: Shallow Processing of Attended Nontargets.** ROGER W. REMINGTON, ERIC RUTHRUFF, & JOEL LACHTER, *NASA Ames Research Center*—We examined the depth of processing that ensues when attention is captured to a distractor location by an irrelevant peripheral cue. Stimuli were oriented letters; subjects responded either to target orientation or to identity on separate trials. Previously, Remington and Folk (in press) found response-compatibility effects only for the task-relevant dimension of the cued distractor (i.e., if subjects responded to target identity, the response was influenced only by the identity of the cued distractor, not the orientation). They argued that features of attended distractor items do not have automatic access to response mechanisms unless selected for response. Here, we extend this finding by demonstrating that the compatibility effect of the cued distractor is sharply reduced when it does not have a shape very similar to that of the target (e.g., strong “identity” priming, weak “semantic” priming). This finding argues that without selection for response, only superficial properties of attended items are processed.

#### 8:55–9:10 (134)

**Capture at the Fovea: Control Settings and the Attentional Blink.** CHARLES L. FOLK, *Villanova University*, & ANDREW B. LEBER & HOWARD E. EGETH, *Johns Hopkins University*—In the attentional blink (AB) paradigm, decrements in the report of T2 are usu-

ally apparent only when a response to T1 is required. However, there are hints in the literature that even an ignored T1 can produce an AB, perhaps through the “capture” of attention. The present experiments explored the link between attentional capture and the AB. Subjects reported the identity of a letter of particular color in a stream of colored letters appearing inside a gray box at fixation. On critical trials, the gray box changed color for one frame. This task-irrelevant color change produced a significant decrement in T2 report, but only when it matched the color of the target to be reported. The results confirm that the AB can be produced by irrelevant, ignored stimuli and suggest a form of nonspatial attentional capture that is contingent on top-down attentional control settings.

#### 9:15–9:30 (135)

**Neural Basis of Goal-Directed and Stimulus-Driven Attentional Control.** JOHN T. SERENCES, SARAH SHOMSTEIN, ANDREW B. LEBER, STEVEN YANTIS, & HOWARD E. EGETH, *Johns Hopkins University* (read by Howard E. Egeth)—Voluntary shifts of attention are caused by transient control signals issued by the superior parietal cortex. It is not known, however, whether stimulus-driven attentional capture recruits these same areas. We used rapid event-related fMRI to investigate this question. Digit cues embedded within a central (fixated) RSVP stream instructed subjects either to maintain attention there or to deliberately shift attention to one of two peripheral streams in preparation for a color singleton target in the attended stream. When attention was focused on the central stream, a singleton distractor matching the target color could appear in one of the to-be-ignored peripheral streams. Behavioral studies have shown that such distractors capture attention. We examined whether the singleton distractor caused attentional modulation in the extrastriate cortex and the extent to which stimulus-driven and voluntary shifts of attention recruit the same attentional control circuits.

#### 9:35–9:55 (136)

**Neural Basis of Space-Based and Object-Based Attentional Control.** STEVEN YANTIS, JOHN T. SERENCES, JENS SCHWARZBACH, SUSAN M. COURTNEY, ROBERT L. CARLSON, & MICHAEL A. STEINMETZ, *Johns Hopkins University*—Visual attention can select regions of space or spatially invariant object representations by modulating the strength of early sensory representations in the visual cortex. We investigated the source of attentional control, using rapid event-related fMRI. The spatial shift task required participants to periodically shift attention between RSVP streams on the left or right of fixation upon detection of a switch signal embedded in the streams. The object shift task required participants to shift attention between streams of superimposed faces and houses at fixation. Both experiments revealed location- or object-specific attentional modulation of early sensory representations in the extrastriate cortex and transient increases in activity in the superior parietal lobule (SPL) related to shifts of attention between locations or objects. These results show that the SPL mediates the control of both spatial and nonspatial shifts of visual attention.

#### Categorization

Durango, Friday Morning, 8:00–10:00

Chaired by Alan W. Kersten, Florida Atlantic University

#### 8:00–8:20 (137)

**Shepard, Hovland, Jenkins, and Monkeys.** J. DAVID SMITH, *SUNY, Buffalo*, JOHN PAUL MINDA, *Beckman Institute, University of Illinois, Urbana-Champaign*, & DAVID A. WASHBURN, *Georgia State University*—In influential research, Shepard, Hovland, and Jenkins (1961) surveyed humans’ categorization abilities, using six logical task types, including tasks based in rules (Type I), feature correlations (Type II), family resemblances (Type IV), and so forth. Humans’ performance was not well predicted by cue-conditioning or stimulus generalization processes, causing Shepard et al. to describe humans’ performance more in terms of active abstraction, hypothesis

selection, and rule application. We surveyed monkeys’ categorization abilities in the same way. Four rhesus macaques (*Macaca mulatta*) completed thirty-six 2,000-trial sessions comprising six rotations of the six task types. Monkeys, like humans, found rule-based tasks (Type I) the easiest and perceptually chaotic tasks (Type VI) the hardest. But monkeys also showed important differences from humans. We consider the character of monkeys’ categorization system, possible limitations on it, and whether monkeys instantiate the similarity- and generalization-based cognitive system that Shepard et al. demonstrated that humans do not.

#### 8:25–8:45 (138)

**Exemplar and Prototype Models Revisited.** ROBERT M. NOSOF-SKY & SAFA R. ZAKI, *Indiana University*—In a recent series of articles, J. D. Smith and colleagues (Minda & Smith, 2001; Smith & Minda, 1998, 2000; Smith, Murray, & Minda, 1997) presented evidence that they claimed challenged the predictions of exemplar generalization models of categorization and that supported the predictions of prototype models. This evidence confounded the issue of the nature of the category representation with the type of response rule (probabilistic vs. deterministic) that was used. Also, because these researchers did not include novel transfer stimuli in their designs, they failed to test whether the prototype models correctly predicted generalization performance. In the present work, we show that a current exemplar generalization model that includes a deterministic response rule provides a natural account of all of J. D. Smith and colleagues’ experimental results. Furthermore, the exemplar model predicts classification performance far better than do the alternative prototype models when novel transfer stimuli are included in the experimental designs.

#### 8:50–9:05 (139)

**Representation Change: New Attributes Are Formed From Features During Concept Learning.** DORRIT BILLMAN & CARL BLUNT, *Georgia Institute of Technology*—With learning and expertise, people seem to represent instances in terms of new attributes (as well as new categories and features): type of shot in film or type of cell membrane in microbiology. People reorganize multiple features into values of one new attribute. We investigate the conversion of unrelated features into contrasting values of a new attribute and consider what the evidence for such representation change would be. Participants learned three contrasting categories of alien organisms. The “same” features were configured differently in two conditions. These features come to be seen as values of different attributes following learning. We used several measures to make inferences about attribute formation and found condition differences in (1) asymmetry in generalizing the old categories when old properties changed, (2) inductions about novel categories using novel values of the new attribute, and (3) the 3-D qualities participants used to describe 2-D images.

#### 9:10–9:30 (140)

**Understanding Makes It Normal: Causal Explanations Affect the Perception of Psychological Symptoms.** WOO-KYOUNG AHN & LAURA R. NOVICK, *Vanderbilt University*, & NANCY S. KIM, *Yale University*—Meehl (1973) has informally observed that clinicians fallaciously perceive that a patient is more normal if the clinician can understand the patient’s psychological symptoms. In Experiment 1, undergraduate participants received descriptions of people, each with three symptoms taken from DSM-IV (e.g., “frequently suffers from insomnia”). As compared with those who did not receive any information about causal relations among symptoms, participants judged that the patients were more psychologically normal when these symptoms formed a plausible causal chain, but more abnormal when they formed an implausible causal chain. In Experiment 2, a negative life event (e.g., “is very stressed out due to her workload”) was added as an explanation for the first symptom in a three-symptom causal chain. Undergraduate students, expert clinicians, and graduate students in clinical psychology all perceived that patients were significantly more normal given these explanations than without them, confirming Meehl’s prediction.

**9:35–9:55 (141)**

**Perspective in the Conceptualization of Categories.** ANNA M. BORGHI, *University of Bologna*, & LAWRENCE W. BARSALOU, *Emory University* (read by Lawrence W. Barsalou)—If perceptual simulation underlies the conceptualization of categories, then conceptualizations should have perspectives, given that perceptions do. Amodal views of concepts have never made this prediction. Five experiments using the property generation task demonstrate two types of perspectives in conceptualizations: entrenched and contextual. Entrenched perspectives provide default ways of constructing simulations, such as perceiving objects from the outside, from the front, up close, and visually. Contextual perspectives override default perspectives, inducing perspectives relevant in the current situation, such as perceiving objects from the inside, from above, at a distance, or auditorily. Even when contextual perspectives are relevant, default perspectives sometimes reinstate themselves, perhaps because of their informativeness. Thus, subjects zoom in on distant objects or turn around objects perceived from behind. Such transformations occur primarily when compatible with the background setting. In general, the perspectives underlying simulations prepare subjects for situated action.

**Metacognition****Yucatan, Friday Morning, 8:00–9:55***Chaired by Christopher Hertzog, Georgia Institute of Technology***8:00–8:15 (142)**

**The Efficacy of Metacognitively Guided Study Time Allocation.** JANET METCALFE, *Columbia University*—Although most of the literature on people's allocation of study time has suggested that they devote their time selectively to the most difficult items (consistent with the discrepancy-reduction model), these results may have occurred because people had unlimited time, because the items were all fairly easy, or because the choice situation was virtually impossible. I will review several recent studies from our laboratory indicating that when the items vary widely in difficulty, when people are time limited, and when they can easily make the choice, they instead devote their time to items of easy or medium difficulty (consistent with the idea that people study selectively within a region of proximal learning). These experiments additionally investigate whether people's choice of items is efficacious for learning or whether, instead, they provide less-than-optimal learning returns.

**8:20–8:35 (143)**

**“Zoning Out” During Reading: Evidence for Dissociations Between Experience and Meta-Awareness.** JONATHAN W. SCHOOLER, ERIK D. REICHLER, & DAVID V. HALPERN, *University of Pittsburgh*—Everyone has had the experience of suddenly realizing that they have no idea what they have been reading but, instead, have been thinking about something entirely unrelated. Several experiments explored this zoning-out phenomenon with a computer-based reading paradigm in which participants read dull text, pressing a key every time they caught themselves zoning out. In addition, some participants were intermittently probed regarding whether they were zoning out at that moment. On average, people self-caught themselves zoning out approximately five times during a 45-min period. Moreover, on more than 11% of the probe trials, participants were caught unaware of the fact that they had been zoning out. Although the frequency of self-caught zoning out was unrelated to final comprehension performance, the incidence of probe-caught zone outs was negatively related to comprehension. Together, these findings illustrate how zoning-out episodes can provide a window into dissociations between individuals' conscious experiences and their meta-awareness of those experiences.

**8:40–8:55 (144)**

**Illusions of Competence in Monitoring One's Knowledge During Study: The Foresight Bias.** ASHER KORIAT, *University of Haifa*, & ROBERT A. BJORK, *UCLA*—The monitoring of one's own knowl-

edge during study suffers from an inherent discrepancy between study and test situations: Judgments of learning (JOLs) are made in the presence of information that is absent but solicited during testing. The failure to discount the effects of that information when making JOLs can instill what we have labeled a foresight bias—a sense of competence during learning that proves unwarranted during testing. Using a paired-associates task, we examined four item attributes that seemed likely contributors to such illusions of competence. They all have the potential to create differential strengths of a priori and a posteriori associations—that is, the probability with which a cue, when presented alone, elicits the corresponding target versus the perceived association between the cue and the target when both are present. We argue that the former has the greater influence on later recall, whereas the latter has the greater influence on JOLs.

**9:00–9:10 (145)**

**Metamemory and Used Books: Reading Previously Highlighted Material Leads to Overconfidence.** CHARLES A. WEAVER III, ANGELA TODD, & KEVIN KRUG, *Baylor University*—Subjects read brief (approximately 600-word) expository passages, in one of three conditions: (1) a highlighting condition, in which readers highlighted material as they read; (2) a previously highlighted condition, in which they read texts that had already been highlighted; or (3) a control condition with no special materials or instruction. After reading, subjects predicted their performance on a later multiple-choice test and then answered 14 questions for each text. Consistent with previous findings, those who highlighted themselves performed best on the test of comprehension, whereas those reading previously highlighted passages performed worst. Furthermore, those who read previously highlighted passages were significantly more overconfident. Students who buy used books—which are likely to have been highlighted by a previous owner—may suffer a double penalty: Their comprehension will suffer, and their metacomprehension (the ability to monitor comprehension and predict future performance) will be impaired, too.

**9:15–9:30 (146)**

**Metacomprehension of Text: A Test of the Optimum Effort Hypothesis.** RUTH H. MAKI & ERIC W. HOLDER, *Texas Tech University*, & MICHAEL J. MCGUIRE, *Northern Michigan University*—In order to test Weaver and Bryant's (1995) optimum effort hypothesis, we studied the accuracy of performance predictions and posttest confidence judgments for easy and difficult texts as a function of participants' comprehension ability. According to the optimum effort hypothesis, matches between text difficulty and ability should produce the most accurate metacomprehension. There was no evidence for this pattern in either predictions or confidence judgments, although comprehension ability related positively to the accuracy of posttest confidence judgments and easy texts produced more accurate judgments than did difficult texts. We also attempted to boost the accuracy of predictions by having some participants read texts twice (Rawson, Dunlosky, & Thiede, 2000). Rereading interacted with text difficulty, but not with participant ability. Predictions were higher for easy texts when they were read once, as compared with twice, but there was no rereading effect for the more difficult texts.

**9:35–9:50 (147)**

**The Memory Confidence–Accuracy Relationship: The Interactive Interplay of Memory and Knowledge.** CHRISTOPHER T. BALL, *College of William & Mary*—The present experiment examined the interactive interplay between specific memories for an event and one's knowledge of such events. The event involved a campus tour. Participants were tested on their general knowledge, event knowledge (i.e., campus tours), common event memory (i.e., details common to other tours), and specific event memory (i.e., details unique to this tour). Participants were also required to rate their confidence in the accuracy of each answer. Half of the participants were given the memory tests 1 day after the tour presentation, whereas the other half were tested 7 days after the tour presentation. Half of the participants were

given the knowledge tests just before the tour presentation, whereas the other participants were tested after the memory tests were completed. As was expected, the priming of knowledge scripts influenced memory accuracy and resolution, and in addition, weakening memory traces influenced knowledge accuracy and resolution.

**Touch/Haptic Perception**  
**Coronado A, Friday Morning, 8:00–10:05**

*Chaired by Jean Vroomen, Tilburg University*

**8:00–8:15 (148)**

**Parallel Projection in Drawings From Gaia, a Blind Girl.** JOHN M. KENNEDY, *University of Toronto*—Gaia is a 12-year-old totally blind girl, whose vision at best is peripheral. She draws out of interest and has drawn with encouragement from her mother since age 3. She makes raised-line drawings. Gaia uses several projection systems in her drawings. She was asked to draw a table from below, two cars (one behind the other), and two parallel rows of apples (receding from her, on a table top). These scenes involve depth from a vantage point. Gaia used parallel projection to solve these picture-making tasks. She also used height in the picture plane.

**8:20–8:35 (149)**

**Vibrotactile Spatial Resolution in Linear Arrays.** ROGER W. CHOLEWIAK & AMY A. COLLINS, *Princeton University*, & M. CHRISTOPHER BRILL, *Naval Aerospace Medical Research Laboratories*—When developers wish to present information that encodes environmental events to the skin through arrays of vibrators, a common concern is the spatial proximity of the tactors: How close can they be placed and still be uniquely distinguished? The minimum separation necessary for accurate resolution could depend on many factors, including body site and stimulus parameters such as frequency, waveform, or contactor area. Using linear arrays of vibrators with small contactors, we explored localization accuracy for single bursts of vibration on the skin, manipulating some of these variables. Arrays of 7 tactors along the volar forearm and 12 tactors equally spaced around the girth of the trunk were tested. Whereas our understanding of tactile physiology would argue that, because of the nature and locations of receptors and the spread of mechanical energy, localization should be poorest for higher frequency stimulation and for sites over bony tissue, this was not the case.

**8:40–8:55 (150)**

**Recognizing Pictures by Touch: The Effect of Training With Raised-Line Drawings.** FRANCISCO J. LIMA & JOSÉ A. DA SILVA, *University of São Paulo at Ribeirão Preto* (read by José A. Da Silva)—The present study investigated the recognition of raised-line drawings after a 45-h training with two-dimensional pictures. Subjects were 8 totally blind individuals (mean age, 15 years), all naive for the task. Thirty-three drawings were used for the training. Subjects improved significantly both after training with geometric drawings ( $p < .01$ ) and after training with pictures of objects ( $p < .01$ ). It is claimed that vision mediation is not necessary for picture recognition by touch.

**9:00–9:20 (151)**

**Serial Order Effects in Temporary Haptic Memory for Spatial Information.** SUSANNA MILLAR & Z. AL ATTAR, *University of Oxford*—The study reports serial position effects in temporary haptic memory for spatial locations, with and without added external and body-centered reference information. Blindfolded participants were tested on recall of five landmark locations along a designated route in a tactile display. Body-centered and external reference conditions were manipulated experimentally, by adding external reference frame cues in aligned conditions and by display rotation, which disrupts body-centered reference. Location recall was significantly improved with added reference information but also showed significant serial position curves. The findings show new evidence for serial order effects

in haptic spatial memory. The results support the hypothesis that temporary memory for spatial information from touch and movement depends on the coordination of sequential information with spatial coding in terms of external and body-centered reference frames.

**9:25–9:40 (152)**

**Visual and Haptic Symmetry Discrimination of Stimuli Extended in the z-Axis.** SOLEDAD BALLESTEROS & JOSE M. REALES, *UNED, Spain*—Touch was better in detecting asymmetric raised-line shapes than symmetric ones under one-finger exploration, but bimanual exploration improved processing of symmetric shapes. In contrast, touch was more accurate with 3-D symmetric objects (Ballesteros, Manga, & Reales, 1997). Furthermore, shape symmetry facilitated haptic as well as visual processing of raised patterns when body-centered information was provided (Ballesteros, Millar, & Reales, 1998). Four new sets of comparable symmetric and asymmetric stimuli were constructed by extending the z-axis (raised lines, raised surfaces, short 3-D objects, and 3-D objects). A visual study showed that symmetric judgments were more accurate than asymmetric ones in all stimuli sets. In line with our previous results, a tactual study showed that under bimanual exploration, symmetric and asymmetric raised-line shapes did not differ. However, as the z-axis was extended, touch as vision was more accurate for detecting symmetric than asymmetric stimuli. RTs results differed between vision and touch.

**9:45–10:00 (153)**

**Haptic Face Processing.** SUSAN J. LEDERMAN & ANDREA KILGOUR, *Queen's University*—We investigated how well people can identify and represent faces solely by hand. In Experiment 1, participants proved surprisingly capable of identifying unfamiliar live human faces, using only their sense of touch. To evaluate the contribution of geometric and material information more directly, we biased participants toward encoding faces more in terms of geometric than material properties, by varying the exploration condition. When participants explored the faces both visually and haptically, identification accuracy did not improve relative to touch alone. When participants explored masks of the faces, thereby eliminating all material cues, matching accuracy declined substantially relative to haptic identification of live faces. In Experiment 2, we explored intersensory transfer of face information between vision and touch. The findings are discussed in terms of their relevance to haptic object processing and to the face-processing literature in general.

**False Memory**

**Coronado H, Friday Morning, 10:10–12:00**

*Chaired by William E. Hockley, Wilfrid Laurier University*

**10:10–10:20 (154)**

**False Memories While DRMinG: Self-Generated Memories Attributed to Others.** FRANCIS T. DURSO, *Texas Tech University*, & JENNIFER DEVITO & SCOTT D. GRONLUND, *University of Oklahoma*—If the DRM paradigm is to serve as a viable laboratory analogue for false memories, it is important that the false memory be attributed to an external event, and not to the participant's imagination processes. A participant and a confederate alternated reading words from DRM lists. Participants recognized foils (e.g., sleep) as often as they recognized words they read. Participants attributed the critical foil to the confederate, an attribution uncommon for read words. Thus, like other self-generated information, critical foils can be remembered well, but the information that usually allows one to attribute the memory to one's self is absent. With more cognitive processing (e.g., stem completion, anagram), false memory rates decreased, but those critical foils that were remembered were still attributed to external sources. Thus, thinking about the events does not make it more likely that one will correctly remember it as merely a passing thought.

**10:25–10:45 (155)**

**Decreased Attention Increases False Memory.** MARILYN C. SMITH & RACHELLE TA-MIN, *University of Toronto*—This study investigated the effect of divided attention on the incidence of false memory with the Deese–Roediger–McDermott paradigm. In Experiment 1, participants were required to perform a visual monitoring task as they listened to the lists of associated words. In Experiment 2, words were presented visually, and subjects either read the words silently (full attention) or indicated by making a keypress response whether there were any repeated letters in the word (divided attention). Results of both experiments were very similar: When participants were prevented from focusing full attention on the meaning of the presented words, there was a decline in veridical memory and an increase in false memory.

**10:50–11:05 (156)**

**Is the Cognitive Process in False Recognition Really the Same as in True Recognition?** JERWEN JOU, JAMES W. ALDRIDGE, & LORENA L. GONZALEZ, *University of Texas, Pan American*—Subjects learned 15 visually presented words as in the Deese–Roediger–McDermott paradigm. The list of words was presented once, twice, or three times. They then counted backward by three for 30 sec as the interpolated task. The recognition test consisted of 15 old and 15 new words, with all the new words semantically related to the old words. In half of the tests, the critical lure word was presented; in the other half, it was not. Results showed that the RT for the false positive recognition of the new words was longer than that of the correct positive recognition of the old words. More important, false positive recognition of the nonpresented lures took consistently longer than correct positive recognition of the presented lures. This RT difference increased with the number of presentations. The result contradicts subjects' subjective reports of the vivid phenomenological experiences of false recognition.

**11:10–11:30 (157)**

**Phantom Recall.** C. J. BRAINERD & RON WRIGHT, *University of Arizona*, & DAVID G. PAYNE, *University of Binghamton*—When subjects study lists containing several semantically related targets (e.g., COLLIE, HOUND, POODLE, SPANIEL), recognition probes for meaning-preserving distractors (e.g., DOG) sometimes provoke high levels of phantom recollection—vivid but illusory conscious experience of distractors' "presentation" on the study list. Although this illusory phenomenology is well established in false recognition, it is not known whether phantom recollection accompanies false recall. We summarize data from a series of free-recall experiments in which phantom recollection of meaning-preserving intrusions was measured using a dual-retrieval model of recall. The study materials were either lists containing same-category exemplars or Deese–Roediger–McDermott lists, and the intrusions were either category names or critical associates. High levels of phantom recollection accompanied such intrusions, and in certain instances, intrusions were chiefly due to phantom recollection.

**11:35–11:55 (158)**

**The Time Course of False Recognition Memory: Data and Models.** EVAN HEIT, NOELLIE BROCKDORFF, & KOEN LAMBERTS, *University of Warwick*—In the Deese–Roediger–McDermott false memory paradigm, after subjects study a list of interrelated words, they falsely recognize semantically similar lures nearly to the extent that they correctly recognize studied items. This result seems to persist even when subjects are forewarned about the nature of the illusion. In three experiments, we examined the time course of false recognition judgments. Using an old–new recognition task, we elicited responses at different time lags from presentation of the stimulus through a response-signal procedure. We investigated the effects of study list length and forewarning on the time course of false recognition judgments and examined the results in terms of changes in accuracy and changes in response bias over time. We report changes in the false recog-

niton of lure items over time, as well as changes in the effect of forewarning over time. In addition, we present simulations of these results in terms of global-matching models of recognition memory.

**Phonemic Effects I****Coronado L, Friday Morning, 10:10–12:00**

*Chaired by Keith Rayner, University of Massachusetts, Amherst*

**10:10–10:30 (159)**

**Explorations in Connectionist Modeling: Another Look at the Dual-Route Cascaded Model.** DEREK BESNER, MARTHA ROBERTS, & MIKE REYNOLDS, *University of Waterloo*—Coltheart and colleagues' dual-route cascaded model of word recognition and reading (*Psychological Review*, 2001) is argued to be the best and most comprehensive computational connectionist model to date. We show that the model produces qualitatively different results from intact skilled readers with respect to how both words and nonwords are read aloud. Suggestions as to how these problems might be rectified are provided.

**10:35–10:55 (160)**

**Towards a Connectionist Account of Visual Word Identification in Serbo-Croatian.** JAY G. RUECKL, DANIEL J. YAFFEE, CAROLINE MINER, & CLAUDIA CARELLO, *University of Connecticut and Haskins Laboratories*—The writing system of Serbo-Croatian employs two partially overlapping alphabets. Within each alphabet, there is a one-to-one mapping between letters and phonemes, but the overlap between the alphabets makes some letters phonologically ambiguous. We present a connectionist model of the effect of this ambiguity on the naming of Serbo-Croatian words and nonwords, as well as the modulation of this effect by phonologically related primes, phonologically unrelated primes written in the same alphabet as the target, and the other letters in the letter string in which an ambiguous letter appears. Analyses reveal how this pattern of effects arises from the influence of the structure of the orthographic-to-phonological mapping on the organization and componentiality of the network's activation dynamics. The similarities and differences between network models of Serbo-Croatian and English are discussed.

**11:00–11:15 (161)**

**Phonological Mediation in Visual Word Recognition in English and Chinese.** IN-MAO LIU, *National Chung-Cheng University*—Evidence of phonological mediation in visual word recognition found with various "multiple-word" paradigms (priming, backward masking, etc.) is problematic. This is because such evidence is obtained in a situation in which visual information is impoverished and participants are forced to rely on auditory information for recognizing words. In a "single-word" paradigm, participants either identified or named words and embedded words. In this paradigm, whole-word-related (WWR) variables and embedded-word-related (EWR) variables were orthogonal. It was found that EW recognition and EW naming tended to be affected not only by EWR variables, but also by WWR variables, whereas WW recognition and WW naming tended to be affected only by WWR variables. It is concluded that (1) there is no unequivocal evidence of phonological mediation in visual word recognition in English and that (2) Chinese words are recognized through direct access in normal reading.

**11:20–11:35 (162)**

**Effects of Spoken Words on Concurrent Visual Word Recognition.** ALBRECHT INHOFF & CYNTHIA CONNINE, *SUNY, Binghamton*—A novel eye-movement-contingent release of speech paradigm was used to examine the degree to which phonological representations in reading approximate those in spoken language. Spoken word tokens that were identical to a visual target word /TRAIN(speech)/train(text), similar to it /TRAIL/train, or dissimilar /BLAST/train were released when the visual target was fixated. Dissimilar and similar spoken words increased the time spent viewing the visual target; deleterious effects of similar

spoken words further extended into the reading of posttarget text. These effects were independent of speech duration and appear to be due to the competition of phonological forms during visual word recognition and storage. Preliminary results from Experiment 3 indicate that the preferred pronunciation of a visual target (e.g., /PREDDY/ of *pretty*) is less useful than its nonpreferred pronunciation, /PRETTY/, suggesting that visual word forms do not activate speech-like phonological representations.

11:40–11:55 (163)

**Exploring the Effects of Age, Alzheimer's Disease, and Semantic Impairment on Spelling Performance.** MICHAEL J. CORTESE, *Morehead State University*, & DAVID A. BALOTA, SUSAN D. SERGENT-MARSHALL, & RANDY L. BUCKNER, *Washington University*—Spelling was examined in young adults, healthy older adults, individuals with dementia of the Alzheimer's type (DAT), and 4 individuals with a primary semantic impairment (PSI). The stimuli included homophones and two sets of low-frequency consistent (i.e., words with more predictable spellings) and inconsistent (i.e., words with less predictable spellings) words. The results indicate that when spelling homophones, younger adults and, to a greater extent, individuals with PSI placed relatively more emphasis on phonological information, whereas healthy older adults and individuals with DAT placed relatively more emphasis on semantic information. For nonhomophonic words, large consistency effects (spelling plaid as *plad*) were observed for both individuals with DAT and individuals with PSI. It is proposed that the decrease in accuracy for inconsistent words has different bases in DAT and PSI. We propose that deficits in attentional control underlie performance in DAT, whereas disruption of basic semantic representations underlies performance in PSI.

Divided Attention

Monterrey, Friday Morning, 10:15–12:00

Chaired by Charles L. Folk, *Villanova University*

10:15–10:30 (164)

**Set-Size Effects in Identification and Localization: Theory and Data.** TOM BUSEY, *Indiana University*, & JOHN PALMER, *University of Washington*—The effect of divided attention is different for identification and localization. We ask whether this difference is due to perceptual processing capacity or to the decision process. Using visual search, we measured set-size effects for finding a target grating (left-leaning) among distractor gratings (right-leaning). The identification task was yes–no detection, and the localization task was to specify the target location. The observed set-size effects were larger for localization than for identification. This difference was shown for several spatial and temporal frequencies, and controls ruled out explanations based on task difficulty, sensory factors, and response measures. The different decision requirements for the two tasks was modeled by using signal detection theory and by assuming unlimited capacity for both tasks. This model predicted much of the observed difference between tasks. Thus, the observed difference may be due to the differences in the decision process.

10:35–10:50 (165)

**To Attend or Not to Attend: Impact of Divided Versus Skill-Focused Attention on Novice and Expert Task Performance.** SIAN L. BEILock & THOMAS H. CARR, *Michigan State University*, & CLARE MACMAHON & JANET L. STARKES, *McMaster University* (read by Thomas H. Carr)—Does attending to step-by-step execution of well-learned sensorimotor skills harm performance? Experiment 1 examined golf putting under conditions of divided attention (putting combined with auditory tone discrimination) or skill-focused attention (attention to keeping the club head straight throughout the golf swing and saying “straight” at ball contact). For novices, skill focus helped accuracy relative to divided attention. For experts, the pattern was reversed—skill focus hurt. Experiment 2 examined speed of soccer

dribbling, again under divided attention (auditory word discrimination) or skill focus (dribblers reported which side of the foot contacted the ball). For novices, skill focus again helped performance. For experts, the pattern depended on the foot being used. With the more practiced dominant foot, skill focus hurt, as in expert putting. Conversely, the nondominant foot pattern was like that for novices—skill focus helped. Thus while less-practiced performance benefits from skill-focused attention, well-learned performance may actually be harmed.

10:55–11:10 (166)

**Working Memory Capacity and Maintenance of Simple Auditory Information.** TABITHA W. PAYNE & RANDALL W. ENGLE, *Georgia Institute of Technology* (read by Randall W. Engle)—Working memory capacity (WMC) is important for maintaining information over brief periods. In Experiment 1, WMC predicted accuracy on delayed match-to-sample tasks for pitch with intertone intervals as small as 500 msec. In Experiment 2, WMC predicted difference threshold needed for achieving 80% accuracy. Specifically, low working memory span individuals needed a larger difference threshold than did high spans. Experiment 3 was designed to address an alternative hypothesis that differences on pitch tasks were really due to differing sensory ability for high- and low-WMC subjects. Findings showed that low- and high-WMC individuals did not differ on a sensory acuity task requiring no maintenance. These three studies lead us to conclude that WMC is needed for maintenance of sensory events such as pitch, but not for detection of change in pitch when the need for maintenance is removed from the task.

11:15–11:35 (167)

**Prerequisites for Virtually Perfect Time Sharing in Dual-Task Performance.** DAVID E. MEYER & DAVID E. KIERAS, *University of Michigan*, ERIC H. SCHUMACHER, *University of California, Berkeley*, & DAVID FENCSEK & JENNIFER M. B. GLASS, *University of Michigan*—Consistent with the classic response-selection bottleneck hypothesis, dual-task performance in the psychological refractory period (PRP) procedure has often yielded large interference effects on choice reaction times. However, when some basic aspects of the PRP procedure are modified appropriately, virtually perfect time sharing in dual-task performance may occur after moderate practice (e.g., Schumacher et al., 2001). This suggests that dual-task performance is mediated by adaptive executive control and flexible task-scheduling strategies through which central parallel cognitive processes and peripheral limited-capacity perceptual–motor mechanisms are allocated to achieve task and personal goals. Yet, in order for these system resources and their processing capabilities to be manifested fully, a number of crucial prerequisite conditions must be satisfied. Failure to satisfy all of these prerequisites may lead investigators to conclude mistakenly that there is a pervasive immutable cognitive response-selection bottleneck in dual-task performance.

11:40–11:55 (168)

**Strong Evidence on Parallel Versus Serial Processing in the Sternberg Paradigm.** JAMES T. TOWNSEND, *Indiana University*—Advances in systems factorial technology has extended Sternberg's additive factors method to a wide variety of architectures and stopping rules. In addition to generalizing the method to parallel and more complex processes (e.g., Ashby; Schweickert; Townsend), we have recently developed powerful distributional contrast functions (in addition to the traditional mean contrast). For instance, our survivor interaction contrasts describe functions across time that pinpoint distinct signatures for parallel exhaustive versus parallel self-terminating versus serial exhaustive versus serial self-terminating processing. However, such strategies, as well as those based simply on mean RTs, have mostly been applied to perceptual tasks (e.g., visual display search) so far, due to obstacles associated with manipulating processing speed in short-term memory search. We devised an experimental strategy based on the similarity of the probe item to the distractors in the memory set that reliably influences processing speed. The negative (NO)

trials are the most interesting to analyze. Our experimental findings demonstrate that some individuals can process in parallel, whereas others are serial in the same task, and that the same individuals can shift their strategy under different experimental conditions.

**Animal Cognition I**  
**Durango, Friday Morning, 10:10–12:00**

*Chaired by Peter J. Urciuoli, Purdue University*

**10:10–10:25 (169)**

**The Misbehavior of Monkeys: When Good Learners Go “Bad.”** DAVID A. WASHBURN, *Georgia State University*—Numerous studies over the last 15 years have altered the perception of the cognitive abilities of rhesus monkeys and other nonhuman primates. These animals have demonstrated numerous milestones of intelligence (e.g., relational learning, numerical cognition, metacognition), including mastery of the basic psychomotor skills necessary to perform the joystick-based computerized tasks that were used in many of these studies. However, there is also a surprising number of tasks on which the monkeys learn associatively rather than relationally, fail to generalize to novel trials, seem not to perform as well as they can or should, and generally appear to be less intelligent than their other behaviors might indicate. These “failures to learn” should be as instructive as the monkeys’ successes. Commonalities among the tasks will be examined to permit their categorization into failures of relational learning, motivation failures, and other conceptual classes.

**10:30–10:45 (170)**

**Failure to Find Evidence of Generalization Within Pictorial Categories in Pigeons.** JENNIFER E. SUTTON, *University of Toronto*, & WILLIAM A. ROBERTS, *University of Western Ontario* (read by William A. Roberts)—Pigeons were reinforced for pecking at pictures within one category (cats or cars). When birds were tested with novel pictures from the reinforced category and pictures from the previously unseen category, they pecked no more at pictures from the reinforced category than at those from the unseen category. When pigeons were reinforced for pecking at pictures in one category and nonreinforced for pecking at pictures in the other category, tests with novel pictures from both categories showed more pecking to the reinforced category pictures than to the nonreinforced category pictures. These findings suggest that conceptual categories do not exist cognitively or behaviorally until pigeons discriminate pictures in one category from pictures in another category.

**10:50–11:05 (171)**

**Long-Term Associative Memory in Pigeons.** ROBERT G. COOK, DEBORAH LEVISON, VALERIE PARKISON, & AARON BLAISDELL, *Tufts University*—New experiments looking at the size and nature of long-term associative memory in pigeons are reported. Two pigeons were tested using color photographs that were arbitrarily assigned to one of two discriminative responses (right vs. left). New images were added in sets of 30, while continuous testing of all old images was simultaneously conducted in each session. Examination of the speed of new learning and memory testing of old items suggested that the size of pigeon reference memory is larger than previously estimated. Estimates as of this abstract are twice (>800) that reported, for instance, by Vaughn and Greene. New tests looking at the nature of the memorized features in this type of discrimination are reported. The relations between the mechanisms of exemplar memory and conceptual behavior are discussed.

**11:10–11:30 (172)**

**Simultaneous Vocal and Physical Object Combinations by a Grey Parrot.** IRENE M. PEPPERBERG, *MIT Media Lab*, & HEATHER R. SHIVE, *NCSU, College of Veterinary Medicine*—On the basis of primarily behavioral data, researchers (e.g., Greenfield, 1991) argue that (1) parallel development of communicative and physical object (man-

ual) combinatorial abilities exists in young children, (2) these abilities initially have a common neural substrate, (3) a homologous substrate in great apes allows for similar, if limited, parallel development of these two abilities, and (4) such abilities thus may indicate a shared evolutionary history for both communicative and physical behavior (Johnson-Pynn et al., 1999). We find a comparable, if limited, parallel combinatorial development in a grey parrot (*Psittacus erithacus*). Given the evolutionary distance between parrots and primates, we suggest that the search for and arguments concerning responsible substrates and common behavior should be approached with care and not be restricted to the primate line.

**11:35–11:55 (173)**

**Do Birds Experience Sensory Pleasure?** MICHEL CABANAC, *Université Laval*—To answer this question I trained an African grey parrot (*Psittacus erythacus*) named “Aristote” to speak, in order to allow verbal communication with it. The first step of the study consisted in gaining Aristote’s affection. Then, Aristote was taught to speak, following Irene Pepperberg’s triangular method: Another person and I would speak together and would look at Aristote only when it used understandable French words. Thus Aristote learned to say a few words for obtaining toys or getting my attention—for example, “donne bouchon” (give cork) or “donne gratte” (give scratch), with the appropriate reward. Lastly, the word “bon” (good) was added to the short list of words known to Aristote. I said “bon” when Aristote obtained the sensory stimuli that it had requested (e.g., “gratte bon”). Aristote started to use short expressions, such as “yaourt bon” (yogurt good). Finally, Aristote transferred the word “bon” to new stimuli, such as “raisin bon” (grape good), an expression I had never used myself. Such a transfer likely shows that this bird experienced sensory pleasure.

**Spatial Cognition**

**Yucatan, Friday Morning, 10:10–12:00**

*Chaired by Raymond M. Klein, Dalhousie University*

**10:10–10:20 (174)**

**A Cross-National Comparison of Biases in Subjective North American Geography.** ALINDA FRIEDMAN, *University of Alberta*, DENNIS D. KERKMAN, *Southwest Texas State University*, & NORMAN R. BROWN, *University of Alberta*—We examined alternate explanations for distortions in the subjective representation of North American geography. A physical proximity explanation predicts that the bias in location estimates should increase with distance from the participants’ home region. An alternative is that biases arise from combining accurate and inaccurate beliefs about superordinate regions that cities belong to, including beliefs that may have social or cultural origins. To distinguish these alternatives, Canadians from Alberta and Americans from Texas judged the latitudes of cities in Canada, the U.S., and Mexico. Both groups divided North America into the same four regions. In contrast to a proximity-based prediction, Texans’ estimates of Mexican locations were 16° more biased than their estimates of Canadian locations that were 1,344 kilometers (840 miles) further away. This finding eliminates proximity as a primary source of geographic biases and underscores the role of categorical beliefs as an important source of biased judgments.

**10:25–10:40 (175)**

**Distance Estimates Reflect Objective and Subjective Geographical Categories.** NORMAN R. BROWN, ALINDA FRIEDMAN, & PETER JAMES LEE, *University of Alberta*—Participants estimated the distance in kilometers from Edmonton, Alberta, Canada to 66 randomly presented North American cities. When objective distance was held constant, estimated distance was greater for Mexican cities than for U.S. cities, and greater for U.S. cities than for Canadian cities. Similarly, southern U.S. cities elicited greater estimates than equidistant northern U.S. cities, which elicited greater estimates than equidistant Canadian cities. These results provide converging evidence for the existence of

a distorted four-region representation of North American geography (Friedman & Brown, 2000a, 2000b) and demonstrate that distance estimation is sensitive to both national borders and subjective category boundaries.

#### 10:45–11:00 (176)

**Alignment Effects in Room Space: Attenuating, Eliminating, Reversing.** DAVID WALLER, DANIEL R. MONTELLO, MARY HEGARTY, & ANTHONY E. RICHARDSON, *University of California, Santa Barbara* (read by Daniel R. Montello)—Alignment effects in spatial memory occur when directions are estimated more quickly and/or accurately in the learned orientation than from another orientation. In four experiments, we examine the effects of body movement, testing orientation, and instructional set on alignment effects. Participants learned layouts from a single viewpoint and pointed to targets from actual and imagined locations and orientations. Participants were tested after (1) remaining in place, facing forward, (2) walking directly to the to-be-imagined location, (3) being circuitously wheeled to the location, or (4) remaining in place but rotating 180°. After being wheeled, participants were told their new facing orientation or deceived with another orientation. Half the participants were instructed to ignore their rotation in (4); half were not. We were able to attenuate, eliminate, or even reverse alignment effects. Individual differences and speed/accuracy tradeoffs are discussed.

#### 11:05–11:15 (177)

**Using Spatial Terms to Select an Object.** LAURA A. CARLSON, *University of Notre Dame*, & GORDON D. LOGAN, *Vanderbilt University*—Our interactions with the world often involve selecting one object from a cluttered array of objects. One way to accomplish this is with language. For example, spatial terms such as “above” guide selection by specifying the position of one object (the located object) with respect to a second object (the reference object). Most of the work on the apprehension of spatial terms has examined displays that contain only these two objects. The present work examines how the presence of an extra object (distractor) in the display impacts apprehension. Consistent effects of distractor presence were obtained across acceptability rating and speeded sentence/picture verification tasks. Importantly, these effects were independent of the placement of the distractor. These results suggest that the distractor has its influence during processes that spatially index and identify the located and reference objects and that processes involved in computing the spatial term operate only on these objects.

#### 11:20–11:35 (178)

**Context Effects in Spatial Memory.** KARL F. WENDER, *University of Trier*; DANIEL B. M. HAUN, *University of South Carolina*; BJOERN RASCH, *University of Trier*; & MATTHIAS BLUEMKE, *University of Heidelberg*—Participants learned a complex route through our university library. At 39 intersections, they had to remember particular landmarks and directions. After two trips, they were tested by cued recall either on the route or in a separate neutral room. In addition, they had to estimate bearings to distant objects. Data were analyzed by multinomial models and circular statistics. Results showed a context effect that generalized along the route with a negative gradient. The results speak against the dominant framework of route knowledge and suggest that survey knowledge develops right from the beginning.

#### 11:40–11:55 (179)

**High-Capacity Visual Short-Term Memory for Layout.** THOMAS SANOCKI, ERIC SELLERS, & JEFF MITTELSTADT, *University of South Florida*—How much information is represented in a viewer’s memory during scene perception? Although many studies of change detection and visual short-term memory (VSTM) reveal severe capacity limits of about 3–4 items, several past studies suggest that VSTM capacity for layout (the position of elements) is considerably higher. We measured VSTM with a change detection task and layouts of 4–20 items. In Experiment 1, we used a dollhouse with over 24 pieces of

furniture distributed among 12 regions. Capacity, estimated using Pashler’s (1988) formula, averaged 5.2 regions, or over 10 objects. The high capacity cannot be attributed to a few single-object configurations. In Experiments 2–4, with simpler elements, capacities exceeded 10 items. Layout memory was independent of object identity, surviving a complete change in the items’ identities. The memory was influenced by perceptual organizational factors, suggesting that it is related to high-level vision.

#### Perception I

#### Coronado A, Friday Morning, 10:15–12:00

*Chaired by James T. Enns, University of British Columbia*

#### 10:15–10:30 (180)

**Context Modulates the Gestalt Configural Cue of Convexity.** MARY A. PETERSON & JEE HYUN KIM, *University of Arizona*—We investigated whether context alters the effectiveness of the configural cue of convexity by varying both the number of vertically elongated convex regions in a display from 1.5 to 3.5 (an equal number of concave regions alternated with the convex regions) and the number of local convexities within each region. Black-and-white displays were shown for 100 msec. Participants reported whether the black or the white regions appeared to be figures. Convexity was a substantially more effective configural cue in the 3.5 region condition than in the 1.5 region condition ( $p < .01$ ). The number of local convexities in the vertical direction had no effect on cue strength, suggesting that context effects operate between regions, rather than within regions. For stimuli rotated by 90°, context effects were unchanged, although convexity was a weaker cue. Additional experiments investigated the extent to which these context effects depend on cue repetition, rather than shape repetition.

#### 10:35–10:50 (181)

**Visual Length Illusions and the Perception of Configural Information in Faces.** A. SCHWANINGER & S. RYF, *University of Zürich*, & F. MAST, *Harvard University* (read by F. Mast)—This study explored the perception of configural information in faces. Participants adjusted the length of a line to the intereye distance and the distance between the eyes and the mouth. Experiment 1 revealed an overestimation of the eye–mouth distance by 32% and an overestimation of the intereye distance by 16%. These large effects were replicated in Experiment 2 with a different set of stimuli (overestimation of 41% for the eye–mouth distance and 16% for the intereye distance). In both experiments, the perceived length of the intereye distance was dependent on orientation following the pattern of the horizontal vertical illusion (HVI). In two final experiments, we further investigated whether the perception of facial configurations can be explained by the same mechanisms that underlie visual length illusions (e.g., HVI, Müller-Lyer, Oppel–Kundt) or whether there are face-specific mechanisms at work.

#### 10:55–11:15 (182)

**Domain Specificity Versus Expertise in Visual Face Processing.** SHLOMO BENTIN & DAVID CARMEL, *Hebrew University of Jerusalem*—We compared the role of task-associated strategies and expertise on the N170, an ERP component elicited by human faces, with the ERPs elicited by cars, birds, items of furniture, and ape faces. Faces elicited an equally conspicuous N170, significantly larger than the ERPs elicited by nonface categories, regardless of whether they were ignored or had an equal status with other categories or whether they were predetermined targets. In contrast, the negative component elicited by cars during the same time range was larger if they were targets than if they were not. Faces of apes elicited an N170 that was similar in amplitude to that elicited by the human face targets. These results demonstrate the domain specificity of the visual mechanism implicated in processing faces, a mechanism that is not influenced by either task or expertise. The processing of other objects is probably accomplished by a more general visual processor, which is sensitive to strategic manipulations and attention.

**11:20–11:35 (183)**

**Early Peripheral and Foveal Processing in Fixations During Scene Perception.** GÉRY D'YDEWALLE & PAUL M. J. VAN DIEPEN, *University of Leuven*—To compare early foveal and peripheral information extraction, visual scenes were masked either foveally or peripherally during the initial 20, 70, or 120 msec of fixations, using an eye-movement-contingent display-change technique. The sequential attention model of eye movement control predicts a substantial effect of early foveal masking, whereas early peripheral masking should not affect the ongoing processing. Foveal masking indeed postponed foveal processing, as was reflected by a considerable increase of average fixation durations with longer masking. However, there was also an effect of peripheral masking, mainly on the saccade target selections with an increased number of fixations in conjunction with smaller saccade amplitudes. Overall, scene perception was more influenced by early foveal masking than by early peripheral masking, and this is partly in agreement with the sequential attention model of eye movement control.

**11:40–11:55 (184)**

**Detection of Counterfeit Currency.** IRA H. BERNSTEIN & ANNE P. HILLSTROM, *University of Texas, Arlington*—This study evaluated the effectiveness of changes made by the U.S. Bureau of Engraving and Printing when they redesigned the currency for the 1996 series. A two-alternative forced-choice task evaluated accuracy in discriminating genuine currency from counterfeit currency intercepted by the Secret Service. The variables studied were the series, denomination, type of printing of the counterfeit, brief versus no training at counterfeit detection, design feature, and type of judgment (whether the entire bill or a feature was judged and whether or not participants could see the whole bill). The major findings were that familiarity with U.S. currency and accuracy were related, training led to higher accuracy, global judgments were more accurate than featural ones, genuine bills were discriminated more easily from inkjet counterfeits than from offset counterfeits, and, most critically, the 1996 series was judged more accurately than the 1990 series. The results illustrate a useful application of psychophysics.

**Invited Symposium: Perspectives on Spatial Representation: What We Can Learn From Special Populations**  
**Coronado H, Friday Afternoon, 1:00–3:10**

*Chaired by Helene Intraub, University of Delaware*

**1:00–1:05 (185)**

**Perspectives on Spatial Representation: What We Can Learn From Special Populations.** HELENE INTRAUB, *University of Delaware*—Introduction.

**1:05–1:20 (186)**

**Spatial Representation in Deaf ASL Signers.** KAREN EMMOREY, *Salk Institute*—To linguistically represent the visual world requires a crucial interface between language and spatial cognition. Signed languages differ dramatically from spoken languages with respect to this interface because, rather than specifying spatial relations with a closed-class set of prepositions, signed languages encode spatial relations by using space itself via “classifier” constructions. In these constructions, handshape morphemes specify object type, and the position of the hands in signing space schematically represents the spatial relation between objects. This spatialization of linguistic expression has ramifications for the nature of linguistic categories, for the spatial cognitive processes required for language comprehension, and for the neural systems that underlie spatial language. Specifically, when space itself is used to linguistically represent spatial relations, the linguistic encoding is gradient rather than categorical, mental rotation is often required to understand spatial perspective, and the right parietal cortex is engaged during production of spatial language for signed, but not for spoken, language.

**1:25–1:40 (187)**

**Spatial Representation of Scenes in a Deaf and Blind Observer.** HELENE INTRAUB, *University of Delaware*—The spatial world is continuous, yet perception is based on successive, discrete inputs. Sighted observers who explore a region through vision or haptics (while blindfolded) are subject to “boundary extension” (BE). They remember having seen or touched adjacent, unexplored areas—anticipating layout. This may serve to facilitate integration of successive “views.” However, blindfolding sighted observers does not necessarily prevent recruitment of visual resources (e.g., visualization). Does BE truly generalize, or is it specifically visual? A 25-year-old woman who has been deaf and blind since early life (Leber’s syndrome) explored the same regions. Her mode of exploration is normally haptic, her spatial language (ASL) is understood through touch, and reading is accomplished through Braille. Yet, she too was prone to comparable amounts of BE. Anticipatory representation may be a fundamental aspect of spatial cognition irrespective of modality and irrespective of the observer’s access to all the primary spatial senses.

**1:45–2:00 (188)**

**Navigation Without Vision in Blind and Sighted.** ROBERTA L. KLATZKY, *Carnegie Mellon University*, & JACK M. LOOMIS & REGINALD G. GOLLEDGE, *University of California, Santa Barbara*—Spatial cognition encompasses such basic processes as understanding spatial concepts, encoding and mentally transforming spatial representations, and using representations to act within space. Our long-term project has addressed these capabilities in blind and sighted populations. The major navigation ability we have studied is path integration—that is, keeping track of one’s position in space on the basis of cues to self motion. We will present data from such tasks as returning to the origin of a multisegment path via a shortcut, reproducing a previously traveled path, traveling to a location specified by a verbal description, and traveling to the location of a real sound. We have also compared the performance of blind and sighted in “tabletop” tasks, such as matching forms that differ by a rotation and mental part-whole assembly. We find that blind people who are habitually mobile show little if any deficit in these abilities.

**2:05–2:20 (189)**

**Selective Spatial Breakdown in Williams Syndrome.** BARBARA LANDAU, *Johns Hopkins University*, & JAMES E. HOFFMAN, *University of Delaware*—Williams syndrome is a rare genetic defect causing profound spatial impairment together with relatively spared language. We review evidence from our research program, which indicates that the spatial breakdown in Williams syndrome is highly selective, sparing spatial capacities such as object recognition, perception of biological motion, and some aspects of spatial language. At the same time, we have found fragility in certain other aspects of spatial representation, and we speculate that the breakdown observed in hallmark tasks, such as block construction, is the result of complex interactions between these fragile spatial representations and procedures that operate on them.

**2:25–2:40 (190)**

**Simultanagnosia: A Deficit in Binding Object and Spatial Representations?** H. BRANCH COSLETT, *University of Pennsylvania*, & ELEANOR M. SAFFRAN & EUNHUI LIE, *Temple University*—Simultanagnosia, a disorder usually associated with bilateral parietal lesions, is characterized by the inability to “see” more than one object in an array. Data from patients with this disorder speak to the role of the parietal cortex in spatial representations and awareness. We will present data from two patients (B.M., J.D.) demonstrating that report of stimuli was influenced by the semantic relationship between the items in the array, suggesting that the deficit is not solely attributable to early visual impairment. Additionally, J.D. was unable to report more than one attribute of the SAME object or word. Several lines of evidence demonstrate that he processed stimulus attributes that he denied seeing. These data suggest that the parietal lobe is critical for binding object and spatial representations and are consistent with the claim that binding to spatial markers supported by the parietal lobe is necessary for conscious perception.

**2:45–3:00 (191)**

**Spatial Representation in Hemispatial Neglect.** MARLENE BEHRMANN, *Carnegie Mellon University*—Patients with hemispatial neglect, usually acquired after right parietal lobe damage, fail to process or report left-sided information. Studies with such patients allow us to elucidate the psychological and neural mechanisms underlying spatial representation. Two issues will be addressed. The first concerns the factors that determine when a stimulus will be neglected. We will show that the probability of detecting a left item depends not only on its spatial position, but also on the time course of its activation. Furthermore, the extent to which the target location is predictable also enhances the probability of detection. Because spatial position cannot be absolutely determined, the second issue concerns the spatial reference frame or set of coordinates used to code spatial location. We will show that position is coded with respect to multiple reference frames and that, depending on the requirements of the task, a particular reference frame becomes dominant.

**3:05–3:10 (192)**

**Closing Remarks.** HELENE INTRAUB, *University of Delaware*—Closing remarks and discussion.

**Language Production**

**Coronado L, Friday Afternoon, 1:00–3:15**

*Chaired by Gail Mauner, SUNY, Buffalo*

**1:00–1:20 (193)**

**Judgments About Common Ground in Language Production.** RICHARD J. GERRIG & WILLIAM S. HORTON, *SUNY, Stony Brook*—In fluent conversation, speakers’ utterances must reflect efficient judgments about the topics (e.g., individuals or experiences) with which they are on common ground with their addressees. We suggest that these judgments involve two dissociable processes: copresence as-

assessment and utterance formulation. Copresence assessment, operating in either a strategic or an automatic fashion, indicates whether a topic (e.g., an individual or experience) is mutually known to a speaker and addressee. Utterance formulation involves planning utterances that adequately reflect the current context, as well as the speaker and addressee's history with respect to a mutually known topic. To provide evidence for our perspective, we conducted a referential communication experiment in which we required directors to describe an array of objects to 2 matchers in alternation. We varied the ease with which directors could encode the relationships between particular objects and particular matchers. The complexity of copresence assessment had a clear impact on directors' language production.

#### 1:25–1:40 (194)

**Does Conversational Grounding Involve Partner-Specific Pacts? An Example of the Adaptive Use of Language.** BOAZ KEYSAR, *University of Chicago*, DALE J. BARR, *Beckman Institute, University of Illinois, Urbana-Champaign*, & SHUHONG LIN, *University of Chicago*—It has been argued that when participants in conversation use a name for an object, they implicitly agree on a conceptual-naming pact. Such precedents are assumed to be partner specific, to be used only with the grounding partner. Using an eyetracker, we demonstrate that once a precedent is established, listeners do expect speakers to use it. But we also show that listeners expect the precedent even with a speaker who never grounded the term. Thus, grounding need not involve partner-specific pacts. Our second experiment shows that precedents can be partner specific, but only when the identity of the speaker is highly diagnostic. When 2 speakers used different names for the same object, listeners' expectations became sensitive to the identity of the grounding speaker. We suggest that although grounding does not routinely involve partner-specific pacts, interlocutors can adapt to circumstances that require partner specificity.

#### 1:45–2:00 (195)

**When Conceptual Pacts Are Broken: Partner Effects in Comprehending Referring Expressions.** CHARLES A. METZING & SUSAN E. BRENNAN, *SUNY, Stony Brook* (read by Susan E. Brennan)—When people in conversation refer repeatedly to objects, they typically converge on the same expressions. This could be due simply to associating an object with the same perspective, or to achieving a conceptual pact that is partner specific. We had people follow directions from a confederate-director, entraining on perspectives over three trials ("the shiny cylinder"). The director then left and returned, or else a new director entered. In Trial 4, directors used either the original expression or a new one ("the silver pipe"). Upon hearing the original expression, people looked at or touched the object equally quickly regardless of director. However, upon hearing a new expression from the original director, people were 232 msec slower to look at the object and 541 msec slower to touch it than with a new director. This supports the idea of partner-specific conceptual pacts that track what partners know rather than what they don't know.

#### 2:05–2:15 (196)

**"Let's Do Lunch Sometime": An Analysis of Ostensible Speech Acts.** KRISTEN E. LINK, *SUNY, Oswego*, & ROGER J. KREUZ & JACKIE SOTO, *University of Memphis* (read by Roger J. Kreuz)—Isaacs and Clark (1990) have defined ostensible speech acts as possessing a number of characteristics. These include pretense, mutual recognition, collusion, ambivalence, and off-record purpose. In addition, they have proposed several cues (e.g., hedging and vagueness) that are used in the service of such utterances. The present research was designed to assess the role of these characteristics and cues in the perception of ostensible speech acts. Participants read actual conversations with sincere, ambiguous, or ostensible speech acts. Separate groups of participants were asked to provide ratings of pretense and mutual recognition, to make predictions about the next speech act, to make judgments about the attitude of the speaker, and to indicate the primary reason for the speech act. The results provide support for Isaacs

and Clark's description of ostensible speech acts, as well as demonstrate that these cues are used to recognize such language.

#### 2:20–2:30 (197)

**Perspective in Political Interviews.** DANIEL C. O'CONNELL, *Loyola University, Chicago*, SABINE KOWAL, *Technical University of Berlin*, & CAMELIA SULEIMAN, *Hebrew University of Jerusalem*—Both quantitative and qualitative analyses were applied to two television interviews (Shimon Peres and Edward Said with Tim Sebastian in BBC HARDtalk) to identify indicators of perspective. In addition to pronominal usage (first-person singulars and plurals), a number of other indicators were found to discriminate perspective of interviewers and interviewees: turn-initial words, hesitations, questions, emphatic affirmation and negation, personal reference utterances (e.g., I think), interjections, number of syllables spoken, and interruptions and overlaps. Relative literacy of the interviewer and orality of the interviewees were also noted. The findings are interpreted within a general theoretical concept of perspective, derived from Bakhtin's dialogicality.

#### 2:35–2:50 (198)

**Clock Talk.** KATHRYN BOCK, *Beckman Institute, University of Illinois, Urbana-Champaign*, DAVID E. IRWIN, *University of Illinois, Urbana-Champaign*, & W. J. M. LEVELT, *Max Planck Institute for Psycholinguistics*—Telling time is an exercise in coordinating language production with visual perception. By combining different ways of saying times with different ways of seeing them, the performance of time-telling can be used to track cognitive transformations from visual to verbal information in connected speech. Findings from eyetracking during the production of time expressions suggest that an effective interface between what has been seen and what is to be said can be constructed within 300 msec and is used to guide the incremental formulation of words and phrases.

#### 2:55–3:10 (199)

**Metrical Encoding During Speech Production.** NIELS O. SCHILLER, *Universiteit Maastricht and Max Planck Institute for Psycholinguistics*—This study investigated the encoding of metrical information during speech production. In Experiment 1, participants were asked to judge whether bisyllabic picture names had initial or final stress or whether a prespecified consonant belonged to the first or the second syllable. Results showed significantly faster decision times (RTs) for initially stressed targets (e.g., KAno, "canoe") than for targets with final stress (e.g., kaNON, "cannon"); capital letters indicate stressed syllables) and faster RTs for first than for second syllable affiliation responses (e.g., kaN.sel, "pulpit" vs. ka.No, "canoe"; capital letters indicate pivotal consonants, dots mark syllable boundaries). This result demonstrates that metrical information is encoded incrementally from beginning to end of words during phonological encoding in speech production. Finally, an object/nonobject decision control experiment demonstrated that the outcome of the first experiment is unlikely to result from a visual input effect.

#### Information Processing

##### Monterrey, Friday Afternoon, 1:00–3:00

*Chaired by Frank N. Dempster, University of Nevada, Las Vegas*

#### 1:00–1:20 (200)

**ACT-R 5.0 Predicts BOLD Activation Functions.** JOHN R. ANDERSON, YULIN QIN, & MYEONG-HO SOHN, *Carnegie Mellon University*, CAMERON CARTER, *University of Pittsburgh*, & JON FINCHAM, *Carnegie Mellon University*—ACT-R 5.0 is a cognitive architecture that models cognition as a sequence of tests and transformations of "buffers." These buffers include a goal buffer, retrieval buffers, visual buffers, and motor buffers. Two mathematical problem-solving tasks were modeled in terms of changes in these four kinds of buffers. Event-related fMRI studies were performed of these tasks to obtain neural evidence for the buffer manipulations proposed by

this architecture. Our results confirm prior results about the importance of the left posterior parietal cortex for mathematical transformations. We show similar effects for abstract symbol manipulation tasks devoid of arithmetic content. Predicted *bold* responses were derived on the basis of the timing and duration of buffer manipulations. These predicted functions were fit to the obtained functions in different brain regions.

1:25–1:45 (201)

**The Role of Capacity in Organized Perception: Tools for Hypothesis Testing.** MICHAEL J. WENGER & CHRISTOF SCHUSTER, *University of Notre Dame*, & JAMES T. TOWNSEND, *Indiana University*—Process capacity—the amount of work that a cognitive system can accomplish in a unit of time—is a central construct in cognitive theory in general and holds special import for accounts of organized (gestalt) perception. We present an approach to modeling hypotheses regarding cognitive process capacity based on the hazard function of response times and its integrated form. For example, we can define relative capacity in a situation in which we change processing load by  $C(t) = \text{Hab}(t)/[\text{Ha}(t) + \text{Hb}(t)]$ , where  $\text{Ha}(t)$  and  $\text{Hb}(t)$  are the integrated hazard functions for processing individual elements (a and b) and  $\text{Hab}(t)$  is the integrated hazard function for processing both elements. We present an overview of statistical methods for evaluating such hypotheses, ones widely used in the analysis of temporal data (e.g., survival times in various disease states). We illustrate the use of these techniques with data from our studies of facial perception.

1:50–2:05 (202)

**Response Monitoring Causes Sequential Effects in Short-Interval Serial RT Tasks.** ERIC SOETENS & PETER DHAENE, *University of Brussels*, & MAURITS VAN DER MOLEN, *University of Amsterdam*—In random serial reaction time (RT) tasks, the speed of responding depends on the sequence of preceding events. With short intervals between the response and the next stimulus, this pattern is governed by automatic facilitation, resulting in a first-order repetition effect and higher order sequential effects of the benefit-only type. The more preceding repetitions and the more recent these repetitions are, the faster the participants respond, independent of the current transition (repetition or alternation) between successive stimuli. This pattern is enhanced by showing larger RT differences when stimulus–response compatibility decreases or when the number of stimulus–response alternatives increases. We demonstrate that increasing the difficulty of the task by influencing perceptual or categorization stages does not enhance the pattern. These data add further support to the assumption that automatic facilitation is located at response selection and is elicited by a decreasing response-monitoring process with preceding repetitions.

2:10–2:30 (203)

**New Procedures for Individual RT Analysis.** RICHARD A. CHECHILE, *Tufts University*—A case is made that the Gumbel and inverse Gaussian distributions have excellent properties for the analysis of response time (RT) data. These highly similar distributions are two-parameter probability functions with well-developed statistical procedures. The Gumbel is particularly well suited for the detection of multiple stochastic processes, and the inverse Gaussian distribution possesses sufficient statistics. The inverse Gaussian is also coupled with a theoretical diffusion model of RT. The model yields separate measures for the diffusion strength and the decision criterion. The methodology is illustrated by several recent studies that focused on individual RT data. The experiments examine RT on a lexical decision task and on a visual search task.

2:35–2:55 (204)

**Tapping With the Mind's Finger: Rhythmic Modulation of Cortical Potentials During Mental Simulation.** ALLEN OSMAN, *University of Pennsylvania*, & ROBERT W. ALBERT, *University of Utah*—A frequency analysis was used to identify cortical activity arising from imagined rhythmic movements and to locate approximately its

sources. Subjects synchronized overt and imagined taps to brief visual stimuli presented at a constant rate of 1.25 Hz. Taps alternated between the left and the right index fingers at a rate of 0.625 Hz. Recordings were made of event-related potentials (ERPs) from 59 scalp sites and activity of the finger muscles (EMG). After spatial filtering to reduce noncortical contributions, the ERP recordings were converted to the frequency domain, and topographic maps were made of power at the frequency of alternation between the left and the right fingers. Two prominent power foci were found in each hemisphere for both overt taps and imagined taps without EMG, one over the sensorimotor cortex and the other over the posterior parietal cortex, with homologous foci in opposite hemispheres arising from oscillations 180° out of phase.

### Context/Repeated Testing in Memory Durango, Friday Afternoon, 1:00–3:05

Chaired by F. Michael Rabinowitz  
*Memorial University of Newfoundland*

1:00–1:20 (205)

**Episodic Context: A Unifying Principle.** MICHAEL S. HUMPHREYS, *University of Queensland*, & GERALD TEHAN, *University of Southern Queensland*—Although there is a long history of theorizing about the role of context in human memory, context is almost entirely ignored in discussions of short-term memory and is frequently ignored in discussions of the difference between direct and indirect memory tasks. Some of the reasons for this neglect are discussed. Then, existing data are reviewed, and new data are presented that show that the postulation of context can serve to unify many disparate findings. The results also allow us to reject many traditional ideas about short-term memory.

1:25–1:35 (206)

**Situation Models and Memory for Story Information.** GABRIEL A. RADVANSKY & DAVID E. COPELAND, *University of Notre Dame*, & ROLF A. ZWAAN, *Florida State University*—Situation models can be composed of several different types of information, including (1) spatial–temporal framework, (2) linking relations, (3) structural relations, (4) entities, and (5) entity properties. Some of these information types are more critical to understanding the nature of the situation (e.g., linking relations), relative to other types of information (e.g., entity properties). Question-answering data from studies using a novel (*The Stone Diaries*) and standard experimental short stories support this characterization. Moreover, using the Schmalhofer and Glavanov (1986) procedure, it is shown that some types of information are more highly related to situation model memory, relative to textbase memory.

1:40–2:00 (207)

**Keeping Meanings in Mind: Evidence for an Independent Semantic Working Memory System.** GEETA SHIVDE & MICHAEL C. ANDERSON, *University of Oregon* (read by Michael C. Anderson)—Many cognitive tasks require maintenance of semantic representations. Currently, there is no clear account of how this maintenance occurs. Here, we report evidence for a distinct semantic working memory system that maintains meanings. When subjects sustain attention to the meaning of a prime (e.g., *anger*) over a 10–15 sec interval, they are slower to respond to a semantically related probe item presented during the maintenance interval. This suppression manifests as slowed reaction time to make a lexical decision to a related probe word (e.g., *hit*) buried in a stream of unrelated items. However, semantic suppression does not occur when subjects (1) maintain the prime by rehearsing it phonologically or visually, (2) respond to the probe after the maintenance interval, or (3) encode the prime into long-term memory and later recall it. Together, these findings provide strong support for a semantic working memory system and suggest that maintenance is achieved in part through inhibition.

**2:05–2:20 (208)**

**Gains and Losses in Multiple Recall Tests of Actions.** JOHANNES ENGELKAMP & KERSTIN SEILER, *Saarland University*—Verbally learned action phrases (VTs) are recalled worse than phrases that are also enacted (SPTs). This enactment effect is usually attributed to better item encoding in SPTs than in VTs. However, there is little direct evidence for this assumption in free-recall tests. The assumptions concerning relational information are controversial, and evidence is restricted to related lists. Unrelated lists are hardly studied, because appropriate measures are lacking. We applied multiple testing as another means to study the role of item and relational information in unrelated lists of action phrases. We assumed with others (e.g., Mulligan, 2001) that good item information is reflected in many intertrial gains, and good relational information in few intertrial losses. Our results showed that SPTs provide better item information and worse relational information than do VTs. Moreover, we found that losses tap a different type of relational information than ARC scores in related lists.

**2:25–2:40 (209)**

**Clue Insensitivity in Memory Recovery.** STEVEN M. SMITH, HYUN CHOI, DAVID R. GERKENS, BENTON H. PIERCE, & MARIE H. FLESCH, *Texas A&M University*—When people initially fail to recall presented material, do incidentally encountered clues stimulate recovery of forgotten material? Three experiments examined the role of incidental clues in memory recovery. Subjects took an initial free-recall test in which they listed the names of 21 categorized lists (e.g., fruit, clothing) they had seen. An intervening affect rating task preceded a retest (free recall of initially unrecalled category names). Inserted in a list of unrelated words on the affect rating task were either unrecalled category names or no clues. When subjects were not warned of the subsequent retest, incidental clues did not benefit recovery, and when they were warned of the retest, there was a marginal effect of the clues. Only when explicitly instructed to watch for clues did subjects benefit from their presentation. We will discuss several factors, especially one's metacognitive monitoring state, that may influence sensitivity to incidentally encountered clues.

**2:45–3:00 (210)**

**Retrieval-Induced Forgetting in the Recall of Complex Episodes.** MICHAEL P. GOARD & DANIEL REISBERG, *Reed College* (read by Daniel Reisberg)—Previous studies have shown that practice in recalling some elements of a category can actually inhibit the subsequent recall of other elements in the same category (e.g., Anderson, Bjork, & Bjork, 1994). However, these studies have typically relied on simple, abstract stimuli (word lists) in clearly delineated categories (e.g., names of fruits), with the memory interference occurring only within the categories. In the present experiment, we show that retrieval-induced forgetting can occur with more complex stimuli (a video of a burglary) with materials not explicitly categorized during the encoding event. Participants practiced recalling details about one of the two criminals (what he was wearing, what he was carrying). Later, they recalled more of these practiced details than did control subjects, but fewer of the unpracticed details (concerning the other criminal) than did controls. We discuss these results in terms of the function of retrieval-induced forgetting in everyday episodic recall.

**Auditory Pattern Perception**  
**Yucatan, Friday Afternoon, 1:00–3:05**

*Chaired by Elisheva Ben-Artzi, Bar-Ilan University*

**1:00–1:15 (211)**

**Memory for Absolute Pitch Is Widespread.** E. GLENN SCHELLENBERG, SANDRA E. TREHUB, & KEIRA C. STOCKDALE, *University of Toronto*—Absolute (perfect) pitch, or the ability to name or produce the pitch of specific tones (e.g., middle C) in isolation, is thought to be rare (1 in 10,000). Nonetheless, recognition memory for absolute pitch may be improved by the provision of contextual cues.

We selected 5-sec excerpts from the theme music of five popular television programs (*ER*, *Jeopardy*, *Law & Order*, *The Simpsons*, *X-Files*), altering the pitch of the excerpts without changing the tempo or timbre. On each trial, adults (regular viewers of the programs) were asked to distinguish between the original excerpt and an altered version. Performance exceeded chance levels when the altered version differed from the original by 2 semitones. Although performance decreased for 1-semitone differences, it was still better than chance. In short, memory for the absolute pitch of familiar recordings is remarkably accurate in listeners with little or no musical training.

**1:20–1:40 (212)**

**Relative Pitch in Songbirds.** RONALD G. WEISMAN, *Queen's University*—The talk summarizes several years of research on relative pitch perception in oscines (the true songbirds). It is now well known that songbirds learn to produce and perceive relative pitch changes in their songs. Here, I describe the production of relative pitch changes in oscine song, the perception of relative pitch, the role of experience and development in relative pitch perception, and the biological functions of relative pitch in territorial defense and mate attraction. Finally, I will discuss some contrasts between the functions of relative pitch in oscines and humans.

**1:45–2:00 (213)**

**Understanding Meter in Syncopated Musical Passages.** PETER VAZAN & MICHAEL F. SCHÖBER, *New School for Social Research* (read by Michael F. Schöber)—We examined how people process temporal structure in music by manipulating musical parameters that affect whether listeners hear events as syncopated versus on-beat. Participants listened to an ongoing 2:3 polyrhythmic pattern that could be interpreted as either duple or triple meter. Their task was to continue tapping the rhythm of a short melody that was either aligned or syncopated with the polyrhythmic pattern. Participants were less able to tap accurately when the melody and the polyrhythmic pattern were misaligned and when tempi were faster. In these cases, participants reinterpreted the metrical structure by repositioning the downbeat (phase shift). Similar results were found when participants relied on memory, rather than on immediate perceptual cues; in another condition, participants were only to start tapping four bars after the melody stopped. These data provide initial evidence that tempo and the type of misalignment can constrain listeners' interpretations of syncopated patterns.

**2:05–2:25 (214)**

**Creativity and Variability in Skilled Piano Performance: A Case Study.** ROGER CHAFFIN, ANTHONY LEMIEUX, & EMILEE YURGELES, *University of Connecticut*, & GABRIELA IMREH, *Princeton University*—A concert pianist learned the third movement of J. S. Bach's Italian Concerto (Presto) and assessed the complexity of the music on 10 dimensions (fingering, technical difficulties, familiar patterns, phrasing, dynamics, tempo, pedal, and three type cues attended to during performance). After more than 30 h of practice, the pianist recorded a series of performances in an effort to achieve a "perfect" performance. Interbar intervals were measured for each performance, and regression analyses identified the dimensions that affected this measure. Comparison of successive performances provides a measure of the variability of a highly practiced performance. Differences between performances point to the sources of the spontaneity that is a hallmark of creativity in the performing arts.

**2:30–2:40 (215)**

**Short-Term Adaptation to Auditory–Visual Discordance: The Ventriloquism Aftereffect.** JEAN VROOMEN, PAUL BERTELSON, ILJA FRISSEN, & BEATRICE DE GELDER, *Tilburg University*—The ventriloquism aftereffect is a shift in the apparent location of acoustic stimuli consequent on exposure to synchronous, but spatially disparate, auditory and visual stimuli. In two experiments, we examined the spatial gradient of generalization and the time course of this

shift. Aftereffects were obtained after just 1 min of adaptation, and they dissipated within 1 min also. They were largest at the position of the adapter and decreased linearly with distance.

#### 2:45–3:00 (216)

**A Reverse Ventriloquist Effect: Auditory Capture of Moving Visual Stimuli.** MICHAEL K. McBEATH & JASON D. ADDIE, *Arizona State University*—When dynamic visual and auditory stimuli are coupled together, visual stimuli typically capture the spatial properties of auditory stimuli in the classic ventriloquist effect. The present study examined whether the direction of dominance can be reversed with moving stimuli and explored necessary temporal conditions for this to occur. We coupled clearly moving auditory noise of different speeds with visual bistable apparent motion that had ambiguous directionality. Experienced direction of visual movement was reliably captured by the auditory stimuli when the auditory motion was sufficiently rapid. The findings support the multisensory nature of dynamic spatial perception and suggest that direction of capture is principally a function of the relative reliability of the information for each sensory modality. Normally, the location of an auditory stimulus is more uncertain than a visual one, but when a sound source is experienced as clearly moving across space, it can command direction of ambiguous visual movement.

#### Motor Control

Coronado A, Friday Afternoon, 1:00–3:10

Chaired by Gordon M. Redding, *Illinois State University*

#### 1:00–1:15 (217)

**Kinesthetic Compensation for Manual Control in Rotated Frames of Reference.** STEPHEN R. ELLIS, BERNARD D. ADELSTEIN, & ROBERT B. WELCH, *NASA Ames Research Center*—Guiard (1987) has suggested that cooperative control of the two hands may be modeled as a closed kinematic linkage and that the nondominant hand provides the frame of reference for the dominant hand. Experiments by Hinkley (1997) support Guiard's analysis. We now demonstrate a phenomenon in which the hand not used for control provides a kinesthetic cue to a visually rotated control frame and greatly reduces the manual control difficulty of a controlled element subject to a control–display misalignment. The cuing hand, positioned to align with the orientation of the rotated control frame, provides a kinesthetic reference for the controlling hand. Subjects then may control their hand movement relative to their kinesthetic sense of cuing hand orientation. Experiments show that this technique works, can dramatically reduce control inaccuracy associated with rotational misalignments, and can be used to measure the asymmetry in cuing effectiveness of the dominant and nondominant hands.

#### 1:20–1:35 (218)

**Voluntary and Reflexive Components of Gaze Control: Insights From Hemispherectomy.** PATRICIA A. REUTER-LORENZ, *University of Michigan*, TROY HERTER, *Montreal Neurological Institute*, MAURICE PTITO, *University of Montreal*, & ALAIN PTITO & DANIEL GUITTON, *Montreal Neurological Institute*—Voluntary and reflexive control of saccadic eye movements are thought to be mediated by cortical and collicular pathways, respectively. To date, direct evidence for independent functioning of the collicular pathway comes primarily from animal studies. Hemispherectomy patients are a potential source of such evidence because of the complete unilateral removal of one cortical hemisphere. However, their resulting hemianopia severely limits the study of visually directed gaze. To circumvent blindness, we studied saccades to eccentric tones in the dark in 3 hemispherectomized patients. All the patients generated a preponderance of contralesional “express saccades,” indicating preserved collicular function. Fixation offset effects were exclusively contralesional, suggesting inhibition of collicular processes on the intact side. An ability to generate both contralesional and ipsilesional antisaccades was

accompanied by frequent contralesional errors (reflexive glances toward the target). This constellation of oculomotor performance reveals a functionally disinhibited ipsilesional colliculus and release of an “auditory” grasp reflex.

#### 1:40–1:55 (219)

**A Rational Analysis of Illusion Effects in Reaching.** PETER DIXON & SCOTT GLOVER, *University of Alberta*—We examined the effect of a size-contrast illusion on a grasping movement. Large effects of the illusion were found early in the movement trajectory, but only small effects were found near the end. This suggests that the typically small effect of illusions on actions may be due to the nature of the information used in controlling the action. Indeed, we argue that this particular pattern of results is adaptive. In particular, assuming that reaching is guided by a maximum likelihood estimate of the final target posture provides a quantitative account of the effects of visual display characteristics on movement trajectory over time. Early in the reach, contextual information is influential, since it is mildly predictive of the optimal target posture; late in the reach, accurate information about the target posture is available from proprioceptive and visual feedback, and the contextual information has relatively little predictive value.

#### 2:00–2:20 (220)

**Is Rotation of the Population Vector in Conflict With the Stimulus Uncertainty Effect?** KALEB McDOWELL & JOHN JEKA, *University of Maryland*, WOLFRAM ERLHAGEN, *University of Minho*, & GREGOR SCHONER, *Ruhr Universität Bochum* (read by John Jeka)—For the past century, it has been known that reactions to stimuli are slower when the number of stimulus response pairings is larger. A recent neurophysiological approach to the study of cognitive processes involved in movement preparation, based on rotation of the population vector, seems to be at odds with this classical result. Within a constant angular range, increased number of choices results in smaller angular separation between choices and, thus, decreased average reaction time. To understand how mental rotation can be reconciled with the effect of stimulus uncertainty, we studied the interaction between the number of stimulus–response pairings and response metrics. The stimulus–uncertainty effect was observed when responses were widely separated, but an inversion of the effect was observed when responses were metrically close. An extension of the population vector approach that includes both local facilitation and global inhibition provides a unified account for these two limit cases.

#### 2:25–2:40 (221)

**Attentional Focus on Suprapostural Task Influences Balance Learning.** GABRIELE WULF & MATTHIAS WEIGELT, *University of Reading*—The influence of the attentional focus induced by a “suprapostural” 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). In Experiment 1, the tube contained a table tennis ball that was to be held in the middle of the tube, whereas the tube was empty in Experiment 2. Participants were instructed either to focus on keeping their hands horizontal (“internal” focus) or to focus on keeping the tube horizontal (“external focus”; Wulf, Höb, & Prinz, 1998). External-focus participants demonstrated more effective learning than did internal-focus participants. Also, the external group was superior in keeping the tube horizontal. This suggests that the attentional focus regarding the suprapostural task affects not only performance and learning of the suprapostural task itself, but also that of the postural task.

#### 2:45–3:05 (222)

**Pattern Perception and Production in Paired Circling Movements.** FRANZ MECHSNER & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research* (read by Wolfgang Prinz)—We provide evidence that pattern perception and pattern formation in paired circling movements follow similar rules. It is known that spontaneous transitions from asymmetrical to symmetrical patterns occur in bi-

manual circling. We provide evidence for a perceptual basis of the symmetry tendency. First, participants circled two visible flags with their hidden hands. The flags circled in various phase and frequency relationships with regard to the hands. Asymmetrical patterns often switched into symmetry independent of what the hands were doing. Second, participants circled the flags by way of two joystick-driven motors. Again, switches from asymmetry to symmetry occurred. Third, participants were asked to choose their favorite velocities for flag-circling patterns whose relative phase was mechanically fixed. In this perceptual task, the highest velocities were chosen for symmetrical patterns, as in analogous motor tasks. We believe that these findings support the notion of common representational resources for perception and action.

**Learning Structured Material**  
**Coronado H, Friday Afternoon, 3:30–5:30**

*Chaired by W. Jay Dowling, University of Texas, Dallas*

**3:30–3:50 (223)**

**Cue Competition in Function Learning: Blocking and Highlighting.** JOHN K. KRUSCHKE, *Indiana University*—In function learning, people learn to predict a continuous outcome from continuous cues, whereas in category learning, people learn to predict a nominal outcome. The present research demonstrates that two complementary forms of cue competition, previously found in category learning, also occur in function learning. One form of cue competition is blocking of learning about a redundant cue (e.g., Kamin, 1968; Kruschke & Blair, 2000). A second form of cue competition is highlighting of a diagnostic cue (a.k.a. the inverse base rate effect; Kruschke, 1996; Medin & Edelson, 1988). Bimodality of responses to conflicting test cues suggests exclusivity in cue selection. I argue that these effects are caused by attentional shifts, in both category and function learning. No previously published model of function learning can account for these effects, but a model in progress by Kalish, Lewandowsky, and Kruschke holds promise.

**3:55–4:05 (224)**

**Bimodality in Function Learning: Data and a Model.** MICHAEL KALISH & STEPHAN LEWANDOWSKY, *University of Western Australia*, & JOHN K. KRUSCHKE, *Indiana University*—Models of function learning describe how people acquire new concepts, such as the relation between the rate of alcohol consumption and blood alcohol level. Function learning has been viewed alternatively as a parametric process, akin to polynomial regression, and as a nonparametric process, akin to instance models of category learning. Both model types predict unimodal responses to both training and transfer stimuli. In this talk, we present the results of three experiments, showing that participants, in fact, make bimodal responses. We describe a hybrid model, in which a set of parametric functions is associated with individual instances during training, through the use of an adaptive “gate.” The competition between different functions results in bimodal responses, in accord with the data from our experiments.

**4:10–4:30 (225)**

**Variability and Detection of Invariant Structure.** REBECCA GOMEZ, *University of Arizona*—We investigated learning of nonadjacent dependencies with adults and 18-month-old infants. Learners were exposed to one of two artificial grammars producing three-element nonsense strings (e.g., pel-kicey-jic). Both grammars contained the same pairwise transitions; thus, learners could distinguish the grammars only by acquiring nonadjacent dependencies. We manipulated the size of the pool from which we drew the middle element, to investigate whether high variability of context would lead to better perception of the nonadjacent dependencies. Infants and adults acquired the nonadjacent dependencies under conditions of greatest variability only, suggesting that they focused on adjacent dependencies as a default but switched to the less variable nonadjacent dependencies when the former were no longer reliable. Apparently, learners will focus on

a particular source of information only to the extent that it results in detection of predictable structure. Beyond this point, they seek alternative sources of reliability, demonstrating remarkable flexibility in their learning.

**4:35–4:50 (226)**

**A Neural Network Model of the Hippocampus Predicts Human Training Sensitivities.** WILLIAM B. LEVY, ANTHONY J. GREENE, MADELINE HOGAN, BARBARA A. SPELLMAN, & XIANGBAO WU, *University of Virginia*—What mechanisms underlie performance on nonverbal transitive inference tasks? This is an open question in both human and animal paradigms. We combine evidence from human experiments and simulations using a minimal, biological model of the hippocampus to investigate those mechanisms. Our human subjects learned a transitive ordering based on presentation of premise pairs ( $a > b$ ;  $b > c$ ;  $c > d$ ;  $d > e$ ). When the pairs were introduced out of order ( $c > d$ ;  $a > b$ ;  $b > c$ ;  $d > e$ ), we found (1) no adverse effect on asymptotic performance for novel, transitive pairs ( $b ? d$ ), but (2) impairment during acquisition. The neural network model, too, is affected by ordering during training. The sensitivity of the simulations led us to perform the cognitive experiments. Thus, the modeling is useful beyond its explanatory value. Although the logic of the problem is unchanged by training order, the analogue computations by which biologically based thinking mimics logical reasoning, is precarious in its sensitivities, and this precariousness can be understood with a biologically based model.

**4:55–5:10 (227)**

**Model-Based Analysis of Short-Term Episodic Recognition of Two-Dimensional Textures.** ROBERT SEKULER & MICHAEL J. KAHANA, *Volen Center, Brandeis University*—Using Sternberg’s paradigm, we explored short-term episodic recognition for 2-D textures. Stimuli were generated by summing trios of sinusoidal gratings. The natural multidimensional representation of such stimuli makes it easy to manipulate similarity relations among study items, as well as between study and probe items. Because interitem similarity is central to many theories of cognition, the ability to control and manipulate similarity relations could constitute an important theoretical advance. Our noisy exemplar summed-similarity model (NEMO) gave an excellent overall fit to recognition data from two experiments but failed for a few, individual study–probe sets. Model-based analysis of individual study–probe sets revealed that participants’ decisions reflect not only the probe’s similarity to the study items, but also the study items’ similarity to one another.

**5:15–5:25 (228)**

**Retrieval Inhibition in Recognition Memory.** STEPHEN DOPKINS, *George Washington University*—Participants monitored scrambled sentences for repeated words and made recognition judgments to probe words that interrupted the sentences. Participants were slower and less accurate at recognizing a noun if they had to make the recognition judgment immediately after processing another noun that had been repeated from earlier in the sentence. Participants were not impeded in recognizing a verb or an adjective following the processing of a repeated noun. Participants were not impeded in recognizing a noun following the processing of another repeated noun if the sentence contained many nouns. These results may reflect a process of retrieval inhibition. When a retrieval target is a member of a limited subset within the memory set, other members of the subset may be inhibited when the target is retrieved.

**Semantic Effects**

**Coronado L, Friday Afternoon, 3:30–5:30**

*Chaired by Arthur M. Glenberg, University of Wisconsin, Madison*

**3:30–3:50 (229)**

**Can an Episodic-Retrieval Mechanism Explain Homograph Disambiguation Effects?** DAVID S. GORFEIN, *University of Texas, Arling-*

ton—When the contextually appropriate meaning of a homograph is selected, subsequent encounters with the same homograph show facilitation on same-meaning occurrences and inhibition for different-meaning occurrences. Both facilitation and inhibition are obtained in the relatedness decision task over relatively long (1 min or more) intervals filled with other related-pair decisions. The question of what mediates priming over the filled interval has not been adequately addressed. The present paper employs a shift in environmental context (Bilodeau & Schlosberg, 1951) to assess the possible role of an episodic-retrieval mechanism in the process. Results of the manipulation show that in an incidental memory test, the retroactive interference of a second occurrence of the homograph-related word pair is significantly reduced by an environmental context shift. For the relatedness decision task, facilitation for same-meaning occurrences of the homograph is eliminated by an environmental shift, but inhibition remains. Implications for theories of disambiguation are discussed.

3:55–4:15 (230)

**Comprehension Skill: Suppression Versus Knowledge Activation.** DANIELLE S. McNAMARA & JOSEPH T. COYNE, *Old Dominion University*, & MARK A. McDANIEL, *University of New Mexico*—This study examined effects of participants' knowledge and reading skill on the suppression of irrelevant meanings of homophones. Participants ( $n = 144$ ) were presented with sentences such as "He dug with a spade." They then decided whether a target word related to the irrelevant meaning of the homophone, ACE, was related to the sentence. Previous results showed that skilled readers more quickly respond after a delay than immediately, whereas less skilled readers show a slowed response both immediately and after a delay, indicating that skilled readers more quickly suppress the irrelevant meanings of homophones. Present results indicate that less skilled readers with greater general world knowledge also more quickly suppress irrelevant meanings of homophones. As predicted by the construction–integration model of comprehension, suppression effects may be partially due to greater activation of knowledge related to the intended meaning of the homophone, which results in competition and, thus, quicker deactivation of irrelevant meanings.

4:20–4:35 (231)

**Brain Imaging the Mechanism of Suppression in Sentence Comprehension.** MORTON ANN GERNSBACHER & JENNIFER M. BINZAK, *University of Wisconsin, Madison*, DAVID A. ROBERTSON, *Georgia Institute of Technology*, & MATTHEW D. BUDDE, *University of Wisconsin, Madison*—More than a dozen years ago, we began asking subjects to read a sentence and then judge quickly whether a test word was related to that sentence. When the test word was presented immediately after subjects read the sentence, we (and numerous other labs) observed that subjects were slower to correctly reject a test word like ACE after reading a sentence like "He dug with a spade" than after reading a sentence like "He dug with a shovel." When the test word was presented after a brief delay, this putative interference diminished. We interpreted this pattern as manifesting a cognitive mechanism of suppression. In the experiment to be reported, we used event-related fMRI to image the brain activity underlying this behavioral pattern. When the test words were presented immediately after the sentences, we observed left supramarginal gyrus activity. When the test words were presented 3 sec after the sentences, we observed bilateral supramarginal gyrus activity.

4:40–5:00 (232)

**Graded Semantic Effects in Word Production and Comprehension.** GABRIELLA VIGLIOCCO, DAVID VINSON, & YOKO NAKANO, *University College London*—We developed an empirically based model of lexical-semantic representation, starting from speaker-generated features for a set of 456 words (objects and actions). We used semantic distances in this space to predict performance on several linguistic tasks involving objects and actions. In a speeded picture-naming task, we found that semantic distances predicted the pattern of substitution

errors even after visual and phonological similarity was taken into account. In picture–word interference, we observed graded semantic effects on naming latencies. In a semantically blocked picture-naming task, we observed graded interfering effects across semantic categories. Finally, in comprehension, we found graded effects of semantic distance between prime and target in lexical decision. These experiments provide converging evidence of the plausibility of our model. Furthermore, because this model was developed for words referring to objects and actions, it makes predictions concerning semantic organization for action words, a domain that has historically received little attention.

5:05–5:25 (233)

**Semantic Feature Characteristics of Natural Kind and Man-Made Concepts.** CURT BURGESS & PATRICK CONLEY, *University of California, Riverside*, & CHAD AUDET, *Ejemoni Inc.*—The semantic characteristics of man-made and natural-kind concepts were explored using the HAL model of semantic memory. Early research with these concepts suggested that natural kinds have semantic characteristics that are more highly intercorrelated than man-made objects, owing, in large part, to our perceptual experience with the objects. More recent work by McRae and colleagues has supported this conclusion by modeling concepts using feature-based word vectors that were derived from human norming procedures. Research with the HAL model confirms that this pattern of intercorrelations can be reproduced with a model that limits its experience to language input and is purely inductive in its acquisition process. The relationship of these characteristics to categorization and semantic priming are discussed.

Working Memory

Monterrey, Friday Afternoon, 3:15–5:20

Chaired by Scott D. Gronlund, *University of Oklahoma*

3:15–3:35 (234)

**Phonological Working Memory: One Buffer or Two?** STIAN REIMERS, *University of Cambridge*, & STEPHEN MONSELL, *University of Exeter* (read by Stephen Monsell)—The standard model of working memory for verbal sequences (e.g., Baddeley, 1986) assumes a single phonological buffer to which heard speech gains automatic access, and into which internally generated speech can also be encoded. In contrast, Monsell (1987) and others have proposed separate but linked input and output buffers for phonological sequences, the former specialized for comprehension, the latter for production. The two-buffer model allows for the possibility of different phonological content's being loaded into the two buffers at the same time. In two experiments, we required subjects simultaneously to encode a visual stream of words for ordered recall, and an auditory sequence of nonwords for an order-recognition probe. The dual-task cost to estimates of capacity for each kind of sequence was much smaller than would be expected if input and output phonology must share the capacity of a single buffer.

3:40–3:50 (235)

**Effects of Frontal Lobe Damage on Interference Effects in Working Memory.** SHARON L. THOMPSON-SCHILL, *University of Pennsylvania*, JOHN JONIDES, *University of Michigan*, CHRISTY MARSHUETZ, *Yale University*, EDWARD E. SMITH, *University of Michigan*, MARK D'ESPOSITO, *University of California, Berkeley*, IRENE P. KAN, *University of Pennsylvania*, ROBERT T. KNIGHT, *University of California, Berkeley*, & DIANE SWICK, *University of California, Davis*—We examined interference effects in working memory, using a modified version of an item recognition task in which interference from previous trials was manipulated. Recent neuroimaging studies have isolated a region of the left inferior frontal gyrus (LIFG) that appears to be related specifically to such interference. We measured baseline working memory performance and interference effects in patients with unilateral frontal lobe lesions and in age-matched controls and young controls. In particular, we focused on patient R.C., whose lesion uniquely impinged on the LIFG. Normal

aging was associated with changes to both working memory and interference. Frontal damage was associated with further declines in working memory but did not increase interference, with the exception of R.C., who exhibited a pronounced interference effect on both response time and accuracy. We propose that the LIFG subserves a general function of selecting relevant information in the face of competing alternatives.

### 3:55–4:15 (236)

**A Comparison of Auditory and Visual Working Memory Processes.** NELSON COWAN, J. SCOTT SAULTS, & EMILY M. ELLIOTT, *University of Missouri, Columbia*—We seek to characterize similarities and differences between auditory and visual working memory. For both auditory and visual stimulus sets, immediate memory is presumably bounded by limitations in (1) access to sensory memory and (2) the amount of information that can be held in a categorized form. We argue that the basic difference between auditory and visual immediate memory, producing the well-known auditory modality superiority effect, is that auditory sensory memory is more resistant to retroactive interference than is visual sensory memory. Despite this difference, similar estimates of capacity for derived categorical information emerge from the two modalities when chunking processes are controlled. New evidence helps to reconcile concepts from the classical era of cognitive psychology and from more recent modeling of serial order memory.

### 4:20–4:35 (237)

**Impulsiveness and Executive Control in Working Memory.** PAUL WHITNEY, TINA JAMESON, MIGUEL CORTES, & JOHN M. HINSON, *Washington State University*—Although impulsiveness is characteristic of a wide range of neurological disorders and is a significant risk factor for substance abuse, the cognitive underpinnings of impulsiveness are poorly understood. We examined whether impulsiveness is marked by a distinct pattern of executive control in working memory (WM). A commonly used measure of impulsiveness, the BIS, was collected from 100 participants. These participants also performed the continuous memory scanning (CMS) task that we developed to measure several dissociable aspects of executive control in WM. The CMS task allows us to separate individual differences in WM capacity from individual differences in the ability to modulate WM inputs and outputs. The data suggest that impulsiveness is not associated with a general deficit in WM but, rather, is marked by a particular difficulty with modulating the biasing effects of the contents of WM on the processing of new information.

### 4:40–4:55 (238)

**ACDC Meets ABBA: An Experimental Task Analysis of *N*-Back.** ANDREW R. A. CONWAY, *University of Illinois, Chicago*, & MICHAEL J. KANE, *University of North Carolina, Greensboro*—The *n*-back task is a continuous-performance test in which subjects detect when the current stimulus matches one presented “*n*-back” in the stream. *N*-back is a popular index of working memory function in neuroimaging studies because it is easy to implement and response requirements are simple. However, little empirical work has explored the characteristics of the task that demand working memory. Our experiment assessed the effects of specific stimulus sequences. Specifically, we tested whether *n*-minus “lures” (the sequences ABBA or ABAA in 3-back tasks) would hurt performance by eliciting false alarms and subsequent misses. We also tested whether second targets in “overlapping” *n*-backs (in 3-back, the second B in ABCAB) would be missed relative to first targets (the second A in ABCAB), reflecting postgoal completion errors. Moreover, we tested whether including these sequences would affect performance overall, relative to control contexts. We will discuss implications for neuroimaging studies and working memory theories.

### 5:00–5:15 (239)

**The Costs of Written Versus Spoken Output in Text Recall.** RONALD T. KELLOGG, *Saint Louis University*, & JULIE BAKER & JULIE LEE, *University of Missouri, Rolla*—Recalling a text in writing differs from spoken recall in the demands placed on working

memory. Writing is less practiced than speaking, graphemic codes must be activated only in writing, and the retrieved representations of the text must be maintained in working memory longer because handwritten output is slower than speech. The retrieval mode needed to reconstruct a text may consequently receive less attention during written than during spoken recall. This prediction was tested by presenting Bartlett’s (1932) “The War of the Ghosts” to college students either visually or aurally, followed by a written or spoken test of recall. Spoken recall produced more accurately recalled propositions and more major distortions (e.g., inferences), relative to written recall. Providing extra time for written recall served only to increase the proportion of major distortions observed. The results suggest that writing reduces the effort given to reconstructing the propositions of a text.

### Associative Learning: Animals Durango, Friday Afternoon, 3:20–5:20

Chaired by Robert G. Cook, *Tufts University*

### 3:20–3:35 (240)

**Color Matching and Color Alternation in Honeybees.** P. A. COUVILLON, TODD P. FERREIRA, & M. E. BITTERMAN, *University of Hawaii*—In previous experiments, honeybees choosing between targets colored A and B showed a strong initial matching tendency (choice of A after feeding on A, and choice of B after feeding on B) that could neither be enhanced by differential reinforcement for matching nor reduced by differential reinforcement for alternation. In the present experiments with a different technique, no initial matching tendency was found, and either matching or alternation could be produced by appropriate training. Learned control of performance by short-term memory is implied.

### 3:40–4:00 (241)

**Testing the Anticipatory Mediated Generalization Account of Acquired Equivalence.** PETER J. URCUIOLI & KAREN M. LIONELLO-DENOLF, *Purdue University*—Transfer of new comparison choices across samples occasioning the same choice in many-to-one matching is a common assay for acquired sample equivalence. The traditional explanation of such transfer is that pigeons learn to anticipate the common choices in the many-to-one task and that their sample-specific anticipations acquire conditional control over any subsequently learned choices. This, in turn, permits generalization of performance to other samples generating the same anticipations. We evaluated this explanation by varying when pigeons learned the “new” choices. One group learned new comparison responses after acquiring many-to-one matching, whereas another group learned them prior to many-to-one acquisition. Despite minimizing (or perhaps eliminating) the opportunity for anticipatory mediated generalization in the latter group, these pigeons showed transfer-of-control effects much like those in the former group. These findings question the necessity of appealing to common anticipatory processes to explain acquired sample equivalence.

### 4:05–4:20 (242)

**The Effect of Trial Spacing on Cue Competition.** STEVEN C. STOUT & RALPH R. MILLER, *SUNY, Binghamton* (read by Ralph R. Miller)—Three overshadowing experiments using conditioned suppression with rats were conducted. Experiment 1 found that the massing of training trials attenuated overshadowing. Moreover, in the overshadowing condition (compound cue), massed trials yielded more behavioral control by the overshadowed cue than did spaced trials, in contrast to the usual trial-spacing effect that was observed after training with an elemental cue. Experiment 2 extended these observations to a sensory preconditioning preparation. Experiment 3 used the sensory preconditioning preparation and found that, in the overshadowing condition, (1) posttraining massive extinction of the training context in the massed-trial condition restored overshadowing, and (2) posttraining massive extinction of the overshadowing stimulus restored the conventional trial-spacing effect (i.e., behavioral control by the over-

shadowed cue decreased in the massed-trial condition and increased in the spaced-trial condition). These results are anticipated by the extended comparator hypothesis (Denniston, Savastano, & Miller, 2001), in which the overshadowing stimulus and the context compete in modulating behavioral control by the overshadowed cue.

#### 4:25–4:40 (243)

**Conditioning and Timing in the CS–US Contingency Procedure.** RUSSELL M. CHURCH, *Brown University*, & KIMBERLY KIRKPATRICK, *University of York*—The major goals were to examine the effect of the contingency between CS and US in a conditioned approach paradigm with rats and to compare alternative explanations of the results. Forty-eight rats were assigned to six groups that received different random intervals between successive food deliveries in the presence and absence of a tone CS; the times of head entries were recorded. The mean response rate in the CS was positively related to the rate of US delivery during the CS and negatively related to the rate of US delivery in the absence of the CS. In addition, the response rate in the CS decreased as a function of time since stimulus onset. Comparisons will be made between contingency analysis, associative theory (the Rescorla–Wagner model), and timing theory (packet theory) explanations of the pattern of results.

#### 4:45–5:00 (244)

**Determinants of Spaced-Trial Instrumental Extinction in Pigeons.** MAURICIO R. PAPINI, BRIAN L. THOMAS, & DAWN G. McVICAR, *Texas Christian University*—Reinforcer parameters, such as schedule (partial vs. continuous) and magnitude (small vs. large), have generally produced comparable effects on instrumental extinction in a variety of species. For example, partial and small reinforcements both increase persistence, or both decrease it, depending on the species. As a result, theories developed to account for the effects of one parameter can usually explain the effects of the other (e.g., frustration theory, sequential theory, Rescorla–Wagner model, etc.). A dissociation of these effects was discovered in a series of spaced-trial experiments with pigeons. Instrumental performance in extinction (key pecking and running) is promoted by training with partial (rather than continuous) reinforcement, but it is undermined by small (rather than large) reinforcers. The comparative and theoretical implications of this dissociation will be discussed.

#### 5:05–5:15 (245)

**Ethanol-Induced Sign-Tracking and Ethanol Choice Behavior.** MARVIN KRANK, *Okanagan University College*—Conditioned incentive theories of addictive behavior propose that cues signaling a drug's reinforcing effects activate a central motivational state. This central incentive state enhances drug-taking and drug-seeking behavior and may also stimulate other conditioned responses that are relevant to addictive behavior. I report the behavioral impact of cues associated with ethanol and their interaction with operant self-administration of ethanol. The conditioned response resulting from pairing of spatially localized cue lights with the opportunity to ingest ethanol has three main effects: (1) induction of operant behavior reinforced by ethanol, (2) stimulation of ethanol-seeking behavior, and (3) signal-directed behavior (i.e., autoshaping or sign-tracking). These CRs are motivational and interact importantly with the self-administration of ethanol.

#### Cognitive Control

Yucatan, Friday Afternoon, 3:15–5:10

Chaired by Hal Pashler, *University of California, San Diego*

#### 3:15–3:35 (246)

**Establishing Task Set Reduces Perceptual and Response-Level Interference: The Nature of the Preparation Effect in Task Switching.** JEUNG-CHAN AHN & AKIRA MIYAKE, *University of Colorado, Boulder* (read by Akira Miyake)—Two experiments examined the nature of the preparation effect in task switching by manipulating the

stimulus-onset asynchronies (SOAs) between presentations of the task-relevant and task-irrelevant dimensions of the bivalent target. Participants switched between a shape-decision task and a color-decision task, signaled by a cue presented either 300 or 1,500 msec before the task-relevant dimension. The task-irrelevant dimension appeared before, simultaneously with, or after the task-relevant dimension. The SOA manipulation had a strong effect on switch costs when the preparation time was short. When it was long, however, no such SOA effect was found, although small residual switch costs remained. This contrast suggests that the firm establishment of task set makes one immune to perceptual interference caused by task-irrelevant information. Moreover, an analogous effect of the preparation time found at the response selection level suggests that establishing mental set may also help block automatic (re)activation of task-irrelevant response mapping rules.

#### 3:40–4:00 (247)

**Control in Switching Between Speeded Discrimination Tasks: Preliminary Model and Data.** NACHSHON MEIRAN, *Ben-Gurion University of the Negev*—A preliminary quantitative model of task-switching performance in speeded discrimination tasks will be described. It is assumed that control in such paradigms is based primarily on (1) keeping all relevant S–R mappings active and (2) dynamic input selection. The model explains the usual pattern of interactions between task congruency, task switching, preparation, and response repetition. Modeling results as well as experimental results, which test novel predictions, will be described.

#### 4:05–4:25 (248)

**Switching Between Tasks: What Constitutes a Task Unit?** DANIEL GOPHER & DEGANIT BARNEA, *Technion—Israel Institute of Technology*—Task switching is a popular paradigm in contemporary research of control processes and their influence on task performance. The costs of switching between tasks are taken to reflect the effort associated with the requirement to stop the previous task activities and 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 segment, such that task-switching costs can be observed between the two. We show that internal events, such as subjective significance, are sufficient to create switching costs, similar to those that result from a change in stimulus, response, or required computations. These results are discussed in relation to current interpretations attributing the costs to task set inertia, conflicting activations, and reconfiguration requirements.

#### 4:30–4:45 (249)

**Conflict and Control: Response Competition and Persisting Inhibition in Task-Set Switching.** THOMAS GOSCHKE, *Max Planck Institute for Psychological Research*—Switching between tasks incurs a response time cost, as compared with repeatedly performing the same task. A reduced, albeit reliable, switch cost is usually obtained even after long preparation intervals. The hypothesis was tested that this residual switch cost reflects persisting inhibition of competing task sets, which is mobilized by the detection of response conflicts (“conflict-triggered control”). Participants responded manually to either the identity or the color of letters. A task cue prior to each stimulus signaled the next task. Across three experiments, switch costs were reliably increased on trials that were preceded by trials on which the task-irrelevant stimulus dimensions activated an incompatible response and thus elicited a response conflict. This indicates that seemingly dysfunctional residual switch costs are a side effect of an adaptive tendency to inhibit distracting stimulus dimensions. While this promotes shielding of the current task set against crosstalk, a cost is incurred when flexible task switching is required.

#### 4:50–5:05 (250)

**Process-Specific Consequences of Task Switching.** MICHAEL E. J. MASSON & DANIEL N. BUB, *University of Victoria*—Task switching is typically assumed to involve executive control in coordinating

change in global task demands. In contrast, we describe a process-specific influence of task switching on the performance of the first of two alternating tasks. Task 1 required a response to an unambiguous stimulus (read a word printed in black), and Task 2 required subjects to avoid making a similar response to an ambiguous stimulus (name the color in which a word is printed). Responding on Task 1 was slowed relative to the case in which the colored stimulus on Task 2 was always a row of asterisks. Slowing of Task 1 occurred when that task involved phonological processing (naming or phoneme detection), but not when it required lexical decision or visual comparison. These results indicate that the modulatory effect on Task 1 is specific to phonological processes that are subject to strategic, although not necessarily conscious, modulation.

### Speech Perception

Coronado A, Friday Afternoon, 3:30–5:30

Chaired by Richard Schweickert, Purdue University

#### 3:30–3:45 (251)

**Perception of English Sentences From Dynamic Acoustic Properties.** ROBERT E. REMEZ, REBECCA L. PIORKOWSKI, STEPHANIE WISSIG, & CYNTHIA YANG, *Barnard College*—Phonetic perception is often said to depend on short-term attributes of vocally produced sound. However, the variation in a complex spectrum also appears to promote phonetic perception independent of the short-term physical acoustic properties of a signal and its auditory correlates. In this project, we report the results of a study of intelligibility, using chimerical synthesis to fill the spectrum envelope of natural speech samples with acoustic fine structure derived from one of several non-speech sources: white noise, an unrectified square wave of constant or varying frequency, or a diatonic series of trumpet tones. We also varied the resolution of the spectrum envelope from coarse to fine grained. By comparing the transmission, this set of variants of spoken sentences, we can compare the extent of perceptual devotion to the timbre of short-term signal elements or the spectrotemporal dynamics.

#### 3:50–4:10 (252)

**Representational Specificity of Lexical Form in the Perception of Spoken Words.** CONOR T. MCLENNAN, PAUL A. LUCE, & JAN CHARLES-LUCE, *SUNY, Buffalo* (read by Paul A. Luce)—We examined the specificity and abstractness of form-based lexical representations of spoken words. Using a repetition-priming paradigm, we attempted to determine whether flapped intervocalic alveolar stops in American English are mapped onto underlying representations of /t/ and/or /d/ or whether flaps have an independent representational status. Participants shadowed (Experiments 1 and 3) or made lexical decisions to (Experiments 2 and 4) spoken words in two blocks of trials. Stimuli in the first block served as primes, and those in the second block as targets. Primes and targets consisted of flapped and carefully articulated bisyllabic words. We measured reaction times to target words in the second block as a function of prime type. The results provide evidence for both abstract underlying perceptual representations and exemplar-based representations.

#### 4:15–4:25 (253)

**The Role of Feedback in Perceptual Learning of Synthetic Speech.** HOWARD NUSBAUM & KIMBERLY FENN, *University of Chicago*—Speech perception is typically viewed as mediated by mechanisms that are fixed in processing after a sensitive period of development. However, our previous research has shown that adult listeners recognize synthetic speech more accurately after moderate amounts of training. Training appears to shift the distribution of attention to speech and to increase efficiency of working memory use. The present experiments more directly investigate the use of attention and feedback during learning. In one experiment, during training, listeners identified synthetic speech and were given either explicit, high-level linguistic feedback or no feedback. In a second experiment, listeners were given feedback

on each training trial, along with a secondary cognitive load task. The results suggest that listeners use high-level linguistic feedback to shift attention to acoustic properties in speech that are consistent with linguistic categorization. Our results suggest that theories of speech perception must incorporate more active processing mechanisms.

#### 4:30–4:40 (254)

**Bias and Automatic Components in Rhyme Priming.** DENNIS NORRIS, *MRC Cognition and Brain Sciences Unit, Cambridge*, & JAMES M. MCQUEEN & ANNE CUTLER, *Max Planck Institute for Psycholinguistics*—There is robust facilitation when target spoken words rhyme with preceding spoken primes. Four experiments examined the processes underlying this facilitation. Lexical decisions were faster to words following rhyming primes (ramp-LAMP) than to those following unrelated primes (pink-LAMP), but there was no effect for nonword targets (Experiment 1). When targets were added that almost rhymed with their primes (foils, bulk-SULSH), facilitation for rhyming words was significantly weaker (Experiment 2). In single-word shadowing, however, there was facilitation for rhyming words and nonwords (Experiment 3) and no significant reduction in priming when foils were included (Experiment 4). There is a strategic component to phonological facilitation that operates only in lexical decision: Listeners are biased to respond “yes” to rhyming targets, unless foils discourage this bias. There also appears to be a nonstrategic component to phonological facilitation in both tasks; we argue that this is due to prelexical speech perception processes.

#### 4:45–5:05 (255)

**Lexical Retuning of Phonological Categories.** JAMES M. MCQUEEN, *Max Planck Institute for Psycholinguistics*, DENNIS NORRIS, *MRC Cognition and Brain Sciences Unit, Cambridge*, & ANNE CUTLER, *Max Planck Institute for Psycholinguistics*—Dutch subjects made lexical decisions on a list of words and nonwords. The final fricative of some words had been replaced by an ambiguous sound, midway between [f] and [s]. One group of listeners heard ambiguous [f]-final Dutch words like [kara?] (based on karaf, carafe) and unambiguous [s]-final words (e.g., karkas, carcass). Another group heard the reverse (ambiguous [karka?], unambiguous karaf). Neither [karas] nor [karkaf] is a word, so lexical information constrained the final fricative’s identity. Subsequently, listeners who had heard [?] in [f]-final words were more likely to categorize the ambiguous fricative [?] as an instance of [f] than of [s]. The converse was true for listeners who heard [?] in [s]-final words. In conjunction with control experiments, this demonstrates that lexical information can be used to train categorization of the speech signal. This use of lexical information is qualitatively different from the top-down feedback embodied in interactive models.

#### 5:10–5:25 (256)

**Talker Behaviors in Stressful Environments and Automatic Speech Recognition.** ASTRID SCHMIDT-NIELSEN, *Naval Research Laboratory*, THOMAS H. CRYSTAL, *Consultant*, ELAINE MARSH, *Naval Research Laboratory*, & ELIZABETH WOODARD KREAMER, *Arcon Corp.*—Pairs of talkers seated in separate sound booths performed a collaborative task (seeking and destroying an enemy ship) while talking over various digital voice communication systems (vocoders). The communication task was further stressed by piping in accurately reproduced military background noises to each booth. The recordings (originally made for another purpose) were used to evaluate automatic speech recognition (ASR) systems. These evaluations provide ways of investigating the compensatory strategies talkers adopt to cope with the stresses of game pressure, vocoder distortion, and ambient noise and of seeing how human and ASR performance are separately affected by these compensations. The transcriptions made for the ASR evaluation allowed us to measure talker behaviors—for example, changes in vocabulary, in numbers of sentences and words, and in spelling out words. ASR performance is adversely affected by the compensatory behaviors, over and above any effect of acoustic background noise in the speech signal.

## POSTER SESSION II

Fiesta Ballroom, Friday Evening, 5:30–7:00

## • PSYCHOLINGUISTICS •

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**Psychophysical Scaling of Emotional Intensity.** FRANCISCO M. S. CARDOSO, *University of Coimbra*, ELTON H. MATSUSHIMA & RICARDO KAMIZAKI, *University of São Paulo at Ribeirão Preto*, ARMANDO M. DE OLIVEIRA, *University of Coimbra*, & JOSÉ A. DA SILVA, *University of São Paulo at Ribeirão Preto* (sponsored by José A. Da Silva)—Two experiments were performed for scaling emotional intensities in two different stimuli contexts. In Experiment 1, subjects produced magnitude and line length estimates to verbal descriptors of emotions: anger, aversion, fear, joy, love, sadness, and surprise. For each emotion, approximately 18 descriptors (adjectives) were scaled. The main results showed good fit of the emotion descriptors in continua, except in surprise, probably due to linguistic characteristics of this specific emotion. In Experiment 2, subjects scaled emotional intensities in facial expressions continua (in photos) by using magnitude estimates. The pictures were arranged in three continua that ranged from an emotion to another: anger to fear, sadness to anger, joy to sadness, and the inverted continua. Results indicated that it was possible to scale continua of emotional intensities ranging through different emotions, with better discriminability in joy–sadness continua, followed by anger–fear and sadness–anger. (Supported by FCT Portugal, BD 19784)

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**Tactile Discrimination in Women as a Function of Menstrual Cycle Phase.** VICTORIA MERCER & HELENA KADLEC, *University of Victoria*—Multidimensional signal detection analysis (Kadlec, 1995) is used to explore how menstrual cycle phase affects a woman's simultaneous perceptions of two tactual dimensions of pressure and "prickliness" and their interactions. In a single-subject design, naturally menstruating women ( $n = 4$ ) and those taking oral contraceptives ( $n = 4$ ) were tested twice during their menstrual cycle (ovulation, luteal phase). Naturally menstruating women exhibited more failures of perceptual separability (PS), decisional separability (DS), and perceptual independence (PI). In contrast, women taking oral contraceptives demonstrated PS, DS, and PI of these dimensions. Unlike women taking oral contraceptives who did not show a phase effect, naturally menstruating women also showed greater discrimination during their luteal phase than during ovulation. The applicability of these findings to our understanding of the cutaneous sensory systems is discussed.

## • AUDITION •

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**Within and Between Dimensional Processing in the Auditory Modality.** BENJAMIN DYSON & PHILIP QUINLAN, *University of York*—Three experiments are reported in which subjects made speeded classifications to singly presented auditory stimuli in two sorts of task. In within-dimensional checking, subjects listened for either of two target features from the same dimension. In between-dimensional checking, the target features were taken from different dimensions. Subjects made target/nontarget judgments based on the presence/absence of either target feature. In Experiment 1, the stimuli were speech sounds delivered over headphones defined relative to sound identity and locale. In Experiments 2 and 3, tones were defined relative to frequency and locale. The stimuli were delivered over headphones in Experiment 2; in Experiment 3, free-field presentation was used. A consistent between-dimension cost was observed in all three experiments: Subjects performed less well at the between- than at the within-dimensional checking. The data are compared with the findings from the vision literature and are discussed with reference to notions of stimulus representation in audition.

## • TOUCH •

(260)

**An fMRI Comparison of Haptic and Visual Imagery.** SHARLENE D. NEWMAN, MARCEL A. JUST, & ROBERTA L. KLATZKY, *Carnegie Mellon University*, & SUSAN J. LEDERMAN, *Queen's University* (sponsored by Patricia Carpenter)—Although the word "imagery" often refers to a visual or spatial representation, it can also refer to a representation derived from other modalities, such as haptic. This study used fMRI to compare the brain activation in haptic versus visual imagery. Participants were to mentally compare two objects along either a haptic dimension (e.g., Which is harder, a potato or a mushroom?) or a visual dimension (e.g., Which is larger, a pumpkin or a cucumber?). Although the haptic and visual conditions activated the same cortical regions, the relative activation of these regions differed as a function of modality. Generally, the cortical network associated with semantic and object knowledge, the temporal and extrastriate regions, revealed more activation for the haptic than for the visual conditions. Conversely, the region presumably associated with mental imagery and spatial relations, the intraparietal sulcal region, revealed more activation for the visual conditions than for the haptic conditions.

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**Transducer Effects in Vibrotactile Pattern Perception.** ROGER W. CHOLEWIAK & AMY A. COLLINS, *Princeton University*, & EDWIN G. LANGBERG, *Sensor Electronics, Inc.*—Tactile transducers are used in mobility aids for blind persons, in augmentative speechreading aids for deaf persons, in orientation devices for elderly people or aircraft pilots, and for feedback in remote sensing and telerobotics. The information transfer characteristics of a new vibrotactile device has been compared against those of a tactor used in a commercially available aid to lipreading. The vibrator from the Tactaid-7 and the new ELAN-01 were used in counterbalanced studies of intensive range and speech-signal processing. In almost every advanced measure, the new device demonstrated improved performance over the existing technology. JNDs were smaller and perceived intensity was greater for a given power level, while information transfer and phoneme discrimination indicated that the ELAN-01 was a promising piece of new technology. Physical analyses indicated that the advantages could be related to the greater intensive range and sharper temporal characteristics of the ELAN-01.

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**Noise Lowers Vibration Thresholds in Elderly Feet.** CARI WELLS & LAWRENCE M. WARD, *University of British Columbia*, JAMES J. COLLINS, *Boston University*, & J. TIMOTHY INGLIS, *University of British Columbia*—Deterioration of cutaneous information from the foot sole, present in 30%–50% of older adults, may be a factor in gait dysfunction and its resulting falls. Stochastic resonance (SR) can alleviate this deficiency: cutaneous noise in the form of random vibrations render foot sole mechanoreceptors able to detect subthreshold sinusoidal stimuli. Our experiments show that SR can lower psychophysical vibration thresholds in elderly feet. Further studies using microneurography could reveal whether SR is most effective at the level of single neurons or mechanoreceptor populations.

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**The Haptic Müller-Lyer Illusion in the Blind.** MORTON A. HELLER & DENEEN D. BRACKETT, *Eastern Illinois University*—An experiment is reported on haptic illusions in blindfolded sighted, congenitally blind, late blind, and low-vision subjects. The stimuli for the Müller-Lyer illusion were produced using raised-line drawings. A sliding tangible ruler was used for haptic judgments of extent. Wings-in stimuli were underestimated, compared with the wings-out stimuli. All stimuli were underestimated, and adding an ending to a line further reduced perceived line length. Visual experience had no effect on line length estimates.

## • PERCEPTION •

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**Use of Reference Points in an Orientation Judgment Task.** JOCELYN KEILLOR & JUSTIN HOLLANDS, *Defence & Civil Institute of Environmental Medicine*, & ANDREW MORTON & TEJINDER PAL SINGH VIRK, *University of Waterloo*—Cyclical bias patterns are typically found in angle and orientation judgments, but the effect of figural context on such patterns is unclear. The cyclical power model (CPM) proposes that the subjective choice of available reference points determines the number of cycles in the bias pattern. Sixty observers judged the orientation of a line by extrapolating its position on a response circle. Figural context was provided by nautical symbols in which geometric shape encoded ship identity. A leader line emanating from the symbol center indicated the ship's heading. Most symbols produced a four-cycle bias pattern, as is typically seen with angle judgments, but diamond-shaped symbols also produced eight-cycle patterns (indicating the use of more reference points). This pattern was more pronounced for male participants. The results indicate a role for figural context in the selection of reference points in orientation judgments and clarify the processes that underlie individual differences in spatial judgment.

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**Is Hindsight 20/20? Evidence for Hindsight Bias in Visual Perception Tasks.** ERIN M. HARLEY & GEOFFREY R. LOFTUS, *University of Washington* (sponsored by Geoffrey R. Loftus)—Little work has examined the role of hindsight bias in visual perception tasks. This research addresses whether or not such a bias exists, and if so, under what conditions. In two experiments, participants were asked to search for digits hidden in visual noise. In Experiment 1, participants were given information to aid them in the search process (digit, location, or both) and then estimated what their performance would have been without the aid. Estimates were compared with performance on trials in which no aid was given. In Experiment 2, participants were shown the hidden digits (i.e., were provided outcome information) and predicted the performance of other observers who received no outcome information. A traditional hindsight bias was found in Experiment 1 and in Experiment 2 when outcome information was presented last, but a reverse bias was found in Experiment 2 when outcome information was presented first.

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**The Face Detection Effect: Inefficient Processing of Nonnormal Faces.** DEAN G. PURCELL, *Oakland University*, & ALAN L. STEWART, *Stevens Institute of Technology*—Detection thresholds under conditions of visual backward masking define the face-detection effect (FDE). Normal, upright faces are detected at a shorter stimulus onset asynchrony (SOA) than are nonnormal or inverted faces. Typically, this effect is attributed to better performance on the normal face. However, observers who show the FDE require longer SOAs to detect the nonnormal faces than do observers who do not show the FDE. In effect, delayed perception of nonnormal faces, rather than the efficient perception of normal faces, produces the face-detection effect.

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**Vection and Visual Complexity in an Optokinetic Drum.** ANDREA BUBKA & FREDERICK BONATO, *Saint Peter's College*—Vection is an illusion of self-motion experienced by stationary observers who view a large moving field, such as an optokinetic drum. Under optokinetic drum conditions, a seated observer views the interior of a drum that rotates around them. Within seconds, the observer typically experiences vection, and with longer periods of exposure, motion sickness symptoms may result. The usual interior of an optokinetic drum consists of vertical black and white stripes. In this study, more complex patterns were tested, including patchworks and ones with varying numbers of brightness levels. It is hypothesized that as the complexity of the visual field increases, the magnitude of vection also

increases. Position constancy is mediated by input from both vision and the vestibular system. When information gathered by these systems is in conflict, it seems logical to assume that the system processing the most information would influence position constancy the most.

## • INFORMATION PROCESSING •

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**Factors Affecting Performance on a Graphical Description Task.** IRVIN R. KATZ, *Educational Testing Service*, HYUN-JOO KIM, *Teachers College, Columbia University*, XIAOMING XI, *UCLA*, & PETER C. H. CHENG, *University of Nottingham*—Research on the comprehension of statistical graphs highlights the contribution of a persons graph-reading skill, the visual characteristics of the graph, and the nature of the task driving comprehension. The role of the factors has typically been investigated using artificially created graphs in controlled experiments. The present work investigates these factors within the context of an English oral proficiency exam for nonnative speakers. A portion of this exam asks test-takers to demonstrate their communicative competence through describing statistical graphs. Consistent with previous work on graph interpretation, one of the strongest influences on performance was characteristics of the graph. However, these characteristics melded both visual aspects and the content of the graph: The easier-to-describe graphs expressed the fundamental point of the graph in a way consistent with people's typical graphical description strategies (e.g., Shah, Hegarty, & Mayer, 1999).

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**Active Suppression in the Management of Working Memory.** ROBERT G. MORRISON, JAMES W. MACDONALD, & ROBERT A. BJORK, *UCLA*—Using a paradigm (Bjork, Abramowitz, & Krantz, 1970) in which cues to forget interrupt some trials in a Sternberg memory-scanning task, we examined the role of active suppression in the management of working memory. Consistent with prior findings—and with the idea that cues to forget result in suppression of to-be-forgotten (TBF) items, slowing their subsequent encoding—the presence of TBF items on a given trial did not affect “yes” response times to TBR items, but TBF items, when probed, were rejected more slowly than were nonpresented items. When TBF items were re-presented in the TBR set, however, those items, when probed, behaved like other TBR items, showing no evidence of their prior suppression. Overall, the results suggest that active suppression, as implemented in the human brain, not only is effective in limiting working memory load, but also is easily lifted if suppressed items are once again made goal relevant.

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**On-line Response Preparation During Visual Search Tasks?** JEFF MILLER, *University of Otago*—Two experiments tested for on-line response preparation during visual search. In one experiment, participants searched for letter-color conjunction targets, and distractors containing single-target features were sometimes presented. Target-absent responses were slowed when such distractors were presented, and the lateralized readiness potential (LRP; a psychophysiological measure of response activation) was monitored to determine whether some of the slowing occurred because these single-target features activated the competing target-present response. In a second experiment, participants searched for letter targets without regard to color, and the LRP was used to determine whether target-absent responses were prepared near the end of the search, where the conditional probability of this response was high. The results help to characterize the communication between visual search processes and motor response activation processes with respect to the issue of all-or-none versus continuous information transmission.

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**The Ex-Wald Distribution as a Descriptive Model of Response Times.** W. SCHWARZ, *University of Nijmegen*—We propose a new quantitative model of response times (RT) that combines some advantages of sub-

stantive, process oriented models and descriptive, statistically oriented accounts. The Ex-Wald model assumes that RT may be represented as a convolution of an exponential and a Wald-distributed random variable. The model accounts well for the skew, shape, and hazard function of typical RT distributions. It is based on two broad information-processing concepts: (1) a data-driven processing rate describing the speed of information accumulation and (2) strategic response criterion-setting. These concepts allow for principled expectations about how experimental factors such as stimulus saliency or response probability might influence RT on a distributional level. We present a factorial experiment involving mental digit comparisons to illustrate the application of the model and to explain how substantive hypotheses about selective factor effects can be tested via likelihood ratio tests.

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**Illusory Conjunctions in the Time Domain: Effect of the Emotional Load.** JUAN BOTELLA & ISABEL C. AREND, *Universidad Autónoma de Madrid*—In rapid serial visual presentation tasks, features coming from different items are sometimes miscombined, producing what are called illusory conjunctions in the time domain (Botella, Barriopedro, & Suero, in press). We used this procedure with colored words. The pattern of intrusions was seen to be sensitive to the emotional load of the words in the high-trait anxious subjects. This result is congruent with those from other experimental paradigms that show the special characteristics of cognitive processes with emotional stimuli in this type of subject. The results are discussed in the light of Botella et al.'s model.

• ATTENTION •

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**Preattentive Computation of Part Structure.** MANISH SINGH, *MIT and Rutgers University*, & YAODA XU, *MIT and Harvard University*—The objects we see are not unstructured wholes—they have further part structure. The minima rule proposes that human vision uses negative minima of curvature (points of locally highest curvature in concave regions of a shape) to define boundaries between parts. We used visual search to test whether part structures consistent with the minima rule are computed preattentively. The results of two experiments showed that whereas a shape parsed with a nonminima cut pops out among identical shapes parsed with minima cuts, the reverse search is slow and inefficient. This asymmetry is expected if parsing at negative minima occurs preattentively. Two further experiments showed that although parsed shapes (with both minima and nonminima cuts) pop out among unparsed shapes, the search for minima parsings is nevertheless significantly slower. Together, these results demonstrate that the visual system parses shapes into parts, using negative minima, and that it does so preattentively.

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**Inhibitory Processing in Neglect.** ANA B. VIVAS, *City Liberal Studies, Affiliated Institution of the University of Sheffield*, GLYN W. HUMPHREYS, *University of Birmingham*, & LUIS J. FUENTES, *University of Almeria*—In the present study, inhibitory processing of spatial attention was investigated in a group of four neglect patients with right parietal, left parietal, and right tempoparietal lesions. In a first experiment, a double-cue inhibition of return (IOR) procedure was employed. Neglect patients showed an IOR effect only when they had to detect targets that appeared in the contralesional side. In a second experiment, we combined an IOR procedure with a Stroop task (Vivas & Fuentes, 2001) to explore the neural basis of the inhibitory tagging mechanism (Fuentes, Vivas, & Humphreys, 1999). Results from the control participants replicated the reduction of the Stroop interference at the cued location reported by Vivas and Fuentes. Results from the group of neglect patients showed a reduction of the Stroop interference at the cued location only for the contralesional condition. Results are discussed in terms of neural basis of the IOR and inhibitory tagging effects.

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**Sleep Reduction and Covert Orienting of Attention.** C. CAVALLERO & F. VERSACE, *University of Trieste* (sponsored by Patrizia Tabossi)—Posner and Petersen (1990) divide attention into three subsystems performing different but interrelated functions: (1) orienting to sensory events, (2) detecting signals for focal (conscious) processing, and (3) maintaining an alert state. The relationships between orienting mechanisms and alertness are still unclear. The aim of the present study was to determine whether alerting and orienting can be seen as separate mechanisms or whether they interact to influence the response speed to targets. A classical paradigm of sleep research, sleep curtailment, has been employed in order to modulate alertness levels. Ten subjects performed a cued reaction time task at regular intervals during days, following either 8 or 3 h of uninterrupted sleep. Following sleep curtailment, only reaction times to neutrally and invalidly cued targets significantly increased. This result suggests that the mechanisms underlying orienting of attention are differentially affected by a reduction in alertness level.

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**Differences in Visual and Auditory Distractor Effects as a Function of Perceptual Load.** DONALD J. TELLINGHUISEN, EMILY M. SCHEMPER, & ERIN J. NOWAK, *Calvin College*—Lavie's (1995) perceptual load hypothesis of selective attention was tested in a visual search paradigm that included auditory and visual distractors. Subjects indicated which of two target letters was present within a circular display of similar (low load) or dissimilar (high load) nontarget letters. An irrelevant distractor that was compatible, incompatible, or neutral with respect to the target response was presented simultaneously with the onset of the relevant letters. Visual distractors were presented in the periphery, whereas auditory distractors were presented via headphones. As Lavie found, interference from incompatible visual distractors was greater for low-load than for high-load searches. Auditory distractors, however, had a greater influence on RT and error rate during high-load than during low-load searches. Possible differences in resource allocation for visual and auditory attention are discussed.

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**Regarding Time Sharing With Converging Operations.** PAMELA TSANG, *Wright State University*—The research examines the extent to which the divergent conclusions drawn from two parallel lines of research on divided attention are constrained by the exclusive methodologies used. Traditionally, the psychological refractory period (PRP) paradigm has been used almost exclusively to test the bottleneck theory, and the relative-priority manipulation has been used to test the resource theory. By adopting features of both paradigms, the present research systematically tests the impact of the priority instructions and the simultaneity of stimuli availability on the extent to which two tasks can be performed in parallel. Two discrete tasks are used, as is common in a PRP paradigm. Importantly, the two tasks share the same stimulus, with an effective 0 stimulus onset asynchrony. Unusual for a PRP paradigm is the inclusion of a procedure to induce graded performance tradeoffs. Both theories predict dual-task performance decrement, but only the resource theory predicts graded performance tradeoff and time-sharing improvements with training.

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**Evidence for a Role of Rapid Temporal Coherence in Segmenting Overlapping Patterns.** SATORU SUZUKI & MARCIA GRABOWECKY, *Northwestern University*—Objects overlap in the visual world, and the ability to segment these overlapping patterns into coherent objects is critical. We examined the potential role of temporal coherence in image segmentation. Using rapidly alternating displays, we found that stable grouping could occur within overlapping patterns on the basis of coherent temporal phase, resulting in sustained image segmentation by depth segregation, slow orientation rivalry, and apparent shimmer on one surface. Some of these segmentation mechanisms can utilize temporal phase differences as small as 20–40 msec

(beyond temporal resolution of individual frames). Our results support the idea that sustained temporal coherence of neural responses in the magno pathway plays a role in parsing overlapping patterns.

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**Attentional Selection of Briefly Presented Shape.** SATORU SUZUKI, *Northwestern University*—When an adapting shape and a test shape (backward masked) are presented briefly (e.g., 30 msec each) in a rapid succession (e.g., 200 msec ISI), shape aftereffects occur in some basic geometric dimensions (e.g., skew, taper, convexity, and aspect ratio; Suzuki & Cavanagh, *JEP:HPP*, 1998; Suzuki, ARVO, 1999 & 2000). This study evaluated the effectiveness of attention in selecting overlapping patterns under various conditions, taking advantage of the fact that these shape aftereffects are strongly modulated by selective attention under appropriate conditions. The relative contrast, the scale, and the shape of the overlapping patterns were varied. The results suggest that rapid attentional selection occurs following stages of contrast and scale normalization, but prior to the stage where opponent shape features (e.g., convex vs. concave, tall vs. flat aspect ratio) are explicitly coded.

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**Attentional Capture Explains Reading of Irrelevant Words.** JOEL LACHTER & ERIC RUTHRUFF, *NASA Ames Research Center*—Numerous studies have demonstrated that people unintentionally read distractor words presented peripherally to a central target. Last year, we argued—on the basis of the time course of priming effects—that these distractor words are not read until they capture attention. Folk, Remington, and Johnston's (1992) contingent-capture theory says distractors capture attention when they have properties that subjects are using to find the target. Here, we provide converging evidence for our previous conclusions, using a paradigm where the target is defined by color rather than by location. According to Folk et al., only the target color should capture attention: Distractors of another color should not be attended even with relatively long exposures. Indeed, we find that such distractors do not produce priming. This reinforces our conclusions that (1) words cannot be read without attention and (2) previous evidence for the reading of irrelevant words can be attributed to automatic attention capture.

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**The Interruptibility of Simple Retrievals From Long-Term Memory.** MICHAEL D. BYRNE, *Rice University*—Many simple performance parameters about human memory are not well understood. One such parameter is how the cognitive system handles interruption at a relatively low level. This research is an attempt to determine whether simple, well-practiced retrievals from long-term memory can be interrupted by a higher priority task. An experimental paradigm referred to as the “reverse PRP” is introduced, and the results of three experiments in this paradigm are reported. The results suggest that retrievals can indeed be interrupted, since the difficulty of the retrieval and the SOA between the onsets of the retrieval stimulus and the interrupting stimulus do not affect the response time to the interrupting stimulus. However, there does appear to be a time cost associated with the interruption, and frequency of interruption appears to play a role in determining that cost. Implications of these results for other paradigms will be discussed.

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**Surface-Based Attention Is Separable From Object-Based Attention.** YAODA XU & KEN NAKAYAMA, *Harvard University*—Surfaces have been shown to be important in the allocation of attention. Is the allocation of attention in this case particular to the surfaces or to the objects they bound? We presented search arrays on 16 cubes, with one test item placed on one face of each cube. In the consistent-face condition, all test items appeared on the same face of each cube (e.g., the left face), and in the mixed-face condition, test items appeared randomly on either of the two front faces (left or right). Flat

2-D shapes with three parts equivalent to the three cube faces were used in the control displays. Search was significantly slower in the mixed-face-cube than in the consistent-face-cube condition. This difference did not reach significance for the 2-D shapes. These results indicate that attention to one surface does not readily spread to another even when these surfaces belong to the same object.

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**Interference and Strategic Variability in the Double-Response Stroop Task.** MARSHA C. LOVETT, *Carnegie Mellon University*—What happens to the Stroop effect when participants are asked to respond to *both* of the stimulus dimensions? Relatively few studies have examined this double-response Stroop paradigm, and those that do offer conflicting results. A new double-response Stroop experiment was conducted to study how people combine the processes of color naming and word reading in an explicitly dual task. Results showed that participants in this task exhibit typical Stroop effects. However, the magnitude of the interference effect varied significantly across conditions with different mappings between the stimulus dimension and the response modality (e.g., say word and buttonpress color vs. say color and buttonpress word). Moreover, this double-response task revealed strategic variation between subjects that accounts for differences in the magnitude of interference in double-response blocks, as well as in separate single-response blocks. This work exemplifies how strategy-choice behaviors can modulate “low level” attentional effects.

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**Inhibition of Return Is Strategic in Nature.** TROY A. W. VISSER & ELINA BIRMINGHAM, *University of British Columbia*, WALTER F. BISCHOF, *University of Alberta*, JANICE S. SYNDER, *University of Pennsylvania*, & ALAN F. KINGSTONE, *University of British Columbia*—Detection of a target is initially faster when it is presented in the same location as a spatially nonpredictive peripheral cue. However, as cue–target interval increases, target detection becomes slower at a cued location than at an uncued location. This pattern of performance, termed inhibition-of-return (IOR), has conventionally been attributed to a process that biases attention from returning to previously searched locations. However, it is not yet known whether IOR is strategic in nature or relatively insensitive to task demands. To investigate this issue, we systematically varied the complexity of the search environment by manipulating the potential number of target locations and cue–target probability, both separately and conjointly. Our results suggest that a “smart” process that takes into account the reliability of the initial search at a cued location may determine the magnitude of IOR.

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**Disengaging Visual Attention: Location-Specific or Generalized Interrupt?** DAVID MENZER & DALE DAGENBACH, *Wake Forest University*—The characteristics of the disengage component of visual attention were examined in experiments using multiple cued locations. Two of four placeholders were initially cued using flicker, followed by either a target in one of the placeholders or two more cues and then the target. In trials with just one pair of cues, significant benefit was observed at both cued locations. On trials in which additional cues appeared, one occurred at an already cued location and one at a new location. In one experiment, in which the probability of targets' appearing in the already cued location and the new location was equal on the multiple-cued trials, benefit was equal for both locations, suggesting that disengagement was not location specific. However, in a second experiment, in which the probability of the target's appearing in the already cued location was much higher, the results indicated greater benefit for that location.

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**Simultaneous Delivery of Top-Down and Bottom-Up Information Affects How Attentional Influences Are Combined.** MARK J. FENSKE & JENNIFER A. STOLZ, *University of Waterloo*—Combining multiple top-down expectancies (e.g., stimulus form and location) in

spatial cuing studies typically produces interactive effects (e.g., larger spatial cuing effects for expected targets), even following bottom-up (exogenous) shifts of attention. In contrast, combining a single top-down expectancy with exogenous shifts of attention typically produces additive effects. It was hypothesized that having both top-down and bottom-up information delivered by a single cue would be critical in producing interactive effects of a single top-down expectancy and exogenous attention. Peripheral cues, colored to indicate likely stimulus form (A or V), elicited exogenous shifts of attention. Half of the participants judged target orientation following spatially nonpredictive (exogenous) cues, and the other half did so following spatially predictive (exogenous + location expectancy) cues. Cue–target SOA was also varied between groups. Results are described in terms of processing limitations associated with separate time courses of generating and evaluating top-down expectancies in the context of exogenous shifts of attention.

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**Oculomotor Capture Is Contingent on Attentional Control Settings.** SHU-CHIEH WU & ROGER W. REMINGTON, *NASA Ames Research Center*—Although attentional capture can be modulated by top-down control settings, experiments by Theeuwes et al. (1998, 1999) and Irwin et al. (2000) have found oculomotor capture to be stimulus driven, elicited consistently and exclusively by abrupt luminance onsets. We examined the relationship between attentional and oculomotor capture in a series of experiments that tested identical designs with either attention or saccade task requirements. The presence or absence of attentional capture largely determined the amount of oculomotor capture. In particular, color singletons produced oculomotor capture when they captured attention; oculomotor capture by abrupt onsets was greatly reduced when they did not capture attention. However, oculomotor capture could not be entirely eliminated even in the absence of attentional capture. Results from these experiments indicated coupling between attentional and oculomotor capture. Consistent with the contingent capture theory, both attentional and oculomotor capture are modulated by top-down goals.

• COGNITION •

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**Practice and Working Memory.** ULRIKE BIANGARDI & PRITI SHAH, *University of Michigan*—The ability to actively maintain and update information is a hallmark feature of working memory. This research addresses whether or not this ability can be improved through brief, focused training. A training group practiced on the four-back task, in which they were asked to judge whether a letter presented to them was identical to the one occurring four trials previously, for approximately 2 h. The trials increased in difficulty as the session progressed (self-paced, then ISI of decreasing fixed length). Participants in the training group became more accurate on the four-back task. Furthermore, these participants improved in their performance on a superficially different test of working memory, the reading span task (Daneman & Carpenter, 1980). A control group that received no practice did not improve on the four-back or on the reading span task. These results suggest that the ability to maintain and update information in working memory may be amenable to practice.

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**Models of Causation and the Semantics of Causal Verbs.** PHILLIP WOLFF & GRACE SONG, *University of Memphis*—The probabilistic contrast and the force-dynamic models of causation can both be used to distinguish three kinds of causal verbs: cause-type verbs (cause, force, make), enable-type verbs (allow, enable, let), and prevent-type verbs (block, keep, prevent). However, according to the probabilistic contrast model, prevent-type verbs should be less similar to enable-type verbs than to cause-type verbs. In contrast, according to the force-dynamic model, these three types of verbs should be roughly equally similar to each other. These predictions were tested

in three sorting experiments using sentences from the British National Corpus. In each experiment, multidimensional scaling confirmed the existence of the three predicted classes of causal verbs. Importantly, the pattern of similarities among these classes were as predicted by the force-dynamic model. The results suggest that the force-dynamic model provides a better account of how the verb “cause” and other causal verbs are used and understood in ordinary language.

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**Unconscious Perception and Reading Skill in Second-Language Readers.** SANDRA WILLIS, *California State University, Fullerton* (sponsored by Daniel Kee)—This study assessed the relationship between automatic activation of meaning, using an unconscious-priming paradigm, and reading skill in individuals with varying degrees of reading ability. Skilled native English readers and less skilled nonnative English readers completed two unconscious-priming experiments using verbal and pictorial stimuli. Measures of direct perception and an assessment of reading skill were also completed. In accordance with automaticity theory in reading skill development, differential unconscious priming for word and picture stimuli was predicted across the two groups. Results from the word and picture priming tasks indicated large automatic analysis from word and picture stimuli in skilled readers. For the nonnative English readers, automatic access of verbal information was attenuated, but intact for pictorial stimuli. More automatic analysis of word meaning occurred in the more skilled second-language readers than for the less proficient readers.

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**Mental Subtraction and Working Memory.** DONALD J. SEYLER, MARK H. ASHCRAFT, & MICHAEL KROMERL, *Cleveland State University*—We replicate and extend our earlier work on mental subtraction by testing basic facts and larger problems that require borrowing. For the basic facts, RTs, errors, and SDs increase in stair-step fashion, beginning with  $11 - n$  problems; correlations with two subjective measures of difficulty suggest heavy reliance on reconstructive strategies for these problems. Borrowing is particularly slow and error prone and is heavily dependent on working memory processing.

• PROBLEM SOLVING •

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**The Creative Costs and Benefits of Inhibition.** STEPHEN M. FIORE, *University of Central Florida*, JONATHAN W. SCHOOLER, *University of Pittsburgh*, PATRICIA A. LINVILLE, *Duke University*, & LYNN HASHER, *University of Toronto* (sponsored by Jonathan W. Schooler)—The ability to inhibit low-relevance associations is critical to effective cognitive functioning on many tasks. However, two experiments demonstrated that for certain creativity tasks, inhibitory skill can be counterproductive. In Experiment 1, the number of unique uses for objects generated in the Unusual Uses Test was negatively correlated with inhibitory ability as measured by a reading task (Connelly, Hasher, & Zacks, 1991) that sometimes required ignoring interspersed distracting material. Experiment 2 replicated this negative relationship between inhibitory ability and generating unusual uses but found the reverse pattern on the Remote Associates Test that required generating a single associate (e.g., *salt*) to three words (e.g., *lick*, *sprinkle*, *mine*). These findings suggest a complex relationship between creativity and inhibition, whereby inhibition enhances the focus necessary to solve problems that require a single solution, while reducing the generative fluency that is valuable for tasks that have numerous potential solutions involving low-frequency associations.

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**Discovery, Representational Redescription, and Strategy Transfer.** MATTHEW DOHN & JAMES A. DIXON, *College of William & Mary*—A central question in problem solving is how people transfer strategies to new problems. Past research has shown that strategy transfer is strongly affected by surface similarity—the degree to which

prior and current problems share semantic features. The present study tested the hypothesis that an abstract representation of a strategy would facilitate transfer. When new strategies are discovered via representational redescription, an abstract representation of the strategy is created (Karmiloff-Smith, 1992). Participants first solved a series of balance-beam problems. Half the participants were explicitly taught an efficient strategy for solving the problem. The remaining students were allowed to discover the strategy. Both groups were then given a series of gear system problems. Participants in the discovery condition transferred the strategy to the gear problems more quickly. The results show that discovery via representational redescription creates highly transferrable representations. Implications for analogical transfer and problem solving are discussed.

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**Individual Differences in Fraction Problem Solving.** STEVEN A. HECHT, *Florida Atlantic University*—The unique associations between mathematical knowledge and working memory and individual differences in elementary, high school, and college students' fraction problem solving were examined. Conceptual knowledge of part-whole and measurement interpretations of fractions were assessed. Component processes of simple arithmetic knowledge were indexed by measuring speed, accuracy, and strategy usage while solving single-digit equations (e.g.,  $4 + 2 =$ ). Working memory capacity was estimated via the counting span task. Unique associations were found between the mathematical knowledge and working memory predictors and three kinds of fraction problem solving outcomes (i.e., estimation, word problem solving, and computation). Results were explained in terms of providing new necessary evidence toward an information-processing account of variability in fraction problem solving.

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**Creative Problem Solving in Artists.** AARON KOZBELT & TOM TRABASSO, *University of Chicago*—This study examined the relation between artists' problem-solving strategies and their final products' quality. Twenty-four college art students were videotaped as they each created 3 original drawings (1 h each) from an array of objects. Artists and nonartists reliably rated the drawings' quality. Videotapes were coded for artists' primary activities and subgoals throughout each session. Problem-solving strategies in drawing sessions leading to the 12 highest and lowest quality drawings differed. In sessions leading to high-quality drawings, artists spent proportionally more time selecting drawing media and objects (especially after drawing began), rejected more objects they had handled from inclusion in the drawing, engaged in more coded segments of activity, and developed the composition in a part-to-whole manner, with later appearance of the last major element. These results suggest that more opportunistic strategies in the process of creation are associated with higher product quality.

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**Spatial Imagery in Solving Problems in Physics.** MARIA KOZHEVNIKOV, *Rutgers University*, & MARY HEGARTY, *University of California, Santa Barbara*—In this study, we investigated the role of spatial imagery in solving problems in physics. Specifically, we examined the differences in problem-solving strategies used by high- and low-spatial students while solving problems in kinematics. Sixty undergraduate psychology students, who had not taken any physics courses, were administered spatial visualization ability tests, as well as a kinematics problem-solving questionnaire. Also, 17 students (8 with high and 9 with low spatial visualization ability) were selected for individual interviews, during which they were asked to solve kinematics problems of different types and report on their strategies. The results of statistical and protocol analyses showed consistent differences between problem-solving strategies of low- and high-spatial students for problems involving predicting complex two-dimensional motion of an object, the transition from one system of reference to another, as well as kinematics graph interpretation.

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**When the Presence of Males Causes Females to Experience Problem-Solving Deficits.** TALIA BEN-ZEEV, *San Francisco State University*, MICHAEL INZLICHT, *Brown University*, & STEVEN FEIN, *Williams College*—Placing females in environments in which they have contact with males causes them to experience deficits in problem-solving performance. In one study, participants completed a difficult math or verbal test in 3-person groups, which consisted of 2 people of the same sex as the participant (same-sex condition) or of the opposite sex (minority condition). Females in the minority condition experienced performance deficits on the math test only, whereas males performed equally well on the math and the verbal tests in both conditions. Even females who were placed in a mixed-sex majority condition (2 females and 1 male) experienced moderate but significant deficits. Similar findings from multiple studies are discussed in relation to theories of stereotype threat and arousal and their implications for problem solving.

• HUMAN LEARNING/MEMORY •

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**Processing Strategies and the Generation Effect: Implications for How to Make a Better Reader.** PATRICIA DEWINSTANLEY, *Oberlin College*, & ELIZABETH LIGON BJORK, *UCLA*—Several experiments explored whether the oft-found memory advantage for generated information extends to textbook materials and whether any such advantage would come at a memory cost for to-be-learned materials that were not generated. Results revealed a clear generation advantage without a concurrent cost for nongenerated items. Additionally, it was found that participants—given the opportunity both to generate and to observe the consequent memorial advantage for generated versus read items—were able to profit from that experience when processing subsequent to-be-read information. How these results relate to the characterization of the learner emerging from recent metacognitive research on how individuals monitor their comprehension during study and how this monitoring influences their allocation of learning resources is discussed. Although consistent with the notion that learners are insensitive to many variables that improve long-term retention and transfer, the present results provide promising insights into how learners can be made to process information more effectively.

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**Role of Environmental Reference Systems in Human Spatial Memory.** STEFFEN WERNER, *University of Idaho*—The accessibility of spatial knowledge depends on the way spatial information is structured in memory. Learning spatial information from maps or small-scale representations often leads to orientation-specific spatial knowledge that can be accessed best from headings aligned with the original orientation or viewpoint. This focus on the perceptual experience during knowledge acquisition in previous studies largely ignores the role of intrinsic geometrical properties of the spatial environment to be learned. In recent studies, the importance of such environmental reference systems on the accessibility of spatial knowledge has been demonstrated. In the present series of experiments, the accessibility of spatial knowledge was tested for different geometrical layouts of natural and virtual environments. The results show a marked increase in the availability of spatial knowledge for headings that are aligned with salient geometrical axes of the environment, emphasizing the important role of environmental reference systems in human spatial memory.

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**Tactile and Visual Sequential Learning.** CHRISTOPHER M. CONWAY & MORTEN H. CHRISTIANSEN, *Cornell University*—Sequential learning, characterized by sensitivity to the statistical structure of temporally ordered elements, has been demonstrated in both visual and auditory domains. We tested whether sequential learning is possible via the touch sense. Participants were engaged in a tactile artificial grammar learning experiment, using sequences of vibration pulses de-

livered to the fingers. After exposure to a training set of vibration sequences, an experimental group was tested on their ability to classify novel test sequences in terms of whether or not they were constructed by the same “rules” used to generate the training sequences. The experimental group was significantly better at this classification task than a no-training control group, which performed at chance. The data suggest that the experimental group encoded aspects of the statistical/sequential regularities of the tactile sequences. In addition, we conducted an analogue of this experiment in the visual modality in order to compare performances between touch and vision.

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**The Transferability of “Reversible Skills.”** MEIRA TORENBORG, BLYTHE SILBERMAN, & MITCHELL RABINOWITZ, *Fordham University*—The reversibility of skills has been examined in numerous contexts to determine the relationship between two associated skills. In this experiment, the reversibility of reading and writing Hebrew letters was examined. The assumption under investigation was whether the naming of letters facilitates the acquisition of the writing of letters and vice versa. Graduate students with no prior knowledge in Hebrew participated in the study. During a learning phase, subjects practiced naming or writing or naming and writing 12 Hebrew letters. Upon completion of the learning phase, subjects were tested on naming and writing the letters. Findings indicate reversibility in one direction only. Learning to write letters facilitated the ability to name letters, but learning to name letters did not facilitate the ability to write the letters. Implications for models of skill acquisition will be discussed.

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**Do Mnemonics Leave Us Stuck in Nonoptimal Retrieval Pathways?** TIMOTHY C. RICKARD, *University of California, San Diego*—The question of whether mnemonic mediation is replaced by a direct stimulus–response pathway after sufficient practice is central to research on memory-based skill and automaticity, and its resolution can inform efforts to find optimal teaching strategies for topics such as arithmetic and word reading. In a study of the keyword method of foreign vocabulary learning, Crutcher and Ericsson (2000) showed that if the keyword is associated with an English distractor word after subjects have stopped reporting keyword mediation, subsequent RTs for the correct English translation are slowed. They concluded that the English distractor interfered with continued keyword mediation at an unconscious, or automatized, level. However, their interference effect may depend on the fact that the keyword is a phonological subset of the foreign word. Preliminary results using a task that does not share this property indicate no distractor interference, supporting the alternative direct access account.

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**Personalized Semantics: Autobiographical Memory Influences Lexical and Semantic Knowledge as Evidenced in Healthy Controls and Neurological Patients.** ROBYN WESTMACOTT & MORRIS MOSCOVITCH, *University of Toronto and Rotman Research Institute*, SANDRA BLACK, *Sunnybrook & Women’s Hospital and Rotman Research Institute*, & MORRIS FREEDMAN, *Baycrest Hospital and Rotman Research Institute*—We examined the influence of autobiographical significance of famous names on episodic memory and general semantic knowledge in healthy controls and neurological patients, using an adaptation of the remember/know paradigm. Controls provided norms for the study by making remember/know judgments and rating the familiarity of 200 famous names from the 20th century. Twenty-five *high-remember* and 25 *low-remember* names, matched on familiarity and length, were selected for tests of free recall, delayed recognition, speeded reading, and fame judgment. Across all tasks, controls showed an advantage for high-remember names. This advantage was absent in patients with autobiographical memory loss due to medial temporal damage, but it was present in patients with progressive semantic memory loss but relatively spared medial temporal lobes and autobiographical memory. Our results suggest that lexical

and semantic knowledge are influenced by “personalized semantics,” a subclass of autobiographical memory that depends on the medial temporal lobes.

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**Individual Variations in Brain Regions Contributing to Recognition Task.** MICHAEL B. MILLER, *University of Massachusetts, Boston*, & JACK VAN HORN, GEORGE WOLFORD, TODD HANDY, SCOTT GRAFTON, & MICHAEL GAZZANIGA, *Dartmouth College*—Neuroimaging studies often rely on analyses that seek common activations across subjects. Yet individuals produce very different patterns of activation that are associated with the same task. We have shown that patterns of significant activations at the group level associated with a simple recognition task are very distinct from patterns of significant activations in many individuals. These differences go beyond the relatively small variations due to spatial normalization. For example, some subjects produce more activation in the parietal lobes than in the frontal lobes during a recognition task, whereas many other subjects produce just the opposite. Some subjects produce more activation in the left hemisphere, whereas others produce more activation in the right hemisphere. Furthermore, we have found that these individual patterns of activation are consistent across time. Critical brain regions with large variations in activity may be neglected in many neuroimaging studies relying on group analysis.

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**Is the Self-Reference Effect Due to the Multidimensional Property of the Self?** TAKASHI HORIUCHI, *Tokai Women’s College*—The cognitive dimensions of the self play an important role in the self-referent judgment. In this study, the hypothesis was investigated that richer information processing in the self-referent judgment (six dimensions) than in the semantic judgment (one dimension) or in the other-referent judgment (three dimensions) causes the self-reference effect. In Experiment 1, both the self-reference condition and the six-dimension processing condition produced better recall performance than did the semantic condition. However, there was no difference in the former two conditions. In Experiment 2, both the three-dimension processing condition and the other-reference (mother) condition produced the same recall performance. However, the former two conditions were inferior to the self-reference condition. These results suggest that the self-reference effect is due to the multidimensional property of the self.

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**Can the Magnitude of Mood Congruent Effects Be Predicted by Personality?** DAWN MACAULAY & ERIC EICH, *University of British Columbia*—Materials that match current mood in emotional valence tend to receive enhanced processing. Though there is agreement that these mood congruent (MC) effects are robust, little attention has been paid to differences between tasks or individuals. Prior research points to some variability in MC effects across subjects, variability that we suspected might be accounted for by personality differences. One hundred participants completed personality questionnaires and performed a battery of four tasks designed to elicit MC effects. Subjects performed the tasks on two occasions a few days apart, after experiencing mood manipulations to produce pleasant or unpleasant moods. Within-subjects comparisons revealed significant MC effects for each task, but little correlation across tasks. Regression analyses showed that different personality factors aided in predicting the MC effect for each task. Discussion centers on the importance of these results for understanding mood and memory relations and suggestions for future research.

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**Prospective Memory and Working Memory Capacity.** HEE-KYEONG PARK & JUNG-MO LEE, *Sung Kyun Kwan University*—It has been proposed that the performance of prospective memory might be affected by individual differences in working memory capacity. The purpose of the present study is to examine the relationship

between prospective memory and the individual differences in working memory capacity. In general, participants performed quite well on prospective memory tasks. However, the performance of prospective memory was not related to the performance of retrospective memory, in either a word task or a picture task, although picture superiority effects were observed in retrospective memory. The results of this study also showed that working memory capacity did not have a significant correlation with the performance of prospective memory. The results have implications for prior research on self-initiating process and the relationship between working memory and prospective memory.

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**How Long Does It Take to Master 1,000 Words in a Second Language Perfectly?** TAKAFUMI TERASAWA, *Okayama University*, TETSUYA YOSHIDA & NOBUO OHTA, *University of Tsukuba*, MIWA KAJIKAMI, *Okayama University*, & YUKO IWAI & SHIGERU KOYAMA, *Namiki High School, Tsukuba*—We are conducting a long-term learning study on second-language acquisition, using a new experimental design. It enables researchers to obtain exact data for vast amounts of study contents covering long study periods. Additionally, it inserts a long interval (over 1 month) between studies and tests and measures substantial or implicit lexical ability for the words in the second language. A 6-month learning study was conducted, in which the number and the density of study repetitions were controlled, with a 1-month study–test interval in all study conditions. The data analysis showed that the effects of even slight word learning were accumulated unconsciously. Furthermore, it provided detailed predictions about how long it would take for each learner to master 1,000 words in a second language

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**Directed Forgetting of False Memories: Comparing Implicit Associate Responses and Fuzzy-Trace Theory.** TAMMY A. MARCHE, *University of Saskatchewan*, & CHARLES J. BRAINERD & VALERIE F. REYNA, *University of Arizona* (sponsored by Valerie F. Reyna)—The implicit associate response (IAR) account of false memory in the Deese–Roediger–McDermott (DRM) task posits that false recognition and false recall occur because these words come to mind during the study phase as implicit verbal associations of some of the presented words. Fuzzy-trace theory (FTT) posits that very strong gist traces are stored when lists repeatedly cue the same meanings and that those memories generate false recognition and false recall of critical unrepresented words. IAR and FTT make different predictions about the effects of directed forgetting in the DRM task. IAR predicts that directed forgetting should affect false responses more than true responses, whereas FTT makes the opposite prediction. Participants studied six DRM lists, with half the lists being followed by a forget cue. The forget cue suppressed true recall and true recognition of presented words, but it did not suppress either false recall or false recognition.

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**Influence of Orienting Task on the Facilitative Effect of Bizarreness.** JAMES B. WORTHEN & JEFFREY J. STARNES, *Southeastern Louisiana University*—Previous research has demonstrated that bizarreness can enhance recall of fragments of target stimuli. However, it has yet to be determined whether the facilitative effect of bizarreness is mainly the result of an encoding or a retrieval process. In our study, participants were presented with bizarre and common sentences and were asked to rate either the vividness of spontaneous imagery induced by each sentence or the surprisingness of each sentence. At recall, participants were instructed to use either semantic or orthographic cues to guide retrieval. The results indicated that orienting task interacted with sentence type such that a bizarre recall advantage was found only in the vividness-rating condition. Although the results indicated that semantic retrieval led to greater recall than did orthographic retrieval, the bizarre recall advantage was essentially equal in each retrieval condition. It is concluded that further research investigating encoding explanations of the facilitative effects of bizarreness is warranted.

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**Chunking Effects and Errors Contradict Phonological Loop and Capacity-Based Memory Theories.** CHRISTOPHER B. HADLEY & DONALD G. MACKAY, *UCLA*—Two experiments examined errors and effects of chunking in immediate recall of lists by young and older adults. The 6- to 10-word lists were presented at three rates (70, 90, and 2,000 msec/word), and half contained familiar 2-word chunks (e.g., *night time*) in addition to unrelated words. Error analyses indicated significant proportions of semantically related word-insertions even at fast rates, contradicting the purely phonological account of phonological loop theories. In addition, words in 2-word chunks were better recalled than identical words in unrelated lists, but fewer chunks were recalled overall for lists containing versus not containing 2-word chunks, and recall of identical extraneous words (i.e., unrelated words not part of chunks) was equivalent in the two list types at above-span levels. These results contradicted chunk-based capacity theories that predict (1) better recall of extraneous words in lists containing versus not containing 2-word chunks and (2) constant overall capacity for chunk recall at above-span levels.

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**Comparing Memory Characteristics of Real, Imagined, and Fictional Events.** RUTHANNA R. GORDON & NANCY J. FRANKLIN, *SUNY, Stony Brook*—The source-monitoring framework describes how people differentiate memories of internal, imaginary events and external, real events. Fictional media provide experiences that are external but imaginary. Our study examined how the source-monitoring framework might apply to memory for such experiences. Following Johnson, Foley, Suengas, and Raye (1988), we presented participants with Memory Characteristics Questionnaires for external, internal, and fictional events. Memories for fiction had some similarity to both internally and externally generated events. Memories for prose fiction tended to more closely resemble internally generated memories, whereas memories for film depictions more closely resembled externally generated memories. When differences appeared, fictional memories were generally rated as less rich than other types of memories. However, film depictions were rated more highly than either externally or internally generated memories on overall memory clarity and vividness and on levels of visual and auditory detail, characteristics generally considered diagnostic of memories for “real” events.

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**The Effect of Feedback at Test on Eyewitness Memory.** SHELBY K. MORITA, *Wells Fargo Consumer Learning Center*, & SEAN M. LANE, *Exponent, Inc.*—Numerous studies (e.g., Zaragoza & Lane, 1994) have demonstrated that the accuracy of eyewitness reports can be compromised by exposure to misleading postevent information. For both theoretical and practical reasons, there is interest in developing techniques that reduce the deleterious effects of misinformation. The present study examined the effect of receiving feedback at the time of test on eyewitness suggestibility. All participants watched a videotaped crime and then answered questions that contained misleading information. On a final source memory test, participants who were provided with feedback as to the accuracy of their attributions during the first part of the test made significantly fewer source misattribution errors on the second part of the test than did participants who never received feedback. This manipulation did not affect participants’ accuracy on video items. The relevancy of these findings for real-life witnesses is discussed.

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**Directed Forgetting: Evidence Against a Suppression Mechanism.** DANIEL R. KIMBALL & JANET METCALFE, *Columbia University*—We tested the prevailing account of directed forgetting—that people intentionally suppress episodic access to an entire to-be-forgotten word list—against the theory that they rehearse the to-be-forgotten words less. Participants studied two lists, separated by an instruction to forget or remember List 1. After studying List 2, all participants re-

called List 1. Lists contained both intentionally and incidentally learned words, as in Geiselman, Bjork, and Fishman (1983). Because incidental items presumably are not rehearsed, the differential rehearsal theory predicts a directed forgetting effect for intentional-item recall only. The suppression theory predicts an effect for both intentional and incidental items—as Geiselman et al. found. Unlike that study, however, we minimized opportunities to create and use associations of intentional and incidental items to aid recall. Results showed greater intentional-item recall in the remember than in the forget condition, but no such difference for incidental items—supporting the differential rehearsal account, not the suppression account.

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**Applying the Recollect/Know Procedure to Adult Recollections of Childhood.** KRISTI S. MULTHAUP, JONATHAN TETIRICK, & MELISSA JOHNSON, *Davidson College*—Adult autobiographical recollections typically involve a striking lack of events that occurred in a person's first few years of life (childhood amnesia). We used a modified version of Bruce, Dolan, and Phillips-Grant's (2000) procedure to gain an estimate of when early memories move from facts that may be known about oneself, although not personally remembered (childhood amnesia), to personal recollections of the events' having happened. Participants completed a recollect/know task for childhood events that typically occur before age 8. Participants also rated their age when the event happened and completed a confidence rating on their age estimate. The results indicate that a shift from know to recollect memories occurs, on average, around the age of 4.6 years. This estimate agrees closely with previous estimates with different methodology. Our modified method may be particularly useful when testing a variety of non-college-student populations and for large sample sizes.

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**The Impact of Encoding and Retrieval Schemas on Source Decisions.** JASON L. HICKS, *Louisiana State University*—Recent work has demonstrated that semantic knowledge and schemas greatly affect memory for the source of past experiences. Two experiments manipulated when information concerning the professions of two sources became available to participants. Each source presented information consistent with his profession and with the other source's profession. Participants in a control condition never learned of the sources' professions, those in a second condition learned about the professions only just before the source test, and those in a third condition knew the professions before encoding. The second condition revealed biased source attributions due to the profession schemas, but only as they affected source decision criteria. Although participants in the third condition had the identical profession schema available at encoding, that condition did not demonstrate biased source attributions but, rather, better overall source memory. Experiment 2 demonstrated that the decision bias found for the second condition reflected both increased guessing and increased high-confidence responses, as opposed to only increased guessing.

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**False Memories in Semantically, Graphemically, and Phonemically Related Chinese Words.** WEN-CHI CHIANG & YUH-SHIOW LEE, *National Chung-Cheng University*—This study examined the effects of different lexical features on creating false memories for words. Lists of single-character Chinese words were used as learning materials in the Deese/Roediger-McDermott task. The lexical properties of Chinese characters enabled the construction of four types of lists within which the words were similar exclusively in semantics (S), graphemes (G), phonemes (P), or both semantics and graphemes (SG). False recognition was found for all the four types of study lists, but the effects differed (SG>S>G>P), and those for the SG and P lists differed significantly. In another study condition, the participants were required to count backwards at the study phase. False recognition was again found, but the effects varied in a slightly different order (S>SG>G>P).

The overall false recognition rates were significantly larger for this condition than for the no-counting condition, and no interaction was found between the study condition and the types of study lists.

• **RECOGNITION MEMORY** •

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**ROC Analyses for Recognition Judgments With Different Kinds of Related Lures.** JOHN A. REEDER & CAREN M. ROTELLO, *University of Massachusetts, Amherst*, & NEIL A. MACMILLAN, *Brooklyn College, CUNY*—Participants discriminated previously studied words both from unrelated new words and from lures that were related in one of four ways: by close association, synonymy, antonymy, or singular/plural change. Receiver-operating characteristics (ROCs) for old-unrelated recognition were curvilinear in probability space and linear in  $z$ -space, consistent with a signal detection model in which judgments are based on the familiarity of test items. ROCs for related lures varied in shape according to the type of relation: Associate and synonym ROCs were curvilinear in probability space and linear in  $z$ -space, but antonym and singular/plural ROCs were more nearly linear in probability space and curved upward in  $z$ -space. These latter curves are consistent with models that include a threshold component. The overall pattern of results implies that the form of representation underlying recognition depends on the relation between studied items and lures.

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**Testing the Source-Monitoring Framework and Misattribution of Familiarity Accounts of False Memories Produced by Imagination.** DAVID G. PAYNE & TALIT DITMAN, *SUNY, Binghamton*—Past research has shown that repeatedly imagining an event that never took place leads to an increased probability to falsely believe that this event occurred, termed the imagination inflation effect. Source-monitoring framework (Johnson, Hashtroudi, & Lindsay, 1993) and misattribution of familiarity (e.g., Jacoby, Kelley, & Dywan, 1989) are two accounts that have been used to explain this phenomenon. In order to test between these two theories, pairs of participants performed, imagined, or heard descriptions of actions. Participants later imagined or heard these and other items zero, two, or four times. Participants then returned for a third session 1 week, 2 weeks, or 4 weeks later to identify how the tasks were presented in the first session. Results showed that the imagination inflation effect was greater at longer retention intervals when tasks were imagined or heard, supporting a misattribution of familiarity account of the phenomenon.

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**Recognition Memory and Aging: Recollective Processes.** LEAH L. LIGHT, *Pitzer College*, & MICHAEL R. HEALY, *Claremont Graduate University*—Contemporary theories of recognition memory posit two mechanisms, one based on familiarity or activation and one based on more recall-like recollection processes. The latter can take the form of recall to accept a previously studied item or recall to reject an unstudied lure. Recollective processes are thought to play a greater role in associative recognition than in item recognition. Recollective processes, unlike familiarity processes, are also thought to be age sensitive. We report research designed to examine recollective processes in associative recognition memory in young and older adults. Young and older adults studied lists of paired associates and were tested on intact, rearranged, and new pairs, with instructions to respond "old" only for intact pairs. Test instructions either did or did not urge use of a recall-to-reject strategy. Interest centers on issues related to conditions under which older adults do or do not use recall-like process in associative recognition.

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**Frequency Effects in Recognition Memory: Evidence for a Multi-process Detection Model?** DAVID G. SMITH & MARTY W. NIEWIADOMSKI, *University of Toronto*—The frequency-based mirror effect

refers to the fact that subjects make fewer hits and more false alarms to high-frequency words than to low-frequency words. Current evidence suggests that the effect is based in the fact that high- and low-frequency words are processed using two different types of mnemonic information: one called “familiarity,” and the other called “recollection.” We demonstrate that the false alarm component of the mirror effect can be manipulated by presenting a pure list of either high- or low-frequency words. Our result can be interpreted by assuming that a pure list of words makes the subject rely on one or the other memory process. We argue that our findings, as well as others in the literature, can be best understood in terms of a multiprocess detection model of memory.

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**Recency Effects in Recognition Memory Show Scale Invariance: Evidence From the Continuous-Distractor Paradigm.** YONATAN GOSHEN-GOTTSTEIN & DEBBIE TALMI, *Tel-Aviv University*—In recall, recency effects have been documented when memory was tested immediately after list presentation (i.e., free recall) and in the continuous-distractor task, where each item in the study list was followed by distractor activity and memory was tested after a long retention interval. Our experiments compared single-probe-recognition immediately after list presentation (i.e., immediate recognition) with recognition after a long retention interval when each item in the study list was followed by distractor activity. Reaction times showed comparable recency effects in both tasks, using lists of six or nine words. This provides the first documentation of scale invariance in recognition memory. We discuss the implications of this finding for models of recognition memory and for understanding the nature of recency effects.

• REPETITION/PRIMING EFFECTS •

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**The Influence of Verbal Ability on Mediated Priming.** KAY LIVESAY, *University of San Francisco*—Mediated priming (MP) is a reliable effect, but one that is sensitive to a range of experimental conditions (Balota & Lorch, 1986; Livesay & Burgess 1997, 1998). Livesay and Burgess have found differences among MP stimuli that contribute to the fragility of the MP effect. The present experiment investigated the influence of individual differences in verbal ability on MP. It was found that low-verbal-ability participants were not sensitive to the MP effect, whereas the high-verbal-ability participants showed robust MP. These results raise problems for localist representations of semantic memory, because the spread of activation is considered to occur quickly and automatically. Furthermore, sensitivity to the MP effect for low- and high-verbal-ability participants was influenced by the length of prime duration. These results suggest a view of MP that is consistent with a distributed representational view of semantic memory.

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**Components of Priming in Category Exemplar Generation.** WENDY S. FRANCIS, *University of Texas, El Paso*—Repetition priming in category exemplar generation is typically considered to be a measure of conceptual implicit memory. However, the attenuation of priming across languages and the existence of priming following non-conceptual encoding tasks suggest that it may also depend on increased accessibility of the phonology of the target exemplars. Contributions of conceptual and nonconceptual influences on priming magnitude were assessed by manipulating factorially encoding tasks meant to elicit relevant conceptual processing or relevant phonological processing. Ninety-six Spanish–English bilinguals showed substantial priming across languages and substantial priming from a shallow encoding task within languages. These priming effects were attenuated relative to priming observed after performing both tasks or after performing a deep encoding task within languages. The independence of conceptual and nonconceptual influences on priming magnitude was assessed using both the standard approach (ANOVA) and multiplicative approaches that take into account the linear nonadditivity of proportions.

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**Nonword Repetition in Lexical Decision: Evidence for Two Opposing Processes.** RENÉ ZEELENBERG & ERIC-JAN WAGENMAKERS, *University of Amsterdam*, MARK STEYVERS & RICHARD M. SHIFFRIN, *Indiana University*, & JEROEN G. W. RAAIJMAKERS, *University of Amsterdam*—Many studies have shown that repetition enhances performance for words in lexical decision. The results for repeated nonwords have been inconsistent. We tested the hypothesis that repetition priming for nonwords in lexical decision is the net result of two opposing processes: (1) a facilitatory process based on the retrieval of specific episodes and (2) an inhibitory process based on global familiarity. In four experiments, we manipulated speed–stress to influence the balance between these two processes. Experiment 1 showed improvement for repeated nonwords in a subject-paced lexical decision task. Experiments 2 and 3 used 500- and 400-msec deadline procedures, respectively, and showed no effect of repetition for nonwords. In Experiment 4, we used a signal-to-respond procedure with variable time intervals and found negative repetition priming for repeated nonwords. These results indicate that a complete account of lexical decision requires two opposing processes.

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**Repetition Priming of Spontaneous and Prompted Identification of Familiar Faces.** R. A. JOHNSTON, *University of Birmingham*—Two experiments examined repetition priming of spontaneous and prompted identification of familiar faces. Experiment 1 found face familiarity decisions were made faster if the face had been identified in the pretraining stage. Priming was not demonstrated if the face had not been recognized. If faces were not recognized spontaneously, being prompted to their identity by the experimenter did not yield priming at test. This supports previous work using face familiarity decisions (Brunas-Wagstaff et al., 1992; Johnston et al., 1996). Experiment 2 used the identical set of stimuli but required subjects to make a categorization decision (e.g., whether a person is an actor). Again, priming was demonstrated for faces identified spontaneously and was absent for faces that were not recognized. However, for the categorization task, faces that had only been recognized after prompting during the pretraining stage did show priming at test. These findings are used to develop existing models of face recognition.

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**Unbiased Benefits and Deficits in Short-Term Repetition Priming.** DAVID E. HUBER & RANDALL C. O'REILLY, *University of Colorado, Boulder*—Huber, Shiffrin, Lyle, and Ruys (2001) used a perceptual identification 2-AFC testing procedure that allows for an unbiased estimate of priming and found that short-term repetition priming resulted in performance deficits. They explained this result with a mathematical theory, ROUSE, in which there is source confusion between prime presentations and target presentations. With equally primed choice words, variability in this source confusion results in performance deficits. Using signal detection theory in a perceptual identification paradigm that tests with a single word, Hochhaus and Johnston (1996) likewise found unbiased sensitivity deficits with repetition priming. In the reported repetition priming studies, we adopted their single test word procedure and manipulated the manner in which primes were presented and the similarity of the presented words. In certain conditions, contrary to prior results, unbiased performance benefits were observed. Theoretical mechanisms giving rise to such “perceptual” benefits are discussed.

• IMPLICIT MEMORY •

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**Attentional Effects of Stroop Encoding on Perceptual Priming.** STEPHANIE V. TRAVERS & SUPARNA RAJARAM, *SUNY, Stony Brook*—Generally, perceptual priming is impervious to attentional manipulations at study. Recent findings, including data we presented at a previous meeting, have demonstrated reduction in perceptual

priming resulting from specific attentional manipulations. When participants encode words in a Stroop color-naming task, priming for these words, although significant, is reduced relative to words that were read. In the present series of experiments, we examined the source of this reduction in priming. Participants encoded words twice, where the second presentation required reading the word or naming the color of the word. Subsequently, participants performed stem completion priming or stem cued recall tasks. Once again, we observed reduced priming for words in the Stroop condition. We will discuss these findings, as well as observed repetition effects, within the context of our following hypothesis: Reduction in priming occurs because the requirement to name the color results in the deselection of automatically processed words.

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**Semantic Context Effects and Priming in Free Association.** DIANE PECHER, *Utrecht University*, RENÉ ZEELENBERG, *University of Amsterdam*, RICHARD M. SHIFFRIN, *Indiana University*, & JEROEN G. W. RAAIJMAKERS, *University of Amsterdam*—The present study investigated priming in free association, an implicit memory task. During study, target words were presented in sentences that biased their interpretation. In Experiment 1, the target words were ambiguous (ORGAN); in Experiment 2, they were not (SNOW). The meaning of the target word emphasized by the study sentence (music, temperature) was either congruent (PIANO, COLD) or incongruent (KIDNEY, WHITE), with the cue word presented in the later free-association test. More priming was obtained for targets presented in the congruent study condition than for targets in the incongruent study condition. These results cannot be explained by an account that attributes priming in free association to the strengthening of target responses. Instead, we argue that priming depends on the storage of information relating the cue and the target.

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**A Test of Conscious Involuntary Memory as a Distinct Process.** CHRISTY ENGLAND-SIEGERDT & DAWN M. McBRIDE, *Illinois State University*—Richardson-Klavehn and Gardiner (1996) found evidence for a memory process they called conscious involuntary memory, using an on-line awareness measure. In the present study, Richardson-Klavehn and Gardiner's methodology was used to validate conscious involuntary memory as a distinct memory process through multinomial model fits. Participants studied items with three level-of-processing tasks and then completed a word-stem completion task under either intentional or incidental test instructions. Results from multinomial model fits support the conclusion that conscious involuntary memory is a process that can be successfully distinguished from conscious voluntary memory. These results indicate that in addition to intentional and automatic memory, unintentional awareness of a study episode may contribute to implicit and explicit memory task performance and should be considered when conscious and automatic memory processes are estimated for such tasks.

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**The Isolation Effect on an Implicit Category Verification Test.** LISA GERACI, *Washington University*, & SUPARNA RAJARAM, *SUNY, Stony Brook* (sponsored by Suparna Rajaram)—The distinctiveness effect (better memory for distinct than common items) is typically observed on explicit but not implicit tests (Smith & Hunt, 2000). We sought to test whether (1) the distinctiveness effect depends uniquely on conscious recollection or (2) it could emerge with recapitulation of the type of processing that occurred at study even in the absence of recollection at test. To do this, we used a classic isolation paradigm. Participants studied lists that contained categorically isolated items. At test, they were given explicit and implicit tests of category verification designed to recapitulate evaluative processing carried out at study. We found better recognition in the explicit test and faster reaction times in the implicit test for the isolated items relative to the non-isolated items. These results suggest that distinctiveness can influence

memory without conscious awareness as long as the implicit test recapitulates the specific evaluative processing engaged in at study.

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**Conceptually Driven Processes in Word-Stem Completion Tests.** TERRENCE M. BARNHARDT, *Texas A&M University*—Barnhardt (submitted) reported a double dissociation between priming effects and levels-of-processing (LOP) effects in word-stem completion. Priming, but not LOP effects, depended on intertrial interval at test, the number of solutions for the stems, and the level of subjects' test awareness (as measured by a posttest questionnaire). On the other hand, LOP effects, but not priming, depended on the word frequency of the nontarget solutions for the stems. An attempt in the present experiments to extend these results met with limited success. Priming, but not the LOP effect, depended on the number of solutions, as in Barnhardt. However, both priming and LOP effects were dependent on awareness, and neither was dependent on either nontarget frequency or target frequency. In addition to these findings, two experiments are reported that further establish the posttest questionnaire as a viable method for assessing subjects' awareness during the stem completion test.

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**Voice Specificity Effects in Second-Language Acquisition: Episodic Versus Dualist.** MIN JU & BARBARA CHURCH, *SUNY, Buffalo*—A series of experiments were conducted investigating the voice specificity of long-term auditory word priming at different points in second-language acquisition. To clarify the nature of the representations underlying auditory priming in word identification, the experiments examine priming for Spanish words in native English speakers with different degrees of exposure. Two theories (episodic/dualist) make different predictions about sensitivity to voice changes at different points of learning. In episodic theory, all encountered episodes of a word are stored and used for word identification; thus, early learners will show greater voice specificity effects, since they have stored fewer episodes. In dualist theory, voice specificity arises from the memory binding of specific acoustic instances and abstracted phonological representations used for word identification; thus, no difference should be observed across groups in the magnitude of voice specificity effects. Results are consistent with dualist theory. Actually, advanced learners seem to show slightly more sensitivity.

• LETTER/WORD PROCESSING •

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**Early Vowel-Consonant Associations in Word Identification.** DANIEL A. GAJEWSKI, *Michigan State University*, & STUART E. BERNSTEIN, *Middle Tennessee State University*—We report the third in a series of experiments that explore whether the predictive role of final consonants in the pronunciation of vowels results in a special association between these units when encoding monosyllabic words. A backward masking task was used to compare the benefit of preserving rimes or heads while masking the remaining letters. Masks that preserved the rimes of words (blunt-STUNT) resulted in significantly higher accuracy than did control items (blunt-STALL) whereas masks that preserved the heads of words (stuff-STUCK) resulted in no difference, as compared with control items (stuff-BRICK). The rime effect was equally strong for regular vowels (disk-RISK) and for cases in which the final consonant disambiguates an otherwise irregular vowel (yard-CARD). Results suggest that all vowels become associated with the consonants that follow them during the initial encoding of the stimulus. Results are compared with previously reported work using sublexical repetition blindness, and measurement issues are discussed.

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**A Spatial Model of the Phonological and Semantic Representations Involved in Printed Word Recognition.** AÏCHA ROUIBAH & SABINE PLOUX, *ISC, CNRS*—This study focuses on phonological and semantic representations that lead to combined priming effects dur-

ing visual word recognition (Rouibah et al., 1999). The organization of the lexical representations, on which such effects are based, is difficult to conceptualize when using experimental data only. That is the reason why, after a description of the experimental and scientific context that motivates the interactionist position, a spatial model is presented. Both the model construction principles and the reasons that have led to the choice of such a spatial model are then discussed. Finally, simulation results are compared with experimental data and discussed. It appears that the spatial model gives a better account of the priming results than does the localist model of Collins and Loftus (1975) and the distributed memory model of Masson (1995).

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**Mediated Semantic–Phonological Priming in the Production Lexicon? Evidence From Event-Related Brain Potentials.** JOERG D. JESCHENIAK, *Max Planck Institute for Cognitive Neuroscience*, & HERBERT SCHRIEFERS, *University of Nijmegen*—We addressed the question of whether nonsynonymous semantic competitors become phonologically coactivated during speech production, using a new ERP technique. It combines delayed picture naming with a priming technique. While participants prepared the naming of an object, they heard an auditory word to which the ERP was recorded. This auditory target word was the name of a semantic competitor, phonologically related to the prepared picture name, or related to the phonological form of the competitor (mediated semantic–phonological condition). These experiments consistently showed semantic and phonological priming effects, as manifested in less negative-going ERP waveforms in the N400 time window. They also consistently demonstrated the absence of mediated semantic–phonological priming, even for the case in which the semantic competitor had been named a few trials earlier. Our findings are thus in line with the extant behavioral data, suggesting that mediated priming does not occur for mere semantic competitors.

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**Eye Movements and Reading Skill: Differential Effects of Frequency and Predictability.** JANE ASHBY, KEITH RAYNER, & SUSAN A. DUFFY, *University of Massachusetts, Amherst*—Eye movement research has demonstrated effects of word frequency and predictability on the fixation times of proficient readers. This experiment monitored the eye movements of two groups of college readers as they read sentences containing predictable and unpredictable words of high or low frequency; one group scored in the top quartile of the Nelson–Denny ( $M = 88$ th percentile), and the other group scored below the 75th percentile ( $M = 40$ th percentile). For the most proficient readers, frequency and predictability influenced initial reading time. For the less proficient readers, only predictability influenced initial reading time. Both groups showed additive effects of frequency and predictability in total reading time. Rereading patterns also differed for the two groups. Results suggest that the most proficient readers engage qualitatively different processes to support their comprehension of text.

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**Visual and Language Processing Deficits in Adults With Varying Degrees of Reading Impairment.** STACY BIRCH, *SUNY, Brockport*, & CHRISTOPHER CHASE, *Claremont McKenna College*—In a series of experiments assessing visual and language processing skills, we investigated the extent to which more versus less impaired adult dyslexic readers demonstrated deficits, compared with their nonimpaired peers. Degree of reading impairment predicted the degree of impairment in phonological processing (decoding and analysis), word naming, oral reading, and rapid naming of symbols. Degree of reading impairment did not correlate with visual processing skills as measured by contrast sensitivity or speeded identification of sinewave gratings and line drawings with varying spatial frequencies. Thus, it seems that phonological measures continue to be good predictors for overall reading performance, whereas visual measures do not. Further work on the relationship between perception and reading should in-

clude more refined measures of reading, including visual aspects of text processing, such as orthographic judgments.

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**Direct Assessments of the Processing Time Hypothesis for the Missing-Letter Effect.** JEAN SAINT-AUBIN & ANNIE ROY-CHARLAND, *University of Moncton*, & RAYMOND M. KLEIN, *Dalhousie University*—When asked to detect target letters while reading, subjects miss more letters in frequent function words than in less frequent content words. According to the processing time hypothesis (Healy), this occurs because function words are identified faster than content words. This hypothesis was tested in four experiments using a rapid serial visual presentation procedure, where words of a prose passage were presented one at a time at fixation. In Experiments 1 and 3, subjects looked for a target letter, and they looked for a target word in Experiments 2 and 4. In Experiments 3 and 4, presentation rate was self-paced. In all experiments, there were more omissions and longer response latencies for function words. Moreover, for items, positive correlations were observed between mean response latencies and number of subjects making omissions. Results are contrary to the predictions of the processing time hypothesis and best interpreted within the structural account (Koriat & Greenberg).

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**Feedforward and Feedback Consistency Effects in Visual Word Recognition.** ISABEL LACRUZ & JOCELYN R. FOLK, *Kent State University*—We examined feedforward and feedback consistency effects in word recognition. Feedforward consistency is the degree to which a word's pronunciation is consistent with that of similarly spelled words, and feedback consistency refers to whether there is more than one way to spell a pronunciation. Previously, Stone et al. (1997) reported feedforward and feedback consistency effects for low-frequency words in a lexical decision task. We investigated the effect of feedforward and feedback consistency for both high- and low-frequency words in lexical decision and naming. In lexical decisions, we found that feedforward and feedback inconsistent words were processed more slowly than consistent words, regardless of word frequency. However, these effects were found most reliably for low-frequency words in naming. These findings indicate that there is interaction between spelling and pronunciation in word recognition and that phonology is involved in processing high- and low-frequency words in visual word recognition.

• PSYCHOLINGUISTICS •

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**To Be or Not to Bee: Phonological Influences Over Lexical (Mis)Selection.** VICTOR S. FERREIRA, *University of California, San Diego*, & ZENZI M. GRIFFIN, *Georgia Institute of Technology*—Speech-error evidence reveals that the words that speakers produce are influenced by semantic (“hungry” replaces “thirsty”) and phonological (“ravishing” replaces “ravenous”) similarity. But are semantic and phonological influences mutually independent? In three experiments, speakers named pictures that completed visually presented cloze sentences. The picture was either semantically similar to the sentence-final word (“The boy was stung by the...” [fly]), or it only sounded like it (“She couldn't tell whose voice that might...” [fly]). In both cases, speakers erroneously produced sentence completions (“be” or “bee”) more often than in unrelated control conditions (“check”). Since “be” is similar to “fly” only via its phonological relationship to “bee,” this suggests that semantic and phonological influences work together to influence word selection.

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**Allocation and Reallocation of Sentence Processing Time: A View From Cognitive Aging.** KAREN A. KEMTES, *University of Nevada, Las Vegas*, ALLISON BRENNAN, *SUNY, Stony Brook*, & ARTHUR WINGFIELD, *Brandeis University*—A new method for evaluating on-

line sentence processing was developed to assess initial word-by-word comprehension and reanalysis of sentences varying in syntactic complexity. The technique, reversible self-paced reading (RSPR), based on Just, Carpenter, et al.'s (1982) self-paced reading task, allows individuals to read and then reread words serially within sentences. RSPR measures both working-memory-dependent and working-memory-independent sentence analysis processes. An auditory analogue of this task, reversible self-paced listening (RSPL), based on Ferreira, Henderson, et al.'s (1996) auditory moving window task, was also evaluated. Preliminary results indicate that although young and older adults' frequency of "look-back" during RSPR and RSPL was similar, their regressions differed in terms of depth and syntactic location. Also, young participants used the look-back feature more often in the visual than in the auditory modality, whereas older adults were equally balanced. These results are compared with extant studies of eye tracking and self-paced reading/listening.

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**Phonological Competition as a Function of Practice.** PADRAIG G. O'SEAGHDHA & KRISTINE SCHUSTER, *Lehigh University*—Repetition of paired actions, words, sentences, or other entities sharing structure and partial content is a powerful tool in the analysis of planning and execution processes. Previous work with word pairs has shown strong phonological competition among nonshared later components of begin-related pairs (e.g., margin marble) relative to an unrelated baseline. We examined the effect of practice with such materials over two experimental sessions. Although global performance naturally improves with practice, phonological competition is largely invariant. We assess the hypothesis that phonological competition originates in transient activation processes independent of learning. We also report a qualitative error analysis to assess whether there are underlying changes in the units participating in errors as a function of experience.

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**Plural Reference: Atomic Individuals or Assemblage?** BARBARA KAUP, *Florida State University*, & STEPHANIE KELTER, *Technical University of Berlin*—Two views for mentally representing the denotation of plural expressions are contrasted: (1) the atomic-tokens view, according to which the denotation of a plural expression is represented as a number of distinct individuals, and (2) the assemblage-token view, according to which it is represented as a single whole. Linguistic data suggest that the atomic-tokens view is appropriate for partitioning plural expressions (e.g., "most of the cars," "both cars," "both"), whereas the assemblage-token view holds for unmarked plural expressions (e.g., "the cars," "they"). This hypothesis was investigated in two experiments with German participants, contrasting "sie" ("they") and "beide" ("both"). In Experiment 1, off-line tasks were employed to investigate whether predicate interpretation depends on the pronoun used as subject. In Experiment 2, reading times were measured to investigate whether resolving "sie" ("they"), but not "beide" ("both"), involves grouping the respective individuals. The results support the hypothesis.

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**Context Effects and Lexical Ambiguity in Moving-Window and Cross-Modal Tasks.** FRAZER ORGAIN, LUCIA MEDINA, & PING LI, *University of Richmond*—Two studies are designed to examine lexical ambiguity resolution in sentence processing. In the first study, participants read sentences that are biased toward either the dominant or the subordinate meaning of the ambiguous word and then make a lexical decision on the probe word. The second study involves the same procedure, but participants name the word instead of making a lexical decision on it. These tasks are used to assess the interactions among context effects, frequency effects, and grammatical and semantic relatedness of lexical meanings. In particular, we hypothesize that because of the differences in contextual diversity and semantic relatedness, ambiguous words whose meanings differ in grammatical

categories will be more likely to show context-dependent access than will words whose meanings do not differ in this dimension. The results are discussed in light of recent high-dimensional space models of the lexicon (e.g., Burgess, Livesay, & Lund, 1998).

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**The Production of Subject–Verb Agreement and Verbal Working Memory.** ROBERT J. HARTSUIKER, *University of Edinburgh*, & PASHIERA N. BARKHUYSEN, *University of Nijmegen* (sponsored by Kathryn Bock)—In order to study the nature of cognitive resources required in language production, we elicited errors of subject–verb agreement in sentence completion. We tested the effects of the conceptual number of the to-be-uttered subject noun phrase (matching or mismatching with grammatical number), in conditions with and without an extrinsic memory load. We also determined a measure of working memory capacity (speaking span) for each participant. There were main effects of conceptual number, memory load, and speaking span on the number of agreement errors. The only interaction close to significance was between span and distributivity (a reduced conceptual number effect for high-span speakers). The results show that production of subject–verb agreement involves a processing step that demands working memory resources. We argue for an automatic process that marks number on the subject phrase, followed by a resource-demanding step that transmits number to the verb.

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**On the Interaction of Age of Acquisition and Repetition.** LUCIA COLOMBO, CRISTINA BRIVIO, & REMO JOB, *University of Padua*—Four experiments are reported in which the age of acquisition (AoA) of Italian words, controlled for frequency and familiarity, and repetition are manipulated. The words were presented in lexical decision, naming, and semantic categorization tasks, and the corresponding pictures in a picture-naming task. The presence or absence of the repetition priming effect and the AoA effect and their interaction were investigated. Whereas the main effect of repetition priming was reliable in every task, AoA affected only latencies of late-acquired stimuli in both word and picture naming. The effect of AoA was less strong in lexical decision and in semantic categorization, and its interaction with repetition priming was not significant in either task. The results are discussed in terms of the possible locus of AoA and repetition priming.

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**The Influence of Semantics on Past Tense Inflection.** MICHAEL RAMSCAR, *Edinburgh University*—Previous theories of past tense verb inflection have considered phonological and grammatical information to be the only relevant factors in the inflection process (e.g., Bybee & Moder, 1983; Kim, Pinker, Prince, & Prasada, 1991; Rumelhart & McClelland, 1986). I present a series of experiments that show that semantic information plays a decisive role in determining the inflection of both existing and novel homophone verb stems. These findings indicate that regular and irregular inflections are determined by semantic and phonological similarities in memory and, furthermore, that people are not responsive to the kind of grammatical distinctions among verb roots that default rule theories of inflection (Pinker, 1999) presuppose. It appears that in order to explain the processing of inflectional morphology, an innate, rule-based route is neither required nor empirically justified.

• LANGUAGE/DISOURSE PROCESSING •

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**Integration of Causal Events and World Knowledge in Text Comprehension.** MURRAY SINGER, *University of Manitoba*, & MICHAEL HALLDORSON, *University of Winnipeg*—The study scrutinized the organization of causal situation models constructed during text comprehension. Experiments assessed the integration of implied world knowledge with causal antecedents and outcomes. In a priming task,

the participants read blocks of three passages, one of which described a causal relation or a suitable control. Each block was followed by questions, including some prime–target pairs. We found the following. (1) Causal antecedents and relevant knowledge mutually primed one another, but whereas causal outcomes likewise primed relevant knowledge, the reverse was not true. (2) Relevant knowledge was also facilitated by primes from the other passages in the block and by unrelated-knowledge questions. This suggested that the primes established the retrieval context, rather than serving as a source of spreading activation (McKoon & Ratcliff, *JEP:LMC*, 1988). Nevertheless, the post-reading priming of causal antecedents by relevant knowledge supported the integration of that knowledge with the text representation.

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**Vicarious Learning During Virtual Tutoring: Overhearing Dialog and Monologue Discourse.** DAVID M. DRISCOLL, SCOTTY D. CRAIG, BARRY GHOLSON, & MATTHEW VENTURA, *University of Memphis*—Using a vicarious learning paradigm, students overheard two computer-controlled virtual agents discussing four computer literacy subtopics in dialogue discourse and four in monologue-like discourse. A virtual tutee asked a virtual tutor a mean of 8.25 questions per subtopic (dialogue) or one question (monologue) per subtopic. The contents spoken by the virtual tutor were identical in the two discourse formats. Students wrote significantly more contents on questions probing subtopics they overheard in dialogue discourse ( $M = 20.02$  propositions) than on subtopics overheard in monologue ( $M = 13.896$ ). The recall propositions were further classified as relevant (matched tutor delivered content on that subtopic), related (other computer literacy subtopics), and irrelevant. The participants wrote significantly more relevant propositions on the subtopics discussed in dialogue discourse ( $M = 15.41$ ) than in monologue discourse ( $M = 8.82$ ), but there were no differences in the other two categories.

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**Dimensions of Situation Models: An Experimental Test of the Event-Indexing Model.** MIKE RINCK & ULRIKE WEBER, *Technische Universität, Dresden*—During text comprehension, readers create multidimensional situation models representing the state of affairs described by the text. According to the event-indexing model proposed by Zwaan, Langston, and Graesser (1995), situation models contain information about the protagonists and their goals, as well as the spatial, temporal, and causal aspects of the situation. Through the use of correlational techniques, discontinuity effects were previously observed for all of these dimensions: Sentences containing a discontinuity (e.g., a new person, a time shift, or a spatial shift) caused longer reading times than did continuous sentences. With the present experiment, we manipulated three of these dimensions experimentally. We constructed stories in which target sentences were continuous or discontinuous with regard to the protagonist, the location, and the time of the previous episode. Reading times of the target sentences provided evidence for the event-indexing model: Discontinuity effects occurred for all dimensions, and an interaction of protagonist and space was observed.

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**Situation-Based Expectancies Affect Lexical Ambiguity Resolution.** HOANG VU, *Saint Mary's College*, & GEORGE KELLAS, ERIC PETERSEN, & KIM METCALF, *University of Kansas*—Vu, Kellas, and Paul (1998) provided evidence that specific subject nouns of simple sentences are a source of constraint on lexical ambiguity resolution. The interpretation assumed that subjects have expectancies for agent-specific activities. However, no empirical evidence was provided regarding subject-based expectancies. On the basis of an off-line rating task, the present research, using a naming task, compared empirically derived agents engaging in expected versus unexpected activities. It was predicted that when the activities described in a literally ambiguous sentence were compatible with agent-based expectancies, situation-level constraints would resolve subsequent ambiguities. When the activities violated the subject's expectancies, the conflict between situa-

tional attributes of the agent and the attributes activated by a sentence-final ambiguity, would lead the language processor to settle on the most frequent meaning of an ambiguous word. The results supported these predictions and were discussed in a contextual feature framework.

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**Readers' Use of Privileged Information in Estimating a Character's Knowledge.** KRISTIN M. WEINGARTNER & CELIA M. KLIN, *SUNY, Binghamton*—Keysar (1994) concluded from an off-line task that readers sometimes fall prey to the “illusory transparency of intention,” a phenomenon in which readers misapply their own privileged knowledge when judging a character's interpretation of a message. The purpose of the present research was to determine whether the illusory transparency of intention extends to natural reading contexts. In Experiments 1 and 2, a reading time measure indicated that readers' estimates of a character's interpretation of an ambiguous message depended on the readers' privileged knowledge. Experiment 3 demonstrated that this effect depends in part on which character, the addressee or the message writer, is in focus when the reader encounters the message. On the basis of these results, we conclude that the illusory transparency of intention does influence readers' judgments of a character's knowledge during natural reading.

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**Failure to Detect Inconsistencies in Anaphoric References.** ANNE E. COOK, *University of Massachusetts, Amherst* (sponsored by Jerome Myers)—Readers have been found to fail to detect inconsistencies in both isolated sentences (e.g., the Moses illusion; Erickson & Mattson, 1981) and expository text (Glenberg & Epstein, 1985). The present experiments investigated this phenomenon in the context of anaphoric references in narrative text. In order to examine more closely the processes underlying detection failures, several factors were investigated: featural overlap between the anaphor and the antecedent, saliency of the antecedent, and distance between the anaphor and the antecedent. Readers experienced less comprehension difficulty during reinstatement when overlap between the anaphor and the antecedent was high than when overlap was low, except when the text omitted all description of features of the antecedent. An additional experiment employed eye-tracking methodology to examine the time course of processing on the anaphor. The results are discussed in terms of rates of reactivation of semantic and episodic information from long-term memory.

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**Representing Perceptual Availability During Narrative Comprehension.** WILLIAM S. HORTON, *SUNY, Stony Brook*, & DAVID N. RAPP, *Tufts University*—Do readers encode the perceptual perspectives of characters during narrative comprehension? To address this question, we conducted two experiments in which participants read stories containing narrative events that either did or did not occlude part of the protagonists' field of view. After each story, participants answered a question about some critical story detail. In Experiment 1, participants were slowest to answer questions after stories in which the target information had been occluded. In Experiment 2, we demonstrated that this effect did not extend to other, nonoccluded information. These results are consistent with the claim that readers represent the perceptual availability of information from the perspective of story protagonists. This suggests that narrative comprehension may involve the encoding of story information in a manner akin to actual perception.

• DEVELOPMENTAL/AGING PROCESSES •

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**Age Differences in Eye Fixations During Reading: Effects of Word Degradation and Sentence Context.** TRACY L. MITZNER, *Georgia Institute of Technology* (sponsored by Arthur D. Fisk)—Age differences in context effects were examined by comparing words that are highly predictable from their sentence contexts with words that are less

predictable from their sentence contexts. In addition, stimulus quality was manipulated to explore the extent to which younger and older adults rely on semantic and pragmatic information to compensate for perceptually difficult conditions. In Experiment 1 the stimuli were degraded by inserting asterisks between adjacent letters in the target words, and in Experiment 2 the stimuli were degraded by reducing the contrast between the words and the background on which they were presented. Eye tracking was used to measure fixation times to target words. Several cognitive and vision tests were administered to measure vocabulary, working memory capacity, inhibition, acuity, contrast sensitivity, and useful field of view. The results are discussed in terms of the relation between perceptual and cognitive factors during reading.

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**Construct Validity of the Picture-Naming Test of Cognitive Inhibition.** KATHERINE KIPP, KELLY FRUDD, KACY WELSH, & MICHELLE VERGES, *University of Georgia*, & STEFFEN WILSON, *Eastern Kentucky University*—Cognitive inhibition refers to the suppression of previously activated cognitive contents or processes. The Picture-Naming Test of Cognitive Inhibition isolates inhibitory ability in an individual difference measure. The test has strong face validity and utility. Nevertheless, the test's construct validity has not been adequately tested. This paper compares adults' performance on the Picture-Naming Test of Cognitive Inhibition with various other tests of inhibitory ability and resistance to interference (such as a Stroop negative priming task, a directed-forgetting task, a sentence completion task, and the Wisconsin Card Sorting Task), a working-memory span task, and the Peabody Picture Vocabulary Test. Patterns of performance across tasks within individuals will be discussed in terms of the relative support for the construct validity of the Picture Naming Test and the cognitive inhibition construct and in terms of the relative utility of the Picture Naming Test for studying developmental and individual differences in cognition.

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**Remembering a Nuclear Accident in Japan: Age Differences in Flashbulb Memory?** HAJIME OTANI, *Central Michigan University*, TAKASHI KUSUMI, *Kyoto University*, KOICHI KATO, *Central Michigan University*, KEN MATSUDA, *Kyoto University*, ROBERT L. WIDNER, JR., *Minnesota State University, Mankato*, & NOBUO OHTA, *Tsukuba University*—We administered a questionnaire twice 1 year apart to examine the memory of a nuclear accident that occurred in Tokaimura, Japan, on September 30, 2000. The first 14 items of the questionnaire assessed memory of the situation surrounding the accident, whereas the last 10 items assessed (1) the amount of rehearsal, (2) the consequentiality, distinctiveness, and surprisingness of the accident, and (3) emotions associated with the accident. The results indicated that only a small proportion of participants had formed flashbulb memories of the accident and that the proportion was similar among young, middle-aged, and older adults. The results also indicated that the accuracy of the memory was positively associated with the amount of rehearsal and that the surprisingness and consequentiality ratings had only marginally significant effects on accuracy.

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**The Costs of Doing Two Things at Once for Stroke Survivors.** RUTH E. HERMAN & SUSAN KEMPER, *University of Kansas*, & JOAN M. McDOWD, *University of Kansas Medical Center*—The costs of doing two things were assessed using language sample methodology. Healthy older adults and older adults who were tested at least 6 months after having a stroke were compared. All stroke survivors had excellent recovery, as indicated by their performance on stroke assessment scales. They were matched to a group of healthy older adults in gender, education, age, and performance on the Short Portable Mental Status Questionnaire. A baseline language sample was compared with language samples collected while the participants were tapping their index fingers, tapping four fingers in a pattern, or walking around an elliptical track and while listening to noise or to speech. Whereas the

speech of the healthy older adults showed few costs due to the concurrent task demands, the dual-task measures assessing talking while simple tasks were performed revealed long-lasting effects of stroke that were not evident when stroke survivors were assessed using standard clinical tools.

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**Ordinal Numerical Representations in Human Infants: A Comparative Perspective.** ELIZABETH M. BRANNON, *Duke University*—Brannon and Terrace (1998, 2000) demonstrated that language is not a prerequisite for ordinal numerical knowledge by showing that rhesus monkeys could order novel numerical values. Here, it is shown that 11-month-old human infants are sensitive to numerical ordinal relations. Specifically, 11-month-old infants discriminated sequences of numerosities that descended in numerical value from sequences that increased in numerical value when continuous dimensions did not covary with number. These results suggest that by 11 months of age, infants have a preverbal appreciation of number that includes their ordinal relations. Nine-month-old infants, however, failed to discriminate ascending from descending numerical sequences but did discriminate a change in ordinal relations between single squares that varied in size. Various hypotheses of what develops between 9 and 11 months of age are considered. These results support the view that animals, adults, and human infants share a nonverbal system for representing number.

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**Age Differences in Efficiency and Effectiveness of Encoding for Visual Search and Memory Search.** PAUL VERHAEGHEN, *Syracuse University*—In a time-accuracy study, encoding for visual search and memory search was compared in a sample of 23 younger and 26 older adults. Encoding for visual search proceeded faster and led to higher asymptotic performance than did encoding for memory search. Compared with younger adults', older adults' processing was found to be delayed. Age differences in speed of encoding were found in visual search, but not in memory search. There was no reliable age difference in asymptotic performance. Observed age differences were due mainly to a decrease in hit rates, not to an increase in false alarm rate. The results run counter to capacity or resource accounts of cognitive aging but fit the framework that predicts larger age differences in visuospatial than in lexical tasks (Myerson & Hale, 1993).

## • NEUROPSYCHOLOGY •

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**Malingered Amnesia and Negative Priming.** F. RICHARD FERRARO, RONALD PARK, HILARY HAGE, & STEVE PALM, *University of North Dakota*—Undergraduates performed a word completion task, but were instructed to malingere (e.g., fake) amnesia. Group 1 (informed) received detailed instructions about memory performance and amnesia. Group 2 (uninformed) were not informed about memory performance and amnesia. Group 3 (control) received no such instructions. Results tended to support the notion that some indirect memory tests may be useful in discriminating genuine from simulated amnesia. Groups also performed a negative priming task involving lettercase. Those instructed to malingere (Groups 1 and 2) showed greater negative priming deficits, as compared with controls (Group 3). This is the first demonstration linking deficits in inhibitory processing and control to malingering (simulated amnesia).

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**Stroop Effect With Colored Letters for a Letter Synesthete.** CAROL BERGFELD MILLS, SHARI KAY EDELSON, MEREDITH LYNN VIGUERS, & JOANNE A. INNIS, *Goucher College*—The letter synesthesia of a 46-year old female (M.L.S.), which includes a color percept for letters in both English and Russian, will be described. M.L.S. performed two Stroop-type experiments for English letters, in which she named either colors or letters for five different types of stimuli: colored blocks, black letters, letters in her synesthesia colors, letters in synes-

thesia colors that did not match the letters (scrambled), and letters in color that did not match any of the letters in the alphabet (nonsynesthesia). The naming times and errors will be presented, in addition to a surprising development that occurred in the course of the studies.

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**Dissociation Between Conscious Awareness and Volunteering Behavior in Schizophrenia.** ELISABETH BACON & JEAN-MARIE DANION, *INSERM U405*, & ERICK GOKALSING, *Memory Center, Nice*—Behavior abnormalities of schizophrenic patients seem to be related to an impairment of conscious awareness. We used a theoretical and experimental framework that delineates the role of monitoring and control processes in the strategic regulation of memory accuracy (Koriat & Goldsmith, 1996). Schizophrenic patients and control subjects were first forced to respond to general information questions, then allowed to exercise control during a subsequent free-report phase that included a no-incentive and an incentive condition. Memory accuracy was lower in patients than in control subjects despite their adoption of a higher response criterion. Patients were more confident in their incorrect responses than were normal subjects. Their monitoring effectiveness and control sensitivity were deficient. However, they increased their response criterion in keeping with the incentive to the same extent as normal subjects. The dissociation between conscious awareness and volunteering behavior is therefore also a critical determinant in schizophrenia.

• LATERALITY •

(365)

**Right-Brain Priority in Latency in the Semantic Processing of Chinese Characters.** TIN-CHEUNG CHAN, *Chinese University of Hong Kong*, JING-HAN WEI, *Chinese Academy of Sciences*, & LING-PO SHIU, *Chinese University of Hong Kong*—An experiment was conducted to investigate the difference in brain lateralization in semantic processes of Chinese and English. Object names, such as *hammer*, were presented to participants in both Chinese and English. Their task was to name another object with the same category and function. These target words were primed by a word/character that was similar in sound and shape but was different in meaning, to increase the effort in processing the meaning. The target words were presented in either the left or the right visual field. An EEG was recorded, and ERPs were analyzed for latency and magnitude. Results show that when Chinese characters were presented, irrespective of which visual field, the right hemisphere produced outputs with shorter latency, whereas the left hemisphere produced outputs with greater magnitude. The latency difference was, however, not found in English processing. Results suggest that the graphic nature of Chinese employs more right-brain processing.

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**Left Hemisphere Representation of Categorical Relations and the Identification of Musical Intervals.** STEPHEN CHRISTMAN, *University of Toledo*—Subjects with high versus moderate levels of musical skill (as assessed by a musical interval identification task) performed two auditory tasks on sequential pairs of tones, indicating (1) whether the second tone was above or below the pitch of the first and (2) whether the second tone was near or far in pitch from the first. Frequency differences between the first and the second tones comprised musical versus nonmusical intervals. Moderately skilled subjects had left-ear/right-hemisphere advantages in processing both types of intervals. Highly skilled subjects had left-ear/right-hemisphere advantages for nonmusical intervals but right-ear/left-hemisphere advantages for musical intervals. There was no task  $\times$  ear interaction. Results are discussed in terms of an extension of Kosslyn's theory of categorical versus coordinate visuospatial relations to auditory processing. Specifically, higher levels of musical skill may be associated with left-hemisphere-based categorical representations of musical intervals.

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**Handedness Profiles of Individuals With Successful and Unsuccessful Switches of Left-Hand Writing.** CLARE PORAC, *Pennsylvania State University, Erie*—Research confirms that the handedness behavior most frequently targeted for change is left-hand writing (Porac et al., 1990). There is little information about the hand preference profiles of individuals who are successfully switched left-hand writers, except the observation that they are more ambihanded when compared with individuals with no history of switch attempts (Porac & Friesen, 2000). This study examined the handedness profiles of 360 individuals, ages 18 to 94 years; the 14 handedness items used included both skilled (drawing) and unskilled (pick up a glass) activities (Steenhuis & Bryden, 1989). Results indicated that successfully shifted left-hand writers showed left preference for most of the nonwriting activities; this tendency was particularly strong for the unskilled preference behaviors. Unsuccessfully shifted left-hand writers remained strongly left-handed for both the skilled and the unskilled behaviors. These results support the idea that pressures to change specific hand preference behaviors do not affect all skills in a similar fashion (Porac, 1996).

• PSYCHOBIOLOGY •

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**Sleep Debt Is Associated With Reduced Sensory Gating.** DIANE L. FILION, ALBERT B. POJE, WADE R. ELMORE, & RACHEL C. ALLDAFFER, *University of Missouri, Kansas City*—Sensory gating refers to the continuous filtering of irrelevant environmental stimuli that allows higher level cognitive processing to occur without disruption. A popular index of sensory gating is prepulse inhibition of startle (PPI). Using PPI, sensory gating deficits have been documented in a variety of conditions associated with attentional deficits, including attention deficit disorder and schizophrenia. Despite significant group differences in these studies, PPI scores within clinical and control groups are highly variable. This study examined a factor hypothesized to influence individual differences in sensory gating, sleep debt. College student participants kept a sleep log for a 1-week period and were then scheduled for a PPI test. Correlational analyses revealed that participants with the highest sleep debt scores exhibited the lowest levels of PPI. This finding reinforces the link between sleep and attention and suggests that sleep debt may be an important addition to clinical studies of sensory gating.

• NEUROBIOLOGY OF LEARNING/MEMORY •

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**Effects of Orthographic and Phonological Priming During Lexical Decision: An fMRI Study.** W. EINAR MENCL, *Yale University and Haskins Laboratories*, KENNETH R. PUGH, *Haskins Laboratories and Yale University*, STEPHEN J. FROST, *Haskins Laboratories*, ANNETTE R. JENNER, *Haskins Laboratories and Yale University*, & JAY G. RUECKL & LEONARD KATZ, *Haskins Laboratories and University of Connecticut*—Neuroimaging studies have identified a set of left-hemisphere regions critical for printed word identification. This reading circuit includes ventral and dorsal components in the posterior cortex along with the inferior frontal gyrus. Previous studies have suggested that dorsal and anterior components play a critical role in decoding and analysis. The ventral system, by contrast, appears to constitute a fast word form system. To more precisely isolate functional differences between these systems, we used an event-related imaging paradigm with a primed lexical decision task to examine three kinds of priming relations: orthographically and phonologically similar (e.g., Bribe–Tribe), orthographically similar and phonologically dissimilar (Couch–Touch), and unrelated (Bribe–Touch). A set of areas in the left hemisphere discriminate the phonologically similar and dissimilar prime conditions. Results allow a more precise specification of system level changes in response to adaptive learning demands.

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**Effects of Stimulus Repetition During Word Reading on Cortical Activation Patterns: An fMRI Study.** KENNETH R. PUGH, W. EINAR MENCL, & ANNETTE R. JENNER, *Haskins Laboratories and Yale University*, STEPHEN J. FROST, *Haskins Laboratories*, & JAY G. RUECKL & LEONARD KATZ, *Haskins Laboratories and University of Connecticut*—Neuroimaging studies of skilled readers have revealed a distributed system of left-hemisphere regions critical for printed word identification. This reading circuit includes ventral (occipitotemporal), dorsal (temporoparietal), and anterior (inferior frontal gyrus) components. Across many studies, there is a suggestion that dorsal and anterior components play a critical role in processing unfamiliar stimuli, which require substantial decoding and analysis. The ventral areas, by contrast, appear to constitute a fast word form system. To test this hypothesis in a single experiment, we examined patterns of activation across regions during a semantic categorization task for novel versus repeated items (we examined activation changes over multiple repetitions of the same stimulus). Cortical areas showing both repetition-correlated decreases and increases in activation were isolated. Brain/behavior analyses were performed to link decreased latencies to cortical changes. Results allow a more precise specification of system level changes in response to adaptive learning demands.

• BEHAVIORAL PHARMACOLOGY •

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**What No-Go PRP Can Tell Us About Alcohol-Facilitated Failures of Inhibition.** MARK VAN SELST, *San Jose State University*, & MARK T. FILLMORE, *University of Kentucky*—Depressant and anxiolytic drugs, such as alcohol, are suggested to temporarily weaken behavioral inhibition processes, leaving the activation processes to dominate behavior. Observations of extreme or antisocial behavior under alcohol have led many to infer that the drug “disinhibits” behavior. Only recently has behavioral inhibition under alcohol been measured directly (Fillmore & Vogel-Sprott, 1999, 2000; Mulvihill et al., 1997). That research used the stop-signal paradigm and found that a moderate dose of alcohol selectively reduced the drinkers’ ability to inhibit their behavior, while leaving their ability to activate behavior unaffected. These early findings support the notion that behavioral inhibition is particularly sensitive to the impairing effects of alcohol. Further experiments using the PRP paradigm demonstrate a within-subjects dose effect of alcohol on no-go PRP, thus providing insight into the processes underlying alcohol-facilitated failures of inhibition.

• CATEGORIZATION •

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**The Availability of Salient and Conceptually Central Properties of Concepts in Different Contexts.** FERNE J. FRIEDMAN-BERG & ARNOLD WELL, *University of Massachusetts, Amherst*—How closely is property information tied to a concept, and under what conditions is it available? Two experiments investigated how properties of a concept are activated. In the first experiment, a frequency estimation task was used to examine property activation. If property activation is automatic, participants should be able to estimate the number of items in a studied list that were, for example, “red” or “sweet” without recalling individual items. Because some properties are more important to a concept than others, they may be more likely to be activated, so property centrality and salience (Slooman, Love, & Ahn, 1998) were manipulated to assess their relative importance in property activation. In another experiment, participants read sentences and performed a property verification task. Three sentence contexts were used (neutral, centrality-biased, and salience-biased) to assess whether central and salient properties were more likely to be activated in a context-independent or context dependent manner (Barsalou, 1982).

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**Factors Determining the Perception of the Parts Making Up Event Categories.** CYNTHIA SIFONIS, *Oakland University*—The present study examines the effect of classification experience and congruence on the perception of the parts making up event categories. Participants learned to distinguish between two contrasting categories consisting of four actions each. One of the four actions determined category membership. Conditions varied in whether differences in the direction of the action (congruent condition) or the type of action (incongruent condition) determined membership in each of the two contrast categories. Both classification experience and congruence affected the perception of category parts. In both conditions, actions experienced during classification learning were perceived differently than actions not experienced during learning. This effect differed by condition. Actions predictive of category membership were perceived as larger units in the congruent condition than in the incongruent condition. Participants in the congruent condition were more likely than those in the incongruent condition to identify the actions predictive of membership in both of the contrast categories.

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**Decision Bound Theory and the Influence of Familiarity.** GERT STORMS, TOM VERGUTS, & FRANCIS TUERLINCKX, *University of Leuven*—In this presentation, we derive a nonparametric prediction from decision bound theory. The crucial aspect that is tested is whether or not familiarity of a stimulus affects response time in categorization. We will show that, for our design, decision bound theory predicts no familiarity effect. The prediction is nonparametric in that, rather than fit a specific instantiation of the general decision bound theory, we posit only some general assumptions of this theory and derive the prediction from these assumptions. It is found that familiarity does have a strong impact on response time for at least half of the participants. We suggest that the decision bound theory is in itself incomplete and should be extended with exemplar processes to account for the full range of available data.

(375)

**Categorization With Partial Information.** TOM VERGUTS & GERT STORMS, *University of Leuven*—In this presentation, we look at the categorization process when only partial feature information is available—that is, when (the values of) only a subset of the relevant features are presented. It is assumed that more featural information is added through time. It will be shown that traditional categorization (exemplar) models do not handle partial information well. A new model is presented that does work well with partial information. The model is applied in five experiments that yield empirical evidence for the model.

(376)

**Predictive Learning of Main Effects and Interactions: A Comparison of Computational Models.** MICHELLE R. ELLEFSON & MICHAEL E. YOUNG, *Southern Illinois University, Carbondale*—We examined the acquisition of various tasks involving two candidate causes and an effect. Participants learned one of six tasks: simple main effect (A+, B2, AB+), double positive main effect (A+, B+, AB+), double negative main effect (A−, B−, AB−), inhibition (A+, B−, AB−), positive patterning (A−, B−, AB+), or negative patterning (A+, B+, AB−). In Experiment 1, positive cues (+) were followed by the effect 100% of the time, and negative cues (−) were followed by the effect 0% of the time. In Experiment 2, the contingencies were changed to 80% and 20% for positive and negative cues, respectively. Performance on the six tasks was compared with the performance predicted by various models of causal learning: ALCOVE (Kruschke, 1992), configural-cue (Gluck & Bower, 1988), Rescorla–Wagner (Rescorla & Wagner, 1972), and a hybrid model (e.g., Delamater, Sosa, & Katz, 1999) to evaluate their strengths and weaknesses.

**Arousal, Attention, and Memory**  
**Coronado H, Saturday Morning, 8:00–10:00**

*Chaired by Marilyn C. Smith, University of Toronto*

**8:00–8:15 (377)**

**Triazolam/Amphetamine Interaction: Dissociation of Effects on Memory Versus Arousal.** MIRIAM Z. MINTZER & ROLAND R. GRIFFITHS, *Johns Hopkins University*—It is well documented that benzodiazepine hypnotics impair memory performance. However, benzodiazepines also affect other functions, including attention, psychomotor performance, arousal, and mood. This study was designed to use the stimulant *d*-amphetamine (Dexedrine), which enhances attention, performance, arousal, and mood, to dissociate the sedative and memory-impairing effects of the benzodiazepine triazolam (Halcion). Across four sessions, 20 healthy adult volunteers received a single oral dose administration of placebo, triazolam (0.25 mg/70 kg), and *d*-amphetamine (20 mg/70 kg) and conjoint administration of triazolam and *d*-amphetamine in a double-blind, crossover design. Results suggest that *d*-amphetamine reversed triazolam-induced psychomotor performance impairment and sedative/mood effects, but not triazolam-induced impairment in memory or metamemory performance. In addition to providing evidence that sedative and memory-impairing effects of benzodiazepines can be dissociated, this study demonstrates the usefulness of drug interaction studies as a tool to explore the role of mood and arousal in memory performance.

**8:20–8:35 (378)**

**Retrograde Memory Facilitation by Sedative-Hypnotic Drugs: A Reliance on Automatic Retrieval Processes.** MARK T. FILLMORE, THOMAS H. KELLY, CRAIG R. RUSH, & LON HAYS, *University of Kentucky*—Retrieval processes are implicated as mechanisms by which benzodiazepines produce retrograde memory facilitation. This study tested the degree to which benzodiazepine-induced memory facilitation was due to enhanced automatic retrieval processes. Healthy adults ( $n = 42$ ) received 0.0 mg (placebo), 0.125 mg, or 0.25 mg of the benzodiazepine, triazolam (Halcion) under double-blind conditions. Subjects studied a word list prior to dose administration. One hour after the dose, they performed a word-stem completion task that tested their word retrieval. The influence of automatic and controlled memory processes on word retrieval was estimated using a process-dissociation procedure. Triazolam doses increased the use of studied words as stem-completions by producing an increased reliance on automatic processes. The results suggest that retrograde-memory-facilitating effects of benzodiazepines do not necessarily reflect an improved ability to intentionally retrieve information but could, instead, reflect increased responsiveness to cues that automatically elicit retrieval of predrug information.

**8:40–8:55 (379)**

**Circadian Arousal and Memory: A Dissociation Between Explicit and Implicit Measures.** CYNTHIA MAY, *College of Charleston*, & LYNN HASHER & NATALIE FOONG, *University of Toronto* (read by Lynn Hasher)—A growing literature indicates that circadian arousal has a significant impact on explicit measures of memory, with diminished performance at off-peak relative to peak times of day on many recognition and recall tasks. The present research examined the effect of circadian arousal on implicit measures of memory. We used both perceptual measures (e.g., word-stem completion) and conceptual measures (e.g., category generation) of implicit memory. For comparison, we also included an explicit memory measure. We replicated the finding of impaired explicit memory at off-peak relative to peak times. However, we found that measures of implicit priming were reliably greater at off-peak relative to peak times. The data suggest an increased reliance on automatic, nonconscious processing at off-peak times of day.

**9:00–9:10 (380)**

**The Effect of Sensation Seeking on the Von Resorff Isolation Effect.** RICHARD S. CIMBALO, *Daemen College*, ALEKSANDR I. MATAYEV, *Yeshiva University*, & DOUGLAS CLARK, *Daemen College*—Personality differences (extraversion/introversion and sensation seeking) and memory performance are examined. A short-term free-recall memory task was used. A 10-item list of consonants with (isolated) and without a distinctively larger item in the fifth position was presented to 84 college students. Generally, overall memory performance was found to be superior on the lists without a distinctive item and for the distinctive item itself (the isolation effect [IE]) but the latter occurred only at the shorter duration (2 vs. 10 sec). Overall, list memory performance was more disrupted by the isolated item for low sensation seekers, but they showed a greater IE at 2 sec. General implications of personality and the IE are considered.

**9:15–9:30 (381)**

**Switching Tasks and Resolving Interference Are Distinct Processes.** CHING-YUNE C. SYLVESTER, STEVEN C. LACEY, JOHN JONIDES, TOR D. WAGER, EDWARD E. SMITH, & LUIS HERNANDEZ, *University of Michigan* (read by John Jonides)—There are two alternative views of the organization of executive processes. According to one, there is a unitary central executive responsible for a variety of operations. The alternative view is that there are multiple executive processors, each with a dedicated function. We present an experimental paradigm in which participants switch between tasks and resolve interference between competing responses. An examination of response times reveals evidence of an interaction between the processes responsible for task-switching and interference resolution initially; this interaction dissolves over the course of practice. In a separate experiment, participants were imaged using functional MRI while they performed the very same task. The data reveal evidence of common and dissociable neural circuitry responsible for the two processes in question. Taken together, these results suggest that task-switching and interference resolution are not mediated by a single mechanism.

**9:35–9:55 (382)**

**The Effects of Divided Attention in Young Adults and Adult-Age Differences in Episodic Memory: A Common Associative Deficit Mechanism?** MOSHE NAVEH-BENJAMIN, JONATHAN GUEZ, ASSAF GIVATI, & MICHAL MAROM, *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 (Naveh-Benjamin, 2000), 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 episode components, will be reported, in which younger adults studied information under either full or divided attention and then were tested on their memory for both the episodes' components and the associations between them. The results indicate that, unlike older adults, younger adults under divided attention do not show a differential deficit in memory for associative information; their memory for the components is reduced to the same degree as their memory for the associations.

**Sentence Comprehension**  
**Coronado L, Saturday Morning, 8:00–9:55**

*Chaired by Peter C. Gordon*  
*University of North Carolina, Chapel Hill*

**8:00–8:15 (383)**

**Comprehension of Auditory Sentences With Informative Prosodic Boundaries.** CHARLES CLIFTON, JR., KATY CARLSON, & LYN FRAZIER, *University of Massachusetts, Amherst*—Consider an am-

biguous sentence like *Susie learned that Bill called on Monday*. The presence of a prosodic boundary before the adjunct phrase *on Monday* can bias a listener's interpretation toward "high attachment," in which the adjunct phrase modifies *learn*. The bias created by the prosodic boundary might be a local, context-independent effect, which is dependent only on the acoustic or phonological size of the boundary. Alternatively, it might be a global effect, dependent on the size of the local boundary relative to other boundaries in the sentence. Three auditory questionnaire experiments examined the effects of prosodic boundaries in a variety of sentence constructions. Their results indicated that the effect of a prosodic boundary is determined not by its absolute size, but by its size relative to relevant earlier boundaries. An "informative boundaries hypothesis" was developed, claiming that a listener computes a full prosodic description of an utterance.

#### 8:20–8:35 (384)

**Disfluencies Influence Parsing of Garden Path Sentences.** KARL G. D. BAILEY & FERNANDA FERREIRA, *Michigan State University* (read by Fernanda Ferreira)—Little work has been done on the processing of spoken language, and next to nothing is known about how disfluencies might affect comprehension. Three experiments using spoken garden-path sentences and a grammaticality judgment task demonstrate that disfluencies influence syntactic parsing. In the first experiment, disfluencies were placed either before or after the head of an ambiguous noun phrase. Results showed that disfluencies before the head exaggerated the garden-path effect, just as words do (Ferreira & Henderson, 1991). The second experiment established that the effect is due to the amount of time the parser is committed to the incorrect syntactic analysis. In the third experiment, disfluencies were inserted in either a syntactically informative or uninformative location. For example, a disfluency prior to a clause boundary is helpful, because items such as "uh" often precede complex constituents. Results indicated that the informative disfluencies helped the parser handle or even avoid a misanalysis.

#### 8:40–9:00 (385)

**Temporal Order Relations in Sentence Comprehension.** ELKE E. VAN DER MEER, REINHARD BEYER, BERTRAM HEINZE, & ISOLDE BADEL, *Berlin Humboldt University*—The role of temporal orientation (chronological, reversed) of general event knowledge in language comprehension was examined. The present experiments used a sentence-probe recognition paradigm in which the temporal orientation, the stimulus onset asynchrony (SOA), and the chronological distance between sentence event and probe event were manipulated. The results indicated a general effect of semantic relatedness between sentence and probe events. In addition, a superiority effect for chronological items, as compared with reversed items, was found. It was affected by manipulation of the SOA and the chronological distance between sentence and probe events. Obviously, readers used temporal information conveyed by their knowledge to construct script-based situation models while comprehending sentences (Kintsch, 1998). The internal temporal dimension appeared to be directional (cf. Radvansky et al., 1998; Zwaan, 1996).

#### 9:05–9:25 (386)

**Inference Making and Memory for Text: A Computational Model.** PAUL VAN DEN BROEK, *University of Minnesota*, YUHTSUEN TZENG, *National Chung-Cheng University*, SANDY VIRTUE, *University of Minnesota*, TRACY LINDERHOLM, *University of Florida*, & MICHAEL E. YOUNG, *Southern Illinois University, Carbondale*—A central component of successful reading comprehension is the construction of a coherent memory representation of the text. Such representations result from inferential processes by which readers identify meaningful relations between parts of the text. Much research has been devoted to properties of on-line inferential processes and off-line memory representation, respectively, but little to the relation between the two. In this presentation, we describe a computational model, the landscape model, that captures the inferential processes

during reading and specifies how these processes result in a stable memory representation of the text. In this model, ideas/concepts associated with the text fluctuate in their activation, creating a dynamically shifting landscape of activations. This landscape results in the construction and continual updating of an episodic memory representation of the text. We present empirical data supporting the model and illustrate how it can be used to test theoretical hypotheses about discourse comprehension.

#### 9:30–9:50 (387)

**Do Implicit Agents Introduce Antecedents for Definite and Indefinite Pronouns?** GAIL MAUNER & JEAN-PIERRE KOENIG, *SUNY, Buffalo*—We examined whether implicit agents introduce discourse antecedents. Experiment 1 demonstrated that sentences with indefinite pronoun (they) subjects are easier to process following passives that introduce an appropriate implicit agent than are sentences that do not. Experiment 2 showed that "they" sentences are harder to process when antecedents are implicit rather than explicit agents. Thus, implicit agents do not introduce discourse antecedents but, rather, introduce discourse roles that facilitate inferring an antecedent. Experiment 3 showed that readers more easily infer agent antecedents for definite (he) and indefinite pronouns from discourse roles than from readily available conceptual knowledge. Both "he" and "they" sentences were harder to process following middle sentences that only logically required an agent than following passives that grammatically and logically require an implicit agent. Moreover, antecedents were more easily constructed from conceptual knowledge for "they" than for "he" sentences, suggesting that definite and indefinite pronouns are resolved via different processes.

#### Visual Search

#### Monterrey, Saturday Morning, 8:00–10:10

Chaired by Barbara A. Doshier, *University of California, Irvine*

#### 8:00–8:20 (388)

**Contingent Visual Marking.** MATTHEW S. PETERSON, ARTEM V. BELOPOLSKY, & ARTHUR F. KRAMER, *Beckman Institute, University of Illinois, Urbana-Champaign*—Visual marking is a phenomenon in which a set of new items can be searched with little interference from items already present in the display. Marking appears to occur only when the presentation of the new items is accompanied by a luminance change (Donk & Theeuwes, in press). We extend the type of transients that lead to visual marking to offsets and motion. Like Donk and Theeuwes, we find that marking does not occur when only the old items undergo a transient change, suggesting that the processes responsible for visual marking are triggered when the new items undergo a change detectable by the magnocellular system. In addition, we find that irrelevant transients only interfere with visual marking when they match the current attentional set (e.g., luminance change or motion). Results suggest that visual marking is not the automatic capture of attention by transients but, rather, is contingent on top-down control settings.

#### 8:25–8:40 (389)

**Stimulus Density Affects Search Time in Complex Visual Arrays.** KEVIN JORDAN, *San Jose State University*, ROBERT S. McCANN, *NASA Ames Research Center*, & TUAN Q. TRAN, *Kansas State University*—Participants performed visual search for a target in a vertical array of elements, the bottom half green and oscillating, the top half white and stationary. On each trial, participants were cued as to which group to search by an arrow located in the middle position of the array. The arrow was an element of either the white/stationary or the green/oscillating group. Search was faster when the cue and the target were part of the same perceptual group. However, this within-group search advantage was confined to the two target locations closest to the cue; it was absent at the far location. Was the within-group search advantage limited by stimulus density or cue-to-target distance?

To distinguish these alternatives, we removed the middle target location in each group. The within-group search advantage now extended to the far target location. Density, not distance, limited object-based attentional effects in this task.

#### 8:45–9:00 (390)

**Automatic Multilocation Inhibition of Return.** WILLIAM H. KNAPP III & RICHARD A. ABRAMS, *Washington University* (read by Richard A. Abrams)—Inhibition of return (IOR) refers to a cost in returning attention to a recently attended object or location. In searches that require people to attend to several locations in succession, IOR has been consistently found to affect the one most recently attended location. However, results for penultimate and antepenultimate locations have been equivocal. We report experiments in which transient cues successively captured attention at multiple locations, but with task demands that freed the subjects from attending to the cues. Contrary to reports of other investigators, IOR was observed at multiple locations under those conditions. We have also found that the spatial configuration of the cued locations can exert a profound influence on the spatial distribution of the inhibition. The results have implications for the manner in which IOR facilitates efficient searches of the environment.

#### 9:05–9:25 (391)

**When Is Visual Search “Amnesic”?** JAMES E. HOFFMAN & JASON REISS, *University of Delaware*—Horowitz and Wolfe (*Nature*, 1998) compared search efficiency in two conditions: *random*, in which the target’s location changed randomly during the trial, and *static*, in which location remained constant. They found equivalent set size effects in these conditions, suggesting that visual attention has no memory for previously attended locations. We examined this claim in a series of experiments employing low-contrast letters requiring fixation for identification. Measurement of fixation location showed that (1) subjects rarely fixated previously searched locations, even when they were prevented from adopting a systematic scan path, and (2) search slopes were twice as large in the random condition than in the static condition. Additional experiments revealed that subjects also had good memory for location when eye movements were prevented and search was accomplished by covert shifts of attention. We speculate that evidence for “amnesic search” depends on whether subjects are searching using parallel or serial allocation of attention.

#### 9:30–9:45 (392)

**Quitting Time: When Is It Time to Give Up in Visual Search?** JEREMY M. WOLFE, *Harvard Medical School and Brigham and Women’s Hospital*, & MEGAN HYLE, *Brigham and Women’s Hospital*—In order to model basic visual search, tasks we have looked at RT distributions. We ran subjects for 4,000 trials each for inefficient search (2 among 5s) and conjunction search (color × orientation). Target-present RT distributions have long positive tails. Target-absent distributions are roughly symmetric (for larger set sizes). Miss error distributions resemble target-absent RTs. If the average quitting time for one set size was 1,000 msec, we would expect the percentage of target-present RTs greater than 1,000 msec to estimate the miss percentage. However, this prediction overestimates the actual error rates. Subjects manage to quit 200–400 msec faster than predicted. How can subjects quit so quickly and still maintain low errors? Part of the answer could be borrowed (metaphorically) from romance. Subjects reject distractors swiftly, but they wait before committing to the real thing. We will discuss the implications for visual search models (rather than evolutionary psychology).

#### 9:50–10:05 (393)

**Divided Attention and Visual Search: A Signal Detection Theory Approach.** E. T. DAVIS, T. SHIKANO, S. PETERSON, R. KEYES, & C. E. SHOOK, *Georgia Institute of Technology* (read by E.T. Davis)—Simple-feature search can be difficult. Search is more difficult when distractors are mirror images of targets than when they are not (e.g.,

Wolfe & Friedman-Hill, 1992). Apprehending spatial relations of objects parts can also be difficult (e.g., Davis and Peterson, 1998; Logan, 1994; Palmer, 1994). To examine whether perceptual-capacity limitations occurred, we decomposed visual processing into component parts and applied SDT analyses (Davis & Peterson, 1998; Palmer, 1994; Shaw, 1980). Three types of stimuli were used: letters, pacmen, and lines. For each stimulus type, we tested both mirror image and standard conditions. Prior to testing visual search performance, we equated target–distractor discriminability across all participants and stimulus conditions. Mirror image symmetry affected target–distractor discriminability, but search performance was consistent with pure noise-limited, parallel processing. However, apprehending the spatial relations of objects, parts resulted in search performance worse than noise-limited predictions (Shaw, 1980) but consistent with a fixed sample size capacity model.

#### Animal Cognition II

#### Durango, Saturday Morning, 8:00–10:00

Chaired by William A. Roberts, *University of Western Ontario*

#### 8:00–8:20 (394)

**Serial List Linking by Macaques: List Position Influences.** F. ROBERT TREICHLER, MARY ANN RAGHANTI, & DEBRA N. VANTILBURG, *Kent State University*—Five sophisticated macaques were WGTA trained on two-choice object discriminations arrayed as the typical premise-pairs of a 5-item list (AB,BC,CD,DE). After acquiring three such lists (each with different objects), monkeys did or did not receive (in counterbalanced fashion) between-list linkage training—that is, the last items of two lists were paired in training with first items from lists designated as “farther along.” Then, choices on all possible pairings from a speculative 15-item list (unidirectionally rewarded) were assessed in 50-trial daily sessions for 15 days. Subsequently, three more 5-item lists were trained and tested under that linkage condition not given previously. Without linkage training, all subjects chose on the basis of list position, yielding distinctive error patterns. Contrastingly, with linkage training, selections on all pairs indicated 15-item list integration with only about 12%–16% error. This outcome supports monkey list memory as an organizational process.

#### 8:25–8:45 (395)

**Latent Learning, Detours, Shortcuts, and Cognitive Mapping.** NESTOR SCHMAJUK & HORATIU VOICU, *Duke University*—We describe a neural network model of spatial navigation and exploration that includes an action system capable of guiding, with the help of a cognitive system, the search for specific goals as determined by a motivation system. The cognitive map stores information about (1) the connectivity between places in the environment and (2) the paths traversed by the agent. Computer simulations show that the network correctly describes experimental results, including latent learning in a maze, detours in a maze, and shortcuts in an open field. In addition, the model generates novel predictions about detours and shortcuts in an open field.

#### 8:50–9:10 (396)

**Rats’ Search Patterns and Search Termination in the Radial Maze.** JEROME COHEN & HAROLD GRAHAM, *University of Windsor*—Rats are required to enter all arms in a radial maze that are baited with sunflower seeds or flavored cereal before they can terminate their search by entering an “exit” arm to their holding cage and receive an apple slice. The major purpose of this study is to explore those conditions that affect rats’ premature and nonrewarded exit responses and reentries to the other baited arms. We present a series of experiments that investigate the effects of associating amount and type of food with different proximal visual and tactile arm cues, number of baited arms in each category, and delay between category presentations. We will discuss how well the results of these experiments can be accounted for by the cognitive “chunking” or the optimal foraging model.

9:15–9:35 (397)

**Spatial Learning and Memory in the Radial Maze.** IAN P. L. McLAREN, *University of Cambridge*—Cook, Brown, and Riley (1985) demonstrated that, after a 15-min delay, rats who had visited 2 or 10 arms out of 12 in the radial maze were better able to recognize visited arms than were those who had visited 6 arms in the study phase. Their explanation was couched in terms of an adaptive response to memory load that could be minimized by using prospective coding in the 10-visited-arms case, so that only the 2 to-be-visited arms need be remembered. I shall offer an alternative explanation that notes that the proportion of symmetrical visited-arm configurations varies with number of arms visited and is less in the 6-arms case for a 12-arm radial maze. The suggestion is that those arms that are related by an axis of symmetry in the visited-arm configuration are easier to remember. I shall also comment on the issue of spatial generalization.

9:40–9:55 (398)

**Visual Cues and Spatial Pattern Learning.** MICHAEL F. BROWN, SUE YANG, & KELLY DIGIAN, *Villanova University*—Several previous experiments from our laboratory show that rats learn the spatial pattern in which food items are hidden and are thereby able to locate the food more efficiently. In these previous experiments, there have been no visual cues corresponding to the spatial pattern. The present work examines the effect of such visual pattern cues on control by a spatial pattern. Visual cues might be expected to either compete with control by the spatial pattern or facilitate it. In one set of experiments involving a square pattern of food locations, there was no evidence that visual cues corresponding to the pattern elements facilitated or reduced control by the spatial pattern. Results from a second set of experiments involving a checkerboard pattern will also be described. Implications of the results for models of spatial pattern learning will be discussed.

#### Psycholinguistics

Yucatan, Saturday Morning, 8:00–9:35

Chaired by Wayne S. Murray, *University of Dundee*

8:00–8:10 (399)

**Using ERP to Examine Eye Movement Control in Reading.** ERIK D. REICHLER, LESLEY A. HART, & CHARLES A. PERFETTI, *University of Pittsburgh*—The core assumption of sequential attention shift (SAS) models of eye movement control in reading (e.g., E-Z Reader; Reichle et al., 1998, 1999) is that lexical processing of one word provides a signal for the oculomotor system to begin programming a saccade to the next. This assumption was evaluated using event-related brain potentials (ERPs) in a semantic-judgment task: Participants made saccades to word pairs that were displayed peripherally and rapidly responded if either word referred to an animate object. Saccadic onsets were identified, as were ERP components that (1) were modulated by the words' normative frequencies of occurrence and (2) were predictive of the saccade onset times. These results suggest that the decision about when to move the eyes can be partially determined by lexical processing, thus providing physiological evidence consistent with a direct link between language processing and eye movement control during normal reading.

8:15–8:35 (400)

**A Method for Identification of Neural Regions Preferentially Active for Semantic and Phonological Processing.** KATHLEEN B. McDERMOTT & JASON M. WATSON, *Washington University*, & STEVEN E. PETERSEN & JEFFREY G. OJEMANN, *Washington University School of Medicine*—We present a method for identifying neural regions preferentially involved in semantic and phonological processing within a single group of subjects (and within many of our individual subjects) that uses fMRI techniques. We presented lists of 16 semantic associates (bed, rest, awake) or 16 phonological associates (weep, beep, heap) quickly to subjects and instructed them to attend to the relations among the list items. Contrasting encoding of the two types of lists led to robust differences, primarily within frontal and tempo-

ral cortices. This method represents a powerful way of identifying separate language regions in under an hour of functional scanning. Such identification may prove useful in basic studies of language and memory, in exploring cross-population language differences (e.g., in dyslexia), and perhaps even for identification of language regions within individuals prior to surgery.

8:40–8:50 (401)

**To Go or Not to Go: Is That the Question?** MANUEL PEREA, *Universitat de València*—“Yes” responses in the yes/no lexical decision task (LDT) are supposed to tap the same cognitive processes as “yes” responses in the go/no-go LDT (in this task, the participant is instructed to respond as quickly as he or she can when a word is presented, but to withhold any response if the presented stimulus is a nonword). Interestingly, the go/no-go LDT offers more accurate responding, faster response times, and fewer processing demands than the yes/no LDT. However, the pattern of effects with the two tasks is not always the same (e.g., the word frequency effect can be greater in the go/no-go LDT; Hino & Lupker, 1998). A series of experiments was conducted to analyze whether the effects of orthographic neighborhood (neighborhood size and neighborhood frequency) are modulated by type of decision (yes/no vs. go/no-go) and choice of distractors (close vs. distant). The results show a similar pattern of neighborhood effects with the two techniques.

8:55–9:10 (402)

**Language Comprehenders Activate Implied Object Shapes: Evidence From Recognition, Naming, and ERP.** ROLF A. ZWAAN, ROBERT A. STANFIELD, RICHARD H. YAXLEY, & MARTEN K. SCHEFFERS, *Florida State University*—We examined the prediction that people activate perceptual symbols during language comprehension. Subjects read sentences describing an animal or an object in a certain location. The shape of the object or animal was implied by its location (e.g., an eagle in the sky vs. an eagle in its nest). After reading a sentence, subjects were presented with a line drawing of the object or animal in question, which either matched or mismatched the shape of the object or animal as implied by the sentence. Subjects judged whether the object had been mentioned in the sentence (Experiments 1 and 3) or simply named the pictured object (Experiment 2). In Experiment 3, event-related potentials (ERPs) were also recorded. Mismatching pictures produced longer recognition and naming latencies and a larger N400 amplitude than did matching pictures. These results strongly support the hypothesis that perceptual symbols are routinely activated during language comprehension.

9:15–9:30 (403)

**Grounding Language in Action.** ARTHUR M. GLENBERG & MICHAEL P. KASCHAK, *University of Wisconsin, Madison*—We report a new phenomenon associated with language comprehension: the action–sentence compatibility effect. Adults judged whether sentences were sensible by making a response that required moving toward or away from the body. When a sentence implied action in one direction (e.g., “Close the drawer” implies action away from the body), participants had difficulty making a sensibility judgment requiring a response in the opposite direction. The compatibility effect was also demonstrated for abstract transfer sentences, such as “Liz told you the story.” These data are consistent with the claim that language comprehension is grounded in action, and the data are inconsistent with abstract symbol theories of meaning.

#### 3-D/Movement Perception

Coronado A, Saturday Morning, 8:00–9:50

Chaired by Jeffrey M. Zacks, *Washington University*

8:00–8:15 (404)

**Perception–Action Coupling and the Execution of Observed Movements.** BENNETT I. BERTENTHAL & STEPHEN MAKIN,

*University of Chicago*—Recent neuropsychological, neurophysiological, and psychophysical findings suggest that movement observation facilitates movement execution. A promising paradigm for studying this issue is described by Brass et al. (*Brain & Cognition*, **44**, 124–143, 2000). They report that the execution of a finger movement response is faster when cued by the observation of a finger movement than when cued by a spatial or symbolic stimulus. One interpretation for these results is that imitation plays a central role in this process, because observation of a finger movement primes the execution of the same finger movement. Alternatively, it is the shared motion information that primes the movement. We conducted a series of experiments to test these two interpretations, and the results show that the direction and location of the motion information represent the most significant sources of information for facilitating the response. These findings are discussed in the context of perception–action coupling.

**8:20–8:35 (405)**

**Perceptual Organization Within Dynamic Reference Frames.**

JOSEPH S. LAPPIN, DUJE TADIN, & EMILY GROSSMAN, *Vanderbilt University*—Perceptual organization of form and motion requires a frame of reference. Can the changing form of a moving object serve as the reference frame for perceiving coherent motion of another pattern? We used novel modifications of two familiar paradigms—biological motion and a masked translating pentagon. Oscillating elements—moving Gabor patches, counterphasing black/white disks, or rotating windmills—were placed at the major joints of a human point-light walker or at the edges of a pentagon seen through occluding apertures. Global perceptual organization was varied with upright versus inverted walkers and visible versus invisible aperture boundaries. Observers discriminated coherent oscillations of the internal elements from oscillations with phases randomized among the walker's joints or the pentagon edges. When the changing global framework was perceptually organized, coherence of the oscillating elements was accurately discriminated, but without a perceptually organized framework, coherence was poorly discriminated.

**8:40–8:55 (406)**

**Inertial Cues Do Not Facilitate Large-Scale Spatial Learning.**

DAVID WALLER, JACK M. LOOMIS, & SIBYLLE STECK, *University of California, Santa Barbara* (read by Jack M. Loomis)—The role of sensory information about linear or angular acceleration—inertial information—in spatial learning has not been well established for large-scale environments, although such cues appear to be important for maintaining orientation in a room-sized space. We examine this issue in an experiment in which 93 people learned the spatial layout of a large-scale outdoor environment in one of three conditions. Control participants learned the environment as a typical passenger in a car. Inertial participants learned in the car from a live video of the trip. Video participants subsequently learned in the laboratory from watching these videos. Results show no influence of inertial information on learning large-scale, landmark-rich spaces. Common biases among all three groups may provide insight into how environmental variables are learned and represented in memory.

**9:00–9:15 (407)**

**How General Is the Visual Analysis of Biological Motion?** JEAN-NINE PINTO, *Lafayette College*, & MAGGIE SHIFFRAR, *Rutgers University* (read by Maggie Shiffrar)—Is our visual system optimized for the analysis of human movement? We selected two “gold standard” characteristics of the visual analysis of human movement, orientation specificity and global processing, and examined whether these characteristics could be found in the visual analyses of another complex biological form, a horse. We found similar global processing for human and horse figures. Moreover, orientation specificity was altered by recent experience and thus not clearly attributable to extensive experience.

**9:20–9:30 (408)**

**The Effective Information for the Perception of Natural Object Shape.**

JAMES FARLEY NORMAN, *Western Kentucky University*, FLIP PHILLIPS, *Skidmore College*, & HEATHER E. ROSS, *Western Kentucky University*—In this study of the informativeness of boundary contours for the perception of natural object shape, observers viewed shadows/silhouettes cast by natural solid objects and were required to adjust the positions of a set of 10 points so that the resulting dotted shape resembled the shape of the original silhouette as closely as possible. For each object, the observers were then asked to indicate the corresponding positions of the 10 points on the original boundary contour. The results indicated a close correspondence between the chosen positions of the points and the locations along the boundary contour that were local curvature maxima (convexities or concavities). This finding differs from that of some previous investigations (e.g., Kennedy & Domander, 1985) and shows that at least for natural objects, the original hypothesis of Attneave (1954) is valid: Local curvature maxima are indeed important for the perception of shape.

**9:35–9:45 (409)**

**Does Representational Momentum Reflect Displacement of Final Position or Displacement of Trajectory?**

TIMOTHY L. HUBBARD & MICHAEL A. MOTES, *Texas Christian University*—Theories of representational momentum suggest that forward displacement in memory for the final position of a moving target reflects distortion of memory for just the final position. However, memory for the initial position of a moving target may be displaced forward (i.e., the Froehlich effect), and so forward displacement of final position may reflect distortion of memory for location of the entire trajectory. In Experiments 1 and 2, observers viewed a moving target. In Experiment 1, observers were cued after the target vanished to indicate initial or final position; in Experiment 2, separate groups of observers indicated initial or final position. Memory for final position was displaced forward (consistent with representational momentum), but memory for initial position was displaced backward (inconsistent with the Froehlich effect, consistent with the onset repulsion effect). Remembered trajectory was longer than actual trajectory, and representational momentum did not result from forward displacement of memory for location of the entire trajectory.

**Human Learning and Memory**

**Coronado H, Saturday Morning, 10:15–12:00**

*Chaired by Chizuko Izawa, Tulane University*

**10:15–10:30 (410)**

**Francis E. Nipher: The First Memory Researcher.**

HENRY L. ROEDIGER, III, DAVID A. GALLO, & PATRICK O. DOLAN, *Washington University*—Francis Eugene Nipher (1847–1926), a physics professor at Washington University in St. Louis, reported empirical research on human memory in 1876 (before Ebbinghaus began his own experiments in 1879). Nipher discovered the serial position effect in immediate serial recall of digits. In addition, he invented what today is called the Brown–Peterson distractor technique for studying short-term forgetting and reported that the forgetting curve is logarithmic. All of Nipher's discoveries were confirmed by later work. Nipher's research on memory is relatively unknown today and has had no impact on the development of the study of human memory. However, he was a major scientific figure and made important contributions to the study of magnetism and electricity, among other topics; he also created a forerunner to the U.S. Weather Service. The talk discusses his contributions and speculates on why his work on memory has had so little impact.

**10:35–10:55 (411)**

**In Defense of the Power Law of Forgetting.**

JOHN WIXTED, *University of California, San Diego*—Wickelgren (1974) proposed that the course of forgetting from long-term memory is closely approximated by a power function of time (but not by an exponential), and both

Anderson and Schooler (1991) and Wixted and Ebbesen (1991) presented evidence suggesting that he was right. Since then, two issues have raised doubts about this conclusion. One is that the power law may reflect nothing more than an averaging artifact, and the other is that a variety of alternative functions may better characterize the time course of forgetting. A close look at these two possibilities actually serves to increase, not decrease, confidence in the power law. Furthermore, nonmathematical work on long-term retrograde amnesia offers compelling support for one of its main theoretical implications—namely, that memories undergo a continuous process of consolidation.

#### 11:00–11:15 (412)

**Item and Source Memory in Conceptual and Perceptual Tests.** HASAN GURKAN TEKMAN, *Middle East Technical University*—Item and source memory were measured for words that were presented on the right or left side of the screen, which were made more distinct by associating each side with a different background color. Words were studied by either perceptual (reading) or conceptual (generation) processing. Memory was tested in either a perceptual (orthographic recognition) or a conceptual (standard recognition) test. Both item and source memory increased with generation, as compared with reading, in the standard recognition test. Neither measure showed reliable differences as a function of type of study in the orthographic recognition test, even with an arcsine transformation of scores. In conceptual tests of memory, both item and source information appear to be dominated by conceptual rather than perceptual processing.

#### 11:20–11:35 (413)

**A Comparison of Three Multinomial Models of Word-Stem Cuing.** FRANCIS S. BELLEZZA, *Ohio University*—The two-path model of memory retrieval assumes that the previous study of a word influences its later direct retrieval when its word stem is used as a cue but has no effect on the generation of the item from its stem if the generate-recognize retrieval process is used. The two-path model fit the data collected under a variety of experimental conditions, including orthographic versus semantic study, study based on reading words versus solving anagrams, indirect versus direct recall instructions, and immediate versus delayed recognition. The performance of the two-path model was compared with models proposed by Jacoby (1998) and by McBride and Doshier (1999).

#### 11:40–11:55 (414)

**The Effect of Feature Frequency in Short-Term Recognition Memory.** DOUGLAS J. K. MEWHORT & ELIZABETH E. JOHNS, *Queen's University, Kingston*—We manipulated feature overlap between study and test items. Previously, we showed that the number of extra-list features and the number of studied alternatives to the extra-list feature affect correct rejections (CRs). In the present experiments, we used colored shapes as stimuli and manipulated the frequency of the shapes across trials. When the lure contained an extra-list shape, CRs were faster for lures with a low-frequency shape than for lures with a high-frequency shape. When the lure contained an extra-list color, however, the frequency of the shape did not affect performance. Because frequency would affect the detectability of an extra-list feature, the data affirm that CRs depend on contradictory evidence. Positive items with a low-frequency shape were accepted more readily than those with a high-frequency shape, arguably a frequency effect with manipulated stimuli. Our results demand a mechanism that is sensitive to the history of items across trials.

#### **Working Memory and Language Processing** Coronado L, Saturday Morning, 10:15–11:55

*Chaired by Rolf A. Zwaan, Florida State University*

#### 10:15–10:30 (415)

**Memory-Load Interference in Syntactic Processing.** PETER C. GORDON, RANDALL HENDRICK, & WILLIAM H. LEVINE,

*University of North Carolina, Chapel Hill*—A memory-load study was conducted in which participants remembered a short set of words while reading a sentence. Unlike past uses of this procedure, where the number of items in the memory set has been manipulated, the present study manipulated the similarity between the words in the list and the words in the sentence. Similarity was manipulated by having the words be either matched or unmatched in type in terms of whether they were common nouns or proper names. Performance in comprehension declined when the type of words in the memory load matched those in the sentence. This effect was greater for syntactically complex sentences (object-extracted clefts) than for syntactically simpler sentences (subject-extracted clefts). The results indicate that memory interference plays a substantial role in language comprehension and that common memory resources are used for remembering a list of words and processing syntactic structure.

#### 10:35–10:45 (416)

**Working Memory Effects on the Functional Neuroanatomy of Syntactic Processing.** DAVID N. CAPLAN, *Massachusetts General Hospital*, & GLORIA S. WATERS & LOUISE STANCZYK, *Boston University*—Positron emission tomography (PET) was used to determine the effects of individual differences in verbal working memory on regional cerebral blood flow (rCBF) during syntactic processing in sentence comprehension. Nine high-span and 9 low-span subjects made plausibility judgments about syntactically more and less complex sentences (object- vs. subject-relativized clauses). RTs and accuracy to the sentence stimuli did not differ between the groups in the scan environment. Both groups of subjects showed focal increases in rCBF in left and right inferior frontal regions when PET activity associated with making judgments about the less complex sentences was subtracted from that associated with making judgments about the more complex sentences. The results indicate that high- and low-span subjects who are equated for syntactic processing efficiency utilize the same brain regions to carry out the syntactic operations associated with forming complex relative clauses.

#### 10:50–11:05 (417)

**Working Memory Capacity and On-Line Syntactic Processing.** GLORIA S. WATERS & SASHA YAMPOLSKY, *Boston University*, & DAVID N. CAPLAN, *Massachusetts General Hospital*—Two experiments investigated the nature of the working memory system used in on-line syntactic processing. In both experiments, college students were assessed on a battery of working memory tasks and an on-line task in which listening times for the phrases of syntactically simple and complex sentences were recorded. In the first experiment, subjects were tested in three listening conditions (no noise masking, –3 dB signal-to-noise ratio [S:N] and 4.5 dB S:N), and in the second experiment under three memory load conditions. Listening times were longer with increased noise masking and with greater memory loads, as well as at the most capacity-demanding portion of the syntactically complex sentences. However, listening times were not disproportionately longer at the capacity-demanding portion of syntactically complex sentences or in subjects with low working memory spans under dual-task conditions. The results provide support for a specialized working memory system's being used in syntactic processing.

#### 11:10–11:25 (418)

**The Role of Prior Knowledge in Processing Perspective-Relevant and Perspective-Irrelevant Text Information.** JOHANNA KÄÄKINEN & JUKKA HYÖNÄ, *University of Turku*, & JANICE KEENAN, *University of Denver* (read by Jukka Hyönä)—We examined the influence of prior knowledge on on-line processing of perspective-relevant and perspective-irrelevant information in expository texts. Participants read two texts of different familiarity from a given perspective while eye fixations were recorded. Results showed that encoding of relevant information did not require extra processing time in a text of familiar contents, whereas more processing time was spent on relevant than on irrelevant information in a text with unfamiliar contents. Readers with

high working memory capacity did not show a perspective effect in processing a text of familiar contents, whereas low-span readers did. Both low- and high-span participants fixated longer on perspective-relevant information in a text of unfamiliar contents. The results indicate that prior knowledge influences on-line processing and that the reading span test might measure the ability to encode information to and retrieve information from long-term memory (Ericsson & Kintsch, 1995) and/or the capability for controlled processing (Engle et al., 1999).

#### 11:30–11:50 (419)

**Semantic Relatedness in Noun Phrase and Sentence Production.** MONICA L. FREEDMAN & RANDI C. MARTIN, *Rice University* (read by Randi C. Martin)—A semantically related word distractor presented simultaneously with a picture slows picture-naming times due to the difficulty in selecting the correct picture name when competitor names are primed. The effect of semantic relatedness of two pictures or two written words was investigated when subjects were required to produce a compound noun phrase to describe both (e.g., “table and desk”). If subjects are planning both nouns simultaneously at the semantic level, then semantic interference would be expected. Significant interference was obtained in the picture condition, but not in the written word condition. A small nonsignificant facilitatory effect of semantic relatedness was found when subjects produced a sentence to describe the spatial relation between two pictures (“the table is above the desk”). Aphasic patients with semantic STM deficits showed a greatly exaggerated semantic interference effect in the phrase condition. The results support a phrasal scope of planning at the lexical–semantic level.

#### Eye Movements

Monterrey, Saturday Morning, 10:25–12:00

Chaired by James F. Juola, *University of Kansas*

#### 10:25–10:35 (420)

**A Theory of Eye Movements During Real-World Visual Search.** GREGORY J. ZELINSKY, *SUNY, Stony Brook*—Visual search has typically been studied using buttonpress measures and simple stimuli, methodological choices that have rendered current theories of search ill-equipped to describe the locations and durations of individual search movements to featurally complex objects. In response to these limitations, I introduce a computationally explicit model capable of accommodating oculomotor search for real-world targets. Filter-based image-processing techniques are used to represent real-world search stimuli, and visual routines acting on these representations produce simulated oculomotor behavior. Information available to each eye movement is constrained by a simulated fovea that moves over the scene as the model’s “eye” gradually converges on the search target. I test the model by collecting eye movement data from humans searching for real-world targets, then inputting these same scenes to the model and comparing the simulated sequence of saccades and fixations with the behavioral data. Preliminary findings reveal considerable spatiotemporal agreement between these gaze patterns.

#### 10:40–10:55 (421)

**Parallel Programming of Saccades Requires the Parallel Allocation of Attention.** RICHARD GODIJN & JAN THEEUWES, *Vrije Universiteit* (read by Jan Theeuwes)—The present study examined the allocation of attention prior to the execution of a sequence of two saccades. After participants received cues indicating the destination of both saccades, but before they could actually execute the first saccade, letters were briefly presented at the saccade destinations and at no-saccade locations. After executing the saccade sequence, participants indicated which of two letters had been presented. Results revealed that accuracy was higher when the target letter was presented at the first or second saccade destination than when it was presented at a no-saccade location. The results support a model in which attention is allocated in parallel to both saccade destinations prior to the execution of the first saccade.

#### 11:00–11:15 (422)

**Suppressing Where But Not What: The Effect of Saccades on Dorsal- and Ventral-Stream Visual Processing.** DAVID E. IRWIN & JAMES R. BROCKMOLE, *University of Illinois, Urbana-Champaign*—Previous research has shown that some cognitive processes are suppressed during saccadic eye movements, a phenomenon called cognitive suppression. In a series of experiments, we explored the locus of this effect within the visual system. In one experiment, subjects decided whether pictured objects faced to the left or the right while making saccades of varying length. RT to make this judgment increased with saccade distance, indicating that processing was suppressed during the saccade. In a second experiment, however, when subjects decided whether pictured items were objects or nonobjects, saccade distance had no effect on RT, indicating that saccades do not interfere with object recognition. These results (along with others) suggest that dorsal-stream (“where”) processes are suppressed during saccades, whereas ventral-stream (“what”) processes are not. Because the dorsal stream is instrumental in generating saccades, it is suggested that cognitive suppression results from dual-task interference within this visual subsystem.

#### 11:20–11:35 (423)

**Does Direction of a Planned Eye Movement Affect Boundary Extension?** HELENE INTRAUB, JAMES E. HOFFMAN, C. JEFFREY WETHERHOLD, & STACY-ANN STOEHS, *University of Delaware*—Boundary extension (BE) is an anticipatory projection of scene layout; observers remember having seen beyond the edges of a view. To determine the relation between BE and action planning, subjects centrally fixated each of 20 photographs. After a brief interval, an arrow specified that the subject should fixate an object on the left or the right. The picture was removed before the eye landed. Boundary memory was immediately tested in a border adjustment task. Relative to the uncued side, would the amount of BE on the to-be-fixated side of the photograph (1) remain the same, (2) be reduced (i.e., memory more accurate), or (3) be more expansive? Two experiments revealed that a planned eye movement resulted in greater boundary extension (i.e., more anticipatory spatial extrapolation) on the to-be-fixated side of the photograph. This suggests that boundary extension may serve to facilitate integration of successive views by anticipating upcoming layout.

#### 11:40–11:55 (424)

**The Generality of Hick’s Law.** KESTUTIS KVERAGA, LAUREN PENNIMAN, LISA WEBB, & HOWARD HUGHES, *Dartmouth College* (read by Howard Hughes)—Kveraga and Hughes (Psychonomic Society annual meeting, 2000) reported that refixation saccades violate the logarithmic relationship between reaction time and stimulus–response uncertainty known as Hick’s law. We suggested that this exception may be due to the coregistered mapping of visual locations onto the premotor pathways that initiate saccades. An alternative explanation is that saccades are highly practiced behaviors and that the effect of response entropy is dissipated with practice. To assess the merits of this latter explanation, we explored two response modalities that often are highly practiced in humans. First, unlike earlier reports (e.g., Brainard et al., 1962), we found an effect of response entropy in verbal naming latencies of visually presented Arabic numerals. Second, we showed that while the effect is attenuated in highly skilled typists performing a keypressing task, it is still substantial. These findings suggest that refixation saccades may enjoy a singular immunity from the effects of stimulus–response uncertainty.

#### Lexical Effects I

Durango, Saturday Morning, 10:20–11:55

Chaired by Judith F. Kroll, *Pennsylvania State University, Pittsburgh*

#### 10:20–10:40 (425)

**Differential Deficits in Reading and Inflecting Words: Contrasting Theoretical Perspectives.** JAMES L. McCLELLAND, BRENT

VANDER WYK, & DAVID C. PLAUT, *Center for the Neural Basis of Cognition, Carnegie Mellon University*—This talk will contrast two interpretations of the double dissociation observed, in both word reading and inflectional morphology, between novel words and familiar “exceptional” or irregular words. One account assumes that items of the two different types (novel words vs. familiar exceptions) are processed by two separate mechanisms. The other assumes that all words are processed by the same integrated multicomponent system but that various characteristics of the word types make them differentially vulnerable to damage to different components of the system. Both approaches can explain the double dissociation. The talk will review reasons for preferring the integrated multicomponent approach, which is embodied in the distributed developmental model of Seidenberg and McClelland and its successors, and present recent simulation results bearing on the adequacy of the integrated, multi-component account.

#### 10:45–11:05 (426)

**The Rank Hypothesis: Evidence From Reaction Times, Error Rates, and Eye Movements.** WAYNE S. MURRAY, *University of Dundee*—One currently unfashionable view of the process of written word recognition denies the possibility of full content-addressability and suggests instead that the process involves some sort of serial comparison or verification procedure. This may involve a search through precompiled lists (e.g., Forster) or the candidates delivered by an activation process (e.g., Becker; Norris; Papp; etc.), but to the extent that the set of candidates are ordered by frequency, these models all predict a particular form for the frequency effect. They suggest that recognition time will not be directly affected by frequency at all, but only, and linearly, by the effect of frequency on a word’s rank position in a candidate list. In this paper, I will present the results from a series of experiments using a variety of items and methodologies, all of which provide very strong support for this rank hypothesis.

#### 11:10–11:30 (427)

**What Can the Legibility of Letters Tell Us About Lexical Processing?** TATJANA A. NAZIR & NADIA BENBOUTAYAB, *ISC, CNRS, & RAM FROST, Hebrew University of Jerusalem*—Briefly displayed words and nonwords were presented shifted with respect to a fixation point such that the first, the second, and so forth letter in the string fell under fixation. Participants were required to identify the string or to make a lexical decision. For words, performance was best with fixation near the word center but dropped as fixation moved toward the word beginning or end. This profile was observed independently of task requirements and reflects limits of acuity on the extraction of letter information. For nonwords, the inverted U-shape profile was observed in the identification task, but not during lexical decision. Lexical decision for nonwords was not affected by fixation position even when nonwords were maximally similar to words (e.g., *coll* from *cold-roll*). The qualitatively different response profiles for words and nonwords during lexical decision suggest the existence of distinctive orthographic features that allow nonword rejection without complete letter extraction.

#### 11:35–11:50 (428)

**The Wordier the Better: Strong Repetition Blindness Occurs for Nonwords.** CATHERINE L. HARRIS, *Boston University*, & ALISON L. MORRIS, *Boston College*—Consensus is growing that repetition blindness (RB) reflects limitations in the episodic encoding of preexisting mental types. The assumption that nonwords do not activate mental types predicts an absence of RB for nonwords. Robust nonword RB is predicted if individual letters are the relevant mental type, as suggested by RB for words that merely repeat letters, as in medical seminar. Four experiments examined both orthographic and identity RB. The most RB occurred for words, followed by nonwords that are parts of words (*carb carn*). The least RB occurred for nonwords that never appear as consecutive strings in English (*plume plute*). However, orthographic RB may be stronger in nonwords, since it occurred for repetition of a single interior letter for nonword pairs like *rith vind*, but

not for word pairs like *city bill*. Both individual repeated letters and the frequency of the unitized string appear relevant for RB.

### Decision Making Under Risk Yucatan, Saturday Morning, 9:50–11:55

Chaired by Jerome R. Busemeyer, *Indiana University*

#### 9:50–10:10 (429)

**What a Speaker’s Choice of Frame Reveals: Reference Points, Frame Selection, and Framing Effects.** CRAIG R. M. MCKENZIE & JONATHAN D. NELSON, *University of California, San Diego*—Framing effects are well established: Listeners’ preferences depend on how outcomes are described to them, or framed. Less well understood is what determines how speakers choose frames. Two experiments revealed that speakers selected frames systematically when there was a clear reference point. For example, speakers tended to describe a 4-ounce glass filled to the 2-ounce line as “half full” if it was previously empty but described it as “half empty” if it was previously full. Similar results were found when speakers could describe the outcome of a medical treatment in terms of either mortality or survival (e.g., “25% die” vs. “75% survive”). A third experiment showed that listeners made accurate inferences about speakers’ reference points on the basis of the selected frame. Taken together, the data suggest that frames reliably convey implicit information in addition to their explicit content, which helps explain why framing effects are so robust.

#### 10:15–10:30 (430)

**Risky Choice Framing: Not One Effect but Two.** SANDRA L. SCHNEIDER, *University of South Florida*—Risky choice framing effects occur when preferences for risky alternatives shift as the description of options becomes more positive or negative. This is typically attributed to opposite risk preferences in gain and loss domains, as proposed in Kahneman and Tversky’s prospect theory. In this talk, I describe results of experimental research providing evidence for an alternative dual-process explanation of the effect. The first process is an attribute valence effect, in which attributes described positively are evaluated more favorably than the same attributes when described negatively (see Levin, Schneider, & Gaeth, 1998). The second process has been described elsewhere as a choice, contrast, or set effect, in which the introduction of a new option influences the judged favorability of an alternative. Although these results are consistent with notions of approach-avoidance motivation and reference dependence, there is little evidence that changes in risk preference contribute independently to risky choice framing effects.

#### 10:35–10:45 (431)

**Measuring Risk Preference: All for One?** GRETCHEN B. CHAPMAN & ELLIOT J. COUPS, *Rutgers University*—Someone preferring a certain \$5 over a 50% chance at \$10 is risk averse; the opposite preference is risk seeking. One account of risk preference is based on the utility function for the outcome (money, in this example). A second account is based on the decision weight function—that is, how probabilities are distorted. One hundred ninety-five university employees answered hypothetical risk preference questions about money, life expectancy, and severity of a reaction to a vaccine and a real-life question about movie tickets. Each involved a choice between a riskless outcome and a risky outcome of the same expected value. The utility function account predicts correspondence between measures using the same or similar outcomes (e.g., money and movie ticket). The decision weight account predicts correspondence among all measures. However, correlations among measures appeared to be driven solely by similarities in question formatting. Measurement implications of these results are discussed.

#### 10:50–11:05 (432)

**The Effect of Gain and Loss on Probability Guessing.** GEORGE WOLFORD, SARAH NEWMAN, & JENNIFER CUTLER, *Dartmouth*

College, & MICHAEL MILLER, *University of Massachusetts, Boston*—It is generally thought that humans exhibit frequency matching in a probability-guessing paradigm and that most other species exhibit maximizing. In previous work, we have argued that frequency matching in humans is the result of searching for patterns in the sequence. Using new empirical findings and a reexamination of the literature on other species, we show that the particular strategy employed in a probability-guessing paradigm may have more to do with the size and nature of the gain or loss than it does with species differences.

#### 11:10–11:25 (433)

**Detecting the “Hot Hand”: A Time Series Analysis of Basketball.** YANLONG SUN & RYAN D. TWENEY, *Bowling Green State University* (read by Ryan D. Tweney)—Gilovich, Vallone, and Tversky (1985) attributed the “hot hand” belief to people’s misconceptions of laws of chance, because they found no significant differences between basketball shooting and sequences generated by coin tossing. The present study reanalyzed the field-goal data reported by Gilovich et al., using a new approach in time series analyses. Out of 17 players, the serial correlations in 7 players’ shooting sequences were found to be nonstationary. This finding indicates the existence of a “hot hand,” or “streak shooting,” and weakens the argument that the “hot hand” belief might be “seeing patterns out of randomness.” Furthermore, it is argued that using small samples and paying attention to local anomalies, which have been attributed to cognitive biases or misconceptions by the standard of null hypothesis testing, might be adaptive features of the cognitive statistics that allow people to efficiently cope with a complex and uncertain environment.

#### 11:30–11:50 (434)

**Absolute Identification With Simple and Complex Stimuli.** JEFFREY N. ROUDER, *University of Missouri, Columbia*—In absolute-identification tasks, the number of choices may be large or small. For unidimensional stimuli, performance decreases as the number of choices increases. But for complex stimuli, such as letters or words, performance does not decrease with increasing numbers of choices. To better understand this result, Luce’s similarity choice model (Luce, 1963) was used to estimate the psychological distance between stimuli in line length and letter identification tasks. Psychological distance is the opposite of confusion: the larger the psychological distance between stimuli, the less likely they are to be confused. Psychological distance between line length stimuli decreased with increasing numbers of choices; this result is concordant with the notion of capacity limits in unidimensional absolute identification. The opposite result held with letters. Psychological distance between letters increased with increasing numbers of choices: People process letters more efficiently with more choices. Implications for the role of context in letter identification are discussed.

#### Perceptual Organization

Coronado A, Saturday Morning, 10:05–12:00

Chaired by John Whalen, *University of Delaware*

#### 10:05–10:20 (435)

**Focal and Peripheral Processing in Direction-Coded Visual Search.** HAROLD H. GREENE, *University of Detroit Mercy*—During real-world visual search, the locations and meaning of distractors are usually relevant to the location of a target. This target–distractor relationship may be simulated with direction-coded (DC) and uncoded (UC) displays. Only a few studies have investigated relationships between focal and peripheral processing in visual search. Given the utility of DC information, we speculated that if focal vision is presented with UC and peripheral vision is presented with DC information, targets may be found efficiently with the peripheral information. A gaze-contingent moving foveal window program was used to present congruent and incongruent information to focal and peripheral vision. Numbers of fixations made and their dispersions showed that UC in-

formation was disruptive, even when DC information was presented in the periphery. Thus, we provide direct evidence that search is not guided by the meaning of peripheral information. The findings fit well with reported functional divisions in the visual system.

#### 10:25–10:35 (436)

**A Simple Figural Ambiguity With 15 Different Interpretations.** THADDEUS M. COWAN, *Kansas State University and Weber State University*—A simple figural ambiguity with 15 different interpretations is demonstrated. The ambiguities are derived from an abstract algebraic structure, the defining relations of which are  $fgf = gfg$  and  $fg = gf$ . The mathematical logic of the algebra produces the relation  $ffg = ggf$  and  $gff = ggf$ , seen in the PBS and Girl Scout logos. Finally,  $ffg = gff$  can also be derived, and this is seen in Hershfeld’s ambiguous “The Boys from Syracuse” poster. All of these appear in the ambiguity to be presented.

#### 10:40–11:00 (437)

**Perceptual Organization and Attention.** RUTH KIMCHI & IRENE RAZPURKER-APFELD, *University of Haifa*—We examined grouping under inattention, using a method described in Driver et al., (2001). Subjects were presented with displays that each consisted of a central target surrounded by background elements. They had to judge whether the target in successive displays was the same or different, while the background organization stayed the same or changed. There were four types of background stimuli: dots grouped into columns/rows by color similarity, lines grouped into a square/cross by cotermination and closure, dots grouped into a square/cross by proximity and similarity, and dots grouped into a square/cross by color similarity. Subjects same/different judgments were affected by the background organization (whether it was the same or different in two successive trials) when performing with the first three background stimuli, but not with the last one. These findings suggest that some grouping can occur under inattention. Shape formation that involves figure–ground segregation seems to require attention.

#### 11:05–11:25 (438)

**Rethinking Figure–Ground Organization: Relative Depth and Attention.** STEPHEN E. PALMER, ROLF NELSON, & JOSEPH L. BROOKS, *University of California, Berkeley*—We suggest that the classical concept of figure–ground (FG) is not unitary but the conflation of two more basic perceptual processes—relative depth perception and object-based attention—in simple displays with few surfaces. In complex natural images, FG disintegrates, but relative depth and attention are still relevant. They correlate in FG displays because attention is drawn to closer, complete objects rather than to the surfaces they occlude. Three lines of evidence support this view. First, relative depth cues work well as figural factors, and figural factors can be reinterpreted as relative depth cues. Second, Rubin’s figural memory effect (that figures are remembered better than grounds) also holds for explicitly mosaic displays with no differential depth when subjects’ attention is directed at one region. Third, when one region of a FG display is perceived as closer and more object-like (i.e., figural), it acts as an exogenous (pull) cue to attention at short SOAs in a target detection task.

#### 11:30–11:40 (439)

**Strong Coffee and Strong Illusions: Effects of Caffeine on Visual-Geometric Illusions.** STANLEY COREN, *University of British Columbia*—It has been suggested that a number of visual-geometric illusions involving 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 lines (such as the Müller-Lyer, Zöllner, and Poggendorff alignment effects) but would have little effect on illusions without such elements (such as the Ebbinghaus or Delboeuf illusions or the parallel line effect in the

Poggendorff illusion). Using doses of 0, 100 and 200 mg of caffeine in a counterbalanced design involving testing over three sessions and a subject sample of 20, these predictions were confirmed. Caffeine increased illusion magnitude, but only for configurations involving intersecting line elements and angular effects.

**11:45–11:55 (440)**

**Stereoscopic View of a Fraser Figure.** THOMAS S. AIBA, *University of the Air, Japan*, & HIRONORI KUWAHARA, *Chiba University*—The Fraser figure is an example of the most dramatic geometrical optical illusion figure, where apparent transformation occurs in a set of

concentric circles that are made to look like an Archimedes spiral. In this study, a Fraser figure was seen stereoscopically, with the disparities (uncrossed and crossed) introduced for the concentric circles. In the former case (uncrossed), the concentric circles appeared to be in front of the background spirals, and the illusion appeared to be much reduced. In the latter case (crossed), some unexpected effects were observed. The weakened illusion was seen, but more strikingly, the concentric circles appeared to be in a concave surface with its bottom at the center of the background spirals. The concave surface was not in a uniform crater-shape, but the left and the right sides appeared to stick out more. The explanation of this effect is attempted.

## POSTER SESSION III

Fiesta Ballroom, Saturday, Noon–1:30

## • VISION •

(441)

**Depth and Perceptual Grouping Effects on the Luminosity Threshold.** FREDERICK BONATO, *Saint Peter's College*, JOSEPH CATALIOTTI, *Ramapo College, New Jersey*, & LUCIANE PAULA-PEREIRA, *Saint Peter's College*—The perception of luminous surfaces—that is, surfaces that appear to emit their own light, or glow—has seldom been studied. Although the importance of perceived depth and perceptual grouping has been demonstrated for lightness perception, little is known about how these factors affect luminosity perception. In several experiments, observers adjusted the brightness of a target until it just began to appear self-luminous, or glowing (luminosity threshold). Variables studied included target depth, which was manipulated stereoscopically, and target saliency, which was manipulated by adjusting the sharpness of edges in a black–white background collage (Mondrian). Luminosity thresholds for targets that appeared to be in front of their backgrounds were significantly higher than those for targets that appeared either coplanar or behind their backgrounds. Also, blurring background edges significantly lowered the luminosity thresholds of targets whose edges were sharp. Results will be discussed in terms of lightness anchoring and perceived level of illumination.

(442)

**Improvement in Texture Segmentation Performance Depends on the Structure of the Mask.** ANNA SCHUBÓ, *Universität Erlangen, Nürnberg*, FRIEDRIKE SCHLAGHECKEN, *University of Warwick*, & CRISTINA MEINECKE, *Universität Erlangen, Nürnberg*—Although texture segmentation is traditionally regarded as an automatic, preattentive process, naive participants confronted with texture segmentation in experimental settings (i.e., with brief presentation time and subsequent masking) are initially not able to perform the task. Inasmuch as in “natural” situations the texture is not followed by a mask, we assumed that weak performance in experiments is caused by the mask. We varied its spatial structure in four experiments. Results showed that participants learned to perform the segmentation task when the mask had a regular, homogeneous structure. With an irregular, heterogeneous mask, no improvement was observed. We assume that an irregularity detection process is triggered by the texture and by an irregular mask. Learning consists in separating signals stemming from the texture from signals of the mask and, finally, in ignoring the mask. This is only possible when texture and mask do not trigger the same irregularity detection process.

(443)

**Saccadic Eye Movements and Mislocalizations of Briefly Presented Stimuli.** SONJA STORK & JOCHEN MÜSSELER, *Max Planck Institute for Psychological Research*—When observers are asked to localize the peripheral position of a probe with respect to the midposition of a spatially extended comparison stimulus, they tend to judge the probe as being more peripheral than the midposition of the comparison stimulus (Müsseler et al., 1999). This relative mislocalization seems to emerge from different absolute mislocalizations—that is, the comparison stimulus is localized more foveally than the probe. Comparable foveal tendencies in absolute localizations are known from eye movement studies. We examined whether and how individual saccadic undershoots are related to the relative judgments. As a result, observers produced smaller amplitudes of saccades to the comparison stimulus than to the probe. Moreover, a positive correlation between amplitude differences and the relative judgments was found for observers with short eye movement latencies. Our interpretation is based on the assumption that the saccadic motor components together with sensory information establish spatial perception.

(444)

**Occluded Contours, Once Completed, Are Not Automatically Grouped With Visible Contours.** A. GIERSCH, *INSERM U405*, GLYN W. HUMPHREYS, *University of Birmingham*, & J. C. BARTHAUD, *INSERM U405*—We examined how occluded contours are used in the processing of visual information, once completed. Subjects decided which of two lateral pictures, composed of superimposed or occluded figures, included a visible or occluded line oriented like a reference line. An agnostic patient, H.J.A., unable to assign contours to appropriate figure–ground relations, and healthy volunteers treated with a single dose of lorazepam (a benzodiazepine), were all faster and more accurate when the length of the reference line matched exactly the length of the occluded contour than when it matched the length of the occluded contour added to the length of the visible contours. These results may uncover early processes not accessible in healthy volunteers. They confirm previous studies suggesting that occluded contours are completed early on and suggest further that these completed contours are not automatically grouped with visible contours. Early completion may produce “hypothetical” lines, which may be inhibited later on.

## • PERCEPTION •

(445)

**Mandatory Processing of Biological Motion.** IAN M. THORNTON, *Max Planck Institute for Biological Cybernetics*—Previously, we have used visual search (Cavanagh, Labianca, & Thornton, 2000) and dual-task (Thornton, Rensink, & Shiffrar, in press) methodologies to assess the role of attention during biological motion processing. Here, we continue this line of work by using a modified Eriksen interference paradigm (Eriksen & Eriksen, 1974) to explore the impact of task-irrelevant flanking figures on direction discrimination decisions directed at a centrally attended target walker.

(446)

**Direction of Forward Memory Displacement Is Different From Perceived Motion Direction.** MASAYOSHI NAGAI & JUN SAIKI, *Kyoto University*—The memory for the final position of a moving target is displaced forward in its moving direction. Does the forward memory displacement occur along the perceived or the physical trajectory of the target? To answer this question, we used a hierarchical structure motion of three dots composed of common- (translation of all dots) and relative- (a target's bouncing between the other two dots) motion components, in which the perceived and the physical trajectories of a target were different from each other. Although perceptual judgments showed that the bouncing motion was more salient than the translation, forward memory displacement for the target occurred along the physical trajectories. The results suggested that, unlike the perceptual system, the extrapolation mechanism that produces forward memory displacement equally utilizes both common- and relative-motion components and correctly predicts the future position of a moving target.

(447)

**Localization of Undetected Targets: A Form of Blindsight?** GENIVA LIU, *University of British Columbia*, MARCIA L. SPETCH, *University of Alberta*, JAMES T. ENNS, *University of British Columbia*, & CHRISTOPHER G. HEALEY, *North Carolina State University*—The goal of scientific visualization is to facilitate the exploration of large multidimensional datasets. In the present study, we measured localization of orientation-defined targets on a densely textured 3-D surface, either alone or following simple detection. Localization was measured by direct (pointing to the screen location) and indirect (making a spatially mapped keypress) action, with accuracy being generally higher for direct responses. Direct localization was also unaffected by whether or not a detection report was made first, implying that it does not compete for attention-limited resources. Of greatest interest was the finding that users were able to localize targets they had failed to detect.

These results have theoretical implications for the relationship between perception and action and practical implications for the design of visualization displays.

(448)

**Expecting a Break in Timing Increases Proportion of “Short” Responses in Time Discrimination.** SEBASTIEN TREMBLAY & CLAUDETTE FORTIN, *Université Laval*, & DYLAN M. JONES, *Cardiff University*—Expecting an empty break in a tone, the duration of which has to be estimated, results in underestimation of its total duration. Furthermore, the longer the duration for which the break is expected, the greater the underestimation. The phenomenon, observed initially in a time production paradigm (Fortin & Massé, 2000), is tested here in a discrimination paradigm. In a series of experiments, we varied location and duration of empty breaks in tones (2.5 or 3.5 sec) to be classified as short or long. Proportion of short responses increased consistently with increasing prebreak duration. These results show that the effect of expecting a break in timing is not task specific and support an internal-clock interpretation where attention is shared between accumulation of temporal information and expecting its interruption. Using empty breaks in discrimination reveals also an interaction between break location and duration, which suggests the influence of some contextual factors with this task.

• 3-D/MOVEMENT PERCEPTION •

(449)

**The Pigeon’s Recognition of Depth-Rotated Objects.** JESSIE J. PEISSIG, *University of Iowa*, MICHAEL E. YOUNG, *Southern Illinois University*, EDWARD A. WASSERMAN, *University of Iowa*, & IRVING BIEDERMAN, *University of Southern California*—In two experiments, we demonstrated that pigeons responded more accurately when given novel views if they were trained with five views versus only a single view of each object. This result obtained even when the novel views came from a rotational axis that was orthogonal to the axis of rotation in which the pigeons were trained. These results do not accord with the use of a mental rotation mechanism of recognition or an interpolation mechanism of recognition. The pigeons trained with five views may have formed a general representation as a result of multiple-view training. This result is consistent with a structural description model of recognition. Alternatively, they may have a more detailed shape space of the trained objects in which to measure object similarity, consistent with Edelman’s theory of recognition (1999).

(450)

**The Role of Visual Landmarks During Path Integration.** MELISSA BUD KEARNS & WILLIAM H. WARREN, JR., *Brown University*—People can perform path integration on the basis of optic flow or the body senses (vestibular, proprioception, and efference; Kearns et al., 2001a; Loomis et al., 1993; Peruch et al., 1997; Riecke et al., 2000). When both are available, the body senses dominate (Kearns et al., 2001a, 2001b). To test the contribution of landmarks in path integration, we used a triangle completion task and manipulated the gain of the optic flow during active walking in an immersive virtual environment (VE). The visual gain was either greater than (150%) or the same as (100%) in normal walking and varied separately for observer translation and rotation. We added four or five distinctive local or global landmarks in the VE to examine their contributions to updating translational (local) and rotational (local and global conditions) self-motion. The data suggest that landmarks lead to a greater reliance on vision during path integration.

(451)

**Trajectory Forms and Perceptual Constancy in Visual Event Identification.** EMILY A. WICKELGREN, *California State University, Sacramento*, & GEOFFREY P. BINGHAM, *Indiana University*—Past research has shown that people can use trajectory forms to recognize events. Only a frontoparallel perspective has been investigated thus

far. People view events from many different perspectives. However, the visual components change when events are viewed from different perspectives, and the projected form of the trajectory changes. Does event recognition exhibit perceptual constancy? Participants were familiarized with five different trajectory forms. They then had to identify the same events viewed from three different perspectives. Participants showed perceptual constancy across viewing perspectives. Events can also have paths with different shapes. We investigated perceptual constancy for the following conditions: events with different path shapes, events that vary in the speed profile along a curved path, and events that change in both path and speed patterns. The results showed that adults exhibit perceptual constancy in all conditions.

• PATTERN PERCEPTION •

(452)

**Effects of Stimulus Location and Size on Global and Local Precedence.** P. A. McMULLEN, *Dalhousie University*, & D. I. SHORE, *McMaster University*—Attention to a global form has been shown to precede attention to a local form of hierarchical stimuli, and this effect depends on the size of the stimuli. Smaller sized displays demonstrate global precedence, and larger sized displays demonstrate local precedence (Lamb & Robertson, 1990). With the use of a divided attention task and central presentation, these results were replicated with stimuli sized 3°, 6°, 9°, and 12° of visual angle. Effects of visual field on this cross-over interaction were examined with targets presented 2.7° to the left and right of central fixation for a brief exposure (196 msec). Global precedence was demonstrated in both visual fields. However, this precedence diminished with the larger sized stimuli in the right visual field. This effect was not present for left-field targets. These results support a left cerebral hemisphere advantage in processing local stimuli, relative to the right hemisphere

(453)

**Why You Shouldn’t Count on Subitizing: Evidence From Counting and Estimation.** JOHN WHALEN & VICKI WEST, *University of Delaware*—Response times for speeded counts of visual arrays reveal almost no increase for arrays of between one and four items, whereas larger arrays of five or more reveal systematic response time increases for each additional item. This has been interpreted as evidence for two counting procedures: a fast parallel count of up to four items and a deliberate verbal count of larger arrays. Small array counts have been thought to be performed by “subitizing”: summing the activity of the visual object file system (with a limit of four). However, this proposal fails to account for counts of serially presented stimuli and approximate counts of numerosities well outside the subitizing range. I consider an alternative: that a nonverbal, approximate number system might account for both precise counts of small quantities and approximate counts of larger arrays. Converging psychophysical evidence from nonverbal estimation and subvocal counting will be discussed.

(454)

**Context Facilitates Perception After Training With Unfamiliar Word-Like Strings.** DAVID A. MEDLER & JAMES L. McCLELLAND, *Center for the Neural Basis of Cognition, Carnegie Mellon University*—We present a series of studies in which participants were trained on highly constrained strings of three previously unfamiliar characters and then tested with a variety of test strings to explore the effects of this experience. Participants identified trained characters more accurately when they occurred in strings used in training, as compared with cases in which they were spliced into other strings used in training. Thus presentation of trained characters in trained contexts facilitated perception, analogous to the word superiority effect. We also found that after training, a single novel character (i.e., one not used in training) tended to “pop out” when it replaced a trained character in a familiar string. No such pop-out occurs if the novel item is embedded within other novel items. A Bayesian model encompassing both the context effect and the novelty pop-out effect is used to account for the results.

(455)

**Categorical Coding Explains the Dip in Response Times for Recognizing Inverted Objects.** BRIAN E. BROOKS & ERIC E. COOPER, *Iowa State University*—Recognition times for objects that have been rotated in the picture plane show a dip at 180°, where reaction times actually decrease. A possible explanation for this phenomenon is that objects are represented in terms of the above, below, and side-of (i.e., categorical) relations among their parts and that, at 180° of planar rotation, side-of relations are reconstituted, thus providing a better match to stored memory representations than at other orientations. Two experiments were conducted to test whether the dip is due to side-of relations being reconstituted at 180°. Experiment 1 found that objects that cannot be distinguished using categorical relations do not show the dip. Experiment 2 found that objects with no side-of relations fail to show the dip. The results thus suggest that the dip at 180° is caused by a representation that specifies the categorical relations among the parts.

• ATTENTION •

(456)

**The Transition From Feature-Based to Object-Based Processing.** ERIC RICHARDS, PIERRE JOLICŒUR, JENNIFER A. STOLZ, & MURIEL VOGEL-SPROTT, *University of Waterloo*—The transition from feature-based to object-based processing is examined in a series of experiments. A modified visual search paradigm was used where the target was defined by a change across two visual displays separated by a blank temporal gap. The durations of displays and gaps were varied, changing the cycle length of the display sequence. Search time increased with the number of characters in the display, producing a search slope. Search slopes were steeper when the change defining the target involved fewer features, but only when cycle length was short. The results provide evidence for a transition from feature-based processing to object-based processing as cycle length increased. Longer cycles allow more time for short-term consolidation of object-based representations, which mediates this transition. The results and their interpretation were based on a new method of analysis appropriate for comparisons across conditions that differ in cycle length.

(457)

**Elimination and Enhancement of Spatial Compatibility Effects With Mixed Mappings.** KIM-PHUONG L. VU & ROBERT W. PROCTOR, *Purdue University*—In two-choice tasks, the compatible mapping of left stimulus to left response and right stimulus to right response typically yields better performance than the incompatible mapping. However, when compatible and incompatible mappings are mixed within a block, the spatial compatibility effect is eliminated. Three experiments compared the effects of mixed mappings for physical locations, arrow directions, and location words. With keypress responses in Experiment 1, the compatibility effect was eliminated by mixing for physical locations and arrows but was enhanced for words. With vocal “left”–“right” responses in Experiment 2, the compatibility effect was reduced for all stimulus modes. Experiment 3 used physical locations to signal one mapping, and words to signal the other, using keypresses. The results did not differ from the conditions in which there was no mode distinction. These results are evaluated in terms of an alternative-routes model, and a more specific account in terms of task requirements is provided.

(458)

**Spatial and Temporal Factors in the Attentional Blink.** JACQUELYN M. CREBOLDER & ALEXANDRA J. OSTANIEWICZ, *Defence & Civil Institute of Environmental Medicine*—A previous study showed attentional blink (AB) effects when subjects monitored three rapid serial visual presentation (RSVP) streams in which the spatial location of a first target (T1) was known but that for a second target (T2) was unknown. When the two targets occupied the same spatial location and T2 immediately followed T1, T2 accuracy was high (lag-1 sparing). We now investigated performance when the spatial location of

both targets was unknown. Subjects effectively monitored three RSVP streams, as seen in high accuracy on T1, and AB effects were observed independent of the spatial location of either target. Again, lag-1 sparing occurred only when both targets occupied the same location. Overall T2 accuracy was higher when T2 appeared in the most upper stream, yet this performance difference was not apparent for T1. Whether or not AB effects and lag-1 sparing cascade to a third target was also examined.

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**Parallel Response-Selection in Dual-Task Situations.** SCOTT WAT-TER, *Beckman Institute, University of Illinois, Urbana-Champaign*, & GORDON D. LOGAN, *Vanderbilt University*—Semantic and motor-response priming were studied with the PRP paradigm to investigate the potential parallel nature of dual-task response-selection processes. Both tasks of a dual-task pair simultaneously primed, and were influenced by, response-selection information from the other. RT1 and RT2 were both faster when the finger used to respond to Task 1 was also used to respond to Task 2. This effect was observed at all SOAs for Task 2 and at short SOAs for Task 1. At short SOAs, Task 2 processing had progressed sufficiently to produce response-related information that primed not-yet-complete Task 1 response-selection. Such priming requires Task 2 response-selection to begin before Task 1 response-selection is complete—that is, Task 1 and Task 2 response-selection processes operate in parallel. These data falsify the discrete-stage processing assumption of the locus of slack logic, thus challenging the response-selection bottleneck theory that is built upon it.

(460)

**Enhancement, Extension, and Reversal of the Frequency Selectivity Effect.** TODD A. MONDOR, DAWEI SHEN, & JENNIFER HURLBURT, *University of Manitoba*—The influence of a frequency cue on judgments of whether or not a subsequent target incorporated a brief silent gap was examined. In Experiment 1 there was no predictive frequency relation, and evidence of auditory IOR was obtained, with frequency repetitions producing a facilitative effect at 175-msec SOA and an inhibitory effect at 775-msec SOA. Relative to this baseline performance pattern, increasing the probability of a frequency match to .75 (Experiment 2) served to generate a beneficial effect of frequency repetitions at all SOAs and to enlarge its magnitude at 175-msec SOA. In contrast, a reduction in the probability of a frequency match to .25 (Experiment 3) resulted in an inhibitory effect of repetition at all SOAs except for 175 msec, where no effect was apparent. These results establish that a frequency cue may engage both automatic and voluntary attentional processes within 175 msec following its presentation.

(461)

**Process Interference and Code Overlap in Dual-Task Performance.** IRING KOCH & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research*—Perceptual encoding processes have recently been shown to interfere with response selection in dual tasks (Jolicœur & Dell’Acqua, 1998). To additionally manipulate code overlap across tasks, we varied spatial cross-task compatibility (CTC). To accomplish this, we devised a new response-cuing paradigm in which we used a stimulus movement for later report in a perceptual task and a finger movement as response in a logically independent reaction task. We conducted three experiments showing dual-task process interference, but we also observed shorter reaction times with CTC than without. This CTC priming effect was largest with high temporal overlap between the perception and reaction stimuli. We interpret the CTC effect as resulting from overlap of code activation across tasks, whereas process interference seems to occur to prevent temporal overlap on the level of perceptual encoding and response retrieval processes.

(462)

**When a Mask Is Not Required to Produce an Attentional Blink.** MARY C. POTTER & DANIEL H. O’CONNOR, *MIT*—In earlier studies (Psychonomic Society annual meeting, 1999) Potter and Staub

presented two target words (T1 and T2) in separate RSVP streams among distractors, varying the SOA between the words. They found that at SOAs between 13 and 40 msec, T2 was more likely to be reported than T1, at 107-msec SOA the two were equal, and (as has been widely reported) at an SOA of 213 msec, T2 suffered an attentional blink. In previous AB studies in many labs, insertion of a blank after T1 reduced or eliminated the blink. In the present experiment, we compared two conditions between subjects: a replication of the two-stream experiment just described, without blanks, and the same experiment, but with a blank of 187 msec following each of the targets. Although overall performance was higher with the blanks, there was still a marked attentional blink at an SOA of 213 msec. Implications for models of the attentional blink are considered.

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**Dimension Weighting Modulates a Position Priming Effect in Visual Search.** TAKATSUNE KUMADA & YUJI TAKEDA, *National Institute of Advanced Industrial Science*—Two experiments investigated a cross-trial position priming effect in visual search. In Experiment 1, each display contained a singleton target defined by either color or shape. The target dimension was unpredictable. Consistent with previous studies (e.g., Hillstrom, 2000), RTs to a target presented in the position of a target of trial  $n-1$  were faster than those to a target presented in other positions. In Experiment 2, each search display contained two (one color- and one shape-defined) singletons. The target dimension was switched in every second trial. In repeated trials (e.g., color to color), a priming effect was observed only in the positions of targets of trial  $n-1$ . In change trials (e.g., shape to color), the priming effect occurred in positions where a singleton distractor was presented in trial  $n-1$ . This suggests that the priming effect does not simply occur at positions where attention was engaged in previous trials. Attentional setting for dimension modulates the position priming effect.

(464)

**Attentional Window Effect and Same-Object Interference.** ZHE CHEN, *University of Canterbury*—Previous research shows that when a relevant and an irrelevant object occupy different spatial locations, distractor interference was greater when the attentional window was wide than when it was narrow (Chen, 2000). In two experiments, the attentional window effect was investigated when the relevant and irrelevant information belonged to the same object. Participants identified the color of a Stroop color word or a series of letters. A wide or a narrow response cue preceded the target display. Greater interference occurred on the narrow-cue trials than on the wide-cue trials. Similarly, more interference was observed on valid than on invalid cue trials. However, the differential interference effect disappeared when a larger attentional window was needed on both types of trials for a second letter discrimination task. These results were interpreted in the framework of the attentional modulation on distractor interference.

(465)

**Reduced Change Blindness for Task-Relevant Visual Features During a Social Interaction.** DONALD A. VARAKIN, SHEENA ROGERS, JEFFREY T. ANDRE, & SUSAN L. DAVIS, *James Madison University*—Many participants in a staged social interaction do not notice when their unfamiliar conversation partner is switched with another, if the transition from one to another is occluded (Simons & Levin, 1998). We manipulated the relevance of the visual appearance of the partner to the task at hand and produced variation in the rate of “change blindness.” When the participant gave directions to a stranger (the Simons and Levin task), 33% noticed the switch. When participants passively received directions, 20% noticed the switch. When the participant actively sought directions, only 13% noticed the switch. But when participants were asked “Have I met you before?” 63% of the participants noticed the switch. This result is consistent with the hypothesis that only visual features relevant to the ongoing task are attended to and encoded in detail by a perceiver. In most situations, visual representations are sparse and contain little detail.

(466)

**Distance Effects in Interaction Between Exogenous and Endogenous Orienting.** YI-HSING HSIEH, *Chia Nan University of Pharmacy and Science*, & HARVEY G. SHULMAN, *Ohio State University*—Past research has concluded that an abrupt-onset distractor may or may not override an endogenous cue, depending on spatial certainty of the endogenous cue. Yet the underlying competitive mechanisms are still not clear. In two experiments, the cue-to-distractor stimulus onset asynchronies (SOAs) were manipulated. Following a central cue, an abrupt flash occurred in any location other than the centrally cued location. For 200-msec cue-to-distractor SOA, the nearest distractor produced the largest interruption. In contrast, for 84-msec cue-to-distractor SOA, the farthest distractor produced the largest interruption. In conclusion, the extent to which an abrupt-onset distractor will override a central cue depends on interaction of the cue-to-distractor SOA and on spatial distance between the cued location and the distractor, which has significant implications for the theories of visual search.

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**Visual Marking: Selective Attention to Asynchronous Temporal Groups.** YUHONG JIANG, MIT, LAWRENCE E. MARKS, *John B. Pierce Laboratory*, & MARVIN M. CHUN, *Vanderbilt University*—In visual search tasks, when a subset of distractors is previewed 1 sec before the target and the remaining distractors, search speed is independent of the number of previewed items. The process of ignoring old visual items is called visual marking. We explore the mechanism that allows the old items to be marked. Five experiments show that marking is disrupted if the onset of the new items is accompanied by changes to the old items but is not disrupted by changes restricted to the background or by changes to the old items that are not synchronized with the onset of the new items. Finally, old items can be prioritized over new items when they are behaviorally relevant. We propose that visual marking is based on temporal asynchrony between new and old items, allowing segregation of these items into two temporal groups, with attention then selectively applied to one group.

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**Neural Correlates of Cognitive Control and Conflict Detection.** ROBERT WEST, NICHOLAS WYMBBS, & KRISTEN JAKUBEK, *University of Notre Dame*—ERPs were used to examine the neural correlates of cognitive control and conflict detection in the Stroop and digit location tasks. The relevant dimension was cued on a trial-by-trial basis. Cognitive control was associated with a slow wave that reversed polarity from the frontal-central region of the scalp to the temporal-parietal region of the scalp, whereas conflict detection was associated with a slow wave that emerged approximately 600 msec after stimulus onset and reversed polarity from the lateral frontal regions of the scalp to the central-parietal region of the scalp. Over the left lateral frontal region, the conflict slow wave was similar in amplitude across type of response in both tasks. Over the right lateral frontal region, the conflict slow wave was greater in amplitude for the less dominant stimulus dimension (i.e., color or digit). These findings clearly demonstrate that different neural systems support cognitive control and conflict detection.

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**Task Switching Mediates the Attentional Blink Even Without Backward Masking.** JUN-ICHIRO KAWAHARA, *Hiroshima University*, & SAMANTHA M. ZUVIC, JAMES T. ENNS, & VINCENT DI LOLLO, *University of British Columbia*—When two targets are presented in rapid succession, perception of the second target is impaired at short intertarget lags (100–500 msec). This “attentional blink” (AB) is thought to occur only when the second target is backward masked. To the contrary, we show that task switching between the targets can produce an AB even without masking (Experiments 1 and 4). Furthermore, we show that task switching produces an AB only when the second target does not belong to a class of overlearned stimuli, such as letters or digits (Experiments 1 and 3). We propose that task switching in-

volves a time-consuming process of reconfiguration of the visual system, during which the representation of the second target decays beyond recognition, resulting in an AB deficit. We suggest that overlearned stimuli are encoded in a form that, although maskable, decays relatively slowly, thus outlasting the delay due to reconfiguration and avoiding the AB deficit.

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**Priming of the Stimulus Set in Task Switching.** MYEONG-HO SOHN & JOHN R. ANDERSON, *Carnegie Mellon University*—Switch cost (the disadvantage of performing a new task vs. a repeated task) has been partly attributed to priming of the repeated task, as well as to inappropriate preparation for the switched task. The present study examined the nature of the priming effect in a modified task-switching paradigm, in which only a part of the task was repeated or switched—namely, the stimulus set. Results indicated that repeating the stimulus set alone can result in a switch cost in limited conditions, such as (1) when the intervening interval is short enough so that the activation does not completely dissipate or (2) when there are multiple repetitions so that the activation can be maintained. We argue that the switch cost related to the activation from stimulus set may be automatic and short-lived.

## • COGNITION •

(471)

**Testing Complex Causal Models.** YORK HAGMAYER & MICHAEL R. WALDMANN, *University of Göttingen*—Current research on causal reasoning has focused on how people test simple causal hypotheses (i.e., A causes B). Very little is known, however, about how complex causal models are being tested, such as common-cause models with multiple effects and common-cause or common-effect models with multiple causes and a common effect. Normatively, causal models can be tested by assessing the individual causal links within the model, along with structural implications about indirect relations. For example, a common-cause model in which a single cause leads to two different effects implies separate causal links between the cause and the two effects, along with a correlation between the two effects. This correlation is a consequence of the structure of the causal model. Three experiments were conducted to investigate how people test complex causal models. The results indicate that people assess the individual causal links separately but disregard structural implications of causal models.

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**Hierarchical Coding of Spatial Properties: A Categorical Endorsement.** DANIEL B. M. HAUN & GARY L. ALLEN, *University of South Carolina*—Recent research has indicated that verbal estimates of spatial properties such as geographic slant are influenced by hierarchical coding, whereas motoric estimates with the hand are unbiased (e.g., Creem & Proffitt, 1998). In our study of memory-based verbal and motoric estimates of slant and direction to target, we replicated Proffitt and colleagues' patterns of estimates with small angles. However, by extending the range of target angles, we found evidence that both verbal and motoric estimates were influenced by circular categorization, consistent with Huttenlocher, Hedges, and Duncan's (1991) hierarchical coding model. Estimates of height and reaching distance also revealed effects consistent with categorical influences. Results suggest that fine-grained and categorical information influence the representation of spatial properties regardless of whether that representation supports verbal expression of stimulus magnitude or motoric indication of angle or distance.

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**Implicit Associative Learning in an Incongruent Color-Naming Task.** CÉLINE LERMERCIER, *Université de Toulouse le Mirail*, & THIERRY BOUILLOT & SANDRINE COGNIARD, *Université d'Angers*—This study examined implicit associative learning following a color-naming practice session. The subjects were 20 nonbilingual French students. The practice session contained six French words and their Swedish

translation equivalents (e.g., CUISSE in French and KYL in Swedish were both always in blue; TABLE in French and BORDET in Swedish were both always in red). In a subsequent lexical decision task, the probe/target item was either a nonword (e.g., CEBOD) or a French word (e.g., BRAS). The preceding prime item was always one of the practiced words—either the probe-associated French word (CUISSE) or its Swedish translation (KYL)—or a probe-unrelated French (TABLE) or Swedish (BORDET) word. There was facilitation on lexical decision probe RTs not only when the prime was a French word semantically linked, but also when it was a Swedish word semantically linked. We discuss these data in light of interference and implicit learning theories.

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**Cortical Systems Supporting Figural Encoding, Maintenance, and Rotation.** HIDEYA KOSHINO, *Carnegie Mellon University and California State University, San Bernardino*, & MARCEL ADAM JUST, PATRICIA A. CARPENTER, & TIMOTHY A. KELLER, *Carnegie Mellon University*—This fMRI study examined the brain activation in the inferotemporal (“what system”), the parietal (“where”), and the prefrontal (DLPFC) regions (associated with working memory), in a modified mental rotation task. Subjects showed the typical behavioral effects in response time and errors. Each independent variable affected its associated cortical regions as expected; the complexity of the figures significantly affected activation in the inferotemporal region, the degree of mental rotation significantly affected activation in the parietal region, and the requirement to briefly remember the figures affected activation in DLPFC. In addition, rotation affected the activation of the temporal areas, and figural complexity had effects on the parietal areas. These effects suggest a more integrative model of cortical processing than one that emerges from cortical mapping studies that associate regions, such as the inferotemporal or intraparietal regions, with single visuospatial functions.

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**Beyond Imagination: On Perspective Change Problems.** RANXIAO FRANCES WANG, *University of Illinois, Urbana-Champaign*—Four experiments investigated whether performance in spatial reasoning tasks reflects the ability to “imagine” (i.e., mentally transform the representations) or the responding processes. Performance did not improve even when extended time was given to imagine oneself facing a different direction. When pointed to multiple targets after a single imagination, performance on later responses did not improve. In contrast, when egocentric target directions were reported in terms of verbal estimations, performance in the imagination condition was as good as that in the no-imagination condition. These results suggest that in an imagined self-rotation task, the imagination process itself is not the critical issue and that performance is primarily determined by how well a response can be made according to the transformed representations. The present findings call for a careful reinvestigation of various spatial reasoning tasks by separating different stages of the process.

## • JUDGMENT/DECISION MAKING •

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**Effects of Analytical and Intuitive Decision-Making Styles on Betting Behavior in Horse Race Gambling.** THOMAS E. NYGREN & REBECCA J. WHITE, *Ohio State University*—Participants were given the Decision Making Styles Inventory (Nygren, 2000) assessing propensity toward analytical and/or intuitive decision-making styles and were presented with thirty simulated horse races. High intuitiveness scorers tended to perform best, despite the fact that all participants were constrained to win and lose the same number of times. An ANCOVA on amount bet on a trial following one, two, or three consecutive losses or wins showed no interaction effect with intuitiveness score; however, higher intuitiveness scores were associated with larger amount bet regardless of recent trial history. A comparable ANCOVA did show an interaction effect with analytical score. Higher intuitiveness participants did not appear to change their decision strategy on the

basis of results from previous trials; more analytical bettors did do so, however, suggesting that they may have been more susceptible to the “gambler’s fallacy,” thus resulting in worse overall performance.

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**Causality and Predictions About Runs: “Gambler’s Fallacy” Versus “Hot Hand.”** BRUCE D. BURNS & BRYAN CORPUS, *Michigan State University*—Sometimes people believe that a run of identical independent events will be broken (“gambler’s fallacy”), but other times that such a run will continue (belief in the “hot hand”). These opposite phenomena have both been explained as due to belief in a law of small numbers. We argue that what distinguishes these phenomena are people’s beliefs about how causal the underlying mechanism generating events is. We presented participants with runs of dichotomous events that occurred equally often but varied the scenario so that the mechanism generating events was believed to be random, causal, or competitive. Participants were more likely to go against the run when the scenario was random than when it was causal, but least likely when the scenario was competitive. Participants were more likely to continue runs if the next event was set in the future than in an unobserved past, but only if the scenario was casual or competitive.

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**Context Discrimination and Source Monitoring in Judgments of Frequency.** MICHAEL DOUGHERTY & ANA FRANCO-WATKINS, *University of Maryland*—A common finding in judgment and decision making is that frequency judgments often fail to map onto objective frequencies. The present research examined the possibility that one source of bias in frequency judgment is attributable to the inability to screen out irrelevant memory traces. We used a two-list source-monitoring paradigm to investigate whether frequency judgments are influenced by “extra-experimental” experiences and whether enhancing source monitoring improves judgment accuracy. Across five experiments, we found that (1) frequency judgments regarding one list were biased by the second, (2) manipulating encoding between lists improved source monitoring and resulted in more accurate judgments, (3) manipulating context between lists improved source monitoring and resulted in more accurate judgments, but only when the context was item specific, and (4) manipulating simple background context between lists was ineffective at improving source monitoring. The results were inconsistent with global-matching models of memory.

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**Predicting Prostate Cancer Screening Intentions Using the Health Beliefs Model.** RENEE B. PATRICK, ROBERT M. HAMM, & DAVID E. BARD, *University of Oklahoma Health Sciences Center*—Participants responded to questions about health beliefs, knowledge, and intentions about prostate cancer (PC) screening and treatment before and after exposure to PC information. Analyses focused on a subset of health beliefs questions designed to measure four factors from the health beliefs model (HBM). The aim was to investigate relationships between these factors and participants’ PC screening intentions. Prior to intervention, only *benefits* and *susceptibility* distinguished those desiring screening from those choosing alternate responses (logistic regression), whereas after intervention only *barriers* and *severity* were found to be predictive. The direction of all relations was consistent with the HBM model (e.g., lower agreement with screening barriers relates to higher probability of screening). These results suggest that better-informed participants may use different HBM factors when making screening decisions.

(480)

**Comparison-Induced Distortions in the Asymmetric Dominance Effect.** JESSICA M. CHOPLIN & JOHN E. HUMMEL, *UCLA*—In the asymmetric dominance effect, introducing a decoy item that is similar to, but clearly worse than one of two competing options biases choice toward the option most similar to the decoy (Huber, Payne, & Puto, 1982). Two experiments investigated whether explicitly compar-

ing options distorts estimates of their attribute values, making the option most similar to the decoy appear more favorable. In Experiment 1, participants compared options and later recalled their attribute values. Patterns of bias in recall revealed that memory for attributes was distorted in a manner consistent with observed biases in choice: Recalled attributes of the option most similar to the decoy were more favorable than those of the alternative option. Experiment 2 demonstrated analogous recall effects for stimuli that varied on only a single dimension (line length). These findings support the hypothesis that comparison-induced distortions are responsible for the asymmetric dominance effect.

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**Unwanted Order Effects on Judgment: Shall the First Be the Last?** WANDI BRUINE DE BRUIN & GIDEON KEREN, *Technische Universiteit, Eindhoven*—Little is known about order effects on judgments of sequentially presented options. Yet, many real-world judgment tasks present options in sequence. In the Eurovision Song Contest, for example, judges evaluate 15–20 artists after all have performed in random order. We analyzed the judgments made for Eurovision in the past 36 years and found significant order effects. Possibly, they reflect order effects on memory, with jury members awarding fewer points to songs they could not recall. Memory effects, however, cannot explain why we found similar order effects in expert judgments of yearly World Figure Skating Contests, because each figure skater is evaluated immediately after performing. (We analyzed the results of the Short Program, in which order of appearance is random.) We conducted a series of experiments, which try to explore the mechanisms underlying order effects on judgments. Preventive measures will be suggested.

• HUMAN LEARNING/MEMORY •

(482)

**The False Memory and the Mirror Effects: The Role of Familiarity and Backward Association in Creating False Recollections.** DAVID ANAKI, YIFAT FARAN, & AVISHAI HENIK, *Ben-Gurion University of the Negev*—A common paradigm in investigating false memory is presenting a list of words related to a nonpresented lure and investigating the incorrect memory for the lure. In the present experiments, we examined the effects of (1) lure familiarity and (2) backward association strength on false and veridical memory. The classic mirror effect was revealed: Veridical recognition was higher for low-familiarity targets, whereas the false alarm rate was higher for high-familiarity unrelated distractors. The pattern of results of the nonpresented lures was similar to the presented items: higher false recognition of low-familiarity lures (especially in the high backward association condition). The existence of a familiarity effect in false memory is best accounted for by theoretical approaches that emphasize the associative and activation processes that occur during the encoding stage. The present results suggest that nonpresented lures develop episodic memory traces and act like presented words from the lists.

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**Generative Processing and False Memories: When There Is No Cost.** SAL A. SORACI & RICHARD A. CHECHILE, *Tufts University*, MICHAEL P. TOGLIA, *SUNY, Cortland*, JEFFREY S. NEUSCHATZ, *University of Alabama, Huntsville*, MICHAEL T. CARLIN, *University of Massachusetts*, & CRISTY HO, *Tufts University*—Toglia, Neuschatz, and Goodwin (1999) demonstrated a “more is less” effect, in which manipulations known to facilitate retention (e.g., categorical blocking of items) also resulted in increased false memories. The present series of studies explored this effect with respect to generative processing. In Experiments 1–3, with single word fragment completion tasks, both recognition and recall tests indicated robust congruous generation effects that were orthogonal to false memories. In Experiment 4, we utilized both congruous (e.g., A generator of invisible light: L\_SER) and incongruous (e.g., Not a generator of invisible light: L\_SER) encoding contexts with response cues. A “more is less” pattern was found for congruous generation, and a novel “more is

more” effect (i.e., enhanced retention and a diminution in false memories) was demonstrated for incongruous generation. The critical role of cues in generative processing and the important distinction between congruous and incongruous encoding contexts as they relate to false memories will be discussed.

(484)

**Accessing Causal Relations in Semantic Memory.** DANIELA SELLNER & MICHAEL R. WALDMANN, *University of Göttingen*, & KEITH J. HOLYOAK, *UCLA*—Most studies investigating semantic memory have focused on taxonomic or associative relations. Very little is known about how other types of relations, such as causal relations, are represented and accessed. In several experiments, we presented participants with pairs of words, one after another, describing events that referred to either a cause (e.g., *spark*) or an effect (e.g., *fire*). We manipulated the temporal order in which the words were presented and the question to which participants had to respond. The results show that questions referring to the existence of a causal relation are answered faster when the first word referred to a cause and the second word to its effect than vice versa. However, no asymmetry was observed with questions referring to an associative relation. Thus, participants were capable of accessing different types of relational knowledge in a task-dependent fashion.

(485)

**Superior Recall of Dialogue by Undergraduates Through Accompanying Nonliteral Movements.** HELGA NOICE, *Elmhurst College*, TONY NOICE, *Indiana State University*, & KIM TAMOSAITIS, *Elmhurst College*—Although previous research (Noice, Noice, & Kennedy, 2000) had demonstrated that lengthy complex material learned when moving was recalled more accurately than material learned while remaining relatively still, that investigation was performed with professional actors who had repeatedly performed the material in public. Using untrained nonactors with only brief procedural coaching, two experiments found that participants who processed a script by reading the text aloud while simultaneously moving in ways that were not literally congruent with the text retained more material than did those who used verbal communication only or deliberate memorization controls. When the recall of the participants in the moving condition was analyzed on a speech-by-speech basis, results revealed significantly greater memory for speeches during which the participant had been moving about than for speeches during which the same participant had remained in one place. These findings are discussed in the contexts of embodied cognition and multimodal memory models.

(486)

**Effects of Manipulating Foreground Task on Prospective Memory Performance.** JESSICA LANG NOWINSKI & R. KEY DISMUKES, *NASA Ames Research Center*—Previous experiments demonstrated that prospective memory targets presented during a foreground task introduced at encoding (along with the prospective task instructions) were identified more often than targets presented during a new task introduced later in the experiment. The cause of this task effect is unclear, since initial presentation of each ongoing task was confounded with exposure; the task introduced at encoding was also presented more often. The present experiments varied the two factors separately. In Experiment 1, exposure was held constant across the two tasks, whereas initial presentation was varied. A diminished but significant task effect was observed. In Experiment 2, initial presentation was held constant (both tasks were presented at encoding), whereas exposure during the experiment was varied. Targets presented during the more frequently encountered task were recognized more often, although this effect was not significant. We consider alternative explanations for the task effect.

(487)

**Implicit and Explicit Learning of a Serial Reaction Time Task.** RICK M. HEALEY & F. MICHAEL RABINOWITZ, *Memorial Uni-*

*versity of Newfoundland*—The implicit/explicit learning of children was studied using a serial reaction time task (Nissen & Bullemer, 1987). The independent variables were age (9- and 12-year-olds), stimulus sequence (three levels of structural complexity), and target stimulus (stars and letters). Awareness was assessed using verbal reports, a generation task, and recognition memory. Children’s reaction times decreased as a function of verbal awareness and structural complexity. Verbally aware subjects did not appear to learn the sequence intentionally, as was evidenced by their imperfect recognition and generation task performance. We interpret these findings as reflecting that (1) the sequential learning of all participants was implicit and (2) some part sequences could be explicitly recalled even though they were not explicitly learned, a pop-out effect.

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**Neuro-Scientific Measures of Study (S) and Test (T) Presentation Program Effects.** CHIZUKO IZAWA, ROBERT G. HAYDEN, & MICHAEL FRANKLIN, *Tulane University*, & EDWARD KATKIN, *SUNY, Stony Brook*—To measure hitherto unexamined neurophysiological reactions to five study–test (S–T) presentation programs under SSSSSST, SSST, ST, STTT, and STTTTTT repetitive patterns/conditions, 50 college freshmen (10/condition) learned a 20-pair list, while galvanic skin responses (GSR) and heart rates (HR) were recorded. Correct response analyses showed large differences among S–T presentation programs. Furthermore, (1) large S–T program effects were generated by both HR and GSR, either as a function of S, T, or S+T/total time, respectively; (2) HR remained stable from the beginning to the end of both S and T trials, and differences between them were small; (3) Very intriguingly, GSRs for Ts with successive Ss were dramatically higher than those of the Ss (which differed little among themselves). However, no notable differences obtained between S and T in the conditions with successive Ts. These and other new findings will be discussed from the perspectives of Izawa’s study–test–rest (STR) presentation and alternative hypotheses.

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**Do Problems of Inhibitory Control Underlie Memory Deficits Associated With Multiple Sclerosis?** LAEL J. SCHOOLER, PETER A. ARNETT, & JENNIFER R. LEER, *Pennsylvania State University*—We are exploring memory deficits associated with multiple sclerosis (MS) by testing healthy undergraduates and MS patients, using Deese’s (1959) false-memory paradigm. This procedure induces subjects to produce “false memories” of having studied words that were not studied. Our preliminary results suggest, as has been found by others, that with longer study durations young adults show improved recall and produce fewer “false memories.” Although MS patients show the improved recall with longer study durations, their high rate of “false memory” production seems to be relatively unaffected by study duration. Since MS patients exhibit problems with inhibitory control and such problems have been hypothesized to underlie false memory production, we are administering neuropsychological tests (e.g., Stroop) presumed to measure inhibitory control, to see whether this can account for the differential effects of study duration. Control subjects matched to the MS subjects on age and socioeconomic status are also being run.

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**Evidence in Support of a Selective Rehearsal Account of List-Method Directed Forgetting.** ERIN D. SHEARD, MICHAEL D. DODD, DARYL E. WILSON, & COLIN M. MACLEOD, *University of Toronto*—In list-method directed forgetting, “remember” words (R) are recalled better than “forget” words (F). Increasing study-to-test delay increased the directed forgetting effect for high-memory subjects (R increased, F decreased), but decreased it for low-memory subjects (R decreased). Perhaps only high-memory subjects selectively rehearsed R words during the delay. To test this hypothesis, we gave a pre-delay warning that both R and F words would have to be recalled. (Gilliland et al., 1996, reported that such a warning reduced the R-F

difference.) For high-memory subjects, the warning reduced the directed forgetting effect (R decreased, F increased), consistent with selective rehearsal of F words. For low-memory subjects, the warning had no effect, suggesting no selective rehearsal. In a further experiment, we controlled the amount of rehearsal that subjects performed. Taken together, these results suggest that selective rehearsal can account for list-method directed forgetting.

(491)

**The Ability of Healthy Older Adults and Individuals With Dementia of the Alzheimer's Type to Learn Facts From Fiction.** ELIZABETH J. MARSH, DAVID A. BALOTA, & HENRY L. ROEDIGER, III, *Washington University*—Healthy older adults and individuals with very mild or mild dementia of the Alzheimer's Type (DAT) listened to and read fictional stories containing correct and incorrect facts about the world. Of interest was the use of this story information to answer trivia questions on a later test. Prior exposure to relatively well known facts boosted all subjects' ability to correctly answer questions and led to misinformation effects in healthy older adults and those with very mild dementia. However, only healthy older adults' performance was affected by prior reading of relatively less known facts. The results suggest that while individuals with DAT may be biased by story reading, they are so when there are preexisting knowledge structures that they can easily relate to the incoming information.

(492)

**The Relative Influences of Encoding and Retrieval Processes on Prospective Memory.** BRENDA HANNON & MEREDYTH DANEMAN, *University of Toronto*—Although previous studies have investigated the influence of encoding, retrieval, and the match between encoding and retrieval on prospective memory, they have not investigated the influences of all three factors simultaneously. Our study investigated the relative influences of these three factors in a single design. Prospective memory was measured by instructing participants to press a key whenever the word "animal" or a word denoting any type of animal appeared on the screen while they were engaged in a reading task. Salience at encoding was manipulated by varying whether or not participants generated exemplars of the animal category before beginning the reading task. Effort at retrieval was manipulated by having the prospective memory target appear intact ("All alligators are nasty...") or incomplete ("All allig— are nasty..."). Both factors influenced prospective memory, but it was the degree of match between encoding and retrieval contexts (animal–animal vs. animal–alligator) that had the greatest effect.

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**Effect of Time on Memory for Choices.** LINDA A. HENKEL, *Fairfield University*, & MARA MATHER, *University of California, Santa Cruz*—Research has shown that when remembering a recent choice, people attribute (both correctly and incorrectly) more positive features to the option they choose and more negative features to the option they rejected (Mather, Shafir, & Johnson, 2000). The present study examined whether these choice-supportive asymmetries increase with time, as memory for choice features becomes less accurate. Participants tested 20 min and those tested 2 days after making a choice were both choice supportive, but their choice-supportive asymmetry scores did not differ from each other. Thus, the choice-supportive bias was not affected by the quality of the memory for choice features. However, data from participants who misremembered which option they chose suggest that over time, choice-supportive biases will be more likely to originate from processes operating at retrieval than at encoding. We also examined whether choice supportiveness was associated with subjective well being and happiness but found no correlation.

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**Nature of Representation in Sequence Learning.** BENJAMIN CLEGG, *Colorado State University*—The ability to sequence events is fundamental to human performance. However, the nature of se-

quence representation has remained elusive within work using the serial reaction time task paradigm. Tasks with two stimuli paired to each response were used, with such mappings allowing a separation of stimulus from response sequences. Results from several experiments suggest that performance can be stimulus based or response based, even with the same sequences of stimuli or responses employed. Insight into the representation of sequences can be gained by considering the information-processing demands of the situation.

(495)

**Stereotypes May Override Retrieval-Induced Forgetting.** LISA MAXFIELD, ANDREA ALCALA, HUGH HAIKER, & TAMMY CALVILLO, *California State University, Long Beach*—Retrieval-induced forgetting (RIF) occurs when repeated remembering of some items impairs recall of associated items not practiced with repeated remembering. Using an impression formation paradigm, Macrae and MacLeod (1999) presented participants with 10 personality traits for each of two names (John and Bill). Participants then practiced recalling 5 traits for one name. At later recall, RIF was obtained. Nonpracticed traits associated with the practiced name were forgotten more than traits associated with the nonpracticed name. Adapting their paradigm, we hypothesized that RIF might be overridden if the names and traits suggested a well-learned category that might be resistant to forgetting. We compared a primarily neutral name/trait set (e.g., Jan–motivated) with a name/trait set suggestive of a stereotype (e.g., Bambi–sexy). As was expected, RIF was abolished when the nonpracticed traits invoked the stereotype. Thus, stereotypes may insulate information from RIF.

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**Automatic Entry of Irrelevant Speech Cannot Explain Age Effects.** EMILY M. ELLIOTT, *University of Missouri, Columbia*—The irrelevant-speech effect refers to the finding of poorer recall performance in the presence of irrelevant auditory stimuli. Two broad classes of theories exist for the effect: (1) theories with automatic entry of the sounds into the processing system and (2) theories describing a role for attention. The goal of this study was to differentiate among existing theories of the irrelevant-speech effect by examining the performance of children and adults on a visual, serial recall task with irrelevant sounds. The magnitude of the effects of irrelevant sounds on performance was found to change with age, with children being more adversely affected than adults. The findings were interpreted with respect to current models of memory. Theories of the irrelevant-speech effect that include a role for attention were better suited to handle the results than were those with automatic entry.

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**Encoding and Retrieval Effects in Lineups.** SCOTT D. GRONLUND, *University of Oklahoma*—A man's height was encoded in a relative (e.g., taller than the accompanying woman) or absolute (e.g., 6'2") manner. At test, four different heights for the same man were presented in a sequential or a simultaneous lineup. Wells (1984) argued that sequential lineups lead to more absolute judgments and simultaneous lineups lead to more relative judgments. As is predicted by transfer-appropriate processing, hit rate was better when the encoding and retrieval matched (i.e., the absolute/sequential and relative/simultaneous conditions). The sequential lineup also led to a higher correct rejection rate (as has been found previously), with a parallel benefit for absolute encoding. The type of encoding and type of lineup also differentially affected the distributions of responses. Implications for explanations of false memory effects are discussed.

• RECOGNITION MEMORY •

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**Schemas and Retention Interval Influence False Memories in the Classroom.** JEFFREY S. NEUSCHATZ, *University of Alabama, Huntsville*, MICHAEL P. TOGLIA, *SUNY, Cortland*, JAMES M. LAMPINEN, *University of Arkansas*, & ELIZABETH L. PRESTON,

*University of Alabama, Huntsville*—In two experiments we examined the role of memory schemata in a naturalistic setting. Participants watched a 10-min videotaped lecture in which the instructor enacted both schema-consistent actions (e.g., writing on a whiteboard) and schema-inconsistent actions (e.g., smoking a cigarette). Following the lecture, they completed a recognition test and rated the experiential content of their memories. In both studies, memory was more accurate for schema-inconsistent than for schema-consistent behaviors, since atypical distractors were falsely recognized less frequently. Participants also indicated that their recollections were more vivid for schema-inconsistent than for schema-consistent actions. Interestingly, in Experiment 2 the false memory rate for typical items increased across retention intervals of 48 h and 1 week, and even a jump in illusory atypical memories was observed after a week. The implications of these results regarding the processes of human memory in everyday situations are discussed.

(499)

**The Effects of Negative Mood State on False Memories.** MASA-NOBU TAKAHASHI, *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, a particular mood state was induced in participants by a musical mood induction procedure, and then a long list of semantically related negative-toned words was studied. Results of both experiments demonstrated that participants who were induced into a negative mood state recalled and recognized a significantly greater proportion of critical lures than did the participants who were induced into neutral and positive mood states. The present findings therefore lend support to theories that attribute false memories to heuristic-based factors.

(500)

**Dual-Process Theories of Episodic Recognition and the Remember-Know Procedure.** PATRICK O. DOLAN, *Washington University*, & DAVID I. DONALDSON, *University of Stirling*—Dual-process theories of recognition memory postulate a search-like process that recovers details of the study episode (“recollection”) and a second process that assesses the strength of the test probe (“familiarity”). Much support for these theories has come from the two-list exclusion and remember-know procedures. Exclusion relies on dissociations influenced by the time course of the two processes (recollection is slow and controlled, familiarity is fast and automatic), whereas remember-know procedures rely on dissociations based on encoding and retrieval variables (levels of processing, retention interval). If these procedures tap the same constructs, remember responses might be expected to be slower than know responses. However, across two experiments employing the remember-know-guess procedure and several study/test manipulations (word frequency, list length, one- versus two-stage r/k/g), remember responses were consistently faster than know responses. We discuss the characteristics of the recollection and familiarity processes, and the consequence of these findings for dual-process theories.

(501)

**Global Effects of Timbre on Melody Recognition Are Mediated by Familiarity.** J. DEVIN MCAULEY, *Center for Neuroscience, Mind, and Behavior, Bowling Green State University*—Previous research has shown that effects of changes in global context on recognition memory are mediated by the familiarity of the target (Dalton, 1993; Russo, Ward, Geurts, and Sheres, 1999). The present study extends this research to familiar and novel melodies. Participants rated the familiarity of a set of target melodies and then were tested for their recognition in either matched or mismatched study–test instrument contexts. Instrument context corresponded to the instrument sound (timbre) used to present the set of melodies during the study and test episodes. For novel melodies, changing the instrument context between study and test produced a mirror effect, with greater recognition accuracy found for matched contexts than for mismatched contexts. In contrast,

no effect of instrument context was observed with the familiar melodies. The implications of these findings for current models of recognition memory are discussed.

(502)

**The Attribution of Perceptual Fluency in Recognition Memory.** DEANNE L. WESTERMAN, MARIANNE LLOYD, & JEREMY MILLER, *SUNY, Binghamton*—Three experiments were conducted to determine whether the use of perceptual fluency in recognition memory depends on a perceptual match between study and test. In these experiments, the perceptual fluency of recognition test items was enhanced by briefly presenting a prime that matched the subsequent test item. This manipulation increased the tendency to claim that a test item was old when the study and the test phases were presented in the same perceptual modality. When the study and the test phases were in different modalities, the manipulation of perceptual fluency did not affect recognition responses. The interaction between modality match and perceptual fluency was also found when “counterfeit” study lists were presented. The interaction between perceptual fluency and modality match was found to occur only when modality was manipulated between subjects; when modality was manipulated within subjects, enhancing the perceptual fluency increased positive recognition response for all test items.

• MENTAL MODELS •

(503)

**Taxation With Representation: Eye Movements Reveal Cost of Spatial Frame Switching in Text.** CHRISTY R. MILLER, GARY L. ALLEN, & ROBIN K. MORRIS, *University of South Carolina*—Previous research has raised the issue of whether there are cognitive costs involved in comprehending spatial descriptions that require the reader to switch from one frame of reference to another. We addressed this issue in the present experiment by analyzing readers’ eye movements as they read scenarios that (1) included the use of either a consistent frame of reference (body-centered or global) or a change from one to the other and (2) concluded with mention of either a spatially valid or a spatially invalid target object. Results indicated that switching from one frame of reference to another required extra processing time on the target object. Also, readers who encountered the consistent body-centered perspective spent more initial time—but less total time—on the valid target objects than did readers who encountered the global perspective. Readers may be constructing a frame-of-reference-based mental model useful for validating additional spatial relations that they may encounter.

(504)

**Distinct Neural Substrates Recruited for Logical and Mathematical Reasoning.** JAMES K. KROGER, JONATHAN D. COHEN, & PHILIP N. JOHNSON-LAIRD, *Princeton University*—We recorded brain responses as subjects solved hard or easy deduction and mathematical problems. A strong double dissociation between two distinct regions in the prefrontal cortex (pfc) for deductive and mathematical reasoning was observed. Also, linguistic processing was observed during encoding of problems but was not involved in solution of logic problems. The right pfc was significantly more active during solution of logic problems, and the anterior right pfc responded only during difficult logic problems that entailed formulation of a counterexample. The left dorsolateral pfc, along with the bilateral caudate and intra-parietal sulcus, a network often engaged for working memory, was activated during mathematical reasoning. Our results suggest that an initial linguistic representation of deduction problems is converted to a mental model and operated on by the right frontal cortex, whereas mathematical reasoning recruits the left frontal and bilateral superior parietal regions for working memory. It also suggests that the anterior pfc is engaged to mediate attention to complex representations.

(505)

**Perceiving Temporal Structure in Simple Artificial Events.** JEFFREY M. ZACKS, *Washington University*—People can divide everyday activity into meaningful hierarchies of temporal parts and subparts and can use this part structure to remember the past, react in the present, and plan for the future. The present research asked two questions about the boundary conditions of this perceptual ability. First, does the perception of temporal part–subpart relations require animate agents and naturalistic settings, or can observers find this structure in random movements of simple geometric figures? Second, do observers need to believe that activity is intentional (goal-directed) in order to perceive hierarchical part structure, or do they impose it on activity they know to be random? Data from experiments in which observers segmented simple animations into natural units indicate that participants can see part–subpart structure in simple random animations but that this perceptual structure may be modulated by expectations about whether the sequences depict intentional activity.

(506)

**Students' Knowledge of Geometric Abstractions.** PATRICIA BAGGETT, *New Mexico State University*, & ANDRZEJ EHRENFEUCHT, *University of Colorado, Boulder*—Students can acquire considerable skills in geometric constructions already in the early grades. But the science of geometry is based on several abstractions that cannot be deduced from direct observations. The three main abstractions are the following. (1) Points do not have size; their diameters have length of zero; and therefore no two points can touch. (2) The points on a line are dense, which means that between any two different points there are many other points. (3) A straight line is a set of points, as are other geometric figures. Three hundred eighty-one students from middle and high schools and at the college level were asked about the three abstractions. Only 26% agreed with all three. The poster provides detailed results and presents some hypotheses about students' mental models of geometric space and about some possible reasons why geometric abstractions are so poorly known.

(507)

**Body Schemas.** JULIE BAUER MORRISON, *Bryant College*, & BARBARA TVERSKY, *Stanford University*—How do we think about the space of bodies? This was addressed in body-part verification tasks exploring three accounts of reaction times. An imagery account predicts faster times to larger parts (e.g., back < hand). A part distinctiveness account predicts faster times to more discontinuous parts (e.g., arm < chest). A part significance account predicts faster times to parts that are perceptually distinct and functionally important (head < back). Both name–body and body–body comparisons were investigated in four experiments. In all, larger parts were verified slower than smaller ones, eliminating the imagery account. When comparisons were perceptual, part distinctiveness was the best predictor; however, when implicit or explicit naming was involved, part significance was the best predictor. Naming seems to activate functional aspects of bodies.

• PICTURE MEMORY/PROCESSING •

(508)

**A Phonological Investigation of Picture Naming in English/Spanish Bilinguals.** AIMEE KNUPSKY & PAUL AMRHEIN, *University of New Mexico*—Thirty-five bilinguals named pictures in either English or Spanish. Twenty-three of the participants were English/Spanish bilinguals. Twelve of the participants were Spanish/English bilinguals. Word distractors (in either L1 or L2) were presented simultaneously with the pictures to be named and were related in several ways to the picture names. Words were either directly phonologically related to the picture name, phonologically related through translation to the picture name, or unrelated to the picture name. Picture naming occurred either in blocked conditions (response in either English or Spanish) or in a mixed condition (response in both English and Spanish). Differences in facilitation were found for distractor (direct and through transla-

tion), presentation condition (blocked vs. mixed), and response language (L1 vs. L2) mediated on L1/L2 effects. Results of the study support a model of bilingual processing in which both language-specific and language-nonspecific selection could occur, depending on experimental context and mediated by strong/weak language effects.

(509)

**The Effects of Attention Distribution on Memory for Spatial Layout.** CARMELA V. GOTTESMAN & SCOTT D. GRONLUND, *University of Oklahoma*—When viewers see partial views of scenes, they extrapolate surfaces beyond the view boundaries. The extrapolated information is incorporated into memory, and viewers remember a more wide-angle view than they had seen (“boundary extension”). Four experiments examine how attention distribution affects extrapolation. Participants viewed photographs depicting two objects: one close-up and one farther from the camera. They were told to pay attention to one of the objects. The memory test revealed more extension for the front object, independent of whether it was the attended object or not. This pattern was obtained when eye movements were possible and when they were not. However, when viewers attended globally, the extension was uniform. If viewers moved their attention from object to object, more extension was obtained if the move was toward the foreground than if it was toward the background. Implications regarding the interaction between attention and spatial layout representation are discussed.

(510)

**The Relationship Between Change Detection and Visual Memory: Evidence From Target Postcuing.** ANDREW HOLLINGWORTH, *Yale University*—A traditional assumption in the change detection literature has been that change detection performance directly reflects visual memory capacity. However, constraints on retrieval and comparison processes may also account for limitations on change detection. A paradigm was employed in which the visual form of a target object changed between initial and test views of a natural scene. The target was either cued in the test scene or not. Detection performance was reliably higher (and near ceiling) in the former condition, when participants could limit retrieval and comparison processes to the target. Additional manipulations demonstrated excellent change detection for objects unattended when the change occurred and excellent change detection with concurrent verbal memory load. These data demonstrate that visual memory for scenes can be quite detailed and that limitations on change detection (i.e., change blindness) derive, at least partially, from retrieval/comparison failure, rather than from constraints on memory capacity alone.

(511)

**Perceiving the Internal Consistency of Scenes.** ELISA K. CHENG & DANIEL J. SIMONS, *Harvard University*—Although early studies of object recognition found better naming performance when objects were embedded in consistent rather than inconsistent scene contexts, more recent studies suggest that internal scene consistency does not facilitate object identification. The experiments presented here explore the link between object and scene perception by assessing how readily observers can detect the internal consistency of scenes. Observers successfully discriminated consistent from inconsistent scenes even with exposures as brief as 150 msec. Performance improved with longer presentations and was better for color photographs than for line drawings. Thus, not only can observers perceive the gist of a scene from a brief presentation, they also can judge its internal consistency. However, object identification performance was comparable for consistent and inconsistent objects, supporting more recent findings that consistent scene contexts do not facilitate object identification.

(512)

**Modeling Object Recognition Under Semantic Impairment: The Impact of Conceptual Regularities on Perceptual Decisions.** TIMOTHY T. ROGERS, *MRC Cognition and Brain Sciences Unit, Cambridge*, MATTHEW A. LAMBON RALPH, *University of Bristol*,

& JOHN R. HODGES & KARALYN PATTERSON, *MRC Cognition and Brain Sciences Unit, Cambridge*—Although patients with semantic deficits can sometimes show fairly good performance on tests of object decision, we present evidence that this pattern applies when nonsense object stimuli do not respect the regularities of the domain. Eighteen patients with semantic dementia viewed pairs of line drawings, with a real and a chimeric animal side by side, and were asked to decide which was real. The chimera was either more prototypical (over-regular condition) or less prototypical (irregular condition) than the real animal. Performance in both conditions was modulated by the extent of the patients' semantic impairment, but regardless of severity, patients were less successful in the over-regular than in the irregular condition. The most severe patients were no better than chance on over-regular stimuli, but above 80% correct on irregular stimuli. The results are consistent with a recurrent distributed model of conceptual knowledge, in which structured semantic representations emerge from the interaction of high-level perceptual representations.

• LETTER/WORD PROCESSING •

(513)

**How Flexible Is Sublexical Clustering in Visual Word Recognition?** HEIKE MARTENSEN, *University of Antwerp*, & ERIC MARIS & TON DIJKSTRA, *University of Nijmegen*—Crosslinguistic comparisons suggested that sublexical clustering in each language reflects the phonological ambiguity of the spelling system: Readers rely on the smallest letter clusters that still have an unambiguous pronunciation. Lexical decision and naming experiments were conducted to investigate whether phonological ambiguity also modifies clustering within a particular spelling system. Segmentation effects for Dutch words beginning with a C were compared with those for other Dutch words. In Dutch, the pronunciation of the onset C is determined by the following vowel, whereas all other onsets are unambiguous. According to reading models with distributed representations, separating the onset C from the letter that resolves its ambiguity (C//ENT) should impair reading more than separating other onset letters from the following vowel (T//ENT). The segmentation effects did not differ between C-onset items and control items, which supports a clustering principle that applies in a fixed way to all words in one particular language.

(514)

**Interaction Between Word Frequency and Imageability in Lexical Decision.** ALAIN DESROCHERS, *University of Ottawa*—The present research investigates the role of word imageability and its interaction with word frequency in lexical decision. Eight stimulus lists were constructed from the combination of three variables: word frequency, word imageability, and nonword pronounceability. Participants were shown each list and asked to decide as quickly and accurately as possible whether each individual stimulus was a real word or not. The results showed that (1) responses both to words and to pronounceable nonwords were faster and more accurate when word frequency was high; (2) responses to these stimuli were faster and more accurate when word imageability was high, but only if word frequency was low; and (3) when nonwords were not pronounceable, word frequency and imageability only had small main effects on responses, and their interaction was neutralized. Words and nonwords served as difficulty context for each other, and frequency had priority over imageability in determining lexical decision.

(515)

**Serial Effects in Pseudoword Reading.** REMO JOB & FRANCESCA PERESSOTTI, *University of Padova*—We selected a group of words containing the graphemes *g* and *c* (which have a regular but vowel-dependent pronunciation in Italian) at the beginning, in the middle, or at the end of the word. From each word, two pseudowords were derived, one in which the target grapheme was pronounced as in the word (consistent) and one in which the target grapheme required the alternative pronunciation (inconsistent). Italian participants named aloud a list

containing both words and pseudowords. Naming was affected by the position of the target grapheme in the pseudoword, with pseudowords beginning with the target grapheme being the slowest. Furthermore, the consistency effect proved significant only for the pseudoword with the target grapheme at the beginning. These results suggest a serial mechanism in the phonological processing of pseudowords.

(516)

**Effects of Polysemy and Relatedness of Meanings in Lexical Decision and Semantic Categorization Tasks.** YASUSHI HINO, *Chukyo University*; STEPHEN J. LUPKER, *University of Western Ontario*, & PENNY M. PEXMAN, *University of Calgary*—Azuma and Van Orden (1997) argued that the polysemy advantage in lexical decision arises only when the polysemous words have related meanings and suggested that the speed of semantic access depends on the degree of consistency between orthography and semantics. In order to evaluate their claims, we examined polysemy and relatedness of meaning (ROM) effects in lexical decision and semantic categorization tasks. In the lexical decision task, there was a polysemy advantage, but no ROM effect. In the semantic categorization task (is it living?), there was a polysemy disadvantage, but only for polysemous words with less related meanings. When a narrower semantic category (is it a vegetable?) was used in semantic categorization, however, no effects were observed. These results appear to present a challenge to Azuma and Van Orden's claims. The loci of the polysemy and ROM effects are discussed.

(517)

**Progressively Demasking the Neighborhood Rhyme Effect.** TUAN Q. TRAN & BRIAN FRIEL, *Kansas State University*; LAREE A. HUNTS-MAN, *San Jose State University*, & RICHARD J. HARRIS, *Kansas State University*—Two experiments using a progressive demasking task investigated the influence of frequency effects among rhyming neighbors. Half of the targets came from neighborhoods where most of the rhyming neighbors were higher in frequency. The rest came from neighborhoods where most rhyming neighbors were lower in frequency. In Experiment 1, using all uppercase letters, words with many higher frequency rhyming neighbors yielded faster and more accurate responses, as compared with words with fewer higher frequency rhyming neighbors. However, in Experiment 2, using all lowercase letters, it was found that response latencies and accuracy for both word conditions were equivalent. We hypothesized that the recognition time advantage for words with many higher frequency rhyming neighbors disappeared due to the added cue of word shape, thus facilitating recognition of words with fewer higher frequency rhyming neighbors. A model implementing word shape to reduce the number of candidates in the generation stage of word recognition is discussed.

(518)

**Individual and Developmental Differences in the Interactivity of Visual Word Recognition Processes.** JASON F. REIMER, *California State University, San Bernardino*, & THOMAS C. LORSBACH, *University of Nebraska, Omaha*—Models of visual word recognition that have adopted an interactive activation (IA) framework (e.g., Coltheart et al., 1993; Grainger & Jacobs, 1996) assume that activation spreads in both forward and backward directions during visual word recognition. Using a mediated priming paradigm, Reimer et al. (2001) found direct evidence for the backward spread of activation during visual word recognition in the form of orthographically mediated priming effects. Using the same mediated priming paradigm, two experiments were conducted in order to examine whether or not activation feedback depends on age and perceptual ability. Third-grade, sixth-grade, and adult participants were tested. Results showed that, regardless of age, only high perceptual ability participants exhibited activation feedback. Additionally, unlike older and high perceptual ability children, younger and low perceptual ability children exhibited phonologically mediated priming. Together, these results suggest that the interactivity of certain visual word recognition processes change as age and reading skill increase.

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**TIGER Is Faster Than TRUCK: The Effect of Number of Features on Semantic Processing.** MARIE-H. MONFILS & PENNY M. PEXMAN, *University of Calgary*—Participants list many semantic features for some concrete nouns (e.g., TIGER), and fewer for others (e.g., TRUCK). Pexman, Lupker, and Hino (2001) reported faster lexical decision and naming responses for high number of features (NOF) words than for low-NOF words and attributed the effects to feedback activation from semantic representations to orthographic and phonological representations. In the present research, we investigated the impact of NOF on semantic processing. Experiment 1 was an on-line reading task, and results showed facilitation for high-NOF words when prior context was not congruent with the target word. In Experiment 2 (a semantic categorization task), responses were again faster for high-NOF words. In Experiment 3 (semantic categorization), we disentangled NOF and feature density (e.g., McRae et al., 1997, 1999) and found the facilitory NOF effect only for low-density words. These results suggest that word meaning may be captured, at least in part, by featural representations.

(520)

**Age-of-Acquisition Effects on Naming in Developmental Dyslexia.** BRENDAN S. WEEKES, *University of Sussex*, MICHAEL THOMSON, *University of Kent*, & ROBERT DAVIES, *University of Sussex*—Brown and Watson (1987) argued that the effects of age of acquisition (AoA) on oral reading and picture naming reside at the level of the phonological representations of spoken words. More cognitive processing is required at the phoneme-to-articulation stage to produce or to assemble the phonology of late-acquired words, whereas early-acquired words have phonological representations that are retrieved as whole word units. Stanovich (1988) argued that the phonological representations of spoken words are more “fuzzy” for children at risk for reading difficulties. We report data showing strong effects of AoA on oral reading and picture naming for children with reading difficulties, as well as for children without reading difficulties. We discuss these data with reference to the PC hypothesis, as well as recent connectionist models of the effect of AoA on oral reading, and conclude that the effects of AoA on oral reading in dyslexia reflect the mappings between orthography and phonology.

## • PSYCHOLINGUISTICS •

(521)

**Using Evidence From Repetition Priming to Evaluate the Form of Interlanguage Connections.** NATASHA TOKOWICZ, *Carnegie Mellon University*, & JUDITH F. KROLL, *Pennsylvania State University, Pittsburgh*—The revised hierarchical model of bilingual memory proposes an asymmetry in word-to-meaning connections such that first language (L1) words more readily access their corresponding meanings than do second language (L2) words; however, recent evidence for this asymmetry is mixed. In the present study, English–Spanish bilinguals translated words in both directions, with some concepts presented at both the study and the test phases, in either the same or different direction of translation. In the critical (different direction) conditions, faster translation of repeated concepts than of new concepts was taken to indicate overlap of processing components between directions. The results suggest that the two directions of translation do not share entirely the same processing components. The results also suggest that the components become more similar with increased L2 fluency. These findings are discussed in terms of apparently conflicting claims in the literature and their relevance for current models of bilingual language processing.

(522)

**Naturally Occurring Tip-of-the-Tongue States in Bilinguals.** TAMAR H. GOLLAN, *Pomona College and University of California, San Diego*, MARINA BONNANI, *Harvard University*, & DEBORAH M. BURKE, *Pomona College*—Previous studies indicate that proficient

bilinguals experience more laboratory-induced tip-of-the-tongue (TOT) states than do monolinguals (Gollan & Silverberg, 2001). Using TOT diaries, we compared Spanish–English bilinguals and monolinguals to determine whether bilinguals also have more TOTs in daily life. We hypothesized that proper names are language neutral and therefore provide a baseline that should equate performance across groups. As was expected, for noun, verb, and adjective targets, bilinguals had more TOTs than did monolinguals, more TOTs in L2 than in L1, and fewer TOTs with persistent alternates. However, there was also a robust bilingual *advantage* (i.e., fewer TOTs) for proper names, suggesting that bilinguals may be better than monolinguals at connecting concepts with arbitrary phonology. We discuss two different accounts of the increased TOT rate in bilinguals: (1) cross-language competition for activation and (2) weaker connections from lexical nodes to phonology due to relatively reduced use of words in each language, as compared with monolinguals.

(523)

**Influences of Word Order and Semantic Anomaly on Hemispheric Sentence Processing.** STELLA LIU & CHRISTINE CHIARELLO, *University of California, Riverside*—Three sentence-priming experiments were conducted to better understand how semantic and grammatical constraints influence message-level processing in each hemisphere. Participants made lexical decisions to sentence-final targets presented to the LVF or RVF. Experiment 1 compared four sentence types (normal, nonsense, scrambled, and jaberwocky) to evaluate word order and semantic contributions to sentence-level meaning. Experiment 2 examined lexical-semantic and form-class constraints. Targets were either semantically related nouns or verbs that were of the expected or unexpected form-class. Experiment 3 examined word order constraints by varying the order of both content and function words in the sentence prime. We discuss how different sources of message-level meaning may be available to each hemisphere.

(524)

**Morphological Insensitivity in Sentence Processing in a Second Language.** NAN JIANG, *Auburn University*—Two experiments were conducted to test whether learners of English as a second language are as sensitive to inflectional morphemes in sentence processing as native speakers of English. A self-paced word-by-word (Experiment 1) or phrase-by-phrase (Experiment 2) reading task was employed in which native and nonnative speakers were asked to read sentences (e.g., The key to the cabinets was rusty.) and answer comprehension questions. Native speakers’ performance replicated the previous finding that they took longer to read grammatical sentences whose local noun does not agree with the verb in number (Nicol et al., 1997; Pearlmutter et al., 1999). However, whether the local noun agrees with the verb in number does not affect nonnative speakers’ reading times. The lack of morphological sensitivity in second language sentence processing is consistent with the proposal that inflectional morphological information is not integrated in the lexical entry of second-language vocabulary (Jiang, 2000).

(525)

**Age Differences in Sentence Structure Choice: Effects of Competing Constraints.** LORI J. P. ALTMANN & SUSAN KEMPER, *University of Kansas*—How do speakers choose the syntactic structure for an utterance? Typically, speakers use active sentences that assign animate “agents” to subject position and inanimate “themes” to object position. However, the order in which nouns are activated may influence sentence structure choice—that is, activating inanimate nouns first may encourage production of passive sentences. Choosing unusual verb types may also alter the structure selected; for example, theme-experiencer verbs allow inanimate, “theme” subjects with animate, “experiencer” objects (e.g., “The directions confused Sarah”). Consequently, activating inanimate nouns first with these verbs encourages active, not passive, structures. This study examines age differences in the strength of these constraints by analyzing the frequency of different construc-

tions produced by young and old adults. The animate subject constraint is strongest for both groups and interacts with argument structure to determine structure choice. Order of noun activation also contributes to structure choice, particularly in the responses of older adults.

(526)

**Comprehending the Sarcastic Comments of Males and Females.** ALBERT N. KATZ & ISABELA PIASECKA, *University of Western Ontario*, & MAGGIE TOPLAK, *Ontario Institute for Studies in Education*—Two experiments examined whether a comment that could be understood as sarcasm is understood differently if uttered by and/or addressed to a woman rather than a man. In Experiment 1, participants read passages that ended in a sarcastic comment, uttered intentionally or not by a woman or man. Following each passage, participants answered a series of questions about the intent of the speaker. Experiment 2 employed an on-line moving windows methodology in which participants read passages similar to those of Experiment 1. Men were perceived as more sarcastic, especially when the comment was made without intention (Experiment 1). The on-line data indicated that the sex of speaker and addressee are both processed while the sarcastic comment is being read. These data suggest that social factors act as a constraint to comprehension very rapidly, supporting direct access types of models.

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**The ON/PN Intersection Effect in Visual Lexical Decision.** CHRIS WESTBURY, *University of Alberta*, & LORI BUCHANAN, *University of Windsor*—The tight relationship in English between phonology and orthography makes it difficult to independently study their effects on written word access. We conducted a set of lexical decision experiments, controlling for each word's orthographic neighborhood (ON) while manipulating the extent to which that neighborhood intersected with the word's phonological neighborhood (PN). High overlap between the neighborhoods might be facilitatory, since each common neighbor receives activation through both phonology and orthography. Alternatively, it might be inhibitory, since the number of independent entries in the two neighborhoods is minimized when the neighborhoods intersect maximally. We found support for the latter possibility. Against a nonpseudohomophonic NW background, words with a large ON/PN intersection were recognized more slowly than words with a small intersection. A second experiment used the same words against pseudohomophonic NWs, minimizing the use of phonology. The ON/PN intersection effect disappeared, suggesting that it is indeed attributable to phonology.

• LANGUAGE/DISOURSE PROCESSING •

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**Strategies for Negotiating a Common Conceptual Perspective in Ambiguous Reference.** MIJA M. VAN DER WEGE, *Stanford University*—In these two studies, I investigate some of the strategies people use in negotiating a common conceptual perspective. Participants saw ambiguous referents (e.g., a picture that could be interpreted as a camel or as a house) in a collaborative reference task. When presented with an ambiguous referent, people may take different perspectives on it. But if they want to communicate about the object, they must negotiate a common perspective in order to understand one another. A variety of strategies for reaching a common perspective were tested, such as conversational control, experience, explicit and implicit agreements, frequency, and recency. One finding is that the director, or the person introducing the referent into the conversation, has more control over the final joint conceptualization that is reached on the referent. Experience has little or no effect on the final joint conceptualization, at least in an experimental context.

(529)

**Emotion, Anxiety, and Predictive Inferences in Reading: An ERP Investigation.** IRA FISCHLER & MICHAEL MCKAY, *University of Florida*—Anxious and nonanxious students read short context sen-

tences that invited a predictive inference about potential outcomes (e.g., Your father collapses as he crosses the room.). The contexts were pleasant, unpleasant, or neutral in emotional tone. Completion sentences were then shown, one word at a time, that either confirmed (He stops breathing and...) or disconfirmed (He stops smiling and...) the predictive outcome. Emotional context sentences were read more slowly than neutral sentences. Confirming target words were associated with a reduced N400 component in the ERPs, and this reduction was modulated by emotional tone. Anxious students showed greater effects of emotionality on several measures, except on context reading times, where they were most slowed, as compared with nonanxious students, on reading the neutral contexts. This suggests that they were hyperattentive to all sentences that potentially could concern threatening situations. The effect of emotionality and anxiety on attentional engagement during reading is considered.

(530)

**The Development of Discourse Constraints on the Interpretation of Prenominal and Predicative Adjectives.** APARNA NADIG, JULIE SEDIVY, & HEATHER BORTFELD, *Brown University*—There is some evidence from the word-learning literature that children interpret adjectival modifiers as discourse contrastive and use this information as a constraint on word learning (e.g., Prasada & Cummins, 2000). These findings mirror adults' on-line preference to generally interpret prenominal adjectives as marking a contrast between two referents of the same kind (Sedivy et al., 1999). We used a procedure similar to Prasada's, in which children (ages 3–6) were shown three objects (e.g., a small jar, a big jar, and a big mug) and were given an instruction with a prenominal adjective or an adjective in predicate position. Children could respond either contrastively (the big jar) or noncontrastively (the mug). Unlike Prasada's study, prenominal adjectives did not show more contrastive responses. However, in Prasada's study, but not in ours, prenominal adjectives received primary stress, which may facilitate or drive the effect. In addition, we were interested in whether children's on-line biases would be similar to those observed for adults. To this end, we are currently collecting both off-line response data and eye-movement data from young children to determine whether they understand the contrastive function of prenominal modifiers or whether earlier evidence along these lines was confounded by stress. Results of the study will have implications for the development of discourse constraints in language processing.

(531)

**Reading Span and the Time Course of Cortical Activation in Sentence–Picture Verification.** TIMOTHY A. KELLER & MARCEL ADAM JUST, *Carnegie Mellon University*, & V. ANDREW STENGER, *University of Pittsburgh Medical Center*—Event-related functional magnetic resonance imaging was used to examine the effects of negation and reading span on the volume and time course of activation during performance of a sentence–picture verification task. Consistent with previous research, negation increased the volume of activation in left-hemisphere language areas (inferior frontal gyrus and superior, middle, and inferior temporal gyri). Participants with low reading spans showed greater signal intensity changes in a number of areas during the processing and maintenance of the sentences. These areas included left inferior frontal and left parietal areas thought to be involved in the phonological loop of verbal working memory. The results suggest that participants with low reading spans may need to rely on rehearsal to a greater extent to perform the verification task, because of either less efficient phonological encoding or a faster rate of decay of the phonological representations.

(532)

**On Getting a Joke: Multiple Meaning Activation in Humor Comprehension.** JYOTSNA VAID, *Texas A&M University*, ROBERTO HEREDIA, *Texas A&M International University*, & RACHEL HULL, FRANCISCO MARTINEZ, & DAVID R. GERKENS, *Texas A&M University*—According to most models of verbal humor processing, humor

is experienced when there is a perception of an incongruity between the way things are thought to be and the way they actually turn out to be. The models differ in whether they require the competing meanings of a joke text to be concurrently or sequentially active for humor to be experienced. According to Attardo (1997) and Forabosco (1992), both meanings or scripts of the joke text must be active in working memory for incongruity to be perceived, and both must remain active until the end of the joke text. By contrast, Giora (1991) contends that jokes involve an abrupt shift in meaning, a consequence of which is that the earlier meaning is cancelled, rather than sustained, once the punchline meaning is activated. To test these differing theoretical claims, we undertook a priming study of lexical activation in which target items related to each of the competing meanings and neutral controls were shown at different temporal points in visually presented joke texts. Our findings support a concurrent activation view.

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**Painting Word Pictures/A Word-by-Word Unveiling/Slowly Enjoying.** DAWN G. BLASKO, VICTORIA A. KAZMERSKI, & SHANNON LENZE, *Pennsylvania State University, Erie*—The on-line processing and appreciation of haiku poetry was investigated in two experiments. Participants ( $N = 170$ ) completed a self-report creativity questionnaire, a multimodal measure of reading comprehension, and a measure of vividness of visual imagery. They then read a series of haiku poems either line by line, (Experiment 1) or word by word (Experiment 2) and rated their appreciation of each poem. In Experiment 2, the level of the poems was also varied, ranging from those written by children to well-known poets. Despite the short–long–short pattern of the poems, readers spent proportionally more time on the first and last lines than on the middle. Readers also spent more time reading the poems that they liked the most. Vivid mental imagery was not required to enjoy the poems, but it was related to self-report of other creative activities. Students with higher comprehension ability were more likely to enjoy the work of the more experienced poets.

(534)

**The Status of Predictive Inferences in Long-Term Memory.** MARK A. CASTEEL, *Pennsylvania State University, York Campus*—Cook, Limber, and O'Brien (2001) found that although predictive inferences could be activated in a text following a biasing context, even after a delay, they do not form part of the long-term memory representation. This latter finding, however, stands in contrast to the work of Klin, Guzmán, and Levine (1999), who found slower reading times to sentences that contradicted a predictive inference. Cook et al. interpreted the discrepancy by suggesting that the predictive inferences used by Klin et al. were likely encoded only as vague outcomes, rather than as specific lexical entries. The present study was designed to examine whether predictive inferences can be encoded into memory as specific instantiations. Participants read stories that suggested a predictive inference, followed by background information. Reading time was measured to a critical sentence that explicitly presented the inference outcome. Results are discussed in light of current models of discourse processing.

• DEVELOPMENT/AGING: MEMORY •

(535)

**Category-Specific Deficits in Alzheimer's Disease.** KEVIN M. SAILOR, *Lehman College, CUNY*—The evidence for category-specific deficits in Alzheimer's disease (AD) has been mixed (Gonnerman, Andersen, Devlin, Kempler, & Seidenberg, 1997; Tippett, Grossman, & Farah, 1996). The object-naming data for a large sample of normal controls ( $n = 101$ ) and AD patients ( $n = 130$ ) were examined for differences in the ability to name examples of artifacts and living things. Although accuracy for both categories decreased with dementia severity, AD patients were relatively worse at naming living things than artifacts. In addition, this deficit for living things increased with dementia severity.

(536)

**Age Differences in Temporal and Item Memory.** JULIE DUMAS & MARILYN HARTMAN, *University of North Carolina, Chapel Hill*—Older adults have poor memory for temporal information, but it is not known whether these age differences can be accounted for by age differences in item memory. In a prior study, Dumas and Hartman (2000) found that when older and younger adults were experimentally equated for free-recall performance, there were no differences in temporal memory. In contrast, with equivalent recognition memory, age differences in temporal memory remained. The present study provides a stronger test of the relationship among age, temporal memory, and item memory, using recognition memory tests that are more sensitive to aging. Results showed that when age differences in recognition memory were statistically controlled, the age effect for temporal memory remained. We conclude that aging affects retrieval processes and contextual aspects of memory that are common to temporal memory and free recall but that are not involved in recognition memory.

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**Distracting Sound Increases False Memory for Spoken Words in Older Adults.** DEBORAH M. LITTLE, PATRICIA A. TUN, CORINA KOPP, & ARTHUR WINGFIELD, *Brandeis University*—On the basis of previous findings of an age-related increase in false memory for lists of associatively related words (Tun et al., 1998), we predicted that increasing task difficulty should exacerbate age differences in memory. We introduced background noise during study of lists of spoken words, as well as a delay before testing, in order to increase the tendency to use a gist-based processing strategy. Older adults were as accurate as younger adults in recognizing studied items both from lists of unrelated words and from lists of related words. However, the related word lists produced an increase in older adults' false recognition for associatively related lures, which was magnified by background noise and delayed testing. These findings suggest that older adults may be more likely than young adults to use a gist-based processing strategy when the materials permit and that age differences in memory strategy can be exacerbated under difficult study and test conditions.

(538)

**Item Knowledge and Rule Knowledge in Cognitive Skill Acquisition: Adult Age Differences.** DAYNA R. TOURON, WILLIAM J. HOYER, & JOHN CERELLA, *Syracuse University*—The acquisition of cognitive skills often depends on either or both of two kinds of knowledge, rule knowledge and item knowledge. This research examined the effects of rule and item pretraining on response times, accuracies, and item retrieval probabilities for subsequent rule learning and item learning. Thirty young adults and 30 older adults were tested for 4 consecutive days on a version of Rickard's (1997) pound arithmetic task. As compared with control conditions, item pretraining produced faster item learning for older adults than for younger adults. Rule pretraining served to improve initial response times and accuracies for both age groups. The efficiency of cognitive skill acquisition depends in part on the kinds of knowledge that individuals bring to the learning situation.

• DEVELOPMENT/AGING: PROCESSES •

(539)

**Statistical Learning in SRTs by Children and Adults.** CLAUDIA MARTIN, *University of Würzburg*—Sequential learning has been investigated with the serial choice reaction task (SRT): Individual stimuli are successively presented to the subjects, and they have to react with corresponding responses. Statistical structure in the sequence of stimuli and responses decreases reaction time, indicating sequential learning. It is still an issue whether the learning of stimulus and response sequences is based on the same learning mechanism and how sequence learning develops. In the present SRTs, playing cards were used as stimuli, and pressing keys of a keyboard as the responses. Frequencies and transitions of stimuli and responses were separately varied in four experiments. The subjects were 8- and 10-year-old children and adults.

The results show that statistical regularities in the sequence of responses have a much stronger impact on learning than do those in the sequence of stimuli. The data of children and adults demonstrate differences in explicit versus implicit knowledge and speed versus accuracy.

(540)

**Speech Errors Reveal Selective Age-Linked Deficits in Language Production.** LORI E. JAMES, *University of Colorado, Colorado Springs*, & DONALD G. MACKAY, *UCLA*—To test predictions derived from age-linked transmission deficits in node structure theory (NST), young and older adults performed a task designed to elicit speech errors. Stimuli were visually presented words containing a /p/ or a /b/, and the task was to change the /p/ to /b/ or vice versa and produce the resulting word as quickly as possible. For example, the correct response was “bunk” if participants saw *punk* and “ripped” if they saw *ribbed*. Older adults took longer to respond and exhibited a stronger lexical bias in their errors, but they only produced certain types of errors reliably more often than did young adults. For example, older adults produced more omission errors than did young adults and more inflectional-adjustment errors (e.g., *ribbed* misproduced as “rip” rather than *ripped*), but not more addition errors (e.g., *nap* misproduced as “nabs” rather than *nab*). These selective age-linked deficits supported NST predictions.

(541)

**Age Differences in Reading With Distraction.** HEATHER HUMPHREY, *University of Kansas*, JEFF RADEL, *University of Kansas Medical Center*, & SUSAN KEMPER, *University of Kansas*—Eye fixation patterns for young and older adults were compared while they read single sentences containing low-probability target words. In the experimental conditions, the targets were preceded by distractor words, presented in a contrasting font or color. The distractors were related or unrelated to the content of the sentences, as in “They were startled by the sudden utter [office] voice from the next room.” Readers were instructed to ignore the distractors and read for comprehension. Probe questions also followed some trials. Reading comprehension and fixation times to the distractors and target words were examined to determine how relatedness and salience of the distractors affected age differences in the ability to ignore distractors while reading.

• HUMAN PERFORMANCE •

(542)

**Effects of Delayed and Advanced Auditory Feedback on Music Performance.** PETER Q. PFORDRESHER, *University of Texas, San Antonio*, & CAROLINE PALMER & GRANT BALDWIN, *Ohio State University*—Evidence from sequence production tasks indicates both directional (anticipatory/perseveratory) and distance (range or scope) constraints on planning. We examine the relationship between these planning constraints and how auditory feedback guides music performance by manipulating the contents of feedback with a novel methodology. In each experiment, pianists performed simple melodies from memory. Pitches that sounded at each key depression were manipulated to match the contents of previously produced events (serial delay) in one experiment or to-be-produced events (serial advance) in another experiment. The amount of lag or lead (in number of sequence events) between produced events and feedback contents was also manipulated. The degree of disruption from the feedback manipulations, measured in errors, indicated that feedback contents interact with planning constraints on serial ordering in music performance.

(543)

**Orthogonal Stimulus–Response Compatibility: Hand Posture and Response Eccentricity Effects.** YANG SEOK CHO & ROBERT W. PROCTOR, *Purdue University*, & DANIEL J. WEEKS, *Simon Fraser University*—When unimanual left–right responses are mapped to vertically arrayed stimuli, performance is better with the up–right/down–left mapping than with the up–left/down–right mapping. This mapping effect is influenced by response eccentricity, being enhanced at the

right hemispace but reversed at the left hemispace. The end-state comfort hypothesis attributes this response eccentricity effect to movement constraints established by the interaction between hand posture and location. However, the salient features coding hypothesis attributes the effect to the spatial codes assigned to the response locations. Our experiments showed that the influences of hand posture and response eccentricity on orthogonal SRC were additive and that hand posture effects are due in part to the hand’s providing a frame of reference for coding switch location. The results are consistent with the view that the response eccentricity effect is due to the increase in the relative salience of code corresponding to the response location.

(544)

**Funding Opportunities Available Through the Department of Defense Polygraph Institute.** STUART M. SENTER, *Department of Defense Polygraph Institute*—In January 1999, the Department of Defense Polygraph Institute (DoDPI) began an effort to broaden its presence in the scientific and academic communities in response to the need for more advanced technical expertise. The goal is to develop a research workforce competitive with the best minds of academia and to keep pace with emerging technologies. We are seeking multiple sites around the country to support this initiative. In addition to funding investigators, we hope to offer postdoctoral positions, visiting faculty positions, and sabbatical assignments to bolster production. We hope to solicit the highest quality university labs and industrial technology with ideas on our subjects of interest. Our research mission is threefold: (1) evaluate the validity of psychophysiological detection of deception (PDD) techniques used by the Department of Defense (DoD), (2) investigate countermeasures and anticountermeasures, and (3) conduct developmental research on PDD techniques, instrumentation, and analytic methods.

(545)

**Learning and Spatial Updating of an Array of Five Objects Specified by 3-D Sound, Spatial Language, and Vision.** ROBERTA L. KLATZKY, *Carnegie Mellon University*, & YVONNE LIPPA, JACK M. LOOMIS, & REGINALD G. GOLLEDGE, *University of California, Santa Barbara*—In three experiments, participants learned five object locations, specified by a sound emanating from space, a verbal description specifying direction and distance, or a visual preview (Experiment 3 only). Thereafter, participants indicated the same object locations by giving directional and distance estimates from a new vista (Experiment 1 and 2) or by walking to each location along a direct and indirect path (Experiment 3). Spatial updating performance in the 3-D sound and spatial language conditions were generally comparable, and both were worse than when objects’ locations were specified visually.

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**Spatial Updating After Object and Viewer Translation: Real Versus Imagined Movement.** SARAH CREEM, *University of Utah*—Updating the positions of objects in space is easier after imagined viewer movement than after object movement, a finding that is similar for both rotation and translation (Creem, 2001; Wraga, Creem, & Proffitt, 2000). A question exists as to the importance of real movement in spatial updating. Physical self-movement has been shown to improve updating performance, as compared with imagined self-movement, for rotation tasks, but not for many translation tasks. We compared updating performance after real or imagined translation for (1) viewer translation relative to an array of objects and (2) translation of the objects themselves. We found that real movement of an array of objects improved updating performance, as compared with imagined movement of the array, but real movement of the viewer did not improve performance over imagined viewer movement. These findings have implications for the mechanisms involved in updating spatial relationships between oneself and objects amid a changing visual world.

(547)

**Response Selection Demands in a Secondary Task Modulate the Simon Effect.** BIRGIT STÜRMER, *Humboldt-University, Berlin*, ELLEN SEIB, *University of Birmingham*, & HARTMUT LEUTHOLD, *University of Glasgow*—We demonstrated previously that interference effects in the Simon paradigm underlie sequential modulations, depending on the directly preceding correspondence condition: The Simon effect was present after a corresponding event, whereas no Simon effect at all showed up after a noncorresponding event. Regarding dual-route models of response preparation, this effect can be accounted for by suppression of direct route priming induced by a response conflict in the preceding event. The present study investigated control over response priming, using a dual-task paradigm. Here, a Simon task and a secondary task were performed in succession. A Simon effect after noncorresponding events was clearly present in case the secondary task induced a response conflict. However, the Simon effect after noncorresponding events was still absent when a secondary task without response selection demands was performed. These results indicate response-monitoring processes to be relevant for context-dependent modulations of the Simon effect.

(548)

**Ideomotor Compatibility in the Psychological Refractory Period Effect.** MEI-CHING LIEN, *NASA Ames Research Center*, ROBERT W. PROCTOR, *Purdue University*, & PHILIP A. ALLEN, *University of Akron*—Four experiments examined whether the elimination of the PRP effect for two ideomotor compatible tasks in Greenwald and Shulman's (1973) Experiment 2 is replicable. Combinations of a left/right movement to a left- or right-pointing arrow (ideomotor compatible) or "left" or "right" word (stimulus–response compatible) for Task 1 and responding to an auditory letter A or B by saying A or B (ideomotor compatible) or *one* or *two* (stimulus–response compatible) for Task 2 were varied between participants. Participants were instructed that most often the two stimuli would be presented simultaneously, as in Greenwald and Shulman's experiment. A PRP effect was obtained for all task combinations regardless of (1) the set of stimulus onset asynchronies used, (2) whether single-task blocks were intermixed, and (3) whether the arrows were at the center or in left and right locations. The findings suggest that response selection is required even for ideomotor compatible tasks.

## • MOTOR CONTROL •

(549)

**Prescriptions and Perceptions of Action Difficulty.** ANDREW B. SLIFKIN, *Cleveland State University*—Participants provided magnitude estimates of the perceived difficulty of performance under the speed–accuracy instructions of a Fitts (1954) cyclical movement task. Movement was not generated in the present task. Rather, perceived difficulty ratings were made following 15-sec viewings of target displays where prescribed difficulty [ $\log_2(2A/W)$ ] levels ranged between 1 and 6 bits. When target width ( $W$ ) was 0.2 in., the relation between prescribed and perceived difficulty was well described by a linear regression equation with a  $y$ -intercept and slope close to zero and one, respectively. Thus, the scaling of perceived to prescribed difficulty was almost perfect. However, when  $W$  was halved (0.1 in.), although the relation remained linear and positive, the  $y$ -intercept was greater than zero, and the slope was less than one. Overall, it can be concluded that even in the absence of action, when prescriptions of action difficulty increased, perceptions of action difficulty also increased.

(550)

**The Relevance of Proprioception in Action Timing Studied in a Case of Deafferentation.** PRISCA STENNEKEN & GISA ASCHERSLEBEN, *Max Planck Institute for Psychological Research*, JONATHAN COLE, *University of Southampton*, & WOLFGANG PRINZ, *Max Planck Institute for Psychological Research*—Sensory feedback is assumed to be crucial for the temporal control of movements. To study the

specific contribution of intrinsic feedback components, we ran a series of timing experiments with a deafferented patient exhibiting a complete loss of tactile and kinesthetic reafferences. When healthy subjects are required to move a finger and foot simultaneously, movements are not performed in perfect synchrony: Systematic timing errors are observed (foot responds earlier than finger), reflecting effector-specific somatosensory processing. We replicated this finding in control groups of different ages under conditions requiring simultaneity either between the two limbs or of both limbs each with predictable acoustic signals. Despite his sensory loss, the patient showed a temporal pattern similar to that of the healthy controls. Results suggest that the timing of movements relies not only on the movements' actual sensory consequences, but also on a corresponding internal prediction.

(551)

**Audition Dominates Vision in Temporal Processing: New Evidence From Sensorimotor Synchronization.** BRUNO H. REPP, *Haskins Laboratories*, & AMANDINE PENEL, *Ohio State University*—Evidence that audition is superior to vision in temporal processing has come from tasks requiring explicit perceptual judgments. We compared the two modalities in a sensorimotor synchronization task. Participants synchronized finger taps with auditory and visual sequences containing a perturbation—a single event onset shift (EOS), expected to elicit an involuntary phase correction response (PCR)—and also tried to detect the EOS. The sequences were presented in unimodal and bimodal conditions, including one in which auditory and visual EOSs of opposite sign coincided. Unimodal results showed higher tapping variability, smaller PCRs, and higher EOS detection thresholds for visual than for auditory sequences. In the bimodal conditions, variability was similar to that for unimodal auditory sequences, and the PCRs depended more on the auditory than on the visual information, even though attention was focused on the latter. Thus, auditory dominance for temporal information extends to the subconscious processes governing sensorimotor coordination.

(552)

**First-Trial "Adaptation" in Prism Exposure Arises From Ordinary Motor Control.** GORDON M. REDDING, *Illinois State University*, & BENJAMIN WALLACE, *Cleveland State University*—Terminal target pointing error on the first trial of exposure to optical displacement is usually less than would be expected from the magnitude of the optical displacement. Data are presented supporting the conclusion that such adaptation arises from ordinary undershoot and movement correction.

## • ANIMAL MEMORY •

(553)

**Omission-Induced Release From Proactive Interference.** W. SCOTT TERRY, *University North Carolina, Charlotte*—Does reinforcer omission as a distinctive event provoke release from proactive interference? Rats were trained in two T-maze delayed alternation tasks. In one version of the Brown–Peterson task, correct alternation declined within blocks of trials (proactive interference). Reward omission during the final trial reinstated a high level of accurate choice. In a second task, trials consisted of maze triplets. Performance declined across blocks of triplets. Omission increased alternation in the one nonrewarded maze, but not in other mazes of the triplet.

(554)

**Many-to-One Matching With Hedonic and Line Samples in Pigeons.** DOUGLAS S. GRANT, *University of Alberta*—Pigeons were trained with hedonic (food and no food) and line (horizontal and vertical) samples mapped to color comparisons (many-to-one, MTO, mapping). Consistent with earlier work, retention asymmetries were apparent with both sets of samples. However, mediated-transfer testing revealed no evidence of positive transfer, suggesting that the two sets of samples were not commonly coded. Moreover, delay tests using the line sam-

ples revealed retention asymmetries when those samples were followed by the color comparisons from the MTO procedure, but no evidence of retention asymmetries when they were followed by the line comparisons from interim training. These data suggest that (1) each line sample activated a code different from that activated by the hedonic samples and (2) bias guessing in the absence of an activate code was induced by the hedonic samples only with the comparisons used in the MTO procedure.

• ASSOCIATIVE LEARNING: ANIMALS •

(555)

**CS–US Similarity Effects in Sexual Conditioning.** BRIAN CUSATO, *Sweet Briar College*, & MICHAEL DOMJAN, *University of Texas, Austin*—The conditioning of male sexual behavior involves the association of a conditioned stimulus (CS) with a live female (the unconditioned stimulus, or US). Studies using male domesticated quail have shown that adding taxidermic female cues to a CS facilitates conditioned sexual responding. Two experiments examined CS–US similarity as a possible mechanism for this facilitation. In Experiment 1, CS–US similarity was manipulated by using different CSs—one without female cues and two others with female cues from different quail strains. In Experiment 2, the CSs and US-females were both artificially colored. The results suggest that, even with arbitrary CSs, CS–US similarity facilitates conditioned sexual responding. The results also suggest that color is the most salient feature of the female cues and that female cues may facilitate conditioned sexual responding because adding them to the CS makes the CS more closely resemble the color of the US-female.

• ANIMAL LEARNING/BEHAVIOR •

(556)

**Observing Behavior in Rats: The Role of Responding to the Discriminative Stimuli.** KAREN L. ROPER, *Wake Forest University*—“Observing” can be defined as attending to aspects of an environment that are known to predict the occurrence of reinforcement, even though this behavior does not affect overall reinforcement probabilities. This preference for discriminative stimuli has been well replicated and largely explained on the basis of conditioned reinforcement. In one version, the selective observing hypothesis (Dinsmoor, 1983), discriminative stimuli are said to be preferred because they elicit fewer nonreinforced responses overall than does a mixed  $S_{\pm}$  stimulus. In this research, a two-alternative choice procedure was used with rats to examine whether differences in responding to the discriminative stimuli may account for the preference for predictable reward. When levers were retracted during presentation of the discriminative stimuli, the preference for discriminative stimuli was eliminated, despite the use of very low levels of reinforcement (12.5% for some rats) that have been shown to produce high levels of observing behavior.

• ANIMAL SENSORY PROCESSES •

(557)

**Role of the Vibrissae in Discrimination of 3-D Objects.** PAMELA A. JACKSON, *Radford University*—Three groups of rats (control, blind, and dewhiskered) were ran in two experiments. A successive, simple discrimination procedure was used in which a 3-D object was placed over a food-well on each trial and latency to move it was measured. In the first experiment, the dewhiskered group learned the initial discrimination between two objects (differing on multiple dimensions) at a slower rate than did the normal or the blind rats. All three groups

learned two new discriminations at the same rate. Preliminary results from the second experiment suggest a deficit in both the blind and the dewhiskered groups using objects that differed only on color (black vs. white). When these rats were switched to objects that differed in shape and color, the dewhiskered rats began to acquire the task faster than the control and the blind groups. The data suggest that rats may depend on their vibrissae initially but can switch strategies quite successfully.

(558)

**Discrimination of Complex Sounds by Rats in a Two-Alternative, Forced-Choice Task.** ITZEL ORDUNA, EDUARDO MERCADO, III, & MARK A. GLUCK, *Rutgers University*—Psychophysical studies of sensory processing in animals are a useful tool for understanding the mechanisms underlying perception. To investigate how experience affects the representation of complex sound in mammals, we trained rats to discriminate broadband, time-varying sounds in a two-alternative forced-choice discrimination task. Rats could readily acquire the initial discrimination and generalized their responses to sounds with similar spectro-temporal properties. Our results constitute the first demonstration that rats can perceive and discriminate continuous, broadband sounds on the basis of spectro-temporal features such as the rate of frequency modulation and that a two-alternative forced-choice task is a viable technique for investigating higher level auditory perceptual processes in this species.

(559)

**Behavior Maintenance in Early Portions of an Interfood Interval.** WILLIAM L. PALYA, C. PHILLIP POWELL, & MATTHEW BOWERS, *Jacksonville State University*—The control exerted by various portions of fixed-time and fixed-interval schedules was assessed with a trace stimulus procedure. The entire interval was segmented into 10 bins. In all but 1 of those bins, the stimuli were presented in different random orders on each trial. In 1 bin, the stimulus was the same on each trial. The position of this trace stimulus was varied across phases. The results indicated that a trace stimulus can come to control behavior and that differential control can even extend to the second 10th of an interfood interval. The results were interpreted as indicating that traditional explanations of the rate loss in earlier portions of an interfood interval are inappropriate and that Palya’s bipolar model may provide a framework within which both acquisition and within-trial effects can be understood.

(560)

**Escape and Avoidance Behavior in a Negative Reinforcement Procedure.** DAVID HARPER & MAREE HUNT, *Victoria University of Wellington*—A negative reinforcement procedure was developed in which rats responded on one lever in order to avoid retraction of another lever that provided food reinforcement. Several aspects of this procedure make it more directly comparable to typical positive reinforcement schedule arrangements (relative to traditional avoidance paradigms). Consistent with previous indications, rats were more likely to learn an escape response (i.e., return the positively reinforced lever once it had been withdrawn) than an avoidance response (i.e., avoid removal of the positively reinforced lever in the first place). It was also found that providing a discriminative stimulus indicating the period for effective avoidance responses resulted in an increase in effective avoidance responses, relative to ineffective ones. Relatively few avoidance responses were made when this stimulus was removed. These data are discussed with reference to the two-factor theory of avoidance learning and the general issue of comparability between positively and negatively reinforced responding.

**Invited Symposium:  
Dynamic Approaches to High-Level Cognition  
Coronado H, Saturday Afternoon, 1:30–3:35**

*Chaired by Caroline Palmer, Ohio State University*

**1:30–1:35 (561)**

**Introduction: Dynamic Approaches to High-Level Cognition.** CAROLINE PALMER, *Ohio State University*—The symposium features theoretical approaches to cognition that focus on the role of time. Although many cognitive theories make implicit assumptions about the role of time, dynamic perspectives explicitly incorporate the temporal dimension; they view cognition as inherently temporal, changing, and active. “Getting the timing right” is often critical to the success of a cognitive process. If time is a major substrate of cognition, what kind of substrate is it? Recent research presented here highlights time-sensitive approaches to higher level cognition and how they differ from other approaches. Language, memory, attention, decision-making, learning, and their neural substrates are considered as essentially temporal; prior experience and future expectations influence the selection or interpretation of current behavior.

**1:35–1:55 (562)**

**Language as a Dynamic System? Why Might It Matter?** JEFFREY ELMAN, *University of California, San Diego*—Over the past half-century, most theories of language have been framed—sometimes explicitly, usually implicitly—within the framework of computation via discrete automata. Often referred to loosely as *the symbolic paradigm*, this framework has provided a notational vocabulary not only for many linguistic theories, but also for most processing accounts. In this talk, I describe a dynamical systems account of language. This approach arises from attempts to understand recurrent network models of language and provides what seems to be a very different vocabulary for understanding processing. The questions that I will address (if not conclusively answer) are (1) are the notational differences only apparent or substantively different and (2) which approach, the traditional symbolic or the dynamical, provides a better account of human language processing?

**1:55–2:15 (563)**

**Traces of Dynamic Complexity in the Time Records of Decisions and Intentions.** DAVID L. GILDEN, *University of Texas, Austin*—The residual fluctuations that naturally arise in the measurement of cognitive process are analyzed in terms of their time histories. Although these fluctuations are generally relegated to a statistical purgatory known as unexplained variance, it is shown that they may harbor a long-term memory process known as  $1/f$  noise. This type of noise has been encountered in a number of biological and physical systems and is theorized to be a signature of dynamic complexity. Its presence in psychological data appears to be associated with the most elementary aspect of cognitive process, the formation of representations.

**2:15–2:35 (564)**

**Attending, Synchrony, and Dynamical Constructs.** MARI RIESS JONES, *Ohio State University*—A few basic issues concerned with attending in time are considered. One special focus is upon the role of synchrony between attender and environment. The hypothesis is proposed that synchronicity is a necessary, but possibly not a sufficient, condition for adequate attending in many tasks. Specifically, it is argued that constraints involving attentional synchrony may influence the ways in which people attend to items distributed in space versus those distributed in time. This hypothesis is elaborated in the context of a dynamical model of attentional entrainment where synchrony figures as an attractor state. Several experiments on time and pitch judgments illustrate the underlying importance of synchrony between attender and environment. In these contexts, related properties of the model are considered. Finally, limitations of the entrainment approach are also discussed.

**2:35–2:55 (565)**

**Motivational Basis of Changes in Utilities Over Time in Decision Making.** JEROME R. BUSEMEYER, *Indiana University*—Past research on decision making has emphasized the cognitive processes and information-processing limitations that constrain how we make choices. This emphasis has treated the values or utilities, upon which choices are based, as fixed or permanent entries that one simply retrieves from an attribute by alternative table in memory. Recently, decision researchers have come to appreciate the ephemeral yet powerful effects that affect and emotion have on decision making. However, theoretical modeling of the motivational underpinnings of values has lagged behind the empirical work. Decision field theory is presented, which provides a formalization of the dynamic changes in motives over time. Empirical applications of this theory are presented for several recent findings from decision making, including conflicts between reasons and emotions, deprivation/consummation cycles in preference, and variety-seeking behavior over time.

**2:55–3:15 (566)**

**Dynamics of Infants’ Decisions to Reach.** LINDA B. SMITH, *Indiana University*—Life presents two choices. When two equally intriguing target objects are presented to infants, where do they reach? The choice of a target for reaching is the emergent product of a highly embodied memory for past actions. Evidence is presented both on the embodied nature of these memories and on their dynamic properties.

**3:15–3:35 (567)**

**Metastable Coordination Dynamics of Brain and Cognition.** J. A. SCOTT KELSO, *Florida Atlantic University*—Cognitive functions in the brain arise from coordination within and between cortical areas. The dual nature of this coordination—how the individual parts may retain their local specialized function while interacting to form global context-dependent spatiotemporal patterns of activity—is not understood. Here, the following is shown: (1) The tendency of components to function independently coexists with the tendency to coordinate together. (2) These coexisting tendencies arise from metastable coordination dynamics—that is, in between the idealized states of full cooperation, in which the component parts are locked together, and total independence, in which the parts behave as separate autonomous entities. (3) Metastable coordination dynamics are caused by the interplay of two factors, the intrinsic properties of the components themselves and the nonlinear coupling between them. (4) New information is created in the metastable regime of the coordination dynamics without any need for amplification. (5) Dynamics create information in time, and information modifies and directs dynamics.

**Language, Culture and Individual Differences  
Coronado L, Saturday Afternoon, 1:30–3:35**

*Chaired by Mark H. Ashcraft, Cleveland State University*

**1:30–1:45 (568)**

**Differential Lateralization in First- Versus Second-Language Processing: An fMRI Study.** THAD POLK, CHARLES BEHENSKY, HEATHER POND, STEFAN FRISCH, MARILYN SHATZ, & JUN ZHANG, *University of Michigan*—Second-language (L2) processing has sometimes been hypothesized to make greater demands on the non-dominant hemisphere than does first-language (L1) processing, but this hypothesis is controversial. Using functional MRI, we investigated language lateralization within individual bilingual subjects, all of whom were neurologically intact. Following Kim et al. (1997), we examined neural activity in late, fluent bilinguals under three conditions: (1) silent production in L1, (2) silent production in L2, and (3) control (fixation). We analyzed L1 versus fixation and L2 versus fixation in left and right inferior frontal regions. All of our first 4 subjects have shown an interaction between language and hemisphere, with L1 being more lateralized to the dominant hemisphere than L2.

## 1:50–2:10 (569)

**Motion Events in Language and Cognition.** SILVIA GENNARI, *University of Maryland*, BARBARA MALT, *Lehigh University*, & STEVEN SLOMAN, *Brown University* (read by Barbara Malt)—We investigated whether different lexicalization patterns of motion events in English and Spanish predict how speakers of these languages perform in nonlinguistic tasks. Using 36 motion events, we compared English and Spanish speakers' linguistic descriptions with their performances on two nonlinguistic tasks: recognition memory and similarity judgments. We investigated the effect of language processing on nonlinguistic performance by varying the nature of the encoding before testing for recognition and similarity. Participants encoded the events while describing them verbally or not. No effect of language obtained for recognition after both linguistic and nonlinguistic encoding or for similarity after nonlinguistic encoding. We did find a linguistic effect on similarity after verbal encoding, an effect that conformed to language-specific patterns. This suggests that linguistic and nonlinguistic performance are dissociable but people can use language-specific regularities made available in the experimental context as a strategy to make similarity judgments.

## 2:15–2:30 (570)

**Portraying Events: Does Language Matter?** BARBARA TVERSKY, *Stanford University*, KRISTEN LAM, *Stuyvestant High School*, & DENIS PELLI & MARIA LUISA MARTELLI, *New York University*—In manner languages (English, German), verbs richly describe manner as well as path of motion: swagger, scamper, slink. In path languages (Spanish, Japanese), verbs primarily describe motion path: ascend, exit (Talmy, 1985). In path languages, expressing complex motion is clumsy; in translations from manner languages, it is replaced by spatial descriptions (Slobin, 1997). We wondered whether depictions of events would parallel this dichotomy. We found that soap operas in manner languages are more likely to portray changes of location explicitly than are soaps in path languages. Similarly, comics in manner languages are more likely to depict action than are comics in path languages, where scene-setting is more prevalent.

## 2:35–2:50 (571)

**Perceptual Categories Are Not Universal: New Evidence From Traditional and Western Cultures.** DEBI ROBERSON, *University of Essex*, JULES DAVIDOFF, *Goldsmiths College, University of London*, & IAN DAVIES, *University of Surrey*—The argument that language and thought are only loosely connected has been based on evidence from the color domain suggesting that, although color terms vary widely across different cultures, the underlying cognitive representations do not. Contrary to this argument, we present new evidence supporting the linguistic relativity of color and other perceptual categories. Cross-cultural investigations in New Guinea and Africa have failed to find evidence of a set of universal color (or shape) categories. Moreover, in native English speakers, the greater accuracy normally observed for cross-category judgments, as compared with within-category judgments, disappeared under verbal interference (both for color and facial expressions). This suggests that categorical perception is critically dependent on the availability of a verbal code. Finally, the loss of labels radically impaired the ability of an anomic patient, suffering from a naming disorder, to categorize colors or facial expressions. We conclude that language and thought are tightly linked.

## 2:55–3:10 (572)

**English and Spanish Speakers Attend Differently to Attributes of Novel Events.** ALAN W. KERSTEN & MIREYA L. RIVERA, *Florida Atlantic University*—This study tested one instantiation of the Whorfian hypothesis—namely, that people attend to those attributes of their experience that are prominently marked in their language. The specific attribute that we focused on was the manner of motion of an object. In English, manner is typically conveyed by verbs. In many other languages, such as Spanish, verbs typically convey the path of an object, and manner is often not explicitly mentioned. We investigated whether

this difference causes English speakers to attend more strongly to manner than Spanish speakers do. Native English and Spanish speakers learned to categorize novel, animated events on the basis of either the path or the manner of one of the objects in each event. The two groups did not differ in their ability to categorize the events on the basis of path, but English speakers were better at categorizing the events on the basis of manner.

## 3:15–3:30 (573)

**Sex Differences in Tolerance to Visually Induced Motion Sickness.** MOIRA B. FLANAGAN, ERIKA ALVARADO, JAMES G. MAY, & THOMAS G. DOBIE, *University of New Orleans* (read by James G. May)—Women report a history of motion sickness (MS) about twice as frequently as men, but the results of experimental studies are equivocal regarding this difference. In the present study, men and women were exposed, during two separate sessions, to visually elicited apparent motion, with and without voluntary head motion (pseudo-coriolis stimulation). Measures of latency to apparent motion, magnitude of apparent motion, duration of exposure (tolerance) under each condition, and MS symptoms before, during, and after exposure were recorded. Women reported significantly more MS during and after exposure to either condition, but they exhibited less tolerance with head movements than with head restriction. No differences in latency to apparent motion or apparent motion magnitude were observed for the different conditions or groups. These results indicate that laboratory manipulations that are more provocative of MS and measures of tolerance to provocative stimulation reveal reliable sex differences.

## Implicit Memory

## Monterrey, Saturday Afternoon, 1:30–3:15

Chaired by James E. Cutting, *Cornell University*

## 1:30–1:50 (574)

**The Effects of Generation on Conceptual Implicit Memory.** NEIL W. MULLIGAN, *Southern Methodist University*—The effects of generation have been central to theoretical analyses of implicit memory. The present study examined the effects of three generation manipulations on conceptual implicit memory in the category-exemplar production task, as well as on explicit memory in category-cued recall. Two non-semantic generation tasks, letter transposition and word-fragment generation, dissociated performance between the two tasks, enhancing category-cued recall, but not category-exemplar production. A semantic generation task, however, did enhance conceptual priming, even when test-aware participants were removed from the analysis. Finally, the letter transposition task enhanced conceptual priming when categorical information was salient (in a blocked list condition), but not when it was not salient (in a random list condition). This set of results is at odds with the standard transfer-appropriate-processing account of implicit memory but may be accommodated by an account based on the item-specific-relational distinction.

## 1:55–2:15 (575)

**Conscious and Unconscious Influences of Memory Following Superficial Encoding.** DOUG LOWE, *Trent University*, & STEVE JOORDENS, *University of Toronto, Scarborough*—To assess memory following superficial encoding, participants searched a passage of text, cancelling instances of the letter “e.” Memory for words from the passage was subsequently assessed by instructing participants to complete word stems under inclusion or exclusion instructions. Success and failure at following these instructions was assumed to reflect conscious and unconscious influences of memory, respectively. At retention intervals of between 2 min and 35 days, participants failed to correctly use words from the passage under inclusion instructions and incorrectly used those words under exclusion instructions. The results indicate that unconscious influences established during superficial encoding yield enduring unconscious memories that influence performance over considerable temporal intervals. Additional find-

ings revealed that priming by unconscious influences that are established during superficial encoding impair subsequent episodic learning.

**2:20–2:30 (576)**

**Habit Learning in a Forced-Choice Task.** MARKUS DRESSEL, *University of Potsdam*, & TEENA D. MOODY & BARBARA J. KNOWLTON, *UCLA* (read by Barbara J. Knowlton)—Habit learning refers to the gradual and implicit learning of associations. Although most demonstrations of habit learning have been in experimental animals, this type of learning may also exist in humans. In this study, subjects viewed a pair of shapes on each trial and, under a deadline, guessed which one concealed a smiling face. There were 15 pairs of shapes, each appearing eight times. Learning was equivalent for subjects who did and did not have explicit memory of the pairs. These data suggest that performance in this forced choice task may be supported by implicit habit learning.

**2:35–2:50 (577)**

**In What Sense Is Implicit Memory “Episodic”?** ELINOR MCKONE, RACHEL YATES, & BROOKE FRENCH, *Australian National University*—We consider three aspects of the term “episodic.” We argue that implicit memory (1) does not make conscious autobiographical reference, (2) does code an item’s intrinsic context (e.g., perceptual detail), and (3) does not code extrinsic context (e.g., environmental location). We demonstrate obligatory encoding of perceptual form: Priming for words was sensitive to study–test mismatch in writing form (handwritten vs. typewritten) even when the study phase required abstract semantic processing (animate–inanimate decision), as long as the test task required reference to appearance (name degraded word, then report writing form). We then show no sensitivity of implicit memory to environmental context: Study–test mismatch in location (indoors vs. outdoors) had no effect on stem-completion priming. We conclude that implicit memory reflects traces within perceptual and semantic knowledge systems that are instance specific but do not code the full spatiotemporal context necessary to support conscious recollection.

**2:55–3:10 (578)**

**Midazolam Amnesia and Conceptually Based Implicit Memory.** JASON ARNDT & ANTHONY PASSANNANTE, *University of North Carolina, Chapel Hill*, & ELLIOT HIRSHMAN, *University of Colorado, Denver* (read by Elliot Hirshman)—Numerous studies have demonstrated similarities between conceptual implicit and explicit memory performance. It is possible that the association between implicit and explicit memory performance results from explicit memory contamination of performance on the implicit memory task. In order to address this issue, an experiment was conducted in which participants were administered the sedative midazolam prior to study in order to induce temporary anterograde amnesia. The effects of organization of stimuli by semantic category and generation of stimuli at study were investigated on a category exemplar generation task. Midazolam administration produced dramatic impairment of explicit memory, while leaving implicit memory performance relatively intact. Furthermore, generation of stimulus materials improved implicit and explicit memory performance when generation occurred in organized portions of the study list. Implications for transfer appropriate processing theory (Roediger, Weldon, & Challis, 1989) and the item-specific and relational processing account of conceptual implicit memory (Mulligan, 1996) are discussed.

**Object-Based Attention**

**Durango, Saturday Afternoon, 1:30–3:00**

*Chaired by Anne P. Hillstrom, University of Texas, Arlington*

**1:30–1:45 (579)**

**Free-Viewing Perceptual Asymmetries: An Object or Space-Centered Bias of Attention?** MICHAEL E. R. NICHOLLS & GEORGINA C. HUGHES, *University of Melbourne*—Under free-viewing conditions, judgments of magnitude between the left and the right sides of an ob-

ject are generally biased toward the leftward features. This study determined whether this leftward bias uses object or space-centered coordinates. Dextral and sinistral participants ( $n = 40$ ) made luminance judgements for two left/right mirror-reversed luminance gradients. The stimuli were arranged so that (1) both stimuli crossed the midline and (2) one stimulus fell to the left of the midline and one to the right. Consistent with previous research, participants selected the stimulus with the pertinent feature on the left side in the midline condition. In the lateral condition, participants selected the stimulus with the pertinent feature on the left only when the stimulus fell to the left of the midline. These data suggest that object and space-centered coordinates are both important to the leftward bias that occurs for free-viewing perceptual asymmetries.

**1:50–2:10 (580)**

**Attending to the Locations of Superimposed Visual Objects.** KYLE R. CAVE & DEBORAH WAKE, *University of Southampton*—How does the visual system select a target object when a distractor object is partially superimposed? The target could be selected via object-based attention that is independent of location. Alternatively, object selection could be mediated by location selection, so that the locations occupied by the object are selected and the distractor locations are inhibited. We used spatial probes to measure attention at different locations in a superimposed-object task. Five locations were probed: two locations on the target, two on the distractor, and one in the middle, where the two objects crossed and part of one object occluded part of the other. Locations on the target received more attention than locations on the distractor. Furthermore, the center received more attention when the target occluded the distractor than when the distractor occluded the target. The results indicate that selection of the target object is mediated by location selection.

**2:15–2:35 (581)**

**Attentional Mechanisms and Perceptual Learning in Object Attention.** BARBARA A. DOSHER & SONGMEI HAN, *University of California, Irvine*, & ZHONG-LIN LU, *University of Southern California*—The mechanisms of object attention effects—limitations in judging attributes of different objects simultaneously—were evaluated in psychophysical tasks in clear and noisy displays. The independently varied orientation (O) and phase (P) of two peripheral Gabor patches were judged either within or across objects. Object attention deficits in contrast threshold occurred in both high and low external noise, reflecting a mixture of external noise exclusion and stimulus enhancement (Doshier & Lu, *Psychological Science*, 2000); they were robust primarily for different-response (OP) dual-object conditions. Object attention deficits were reduced with moderate practice and, under some conditions, essentially eliminated. Thus, (1) object attention deficits, when they occur, reflect a mixture of attention mechanisms; (2) object attention deficits are expressed strongly only in more complex response conditions; (3) object attention deficits may be overcome with perceptual learning. (Supported by AFOSR, NIMH, NSF.) Doshier, B., & Lu, Z.-L. (2000). *Psychological Science*, *11*, 139–146.

**2:40–2:55 (582)**

**Attentional Cuing, Attentional Focusing, and Object-Based Versus Space-Based Selection.** MORRIS GOLDSMITH & MENACHEM YEARI, *University of Haifa*—In Egly, Driver, and Rafal’s (1994) widely used “double-rectangle” attentional-cuing paradigm, exogenous (direct) cues yield consistent evidence of object-based selection, whereas endogenous (indirect) cues do not. However, the type of attentional cuing (endogenous vs. exogenous), is generally confounded with the initial focus of attention (focused vs. spread): Endogenous cuing typically requires that attention first be narrowly focused at the center of the display to process and interpret the cue, whereas exogenous cuing allows attention to be more widely spread. Several experiments that unconfound these two factors help clarify the relationship between attentional cuing, attentional focusing, attentional control, and object-based versus space-based selection.

**Decision Processes I**  
**Yucatan, Saturday Afternoon, 1:30–3:00**

*Chaired by George Wolford, Dartmouth College*

**1:30–1:45 (583)**

**Physicians' Use of a Decision Aid and Jurors' Malpractice Verdicts.** HAL R. ARKES, *Ohio State University*—Mock jurors read a case of possible medical malpractice. In half of the cases, the physician used the Alvarado Score to diagnose appendicitis. In the other half of the cases, no decision aid was used. In half of the cases, many symptoms were present; in the other half, only a few were. In half of the cases, the physician heeded the aid (operated when many symptoms were present and did not when few were present). In the other half, he defied the aid. In all cases, the identical adverse outcome occurred. Jurors' verdicts indicated that heeding the aid provided no protection against malpractice judgments; nor did defying it increase such judgments. Jurors punished physicians who did not operate when many symptoms were present, whether or not an aid was used. A second experiment showed that physicians who use a diagnostic decision aid are judged to be less competent than physicians who do not.

**1:50–2:10 (584)**

**On Not Wanting to Know: Choices Regarding Genetic Predictive Testing.** ILAN YANIV, *Hebrew University of Jerusalem*, GIDEON KEREN, *Technische Universiteit, Eindhoven*, MICHAL SAGI, *Hadassah Hebrew University Hospital*, & TAL GREENBAUM & YAEL ZUR, *Hebrew University of Jerusalem*—A major consequence of the genetic revolution is the ability to identify genes tied to late-onset incurable diseases. Research on populations at risk for incurable diseases, such as Huntington disease, has shown only limited willingness to undergo predictive testing. Our research investigated the conditions under which people in the general population (i.e., not at high risk) would be interested in receiving genetic information regarding types of late-onset incurable diseases. The results regarding the “preference not to know” are discussed in light of research on decision making and attitudes toward uncertainty.

**2:15–2:35 (585)**

**People's Belief in Their Ability to Foil Competition.** YAAKOV KAREEV & ALONIT RANIA, *Hebrew University of Jerusalem*—“Here are 16 shekels for you to hide in this 16-compartment box anyway you choose. Your opponent will then open 8 of the compartments. Whatever he or she finds is his/hers, you get the remaining money.” This multi-item multilocation hide-and-seek game was employed to measure people's belief in their ability to mislead or outguess their opponent. With an allocation of 1 shekel per compartment, a player can ensure a gain of 8 shekels, and the degree of deviation from such a uniform allocation is an indication of a player's belief in the ability to outperform an opponent. Role (hider, seeker) and frame (gains, losses) of allocator were manipulated. Allocators were optimistic under all conditions, exhibiting a belief in their ability to outperform their opponent. Role and frame significantly affected that belief. In addition, hidere overused certain locations and underused others; seekers took advantage of that nonrandom placement.

**2:40–2:55 (586)**

**The Informational Value of Group Interaction.** ROBERT SORKIN, SCHENGHUA LUAN, JESSE ITZKOWITZ, & RYAN WEST, *University of Florida*—What information is communicated during group discussion, and how does that information affect the accuracy of decision making? What are the effects of allowing no discussion, limiting discussion to one graded or yes/no comment per member, or maintaining member anonymity? Five participants performed a graphical signal-detection task. On each trial, each participant observed a (signal-plus-noise or noise-alone) input and made a yes/no vote about the signal's presence. Three of the participants were randomly assigned displays with higher noise levels, and 3 participants were given extra

monetary penalties for misses or false alarms. The first votes were displayed to everyone, and then a second vote was taken. In some conditions, the first votes were tagged with information about each participant's display difficulty and penalty. Performance on the second vote was compared with the predictions of a signal-detection model that assumed optimal use of the information from the first vote.

**Problem Solving**

**Coronado A, Saturday Afternoon, 1:30–3:40**

*Chaired by J.F. Kreams, Chemnitz University of Technology*

**1:30–1:45 (587)**

**Mood and Creativity: A Swing or a Level Thing?** GEIR KAUFMANN & OYVIND MARTINSEN, *Norwegian School of Management*—Several recent studies seem to show a substantial and consistent positive relationship between affective disorders and creativity. Competing hypotheses have been advanced to explain this relationship. Two hundred fifteen psychology and arts and craft students completed questionnaires and tests that measured hypomania, depression, bipolar mood swings, and a wide range of various indicators of creativity. On the whole, results show strongest support for the hypomania hypothesis. However, there is a significant effect for bipolarity on a product term that measures high levels on all indicators of creativity, indicating that bipolarity may have a theoretically posited advantage in complex tasks requiring a highly diversified creative ability. The results are explained within the context of a general theory of mood and creative problem solving.

**1:50–2:05 (588)**

**Improving Problem Solving Via Task Analysis: No Theory Need Apply?** RICHARD CATRAMBONE, *Georgia Institute of Technology*—Learners typically have great difficulty generalizing from training examples to novel problems in domains such as probability, algebra, and physics. Although a variety of cognitive models attempt explanations for the transfer difficulties, a series of studies has suggested that a good deal of the variance is explained by considering details of the examples and other training materials and their relationship to the test problems. It has been found across a variety of studies in multiple domains that the key step to aiding problem-solving transfer is to conduct a careful task analysis to identify what a learner will need to know in order to solve problems in a given domain. This task analysis produces the raw material that can then be developed into instructional material.

**2:10–2:20 (589)**

**Training and Tasks Demands That Restrict and Enhance Performance.** ITIEL E. DROR, *Southampton University*; ELLEN J. LANGER, *Harvard University*, MISSY HOULETTE, *University of Delaware*, & ALAN R. S. ASHWORTH, III, *U.S. Air Force Research Laboratory*—Seventy-eight participants were tested in three experiments that examined the effects of prior knowledge on performance. In each experiment, participants were required to build a structure using small custom-made wooden blocks. After initial training, participants were required to perform a number of tasks that could be objectively quantified in terms of level of performance and creativity of solution. We manipulated the way prior knowledge (e.g., examples and instructions) were used during training and the demand characteristics of the tasks (e.g., time pressure and group work) to examine their possible influences on creative problem solving. The results show that the type and amount of examples used during instruction can restrict or enhance creative performance. However, these effects were mediated by task demands.

**2:25–2:45 (590)**

**Property Diagnosticity and Representation Applicability Ratings for Hierarchies, Matrices, and Networks.** LAURA R. NOVICK, *Vanderbilt University*—The benefits of pictures and diagrams for successful problem solving are well documented. Abstract diagrams, in par-

ticular, are important instruments in the toolbox for thought. However, students often do not select an appropriate representation for the problem at hand. I hypothesize that this is due to their rudimentary knowledge concerning the applicability conditions for different representations. Novick and Hurley (2001) proposed a structural analysis of three abstract diagrams—hierarchies, matrices, and networks—and presented preliminary evidence in support of that analysis. The present study more directly tested students' knowledge of the proposed applicability conditions. In addition, it examined whether the links between the applicability conditions and the representations are symmetric or asymmetric. The subjects—advanced computer science majors and students enrolled in introductory psychology—rated how strongly each property (applicability condition) cued each representation (diagnosticity) or how applicable a particular representation was to situations involving each property (applicability).

#### 2:50–3:05 (591)

**Comparing Fractions.** CLAUDE G. CECH, *University of Louisiana, Lafayette*—Do people invariably access value when processing fractions? Several experiments examine potential strategies for comparing the relative values of fractions. Numbers are of general interest because they suggest some preservation of analogue value in the mental comparison paradigm, unlike most other domains. Distance and congruity effects are assessed in comparison contexts that might give rise to different strategies. If people compare simple fractions ( $1/2$ ,  $1/3$ , . . . ,  $1/9$ ) on the basis of the bottom number rather than the fraction value, for example, then distance effects ought to correspond to those obtained with integers, but congruity effects ought to be moderated by Stroop-like interference. Moreover, cross-format comparisons ought to be difficult to the extent that different formats impose biases for different strategies.

#### 3:10–3:20 (592)

**Effects of Number Surface Form on Strategy Choice for Arithmetic.** JAMIE I. D. CAMPBELL, JONATHAN FUGELSANG, & NICOLE DOETZEL, *University of Saskatchewan*—How numerical surface form (e.g., Arabic digits, written number words, Roman numerals, etc.) influences elementary calculation processes is a controversial issue of numerical cognition research. One way that format could affect calculation is by influencing strategy choice. In Experiment 1, university students ( $n = 85$ ) solved simple addition problems in a true/false verification task with equations in digit format ( $3 + 4 = 8$ ) or written English format (three + four = eight). In Experiment 2 ( $n = 50$ ), participants produced the answer to simple addition problems presented in digit or word format. Participants in both experiments reported their solution strategy (e.g., direct retrieval or calculation) after each trial. Reported use of direct retrieval was much greater with digit than with word stimuli, and format interacted with equation type and problem difficulty to affect strategy use and performance. We argue that surface form directly influences central, rather than only peripheral, stages of cognitive arithmetic.

#### 3:25–3:35 (593)

**Telling It Like It Is: The Validity of Verbal Reports in Simple Arithmetic.** JO-ANNE LEFEVRE & BRENDA L. SMITH-CHANT, *Carleton University*—Adults may use a variety of procedures to solve simple arithmetic problems (e.g.,  $4 \times 7$ ;  $12 - 4$ ), such as retrieving the answer from memory, using a related but better known fact, or counting. Researchers have collected information about solution procedures by asking participants to describe their mental processes. Such verbal reports, however, have been criticized as potentially invalid. In two experiments, latencies and errors of participants who provided verbal reports were compared with those of participants who did not. Individual differences in arithmetic fluency were used to explore the effects of verbal-report requirements on performance. For multiplication, less-skilled participants were reactive to verbal-report instructions, but only when accuracy was stressed. For subtraction, no evidence was found for reactivity. In both experiments, patterns of latencies and errors and the relations between these variables and the verbal reports

suggested that these reports were valid reflections of the participants' mental processes.

### Temporal Context and Serial Learning Coronado H, Saturday Afternoon, 3:50–5:30

Chaired by James B. Worthen, *Southeastern Louisiana University*

#### 3:50–4:10 (594)

**A Temporal Context Model of Episodic Memory.** MICHAEL J. KAHANA, *Brandeis University*, & MARC HOWARD, *Boston University*—The authors present a new model of episodic memory based on the idea that the representation of temporal context evolves, not by random fluctuation (e.g., W. K. Estes, 1950), but rather by the retrieval of prior contextual states (M. W. Howard & M. J. Kahana, in press, *J. Math Psych.*). Such retrieval of temporal context also produces episodic associations. By linking contextual representations with item representations, this temporal context model provides a principled explanation for the approximate scale invariance in both recency and contiguity effects in episodic retrieval. It also provides a novel account for associative asymmetries observed in free-recall tasks.

#### 4:15–4:35 (595)

**Separating Item and Order Information Through Process Dissociation.** JAMES S. NAIRNE & MATTHEW R. KELLEY, *Purdue University*—We will discuss a technique, based on the logic of process dissociation, for obtaining essentially “pure” estimates of item and order information. Certain variables, such as phonological similarity, are widely believed to produce dissociative effects on item and order retention. However, such beliefs depend on the assumption that item and order memory can be measured through performance on a particular kind of retention test (e.g., order can be measured through a reconstruction test). Retention measures are probably not process pure but, instead, recruit multiple kinds of information and memory processing. Across four experiments, we show that our derived estimates conform generally to expected trends, although surprising results emerged in some instances. We discuss the implications of our analysis for traditional beliefs about the item–order distinction, and we show that a popular immediate memory model—the perturbation model—is capable of handling the empirical trends.

#### 4:40–5:00 (596)

**Accuracy and Response Time Patterns in Serial Order Recall.** JOHN GRAHAM THOMAS, HALEY MILNER, & KARL HABERLANDT, *Trinity College* (read by Karl Haberlandt)—The effects of report order, serial position, and list length on recall accuracy and response times were investigated in two experiments. Participants studied lists of four to six words, with report order (forward or backward) being postcued. They entered recalled words at the keyboard. Accuracy and response time patterns differed as a function of report order and serial position. In forward recall, accuracy reflected a primacy effect but no recency effect, whereas both effects were evident in backward recall. Response times in forward recall exhibited a peak at output position one, dropping from the first to second position, and leveling off for subsequent positions. In backward recall, responding took longer than in forward recall. There was an inverse U-shaped function, with response times peaking at the early output positions and then continuously decreasing. These results are discussed in terms of search models of serial recall.

#### 5:05–5:25 (597)

**Processing of Elements and Relations: Is There a Temporal Order?** VLADIMIR M. SLOUTSKY, *Ohio State University*, & AARON S. YARLAS, *Grand Valley State University and Ohio State University*—How do people process elements and relations of information structures? For example, when presented with a red triangle above a blue square, is there a temporal order in processing elements, such as color and shape, and relations, such as the spatial position? Previous re-

search has indicated that elements are more likely to be encoded than relations and that elements are processed faster than (or prior to) relations. Presented experiments, conducted in the domains of arithmetic and object arrangements, introduce conditions under which these regularities could be reversed. Two experiments used a categorical recognition procedure in which some recognition items (E+/R– foils) shared elements, but not relations, with study items, whereas other items (E–/R+ foils) shared relations, but not elements, with study items. When elements were either highly correlated or highly identifiable, elements were represented more amply and processed more quickly than relations: E–/R+ foils were correctly rejected more often and more quickly than E+/R– foils. However, when either correlations among the elements or identifiability of elements were attenuated, both accuracies and latencies for these foils were reversed. These data provide evidence that under certain conditions, elements and relations may be processed in parallel, rather than relations being computed from elements.

### Lexical Effects II

Coronado L, Saturday Afternoon, 4:00–5:25

Chaired by Seth Greenberg, Union College

#### 4:00–4:20 (598)

**Lexical Interactions in Dense Neighborhoods.** KENNETH I. FORSTER, *University of Arizona*—Priming effects between words of similar form (neighbors) have the potential to reveal fundamental properties of the architecture of the lexical retrieval system. One such finding is that words in dense neighborhoods resist priming, suggesting that their detectors are more narrowly tuned. Recent evidence from Dutch (van Heuven et al., 2001) argues that neighborhood density may be irrelevant and that the competitive effect of a single shared neighbor is enough to block priming (this result is predicted by the IA model). Similar results are reported for English. However, there appear to be clear exceptions to this rule—for example, density appears to block priming for items in which the vowel is changed (e.g., *troin*–*TRAIN*), even though there is no shared neighbor (Forster & Taft, 1994).

#### 4:25–4:45 (599)

**Lexical Quality and Reading Skill.** CHARLES A. PERFETTI, LESLEY A. HART, & ERIK D. REICHLE, *University of Pittsburgh*—Skill in reading can be understood in part by the quality of individual lexical representations. Variation in lexical quality leads to both obvious outcomes in word tasks (e.g., speed and accuracy of word identification) and nonobvious outcomes in simple comprehension tasks (e.g., susceptibility to form and meaning confusions). Here, we demonstrate how a model that allows lexical quality to affect form and meaning activation can account for these outcomes, and we report ERP results for a simple comprehension task that expose individual differences in the quality of the reader's word representations.

#### 4:50–5:05 (600)

**Lexical Priming of Verb Argument Structure During Auditory Language Comprehension.** JARED NOVICK & JOHN C. TRUESWELL, *University of Pennsylvania* (read by John C. Trueswell)—We introduce a new lexical priming technique designed for use during uninterrupted spoken language comprehension. In these experiments, subjects' eye movements were recorded as they heard a male voice giving spoken instructions. Critical sentences were syntactically ambiguous (e.g., “Now I'd like you to feel the frog with the feather”), where “with the feather” could indicate an instrument or a noun phrase modifier. At the onset of “feel,” a second verb with different syntactic preferences was uttered by a female voice and mixed into the digitized audio-track. Although subjects reported rarely being able to identify primes, prime verbs that prefer to take an instrument role (e.g., “hit”) resulted in significantly more looks to a potential instrument object (a feather), as compared with primes that prefer a modified noun (e.g., “choose”). The findings indicate that the auditory recognition of a verb automatically activates argument roles that are tied to specific syntactic forms.

#### 5:10–5:20 (601)

**“Illusory Conjunctions” From Semantic Priming in a Word Identification Task.** VERONICA J. DARK & PATRICIA A. SCHMIDT, *Iowa State University*—Past research with briefly presented words showed that when targets were defined via a location precue but foils were semantically primed, participants often misreported foils as targets. However, instructions did not emphasize distinguishing targets from foils. In the present research, 100-msec masked pairs were presented 300 or 600 msec after and 1° or 2° above or below a “prime” that was related to one word in the pair. 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, identifying the foils as such. More related than unrelated words were reported. Related foils were misreported as the target at a high rate, suggesting “illusory conjunctions” in which participants thought the foils were in the target color. The highest level of misreport occurred under the near condition at the 300-msec SOA.

### Attention and Action

Monterrey, Saturday Afternoon, 3:25–5:30

Chaired by Wolfgang Prinz

Max Planck Institute for Psychological Research

#### 3:25–3:35 (602)

**Time Pressure Effects in Overlapping Tasks: An LRP Investigation.** WERNER SOMMER, JOERG SANGALS, & LARS ROSS, *Humboldt-University, Berlin*—The effects of time pressure (TP) in overlapping tasks were investigated by recording the lateralized readiness potential (LRP), an indicator of response preparation. Two groups of 14 participants each performed two-choice responses to tones with the feet. Letters presented at SOAs of 166, 466, and 766 msec required two-choice responses with the index fingers. In Session 1, priority was placed on the foot response. In Session 2, this instruction was maintained for Group 1, whereas in Group 2 there was, in addition, TP on the finger response. TP strongly reduced RTs for the finger response. LRP onsets indicated that this effect was exclusively due to a shortening of motoric processes. Neither premotoric or decision processes nor the amount of overlap between the central stages of the two tasks was affected by TP. Interestingly, LRP also indicated the presence of a second, motoric bottleneck, independent of TP.

#### 3:40–4:00 (603)

**Response-Based Attentional Selection of Visual Input.** ASHER COHEN, URI FEINTUCH, NURIT GRONAU, & HAGIT MAGEN, *Hebrew University of Jerusalem*—Selection of visual input can be performed by space-based and object-based mechanisms of visual attention. We propose that input selection is also performed automatically by a different mechanism based on its correspondence to response (or output) specification. We use the Stroop and the flanker interference methods to demonstrate the operation of this response-based attention. In both the Stroop and the flanker paradigms, there are well-documented conditions in which distractors do not affect responses to the targets. Moreover, it is well-established that this lack of interference is due to the operation of visual attention, which filters out the distractors. We employ these same conditions and show that the distractors *do* affect performance when their visual properties correspond to the response specification. For example, requiring subjects to name certain color words causes these words to be selected at the visual input side even when they are normally filtered out by visual attention.

#### 4:05–4:20 (604)

**The Effects of Mental and Visual Attention on Bimanual Actions.** ELIZABETH A. FRANZ & TAMARA PACKMAN, *University of Otago*—Across four experiments, we examined the effects of attention to one hand's task during bimanual circle drawing. Experiments 1A and 1B examined the effects of visual or mental attention in right han-

ders and left handers, respectively. Primary findings revealed a larger circle size for the attended than for the unattended hand, whether attention was visual or mental. This finding was identical in left handers and right handers, despite some differences in the patterns of coordination dynamics demonstrated by the two groups. Experiments 2A (right handers) and 2B (left handers) examined the effects of added attention (visual plus mental) to one hand and divided attention (visual attention to one hand and mental attention to the other). Based on the logic of additivity, findings are consistent with a model in which visual and mental attention draw on some common attention resources and some distinct resources.

#### 4:25–4:40 (605)

**Automatic Actions and Visual Affordances From Objects and the Environment.** ROBERT WARD, JULIAN PHILLIPS, & JANE RAYMOND, *University of Wales, Bangor* (sponsored by Jane Raymond)—Many behaviors are automatic sequences of action, evoked by perception of the environment and the objects within it. Here, we use stimulus–response compatibility methods to look at the character and timecourse of actions automatically evoked by looking at pictures of ordinary objects. We show that presentations of objects (e.g., cups, pans, screwdrivers), with handles oriented to one side, activate a broad set of responses for action in the ipsilateral side of space. The timecourse of response activation develops gradually and is maintained for hundreds of milliseconds, distinguishing these effects from Simon and Stroop response activation. In visual cuing experiments, we demonstrate that object affordances capture attention. Finally, we look at how scene structure and affordances for navigation affect exploration in large environments where participants can look, move, and walk about freely.

#### 4:45–5:05 (606)

**Blinded by Headlights: Blindness to Symbolically Congruent Stimuli.** BILJANA STEVANOVSKI, CHRIS ORIET, & PIERRE JOLICŒUR, *University of Waterloo* (read by Pierre Jolicœur)—Blindness to response-congruent stimuli is the finding that identification of congruent targets presented during planning or execution of a cued response (e.g., right-pointing arrow during a right keypress) is impaired relative to incongruent targets (Müsseler & Hommel, 1997). We examined the importance of target symbol interpretation and whether the blindness effect would be observed for targets following congruent or incongruent stimuli that did not require a response. Two groups of subjects saw physically identical stimuli. A left-facing stimulus for one group was interpreted as a right-facing stimulus for the other group; target interpretation determined congruency between the cued response and the target symbol. Using a cuing paradigm, we encouraged subjects to interpret the symbol that usually functions as a response cue, without planning a response. The blindness effect was observed in the absence of an overt cued response. The results are interpreted in the context of extant theories of the effect.

#### 5:10–5:25 (607)

**Temporal Dynamics of Spatial Information Processing: IOR and the Simon Effect.** JASON IVANOFF & RAYMOND M. KLEIN, *Dalhousie University* (read by Raymond M. Klein)—Speed–accuracy tradeoff functions (SATs) are used to illuminate the nature of activity associated with the irrelevant spatial codes of cues and targets. We first confirm the hypothesized activation and rapid decay of codes elicited by the irrelevant spatial location of a target whose identity is being classified (Simon effect, SE). A meta-analysis revealed that the inhibition associated with removal of attention from the irrelevant location of a spatial precue (inhibition of return, IOR) increases the SE. To explore whether a response bias or genuine difference in information accrual best characterizes the effect of IOR and to determine IOR's underlying influence on the spatial S–R codes mediating the SE, we added an irrelevant spatial precue to the SAT examination of the SE. Shortly after the target's presentation, IOR is characterized by a shift along an SAT function (bias). Later, IOR is characterized by a shift to a less efficient function.

### Animal Learning and Behavior Durango, Saturday Afternoon, 3:20–5:15

Chaired by Karen L. Roper, *Wake Forest University*

#### 3:20–3:40 (608)

**Dynamics of Interval Timing.** J. E. R. STADDON, *Duke University*—Under certain conditions, organisms on interval schedules of reinforcement will rapidly adjust a temporal-dependent variable, such as wait time, to changes in the prevailing interreinforcement interval. I describe data on the effects of impulse, step, sine-cyclic and variable-interval schedules and show that they can be explained by a tuned-trace timing model that also accounts for standard steady-state timing properties, such as proportional and Weber-law timing. The model assumes that reinforcers and other time markers have a decaying effect (trace) with properties derived from the rate-sensitive property of habituation. Responding begins when the trace reaches a threshold value fixed by the most recent reinforcement. The model provides a partial account for the learning of multiple intervals but does not account for response patterns, such as the FI “scallop” and some data from “square-wave” schedules.

#### 3:45–3:55 (609)

**Anticipatory Negative Contrast With Sucrose–Sucrose and Saccharin–Sucrose Pairings.** CHARLES FLAHERTY & MARY LESZCZUK, *Rutgers University*—Rats' intake of 2% sucrose or 0.15% saccharin is reduced if either solution is followed by 32% sucrose in brief daily pairings (anticipatory negative contrast, ANC). We investigated the effects of deprivation and intersolution interval on these contrast effects. Large and equivalent ANC effects occurred in 0.15–32 and 2–32 food-deprived groups (82% BW). However, free feeding reduced ANC in a 0.15–32 group and eliminated ANC in a 2–32 group. Thus, deprivation enhanced the relative suppression of the initial substance, and more so with 2% sucrose than with 0.15% saccharin. The effect of increasing the intersolution interval from 0 to 5 min was to reduce contrast. However, this reduction was much greater when 2% sucrose preceded 32% sucrose than when 0.15% saccharin preceded 32% sucrose.

#### 4:00–4:15 (610)

**Generalization of Auditory Classification Abilities in Rats, Humans, and Neural Networks.** EDUARDO MERCADO, III, ITZEL ORDUNA, CATHERINE E. MYERS, & MARK A. GLUCK, *Rutgers University*—Training animals to discriminate stimulus events can enhance their ability to learn about differences between other stimuli. Past studies of this effect have focused on “simple” features, such as tone frequency. However, animals learn to discriminate many natural events that are much more complex. To examine how learning about complex stimuli generalizes, we trained rats and humans to discriminate broadband, time-varying sounds, using a two-alternative forced choice task, and then tested their ability to classify novel sounds with spectrotemporal features similar to those they experienced during training. Both species generalized learned discriminations to novel stimuli. We then compared generalization performance in humans and rats to performance in a neural network model of corticohippocampal processing that was trained to discriminate auditory cortical responses evoked in rats by presentations of complex sounds. Our results suggest that a mammal's ability to generalize learned discriminations reflects its ability to differentiate cortical stimulus representations.

#### 4:20–4:30 (611)

**Which Attributes of Conditioned Stimuli Elicit Behavior Systems in Rats?** GWEN LUPFER, DAVID EGGLESTON, & JEROME FRIEMAN, *Kansas State University* (read by Jerome Frieman)—Timberlake and Grant (1975) demonstrated that rats behave socially toward another rat that predicts food, but not toward a block of wood that also predicts food and not toward a rat that does not predict food. We replicated this experiment, adding three stimuli that signaled food and approximated

a rat to some extent: an unscented stuffed toy rat, a stuffed toy rat that was made to smell like a real rat, and a block of wood that also smelled like a real rat. Subjects engaged in social behaviors (e.g., grooming, crawling over) toward the rat and the rat-scented stimuli and appetitive behaviors (e.g., biting, hoarding) toward the unscented stimuli. These results indicate that scent is an important trigger for the social behavior module in rats.

#### 4:35–4:50 (612)

**Negative Patterning and Transverse Patterning in a Marsupial (the Dunnart).** C. D. L. WYNNE & K. BONNEY, *University of Western Australia*—We have been exploring two forms of configural learning in an insectivorous dasyurid marsupial—the dunnart (*Sminthopsis crassicaudata*). On the negative patterning task, two stimuli are presented both singly and concurrently. Single presentations are followed by reinforcement; concurrent presentations of both stimuli are not reinforced (A+, B+, AB−). Dunnarts reached into a hole that contained food on light or tone trials but successfully inhibited the reaching response on combined tone and light trials. On the transverse patterning task, three stimuli are reused in three pairwise combinations (A+B−, B+C−, and C+A−). Here, the stimuli were odor-impregnated balls of cotton wool, and the dunnarts had to pull a ball to uncover a food reward. Dunnarts successfully selected the reinforced odor on all three types of trials. Results are discussed in the context of the evolution of learning mechanisms and the very small brain of the dunnart.

#### 4:55–5:10 (613)

**Environmental Enrichment and Quantitative Behavior Analysis in the Malaysian Sun Bear.** JAMES D. DOUGAN, *Illinois Wesleyan University*, & VALERI A. FARMER-DOUGAN, *Illinois State University*—It has become increasingly important to provide enriched environments for captive wild animals. Research suggests that enriched environments reduce unwanted behavior (i.e., repetitive pacing), but relatively little attempt has been made to connect enrichment research with traditional research in animal learning. The present experiment applied a standard quantitative model (the generalized matching law) to an enrichment program used with two Malaysian Sun Bears. Each day, a set of “puzzle tubes” were hidden in the bears’ enclosure, each containing a variable amount of a peanut-butter/popcorn mixture. The task required the bears to locate and open the tubes before consuming the contents. A regression of the relative time spent behaviorally engaged with a tube over the relative quantity of food within the tube was well described by the matching law. The results suggest that it is possible to apply traditional quantitative models to the nontraditional zoo environment.

### Decision Processes II

Yucatan, Saturday Afternoon, 3:30–5:00

Chaired by Gretchen B. Chapman, *Rutgers University*

#### 3:30–3:50 (614)

**Consequences of Competitive Learning on Preference.** DOUGLAS H. WEDELL, *University of South Carolina*, & JOHN K. KRUSCHKE, *Indiana University*—Two experiments examined how cue competition in a learning task transfers to preferences expressed in subsequent rating tasks. Participants first learned to associate trait adjectives with particular persons. Experiment 1 used a learning procedure designed to produce blocking effects, and Experiment 2 used a procedure designed to produce inverse base-rate effects. Likableness ratings of persons were used as indicators of preference, with ratings based on remembered person information, previously encountered attribute combinations, or new attribute combinations. Classification of test pairs provided evidence for robust blocking and inverse base-rate effects in learning, although these effects depended on attribute valence. Transfer of competitive learning effects to likableness ratings occurred when information had to be retrieved from memory or when previously encountered attribute combinations were rated. These effects did not transfer to ratings of new attribute combinations. Results

were examined in light of an explanation of competitive learning revolving around rapid shifts of attention.

#### 3:55–4:10 (615)

**Goal Activation, Goal Inhibition, and Preference.** ARTHUR B. MARKMAN, *University of Texas, Austin*, C. MIGUEL BRENDEL, *INSEAD*, & CLAUDE MESSNER, *University of Heidelberg*—There is a strong intuition that an item in the world becomes more attractive when a goal related to that item is active. That is why people often purchase more food at the grocery store when they are hungry than when they are not. It is less clear what happens to items that are unrelated to active goals. We find that strongly active goals inhibit competing goals. This inhibition leads to a decrease in the attractiveness of items that are not related to the active goal. We have obtained this finding with both physiologically based goals (like eating and smoking) and “cognitive” goals (like paying a bill). We have also used a variety of dependent measures. This phenomenon has the potential to serve as a basis for studies on the structure of goals, because it provides a marker of goal activation and a measure of goal relatedness.

#### 4:15–4:35 (616)

**Multistage Decision Making: The Effect of Planning Horizon on Dynamic Consistency.** JOSEPH JOHNSON & JEROME R. BUSEMEYER, *Indiana University* (read by Jerome R. Busemeyer)—Many decisions involve multiple stages of choices and events, and these decisions can be represented graphically as decision trees. Optimal decision strategies for decision trees are determined by a backward induction analysis that demands adherence to three fundamental consistency principles: dynamic, consequential, and strategic. Previous research by us has found that decision makers frequently violate dynamic and strategic consistency. The present research seeks to extend these findings under new conditions; specifically, it explores the extent to which these principles are violated as a function of decision tree length. Decision-field theory is applied to account for the results.

#### 4:40–4:55 (617)

**Decision Making and Executive Function of Working Memory.** JOHN M. HINSON, TINA JAMESON, MIGUEL CORTES, & PAUL WHITNEY, *Washington State University*—Decision making that favors short-term over long-term consequences of action is typically defined as suboptimal or impulsive. Such temporally myopic decision making may be related to individual differences in the executive functions of working memory (WM). In two experiments, participants made hypothetical judgments of monetary rewards, using a delay-discounting paradigm. For Experiment 1, WM load was manipulated by increasing the number of options to be judged in the delay-discounting task. For Experiment 2, participants were assessed on standard clinical measures of impulsiveness and dysexecutive function. Also, delay-discounting judgments for these people were made along with different types of secondary tasks. Our results show a strong direct relation between standardized measures of impulsiveness and dysexecutive function. Furthermore, individuals scoring high on these measures have steeper temporal discounting functions. Finally, tasks that tax executive functions of WM lead to steeper delay-discounting functions.

### Developmental

Coronado A, Saturday Afternoon, 4:00–5:30

Chaired by Joan M. McDowd, *University of Kansas Medical Center*

#### 4:00–4:20 (618)

**Plasticity and Nativism: Toward a Resolution of an Apparent Paradox.** GARY F. MARCUS, *New York University*—Recent research in brain development and cognitive development leads to an apparent paradox. One set of recent experiments suggests that infants are well endowed with sophisticated mechanisms for learning language and analyzing the world; another set of recent experiments suggests that brain development is extremely flexible. In this talk, I review various

ways of resolving the implicit tension between the two and close with a proposal for a novel computational approach to reconciling nativism with developmental flexibility.

#### 4:25–4:45 (619)

**Age-Related Differences in Strategy Adaptiveness.** P. LEMAIRE & S. DUVERNE, *CNRS and Université de Provence*—One hundred thirty-eight participants (age, 20–90 years) had to say whether simple and complex arithmetic small-split ( $6 + 9 < 17$ ;  $123 + 231 < 358$ ) and large-split ( $6 + 9 < 23$ ;  $123 + 231 < 386$ ) inequalities were true or false. The age  $\times$  split significant interactions on both simple and complex problems' performance suggests that older people are less adaptive in their use of strategies for verifying arithmetic inequalities. These age-related differences in strategy adaptiveness are partially mediated by processing resources. We discuss the implications of these findings for understanding cognitive aging and arithmetic problem solving.

#### 4:50–5:05 (620)

**Signal Modality Interactions Reveal Developmental/Aging Changes in Interval Timing.** CINDY LUSTIG, *Washington University*, & WARREN H. MECK, *Duke University* (read by Warren H. Meck)—Developmental changes in attention and memory components of interval timing were examined in three age groups (5–7, 18–25, and 60–75 years), using a temporal bisection task with visual and auditory stimuli. Participants classified the duration of a current stimulus as “short” or “long” relative to their memories for standard values learned in training. All the groups replicated typical findings of shorter judgments for visual than for auditory stimuli. This discrepancy is explained by

controlled attention demands for processing visual stimuli and “memory mixing” of visual and auditory values (Penney, Gibbon, & Meck, *JEP:HPP*, 2000). The discrepancy was larger for children and older adults than for young adults, but for different reasons. Children overestimated current auditory stimuli relative to standards, whereas older adults underestimated visual stimuli. Parameter estimates suggest that this pattern is due to developmental changes in auditory memory and age declines in controlled attention.

#### 5:10–5:25 (621)

**Auditory and Visual Priming of Nonwords in Elderly Adults.** ANDREA R. HALPERN, *Bucknell University*, & MIEKE VERFAELLIE, *Boston University School of Medicine and Boston Department of Veterans' Affairs*—Studies of implicit memory in young adults, as well as in normal and impaired older adults, typically employ a visual presentation paradigm, such as word-stem completion. Fewer studies have examined auditory implicit memory, and no studies have compared implicit memory in the two modalities. This visual/auditory difference may be crucial in understanding relative successes and failures in implicit memory performance in normal and impaired elderly people. For instance, in two recent studies, both using liking judgments, Alzheimer's patients showed impaired priming for music, but intact priming for faces. The present study compared auditory and visual presentation of the same nonwords, followed by parallel explicit and implicit (liking judgment) tests. Both modalities elicited robust priming among normal seniors, uncorrelated with explicit memory. The next stage is to present this paradigm to Alzheimer's patients to assess the extent to which modality may predict performance on an implicit memory task.

## POSTER SESSION IV

Fiesta Ballroom, Saturday Evening, 6:00–7:30

## • CHEMICAL SENSES •

(622)

**Attention in Flavor Perception.** AMIR ASHKENAZI & LAWRENCE E. MARKS, *John B. Pierce Laboratory and Yale University*—We examined whether attention improves the detection of sucrose (gustatory stimulus) and vanillin (olfactory stimulus) when these flavorants are presented separately or mixed with each other. In a forced-choice design, subjects sipped one solution containing the target flavorant and another containing either water or the nontarget flavorant at a concentration producing the same baseline detection probability. Subjects pinched their noses before “tasting” every stimulus, to prevent smelling the vanillin. As compared with controls, cued attention improved detection of sucrose, but not detection of vanillin. That attention did not even improve detection of vanillin versus water implies severe limitations to olfactory, as opposed to gustatory, attention in flavors. Furthermore, attention to sucrose improved when the target solution was pure sucrose, but not when the target was sucrose–vanillin mixture. These results suggest the possibility that there is greater uncertainty in identification of olfactory, as compared with gustatory, flavors.

## • PERCEPTION •

(623)

**Captured Vision: Sounds Influence the Perception of Visual Temporal Order.** SHARON MOREIN-ZAMIR, SALVADOR SOTO-FARACO, & ALAN F. KINGSTONE, *University of British Columbia*—We examined the influence of sounds on the perceived temporal order of two lights. Temporal order judgment accuracy improved when irrelevant sounds were presented 100 msec before the first light and after the second light, relative to a baseline condition where sounds appeared simultaneously with each light or when a single sound was presented temporally between the lights (Experiment 1). Experiment 2 ruled out alerting by the sounds as the cause for the improved performance. Experiment 3 examined the time course of the effect by testing different temporal intervals between sounds and lights. The effect persisted at lags of over 200 msec. Experiment 4 revealed that two sounds temporally intervening between the lights attenuated performance relative to baseline. In a temporal analogue of the classical ventriloquist effect, by which sounds are mislocalized in space toward lights, our results show that lights can be mislocalized in time toward sounds.

(624)

**What Light Source Positions Facilitate Distance Judgments Based on Shadows?** BEM P. ALLEN, *Western Illinois University*—Seventy-two participants from the US and other countries viewed nine pictures on a Web page, each showing the same two rods in exactly the same positions. The first picture encountered by participants had no shadows. The location of the light source that generated shadows differed for each other picture. Participants were asked to rate the degree to which each picture revealed that the thicker of the two rods was actually more distant. The rating of the shadowless picture was subtracted from that of each other picture to create basic scores. A comparison of composites of frontal-lighting picture ratings and back-lighting picture ratings revealed that frontal lighting facilitated judgments more than did back lighting (difference = 1.30;  $p = .007$ ). However, an analysis involving each participant’s average rating of back-lighted rods minus her or his rating of the shadowless rod revealed that back-lighting did facilitate judgments (difference = .657;  $p = .000$ ).

(625)

**Visual Memory for Moving Scenes: Boundary Extension or Representational Momentum?** PATRICIA R. DELUCIA, *Texas Tech University*—Boundary extension (BE; Intraub, 1992) was obtained with scenes that simulated continuous self-motion forward or backward along the

depth axis. However, as compared with static scenes, the magnitude of BE decreased when scenes depicted backward motion; it increased when scenes depicted forward motion. Such scenes were remembered as relatively farther and closer, respectively. This is consistent with representational momentum (RM; Freyd & Finke, 1984). Results suggest that the mechanisms underlying both BE and RM are involved in memory for moving scenes. Such mechanisms are considered within the framework of a two-visual-systems hypothesis (e.g., Goodale & Milner, 1992).

(626)

**Sex and Age Difference in Time Perception.** PETER A. HANCOCK, *University of Central Florida*—One hundred participants, evenly split between the sexes and divided into five sequential age groups, produced empty intervals of 1, 3, 7, and 20 sec, with 50 trials at each interval. Results showed a linear relationship of the form:  $AE = a + bt$ , where AE was absolute error and  $t$  the length of the target interval. Sex differences were evident in the intercept ( $a$ ) but not the slope ( $b$ ). Age differences were also evident but were contingent upon both slope and intercept change. Results are consistent with patterns reported in previous meta-analytic reviews of age and sex effects in duration perception (Block, Hancock, & Zakay, 2000; Block, Zakay, & Hancock, 1998). Implications for physiological clock models and attention-based models of time perception are examined.

(627)

**Context Effects in Visual Length Perception: Evidence for Preattentive Processing.** YOAV ARIEH, *John B. Pierce Laboratory and Yale University*, YUHONG JIANG, *John B. Pierce Laboratory*, & LAWRENCE E. MARKS, *John B. Pierce Laboratory and Yale University*—Vertical lines are judged shorter when embedded in a set of long vertical and short horizontal lines (Context A) than when embedded in a complementary set of short verticals and long horizontals (Context B). Does attention mediate, or influence, these contextual effects? Participants were presented simultaneously with stimuli from two different sets of lines but were instructed to attend only to one. In different experiments, the attended set could be contextual (A or B) and the ignored set neutral or vice versa, or both the attended and the unattended sets could be contextual, either identical or opposite (complementary) in composition. Results showed that unattended stimuli modestly influenced the ratings of attended stimuli. The strongest and weakest context effects emerged when the two contextual sets were identical or opposite, respectively. That the context effects evidence preattentively is consistent with earlier findings that localized them relatively early in visual processing.

(628)

**Luminance Determinants of Grouping by Brightness Similarity.** SERGIO CESARE MASIN, *University of Padua*—The study explored experimentally whether perceptual grouping of achromatic surfaces presented on an achromatic background depended on the luminance B of the background, on the luminance S of each surface, on the luminance step DL at the border between surfaces, or on some combination of the three factors. Some previous reports suggest that grouping directly depends on the similarity of surface brightnesses. Other literature suggests that surface brightness depends on all three factors. If S, B, and DL all influence surface brightness, it is a logical consequence that S, B, and DL must also influence brightness similarity. If this similarity directly influences grouping, S, B, and DL should also jointly effect grouping. The results of the study show that only S and B influence grouping. This finding implies that surface brightness is influenced only by these two factors.

## • 3-D/MOVEMENT PERCEPTION •

(629)

**Additional Information About Depth While Recognizing Previously Unseen Views of 3-D Objects.** BERT WILLEMS & JOHAN WAGE-

MANS, *University of Leuven*—The goal of this study was to examine the role of additional information about depth (provided by means of horizontal disparities between the images reaching both eyes) while recognizing previously unseen views of 3-D objects. Triangulated star-like objects were constructed whose shape could be manipulated by varying the position of the individual points in space. Observers first learned to discriminate between two of these objects when seen from a fixed set of viewpoints. In this phase, objects were viewed monocularly (no additional information about depth). After that, observers were required to generalize recognition to previously unseen views of these objects under two conditions. In the first condition, additional information about the depth relations of the individual points was provided by sending two different images to the eyes, whereas in the second condition this information was not provided. The results are discussed in light of the different theories about object recognition.

(630)

**Distances Appear Different on Hills.** TOM BANTON, JEANINE STEFANUCCI, DENNIS PROFFITT, & WILLIAM EPSTEIN, *University of Virginia*—Previous research in our lab suggests that spatial layout is perceived in terms of the effort required to act in the environment. For example, hills seem steeper and distances appear farther when observers are encumbered by heavy backpacks. On the basis of these previous findings, we expect uphill distances to seem farther than the same distances on flat ground because of the increased effort required to ascend hills. In contrast, geometric principles suggest that observers should perceive uphill distances as closer due to the perceptual overestimation of slant. To test these hypotheses, we investigated how people perceive distances on both hilly and flat terrains. We found that participants judged uphill distances to be farther than distances on the flat terrain. These results are consistent with the idea that spatial layout is perceived in terms of effort.

(631)

**Behavioral Dynamics of On-Line Route Selection in Complex Scenes.** BRETT R. FAJEN & WILLIAM H. WARREN, JR., *Brown University*—Previous experiments on human walking indicate how turning is influenced by the heading angle and distance of a goal or obstacle. Using a dynamical model derived from these findings, we demonstrate how successful route selection through simple and complex scenes can emerge from elementary steering and obstacle avoidance behaviors. Participants wore a head-mounted display and walked in a 12-m<sup>2</sup> virtual environment through an array of obstacles to a goal. Head position and orientation were recorded using a sonic/inertial tracking system. In Experiment 1, we compared the model predictions with subjects' paths through eight distinct arrays of 12 randomly positioned obstacles. The model correctly predicted the side on which subjects passed each obstacle 85% of the time and predicted the most frequently selected human path within 1 obstacle on six of eight arrays. In Experiment 2, model predictions about differences in route selection for fast and slow walking speeds were tested.

(632)

**Dogs Maintain a Double Linear Optical Trajectory When Catching Frisbees.** DENNIS M. SHAFFER, *Arizona State University West*, MICHAEL K. McBEATH, *Arizona State University*, & SCOTT M. KRAUCHUNAS, *Saint Anselm College*—We tested the optical behavior of dogs catching Frisbees by attaching a microvideo camera and transmitter to the dog's head. The findings support the conclusion that dogs use a heuristic of maintaining the target along a monotonically increasing linear optical trajectory (LOT), similar to the heuristic previously shown to be used by baseball players. In addition, on those trials in which the Frisbee dramatically changed direction, the dog appeared to simply switch from one LOT to a second one that guided it to interception. We refer to this strategy as a double LOT. The work confirms that the invariant principle of optical constancy that underlies the LOT heuristic is generalizable to both other species and to targets with complex trajectories. The work provides strong evidence

supporting the use of simple generic spatial heuristics in interceptive tasks across species.

• SPEECH PERCEPTION •

(633)

**Auditory and Phonetic Processes in Speaking Rate Normalization.** JAMES R. SAWUSCH & KATHLEEN M. MEASER, *SUNY, Buffalo*—Speech segment duration varies with speaking rate and phonetic identity, yet listeners adjust to changes in a talker's speaking rate in a manner that ensures phonetic constancy. Two experiments investigated listeners' adjustment for speaking rate. When vowel duration in a series varied as a result of phonetic context, listeners still used this variation as a cue to speaking rate. A second experiment manipulated listeners' expectations about the signal and used stimuli that could be heard as speech or nonspeech. A speaking rate effect was found only when the signal was heard as speech. Results reveal that speaking rate normalization is a relatively autonomous process based on the rate of events in the speech signal. However, the signal must be processed as speech for rate normalization processes to operate. A model for this rate normalization process and the nature of the events that drive it are outlined.

(634)

**Short-Term Memory and Spoken Word Recognition.** NATHAN LARGE & PAUL A. LUCE, *SUNY, Buffalo*, & MARA GOODMAN, *State College of New York, Fredonia*—Although recognizing spoken words requires maintaining acoustic-phonetic information over time, current models of spoken word perception attribute little or no explicit role to short-term memory in the recognition process. To evaluate the hypothesis that spoken word processing consumes limited short-term memory capacity or resources, we conducted a memory load experiment in which participants were required to repeat spoken words while simultaneously holding a short list of words in memory. In addition, we manipulated the neighborhood density of both the target and the load words in order to determine whether multiple activation of form-based representations places increased demands on short-term memory. Our results implicate a role for short-term memory in spoken word processing and help to specify some of the variables that may be responsible for increased demands on memory capacity during on-line processing.

(635)

**Tone Perception in Mandarin.** SIYUN LIU & ARTHUR G. SAMUEL, *SUNY, Stony Brook*—Tone perception is critical for lexical access in tonal languages. Among the four tones in Mandarin Chinese, Tone 3 is the most changeable, sometimes characterized as a low-falling-rising tone, and sometimes as a low-falling tone. Our first experiment indicated that the final rising  $f_0$  contour of Tone 3 is redundant, suggesting that the true  $f_0$  contour of Tone 3 is therefore low-falling. Experiment 1 also revealed that tone perception was robust even when almost all of the voicing source (and thus  $f_0$ ) was replaced by white noise, suggesting that other information may cue tone perception. Our second experiment used both human-generated and machine-produced whispered words, which have no  $f_0$  information. The results of Experiment 2 indicated that the duration of a tone is another cue in tone perception. This cue is subordinate and becomes salient when  $f_0$  information is not available.

(636)

**Conditional Decomposition of Prefixed English Words.** LEE H. WURM & JOANNA AYCOCK, *Wayne State University*—Wurm (1997) introduced a construct called the conditional root uniqueness point (CRUP), which was defined as the uniqueness point (UP) of the free root of a prefixed word, given the prefix in question. Prefixed words with free roots can be divided into two mutually exclusive categories: those with the CRUP at the same phoneme as the full-form UP and those where the CRUP precedes the full-form UP by one or more phonemes. Two reaction time experiments examine whether words with early

CRUPs have measurable inhibitory consequences for words without early CRUPs. Results of these experiments replicate the processing advantage reported earlier for CRUP words (Wurm & Ross, in press), extending this finding to two additional types of comparison stimuli. In addition, this study sheds additional light on the issue of active versus passive competition in spoken word recognition.

• ATTENTION •

(637)

**The Electrophysiological Correlates of Preparatory Processes in Task Switching.** SHULAN HSIEH, *National Chung-Cheng University*—When subjects are required to either repeat the task from the previous trial or switch to the other task, their reaction times are larger for switch than for repeat tasks. It has been suggested that task-switching cost may consist of two component processes, preparation and interference. In this study, the preparatory process was maximized by providing a long foreperiod and foreknowledge of task transition. The electroencephalography was recorded in order to reveal the physiological correlates of such preparatory processes. With foreknowledge, each successive two stimuli were either performed with the same task judgment across the whole block (repeat block) or performed with different task judgments (switch block). With no foreknowledge, the two stimuli were performed randomly (mixed block). The data show that trials in the mixed block and in the pure switch block were associated with negative-going slow waves. Such negativity might reflect the inhibitory mechanism underlying task preparation.

(638)

**Introducing a Probe Detection Technique for Studying the Role of Attention in Troxler Fading.** ALEJANDRO LLERAS & CATHLEEN M. MOORE, *Pennsylvania State University*—This study evaluates a new technique for studying Troxler fading, which is a dramatic fading and filling-in of the background over a peripheral stimulus. Participants were required to concentrate on a peripheral target and to press a button when the fading occurred. Sometime later, a probe was presented inside the faded target. The probe was the same color and luminance as the background on which the faded target appeared. Detection was more difficult in this faded condition than in control conditions. This technique provided a robust and objective way of measuring Troxler fading. It was then used to investigate the extent to which attention mediates the fading.

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**Reexamining Location-Based and Object-Based Components of Inhibition of Return.** JIM McAULIFFE, *Lakehead University*, JAY PRATT, *University of Toronto*, & CAM O'DONNELL, *University of Western Ontario*—Previous work has indicated that inhibition of return (IOR) may consist of separate location-based and object-based components, and this can be seen in static displays as greater IOR to cued objects (location IOR + object IOR) than to cued “empty” locations where no object was present (only location IOR; e.g., Jordan & Tipper, 1998). To further examine the components of IOR in a static display, the basic finding was replicated when both objects and empty locations were present in the display. However, subsequent experiments showed that the amount of IOR found in displays that contained only objects was equal to the amount of IOR found when only empty locations were present. Overall, the results from these experiments indicate that IOR may not consist of two separate components, but rather that, under some circumstances, cued objects may be better inhibited than cued empty locations.

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**Cerebral Hemovelocity in Sensory and Cognitive Vigilance Tasks.** CHRISTINA A. BEAM, JOEL S. WARM, GERALD MATTHEWS, WILLIAM N. DEMBER, EDWARD M. HITCHCOCK, & LLOYD D. TRIPP, *University of Cincinnati*—Hemovelocity in the right and left medial cerebral arteries was measured via transcranial Doppler sonog-

raphy while observers performed a sensory or one of two types of cognitive vigilance tasks. Stimuli were digit pairs. Critical signals for detection were cases in which (1) one digit in a pair was slightly taller than the other (sensory task), (2) the arithmetic sum of the digits differed by  $\pm 1$  (simple cognitive task), or (3) the digits met the difference rule and also summed to values between 4 and 14, inclusively (complex cognitive task). Accuracy and speed of detections were the performance measures. Blood flow in the right cerebral artery mirrored the accuracy of performance over time in all three tasks, but not the speed of performance. Results are consistent with prior imaging findings of right-hemisphere dominance in vigilance, but not with arguments that speed and accuracy are common measures of vigilance performance.

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**Structured Task Representations as a Determinant of Shift Costs.** THOMAS KLEINSORGE & HERBERT HEUER, *Universität Dortmund*—When participants shift among a set of four tasks that result from a factorial combination of two types of judgment and two judgment-to-response mappings, a characteristic profile of shift costs as a function of the relation between successive tasks can be observed. We interpret this profile as an indication of a hierarchical representation of the two task dimensions, type of judgment and judgment-to-response mapping. In an experiment, it is shown that the characteristic shift cost profile emerges only if the performance of any of the four tasks can be required in the same block of trials. In contrast, with only two tasks occurring in a block of trials, shift costs do not reflect the relation between successive tasks. This finding points to the importance of taking more global representational structures into account for an explanation of shift costs, rather than focusing only on local transitions between individual trials.

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**Episodic Encoding of Inhibitory States: Factors Modulating Long-Term Inhibition of Return (LT IOR).** KLAUS KESSLER, SARAH GRISON, & STEVEN P. TIPPER, *University of Wales, Bangor*—We present a series of experiments aimed at first replicating the finding that inhibitory states associated with an item are encoded into episodic memory and therefore influence selective attention several minutes later. In an initial experiment, we found an LT IOR effect for face stimuli in the left visual field. Accordingly, the second aim was to further investigate the processes during encoding that might explain this finding as (1) due to right-hemisphere face processing that more richly encodes the associated inhibition and/or (2) due to how subjects serially scan the information, resulting in primacy or recency effects in the richness of encoding. According to our data collected in experiments meant to differentiate between these alternatives, there is a complex interaction between the lateralization of processing and the scanning sequence. This suggests that selective attention processes engaged during cuing modulate the encoding of the events as an episode.

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**Episodic Retrieval of Inhibitory States: Long-Term Negative Priming and Inhibition of Return.** SARAH GRISON & STEVEN P. TIPPER, *University of Wales, Bangor*—The controversy over whether attention or memory processes mediate goal-directed behavior is exemplified by the search for long-term negative priming (NP). We report long-term NP with face stimuli when several minutes and over a hundred items intervene between the prime and the probe trials. These results cannot be explained by the maintenance of transient inhibitory processes and suggest that episodic memory can mediate behavior in long-term tasks. The generalizability of this outcome was examined in a second paradigm, inhibition of return (IOR). For the first time, evidence for long-term IOR was obtained with face stimuli when several minutes and over a hundred stimuli intervene between the cue and the target trials. These data provide additional evidence that episodic memory may aid correct behavior in long-term tasks. We propose that during encoding, inhibition of irrelevant information is associated

with the episode in such a way that later retrieval impairs performance when the inhibitory processes are reinstated.

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**Age Differences in Maintenance of Task Goals in Working Memory.** DAVID P. McCABE & ANDERSON D. SMITH, *Georgia Institute of Technology*—In comparison with young adults, older adults consistently show poorer performance on working memory tasks. One possible explanation for this finding is that older adults have greater difficulty maintaining task goals. The present experiment examined this “goal neglect” hypothesis in a working memory span task. Young and older adults were presented with trials of between three and six Stroop color words (congruent and incongruent words were mixed on each trial) and were asked to recall the color of the words in order. Older adults showed a greater number of intrusions (recalling the word instead of the color on incongruent trials) than did young adults, especially early in the task, but other types of errors increased across the task for both age groups. These results suggest that maintenance of task goals, especially when a task is novel, contributes to age differences in performance on working memory tasks.

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**Anxiety and Attention to Threat.** J. YIEND & A. MATHEWS, *MRC Cognition and Brain Sciences Unit, Cambridge*—Research using attentional search tasks has revealed an anxiety-related bias favoring attention to threatening words when they are presented simultaneously with emotionally neutral words. In Experiment 1, using a similar task, a related effect was found with emotionally threatening pictures. When pictures were used as location cues in a second experiment, high trait anxious individuals were slower than less anxious controls when responding to targets requiring attentional disengagement from threat and slower in general with pictures judged to be highly threatening. In a third experiment using the same task, but with a longer cue exposure, a related disengagement difficulty occurred across both groups, although the more general slowing with severe threat was again confined to the anxious group. We conclude that attentional bias involves a specific difficulty in disengaging attention from the location of a potential threat and a more general interference effect that is related to threat level.

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**Linking Actions and Their Perceivable Consequences in the Human Brain.** BIRGIT ELSNER, *Max Planck Institute for Psychological Research*, BERNHARD HOMMEL, *University of Leiden*, CLAUDIA MENTSCHER & ALEXANDER DRZEZGA, *Technical University of Munich*, WOLFGANG PRINZ, *Max Planck Institute for Psychological Research*, BASTIAN CONRAD, *Technical University of Munich*, & HARTWIG SIEBNER, *University College, London*—Voluntary action is goal-directed and therefore depends on the ability to learn associations between movements and their perceivable consequences. The neural substrate of this ability was investigated with positron emission tomography (PET). Healthy adults first learned that self-initiated keypresses were consistently followed by certain tones (i.e., action effects). During PET imaging, participants listened to varied ratios of action-effect tones and neutral tones without performing any movement. The caudal supplementary motor area and the right hippocampus increased their activity with the frequency of action-effect tones, suggesting that these areas participate in binding movements to their outcomes, thus promoting the learning and control of voluntary actions.

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**No Facilitation in the Stroop Task.** URI BIBI, *Ben-Gurion University of the Negev and Sapir College*, & JOSEPH TZELGOV, *Ben-Gurion University of the Negev*—It is a frequently assumed that presenting a congruent color word facilitates response for color naming. In two experiments, we challenge this assumption. In Experiment 1, we show that RTs for naming the color of a congruent stimuli does not differ from RTs for naming the color of meaningless patterns generated by randomly distributing color pixels over an imaginary rectan-

gle. In Experiment 2, we demonstrate that a constant letter string that serves as a neutral acquires lexical status and, consequently, causes interference in color naming.

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**Attentional Orienting: The Costs of Age and the Benefits of Processing Speed.** LESA HOFFMAN & PAUL ATCHLEY, *University of Kansas*—The present study investigated the use of context-based and stimulus-based orienting strategies as a function of age (younger,  $n = 95$ , mean age = 19.7 years; older,  $n = 55$ , mean age = 75.5 years) and processing speed, using a change detection task. Observers searched for change in targets that varied in salience and meaningfulness. Aging appeared to decrease the use of either context-based or stimulus-based orienting when used in isolation, but not when both sources were used in conjunction. An analysis based on processing speed showed the presence of differences in orienting that were due to processing speed and were age-invariant. The slowest third of each age group continued to use both sources of orienting information when presented in conjunction, whereas the fastest third did not. For the younger observers, the fastest subgroup was better able to use context-based or stimulus-based information sources in isolation to orient attention than was the slower subgroup.

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**Task Switch Costs in Simple and Choice Response Time Conditions.** BENJAMIN R. KUNZ & FRANCES J. FRIEDRICH, *University of Utah*—Work by many researchers has shown that switching attention between tasks produces response time costs even when subjects have time to anticipate and prepare for the switch. Our previous work (e.g., Friedrich, Swallow, & Fargo, 2000) showed that this switch cost occurs when the two response sets (with different motor responses for each set) were first well learned as separate tasks. Two experiments presented here map the two different tasks onto the same two motor responses to isolate motor priming effects. As was expected, switch costs were again evident. However, in this case, a comparison of within-task response switches and between-tasks response switches showed that the two types of costs were independent and, in some cases, in opposite directions. Moreover, even when the subject received a precue prior to the target that carried information about both the type of task and the specific response required, switch costs were evident.

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**Substantial Reduction in Switching Costs for Similar Cognitive Operations.** PADMANABHAN SUDEVAN, JOHN HOLMES, PATRICK BLOOM, DANIEL KUEHNER, & CAROLINE VAN ZEELAND, *University of Wisconsin, Stevens Point*—We compared task switching costs with two highly similar classification operations (based on relative position in the alphabet or on the number line) on different stimulus sets (letters and digits), using either the same response keys (Experiment 1) or different response keys (Experiment 2) in a new switching paradigm. This paradigm is based on pairs of tasks repeated or switched within a trial, with a long intertrial interval. In the first experiment, we found that switching costs in response times were dramatically reduced to the lowest levels we have seen in several experiments using combinations of alphanumeric classification tasks. In Experiment 2, we found that, using the same two stimulus sets and classification operations, but different response keys, relatively large switching costs reappeared. We discuss the implications of these results in terms of response organization.

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**Does Visual Search Have Memory?** JAMES F. JUOLA, PRATHYUSHA DUVURU, J. DEVIN LAND, ALICIA MacKAY, & CATHERINE HERNANDEZ, *University of Kansas*—Participants searched through successive frames, each containing four letters, for the presence of one of two targets (L or R). All letters occupied 1 of 12 positions around a circle centered on a fixation point, and each frame lasted for 500 msec. The critical manipulation was whether a target occurred in

a position that had been empty on the previous two frames or one that had been occupied by a distractor on one of those frames. With no ISI between frames, responses were slower to the targets presented in a position occupied by a distractor on the previous frame. With a long ISI, no such interfering effects were observed. Additional experiments determined the relative contributions of forward masking and negative priming to distractor position effects in visual search.

• COGNITION •

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**Limited Resources Reduce Top-Down Constraints on Object Selection in Everyday Action.** TANIA GIOVANNETTI, MYRNA F. SCHWARTZ, LAUREN J. BUXBAUM, & DIANE HOLZ, *Moss Rehabilitation Research Institute*—Brain-damaged patients' errors in everyday tasks approximate those seen in "absent-minded" normal behavior, suggesting that naturalistic action is sensitive to availability of cognitive resources (Schwartz et al., 1998). To explore this further, we developed a laboratory analogue of short-order cooking that reliably elicits action slips in healthy participants, especially when performed with a concurrent, resource-demanding task (oral trail making). Twelve healthy participants were trained to perform the task quickly and without error. Then, four blocks of three trials were run, alternating between standard administration and concurrent task challenge. The mean number of errors was significantly higher in the concurrent task condition [ $t(11) = 4.43, p < .01$ ]. Misreaches to nontargets increased at a rate higher than any other error type, indicating that limited resources reduce top-down constraints on object selection.

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**Two Processing Routes Support Action Imitation: Evidence From Normal Subjects.** ALESSIA TESSARI & RAFFAELLA RUMIATI, *SISSA*—We provide evidence for a two-routes model for the imitation of actions in normal participants. In Experiment 1, meaningful (MF) and meaningless (ML) actions were randomly presented using a dead-line technique. Participants, who were required to imitate each presented action immediately after presentation, performed the same number of MF and ML actions. In Experiment 2, MF and ML actions were presented in separate blocks. Here, participants imitated significantly more MF than ML actions. These results suggest that imitation of actions is sustained by two independent processing routes. When MF and ML actions are intermixed, the cognitive system selects the direct route—from visual analysis of the action to motor system—allowing imitation of both types of stimuli. When MF and ML actions are imitated in separate blocks, the system chooses the direct route for ML actions and the semantic routes for the MF actions, producing the expected facilitation effect.

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**Retention of Prospective Memory.** BEAT MEIER & PETER GRAF, *University of British Columbia*—Retention of retrospective memory (RetM) performance is a logarithmic function with fast forgetting occurring immediately after learning and less forgetting thereafter. In prospective memory (ProM), the pattern of retention is less clear: Some studies have found performance declines across retention intervals, other studies reported no declines, and a recent study reported an increase with higher performance after a 15-min than after a 3-min retention interval. In the present study, we examined ProM performance at 3-, 15-, and 45-min delays. If ProM is similar to RetM, we would expect performance to decline across these delays; if ProM increases initially and declines across longer retention intervals, we would expect a U-shaped function. The results support the first hypothesis and suggest that ProM and RetM are not dissociable by retention interval manipulations.

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**Markov at the Bat: A Model of Cognitive Processing in Baseball Batters.** ROB GRAY, *Arizona State University East*—Anecdotal evi-

dence from players and coaches indicates that cognitive processing (e.g., expectations about the upcoming pitch) plays an important role in successful baseball batting; yet, this aspect of hitting has not been investigated. Hitting performance in a virtual baseball-batting task was analyzed when (1) the pitcher could vary speed randomly, (2) the pitcher could only throw fastballs or change-ups, and (3) pitch location could be either a ball or a strike. Batters (6 college players) swung a baseball bat equipped with a position tracker at simulated approaching baseballs. The pattern of swing errors was consistent with batters' generating expectations about pitch speed on the basis of the sequence of pitches and the count. A two-state Markov model provided a good fit to the hitting performance, and the model parameters were highly correlated with playing level. The model is a hitting strategy of switching between expectancy states, using a simple set of transition rules.

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**The Role of Skeletal Schemas in Bone Identification Expertise.** SHARLENE D. WALBAUM, *Quinnipiac University*—Physical anthropologists must be able to identify and determine the body side of degraded bones and bone fragments. Earlier research suggests that the task of "siding" bones is particularly difficult, even for experts. Physical anthropologists (with  $M = 19.8$  years of experience) and graduate students ( $M = 1.3$  years) named and "sided" 56 bone images that were presented using a laptop computer and Superlab software. Each bone image was from either the left or the right side of the body, was in either an upright or an inverted orientation, and was viewed from either a posterior or an anterior perspective. A significant interaction between level of expertise and bone orientation on reaction time suggests that experts were using what clinicians refer to as an "anatomical" frame of reference or a "skeletal schema." This finding is intriguing because osteology courses and field manuals emphasize the use of one's own body in bone identification (what could be considered an "egocentric" frame of reference).

• JUDGMENT/DECISION MAKING •

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**The Influence of an Opponent in Risky Naturalistic Decision Making?** KELLY A. BURKE & JOHN D. MURRAY, *Georgia Southern University*—This study assessed the extent to which the presence of an opponent affected risk-taking behavior in a modified blackjack game developed by Dror et al. (1998). Forty-eight college students executed a series of blackjack hands that varied with respect to time pressure (yes/no), presence of an opponent (yes, no), and risk level (none, low, medium, high, very high, infinite). Participants' willingness to gamble (i.e., take an additional card) was the dependent variable of interest. Consistent with the results of Dror et al., participants were less likely to gamble as risk level increased. In general, the presence of an opponent was associated with an increased willingness to gamble. However, this tendency was more pronounced at medium and high (i.e., more difficult) levels of risk. The impact of an opponent on risky decision making is discussed.

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**Facilitation of Normative Reasoning on a "Monty-Hall" Type Task by Diagram Versus Frequency Presentations.** KIMIHIKO YAMAGISHI, *Tokyo Institute of Technology*—Recent probability judgment research contrasts two opposing views. Some theorists emphasized the role of "natural frequencies" in facilitating probabilistic correctness. Opponents noted that visualizing probabilistic structure of the task facilitates normative reasoning. Here, I tested the following isomorph of the Monty-Hall dilemma. "A factory manufactures artificial gemstones. Each gemstone has a 1/3 chance of being blurred, a 1/3 chance of being cracked, and a 1/3 chance of being clear. An inspection machine removes all cracked gemstones, and retains all clear gemstones. However, the machine removes 1/2 of blurred gemstones. What is the chance that a gemstone after the inspection is blurred?" A  $2 \times 2$  design was administered. The first variable was the use of frequency

instruction. The second manipulation was the use of a diagram that illustrated the prior and the posterior probabilities. Results showed that frequency alone had limited effects, whereas the diagram achieved facilitation in logical reasoning.

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**Decision-Making Styles and Real-Life Decision Making.** KATHLEEN M. GALOTTI & KELLY E. CARMICHAEL, *Carleton College*—An adaptation of the Scott and Bruce (1995) Decision Styles Inventory was given to two groups of participants who had made or were in the process of making important real-life decisions: 111 college students describing their college major declaration and 121 parents of kindergarten students in the process of making a school choice decision for the following year. Internal reliabilities for each of the five scales (rational, intuitive, dependent, avoidant, spontaneous) were acceptable to very good. Rational scores correlated significantly with satisfaction with amount of information collected, use of specific criteria, and emphasis on future consequences of the decision; dependent and avoidant scores correlated negatively with enjoyment of the process; spontaneous scores correlated negatively with stressfulness of making the decision across both groups of participants. Rational scores correlated significantly with the number of criteria considered; spontaneous scores correlated negatively with this measure. Differences within and between the two samples are discussed.

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**Risk Perception and Risk Taking in Organizational Contexts: Effects of Information Framing and Achievement Motives.** X. T. WANG, *University of South Dakota*, & XIAO-FEI XIE, *Peking University*—We examined how Chinese participants reacted to hypothetical problems of managerial decision making. First, we demonstrated that the gain–loss situation and the information framing of choice separately affected risk perception and risk preference of the participants. Second, we examined the relationship between risk perception and goal-settings (achievement motives) of the participants. The participants with a higher achievement motive perceived greater opportunities than did those with a lower achievement motive in the loss, but not in the gain situation, and the participants with a higher avoidance motive perceived greater threats than did those with a lower avoidance motive in the gain, but not in the loss situation. These findings suggest that (1) gain–loss situation and opportunity–threat perception are two distinct dimensions underlying risk-taking behavior in managerial contexts and (2) achievement motive and avoidance motive may separately determine the goal settings for “success” and for “survival,” by influencing the opportunity–threat perception of the decision maker.

(661)

**The Role of Personal Need for Structure in Individual and Team Judgments.** JOSEPH V. BARANSKI & MEGAN M. THOMPSON, *Defence & Civil Institute of Environmental Medicine*—The present studies examined the role of personal need for structure (PNS: Thompson, Naccarato, Parker, & Moskowitz, 2001) on the quality and latency of individual and team-level judgments. In Experiment 1, 48 participants completed personality and demographic measures, including the PNS scale, and then performed three sessions on a complex simulation of a naval surveillance and threat assessment operation (TITAN: Team and Individual Threat Assessment Network). Individuals who possessed lower levels of the PNS factor termed “response to a lack of structure” displayed faster and more accurate judgments. The results were replicated and extended in a second experiment involving 80 Canadian Forces personnel performing a TITAN simulation in the context of four-person hierarchical teams. We discuss the findings in terms of cognitive continuum theory (Hammond, 1996) and the multilevel theory of team decision making (Hollenbeck, Ilgen, Colquitt, LePine, & Hedlund, 1997).

(662)

**Age Differences in Action–Outcome Contingency Judgment.** SHARON A. MUTTER & THOMAS W. WILLIAMS, *Western Kentucky University*—Young adults are sensitive to the contingency between their actions and environmental outcomes, but whether this sensitivity is maintained in old age is not known. In this study, we compared young and older adults’ contingency judgments for positive, negative, and zero action–outcome contingencies. Experiment 1 examined acquisition functions for the two groups. The accuracy of young adults’ judgments increased for both positive and negative contingencies as they gained experience with these contingencies. However, older adults’ judgments were less accurate overall and increases in accuracy occurred only for positive contingencies. Experiment 2 examined whether increasing the action–outcome interval and the number of learning trials would improve older adults’ contingency judgments. Age differences were eliminated when the action–outcome interval was increased, but surprisingly, this effect was due to an improvement in the accuracy of older adults’ judgments, combined with a decline in the accuracy of young adults’ judgments.

• COMPREHENSION/REASONING •

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**Syllogistic Reasoning Time: Disconfirming Disconfirmation.** VALERIE A. THOMPSON, RAYMOND W. GUNTER, CHRISTOPHER L. STREIMER, & JAMIE I. D. CAMPBELL, *University of Saskatchewan*—The mental models theory (e.g., Newstead, Evans, Pollard, & Allen, 1992) of deductive reasoning posits that when reasoning about a conclusion that is believable, reasoners are likely to accept the conclusion without further scrutiny. In contrast, when the conclusion is unbelievable, they are more likely to scrutinize the logical implications of the conclusion, presumably by engaging a disconfirmation strategy whose goal is to find grounds to refute the unbelievable conclusion. This view makes a very clear prediction: Arguments leading to unbelievable conclusions are more extensively analyzed and should, therefore, take longer to process than arguments leading to believable conclusions. Data from two experiments clearly disconfirm this prediction and, instead, reveal that the reverse is true: Believable conclusions take longer to evaluate than unbelievable conclusions. A modified version of Polk and Newell’s (1995) verbal reasoning theory is proposed to account for these findings.

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**Working Memory Size and the Suppression of Negative Information.** R. BROOKE LEA, HILARY K. MEAD, & JENNIFER M. CHARNLEY, *Macalester College*—How does working memory (WM) size affect logical inferences? Previous research has shown that WM size can influence pragmatic inference making during reading, and recent work indicates that logical inferences seem immune to this effect (Lea, Charnley, & Mead, 2000). The present study showed that one type of logical inference (not both a and b; a, therefore not b) fails to show priming effects with an on-line naming task. Follow-up experiments indicated that when WM span is considered, two very different patterns emerged: (1) Low-span readers showed a clear priming effect for the target, and (2) high-span readers produced no priming effect and, if anything, an inhibition effect. However, when the logical inference yielded a positive conclusion (*a or b*; not *a*, therefore *b*), both high and low spanners showed priming effects. The results have implications for the role of negation and suppression mechanisms in text processing.

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**Effects of LSA-Based Feedback on Learning From Writing.** ADRIENNE Y. LEE, PETER W. FOLTZ, HEIDI BIRON, & HEATHER SANCHEZ, *New Mexico State University*—To what extent does automatic feedback on writing improve learning? A tutoring system for three topics in cognitive psychology was developed. One version of the tutor included a grader using latent semantic analysis (LSA), which provided students with feedback about what was missing from

their essay answers; the other tutor without the grader just provided encouragement. All the students were asked to rewrite each tutor essay question twice. For the Fall 2000 cognitive psychology course, half the students used the LSA tutor, and half received simply encouragement. Two comparisons were made: pre-posttest performance on specific essay exam questions and performance on the next exam in general. In addition, for one module, the previous year's exam performance was compared with the current year's exam performance. Implications are discussed about the effects of feedback on writing on improving learning and about the development of automated systems for evaluating student essays.

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**Reasoning, Processing Speed, Difficulty, and Cognitive Complexity.** ROBERTO COLOM, ISABEL C. AREND, JUAN BOTELLA, & JOSÉ SANTACREU, *Universidad Autónoma de Madrid*—We investigated the relationship between the empirical difficulty of a reasoning task (linear syllogisms) and the cognitive complexity involved. One thousand nine hundred sixty-three participants were asked to solve syllogisms in a computerized format. Latencies, errors, and hits were recorded. Empirical difficulty was operationalized by indexes of accuracy and speed. Cognitive complexity was operationalized by the loadings on the first unrotated principal factor obtained from a factor analysis of the syllogisms. The correlation between cognitive complexity and accuracy was  $-.75$ , whereas the correlation between cognitive complexity and speed was  $-.6$ . Therefore, the higher the cognitive complexity, the lower the accuracy and the speed. These results strongly support the contention that the first unrotated factor reflects the cognitive complexity of the task.

## • HUMAN LEARNING/MEMORY •

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**Social Conformity in Memory.** COLLEEN M. KELLEY, MATTHEW RHODES, & LILI SAHAKYAN, *Florida State University*—We examined social influence on recognition memory and on cued recall. On critical trials, one or two confederates gave a scripted response prior to the actual participant's response. Confederates responded with either the correct or an incorrect memory response. We investigated the effects of study time, of a "random" computer response versus a response from a confederate, and of one versus two confederates, compared older versus younger adults, and investigated the effects of instructions to ignore the confederate. The standard measure of conformity is how often the participant endorses the confederate's response when that response is incorrect. We also analyzed the data, using a variant of the process dissociation procedure to obtain separate estimates of memory versus the strength of the bias to conform. Those estimates reveal that the standard measure of conformity can reflect changes in memory, changes in the bias to conform, or both.

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**Intentions, Capacity, and Salient Target Events.** REBEKAH E. SMITH, *University of North Carolina, Chapel Hill*—Extant explanations of prospective memory propose that intentions are retrieved automatically when a target event occurs. An alternative theory suggests that capacity is required to prepare for target recognition. Consistent with the latter view, successful prospective memory performance can be associated with poorer performance on ongoing tasks (Smith, under review). This cost on the concurrent activity occurs on nonprospective memory target trials. The experiments presented here investigated the effect of successful prospective memory performance on concurrent activities when the target events were either perceptually or semantically salient.

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**Implications of Articulatory Duration and Phonological Similarity Effects in Working Memory.** SHANE T. MUELLER, TRAVIS L. SEYMOUR, ADAM KRAWITZ, DAVID E. KIERAS, & DAVID E.

MEYER, *University of Michigan*—During the past decade, persistent controversies arose about which independent variables are especially good predictors of serial recall from verbal working memory. According to some theorists, recall accuracy and memory span are predicted well by the articulatory durations, but not by the phonological complexity, of stored items, whereas other theorists have claimed the opposite. This disagreement has stemmed at least partly from inconsistent and inappropriate methods for measuring articulatory durations and related variables, such as phonological similarity. However, when they are measured through more appropriate methods that we have developed, articulatory durations and phonological similarity together can account for as much as 99% of the variance in memory-span data, but phonological complexity is not such a good predictor. Our claims are supported by several new experiments and reanalyses of old ones, whose results conform well with Baddeley's (1986) articulatory-loop model of verbal working memory.

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**Memory Improves for Poetry and Music, but Not for Prose.** W. JAY DOWLING, *University of Texas, Dallas*, BARBARA TILLMANN, *Dartmouth College*, & SHANNON SMITH-BERRY, *University of Texas, Dallas*—We replicated Sachs's (1967) result that memory for surface details of story sentences declines after 30 sec. These target sentences were embedded in the story. When one of the first two sentences in a trial was defined as target, memory for surface details also decreased. However, when we substituted poetry for prose, memory for surface details actually improved over time—a result we have obtained in numerous studies using music. We discuss the results in terms of the interaction between encoding and retrieval with musical and poetic (vs. prosaic) structure.

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**Interference in Associative Recognition.** AMY H. CRISS & RICHARD M. SHIFFRIN, *Indiana University*—In associative recognition, subjects must discriminate between test pairs composed of items studied together (intact) or studied separately (rearranged). We ran a series of experiments using unknown faces as stimuli and presenting word–word, face–face, and word–face pairs. Results show that performance is governed by the number of pairs of the same type and is not affected by the number of pairs of a different type. Furthermore, encoding may be impaired due to switching between types of pairs, as is evidenced by superior performance for lists with only one type of pair. A new model based on the REM framework is presented, and implications for other global familiarity models are discussed.

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**Forgetting Episodes of Remembering.** MICHELLE M. ARNOLD & D. STEPHEN LINDSAY, *University of Victoria*—Jonathan Schooler and colleagues (e.g., 1997) described cases of "recovered memories" of childhood sexual abuse, in which individuals had forgotten episodes of talking about the abuse when they were supposedly amnesic for it. We developed a laboratory analogue of this "forgot-it-all-along" effect. In Experiment 1, participants studied homographs with disambiguating context words; in Test 1 they received studied- or other-context words as recall cues, and in Test 2 they received studied-context cues and judged whether they had recalled each item during Test 1. Experiment 2 manipulated retrieval cues on both tests. Experiment 3 was like Experiment 1, but both studied- and other-context cues corresponded to the same meaning of each homograph. In Experiment 4, Test 1 was free recall, and studied- versus other-context cues were presented in Test 2. Participants more often forgot prior remembering when they had been cued to think of the items differently on the two tests.

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**Working Memory and Inhibitory Control: Short-Term and Long-Term Memory of Irrelevant Information.** CESARE CORNOLDI, ROSSANA DE BENI, & BARBARA CARRETTI, *University of Padova*, & PAOLA PALLADINO, *University of Lecce*—Numerous studies have

investigated working memory performances and their relationship to complex cognitive tasks, such as reading comprehension and problem solving. Results have shown a consistent positive relationship between them, although the involvement of underlying factors (general resources available, processing efficiency, inhibitory control) is still unclear. In the present work, four experiments were used to examine individual differences in working memory in order to analyze the role played by the inhibitory control of irrelevant information. This control requires that working memory inhibit processed but no longer relevant information. Activation and memorability of irrelevant information were examined at short and long term and were compared between groups with high and low spans. Results showed that inhibition does not mean elimination of irrelevant information from memory, but reduction of its activation in working memory. Participants with low comprehension and low span presented higher working memory activation, but not better long-term memory of irrelevant information.

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**What and When: The Intention Superiority Effect in Event-Based Prospective Memory.** MARTIN BINK, *University of North Texas*, KEY DISMUKES, *NASA Ames Research Center*, & ANDY THOMAS, *San Jose State University*—There is some controversy in the prospective memory literature concerning the association of the intended action and the cue to perform the action. Previous research demonstrated that intended actions have higher than baseline memory activation. However, there is little evidence to suggest that this activation (known as the intention superiority effect; ISE) is associated with processing the cue to perform the intention. In two experiments, the presence of an ISE in an event-based prospective memory paradigm was found. In Experiment 1, action scripts were used as prospective actions, and a lexical decision task was used as the cover task in an event-based paradigm. Experiment 2 used a similar paradigm and found that the activation of intended action was contingent upon prospective memory cue processing. The results serve as preliminary evidence for an association of the intended action and cue processing in prospective memory performance.

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**Encoding Specificity Affects Source Discrimination Above and Beyond Old–New Detection.** RICHARD L. MARSH & JAIME R. DURLEY, *University of Georgia*—Homographs learned from one of two sources with a particular semantic meaning were tested with the same or a different semantic meaning. Not surprisingly old–new detection was worse with a meaning change. However, conditionalized source scores were also worse. The results imply that reinstating one qualitative characteristic can improve identification of a different characteristic. Thus, qualitative characteristics are not necessarily independent of one another.

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**Structure and Timing of Auditory and Visual Sequences.** SUSAN HOLLERAN & MARI RIESS JONES, *Ohio State University*—In tasks using auditory and visual sequential stimuli, typical auditory advantages have sometimes been attributed to superior processing of structural or interval information. Four experiments examined the question of structure, timing, and modality, using sequences consisting of tones or lights of two different durations. Structure was manipulated by arranging accented and unaccented elements in regular or irregular patterns (accent structures). Interval timing was varied by changing onset times of unaccented or accented elements. In serial recall of element durations (Experiments 1 and 3) and detection of interval changes (Experiments 2 and 4), structure and timing manipulations had similar effects in both modalities, although overall performance was superior with auditory presentation. These results were interpreted in terms of dynamic attending theory (Jones & Boltz, 1989; Large & Jones, 1999), which predicted advantages for sequences with regular structure and constant interval timing.

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**The Relationship Between Verbal and Spatial Representations of Navigation Instructions.** VIVIAN I. SCHNEIDER & ALICE F. HEALY, *University of Colorado, Boulder*, & IMMANUEL BARSHI, *NASA Ames Research Center*—Subjects heard messages instructing them to move within a 2-D depiction of a 3-D space consisting of four stacked grids displayed on a computer screen. They repeated the instructions aloud and, in some cases, followed them. Three groups with identical instructions were compared: The first group was shown no display and made no movements; the second was shown the display but made no movements; and the third was shown the display and made movements. The groups shown the display were divided into two conditions, referring to movement either in a single grid or in multiple grids. The presence of the display did not affect accuracy in repeating the instructions. A significant disadvantage in repeating the instructions was found for the multiple grid condition only when movements were made, suggesting that the verbal representation depends on the spatial representation, which in turn depends on the requirement to make movements.

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**Skilled Perceptual Memory: Explicating Cognitive Mechanisms in the Cross-Race Effect.** CHRISTIAN A. MEISSNER & K. ANDERS ERICSSON, *Florida State University*—Individuals display superior memory for faces of their own race (cross-race effect) and show superior memory for faces compared to a less familiar stimulus class (i.e., Greebles). We asked Caucasian and Black college students to externalize their representation of own-race faces, other-race faces, and Greebles by sorting these stimuli into relevant groupings. During subsequent recognition and re-sorting of the stimuli, the superiority of own-race faces, as well as facial stimuli in general, emerged. Path analyses further demonstrated patterns of cognitive mediation such that higher memory performance was associated with more prior experience with the stimulus class, greater complexity of the grouping structure, and higher reproducibility of encoding (resorting). The semantic structure of the participants' representations were also analyzed. In a second experiment, the cognitive processes mediating encoding and recognition of these types of stimuli were traced using eye movements, retrospective reports, and reaction time measures. A framework for skilled perception is proposed.

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**Where Did the Word Length Effect Go?** IAN NEATH & AIMEE M. SURPRENANT, *Purdue University*—Current working memory theories invoke decay as a fundamental principle, largely because of the word-length effect (WLE). However, the time-based WLE—better recall of temporally short than long words—has recently been shown to depend critically on the particular stimuli used (Lovatt et al., 2000). We investigated the syllable-based WLE—better recall of words with fewer syllables than of words with more syllables. Pure lists, containing only short or only long words, yielded large, robust WLEs. Mixed lists, containing either alternating short and long words or randomly arranged short and long words, failed to yield such effects. Neither the time-based WLE nor the syllable-based WLE provide support for decay and, therefore, pose major problems for decay theories. The transient nature of the syllable-based WLE is better explained by theories based on interference principles, such as the feature model (Neath & Nairne, 1995).

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**Task Interruptions Disrupt Prospective Memory: Interruption Duration and Working Memory Capacity.** MARK A. McDANIEL, *University of New Mexico*, GILLES O. EINSTEIN, *Furman University*, TOM GRAHAM, *University of New Mexico*, & ERICA RALL, *Furman University*—In many everyday prospective memory situations, execution of retrieved intentions must be delayed until the conditions for performing the activity are appropriate. In our paradigm, upon seeing a target event, participants must withhold an action until they encounter a task change (40 sec later). We found that brief interruptions to the

ongoing task during this delay period caused substantial forgetting. Perhaps interruptions remove contextual cues that serve as periodic reminders. If so, then longer interruptions should increase forgetting. Alternatively, interruptions might produce cancellation of uncompleted tasks. By this hypothesis, the length of the interruption should be unrelated to levels of forgetting. We conducted several experiments to clarify this issue. We also investigated the relation between working memory capacity and participants' ability to correctly execute the intended activity. Participants with low working memory generally remembered to perform the prospective memory activity, but did so at inappropriate points during the delay period.

• **RECOGNITION MEMORY** •

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**Recognition Errors for Recombined Compound Words: Effects of Lexical Familiarity?** TODD C. JONES, KIRSTY C. NOVIS, NATASHA BUIST, & KATIE LISS, *Victoria University of Wellington*—Recombining parts of studied compound words (pinstripe, pothole; called *parents*) to form lures on a later recognition test (pinhole; called *offspring*) produces false recognition rates above that for wholly new words. Jones, Jacoby, and Gellis (2001) speculated that a familiarity for the lexical components of compound words may contribute to these errors. To test this notion, a series of experiments examined the error rates for syllabic and lexical recombinations for word stimuli and non-word stimuli. Two experiments used a continuous recognition paradigm where the parent-to-offspring lag was manipulated; two other experiments employed a traditional study–test paradigm. For all experiments, lexical components produced higher error rates than did syllabic components. Across experiments, nonword stimuli produced lower old–new discrimination, but higher error rates, than did word stimuli. For the continuous recognition experiments, errors increased across lags initially, then declined. The increase reflected a change in recollection, whereas the decrease demonstrated a change in familiarity.

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**Effects of Divided Attention and the Passage of Time on Face Conjunction.** SHARON L. HANNIGAN, *Bard College*—Subjects studied pairs of faces and then received a recognition test containing old (previously studied), new (not studied), and conjunction faces of two types. Simultaneous-conjunction (sim-con) items were composites of two faces presented at the same time, and far-conjunction (far-con) items were composites of faces presented at different times. Experiment 1 subjects studied face-pairs in full, weak divided, and strong divided attention conditions. The results showed that as secondary task demand increased, (1) the ability to discriminate old and sim-con items decreased and (2) the false-alarm rate for sim-con relative to far-con items increased, indicating that subjects recognized the episodes (face-pairs), but not the particular faces, in which facial features occurred. In Experiment 2, subjects took the recognition test following retention intervals of 15 min, 1 day, 1 week, and 2 weeks. The results for 15-min and 1-day conditions each showed a clear proximity effect, with the false alarm rate for sim-con items exceeding that of far-con items. With a delay of 2 weeks, however, no difference was observed in the proportion of “old” responses among old, sim-con, and far-con conditions. These findings suggest that, at shorter delays, responses were driven in part by episodic memory processes and, at longer delays, by processes that give rise to familiarity. It appears that divided attention and the passage of time produce quite different effects on the recognition of unfamiliar faces.

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**Phantom Recollection in Children and Adolescents.** ROBYN HOLLIDAY, *University of Kent*, & CHARLES J. BRAINERD, *University of Arizona*—We used a conjoint-recognition model and the Deese/Roediger/McDermott (DRM) paradigm to derive measures of phantom recollection (i.e., illusory conscious experience of the “presentation” of unstudied material) in 11- and 14-year-old children. Children heard

nine lists of words that were all associates of a critical unrepresented word. All the children were then given recognition tests under one of three instruction conditions: children reported whether they remembered the list words from the study phase; children reported whether they remembered the missing exemplars for the previously studied lists (i.e., the unrepresented 12th word for each list); children reported whether they remembered the list words and the missing exemplars from the study phase. We found that high false alarm rates for DRM critical distractors were due to high levels of phantom recollection, as well as to familiarity, and decreases in false alarm rates for other types of distractors were mainly due to decreases in phantom recollection.

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**Word Frequency Effects in Episodic Memory: The Roles of Feature Frequency and Context Frequency.** MARK STEYVERS, *Stanford University*, KEN MALMBERG & RICH M. SHIFFRIN, *Indiana University*, & JOSEPH STEPHENS, *Carnegie Mellon University*—Empirical studies were conducted to assess the separate contributions of two factors in producing the recognition memory word frequency effect (WFE): feature frequency (i.e., the frequency of occurrence of letters in different orthographic positions) and context frequency (i.e., the number of different semantic contexts in which words appear using a large corpus). The main findings are that words consisting of low-frequency features are better recognized than words consisting of high-frequency features, words appearing in relatively few contexts are better recognized than words appearing in many contexts, and both effects contribute to the WFE independently of word frequency per se. Additionally, we examined the effect of these factors on free recall and found that performance is negatively related to feature frequency for both pure and mixed lists. A retrieving effectively from memory (REM; Shiffrin & Steyvers, 1997) model is described to account for these findings.

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**The Time Course of Source Bias in Source Monitoring.** JULIA SPANIOL & UTE J. BAYEN, *University of North Carolina, Chapel Hill*—Source monitoring involves judgments regarding the origin of information (Johnson, Hashtroudi, & Lindsay, 1993). When participants cannot remember the source in a source-monitoring task, they sometimes base their judgments on prior semantic knowledge (Bayen, Nakamura, Dupuis, & Yang, 2000). This leads to a bias toward stereotypical source judgments. The present study aimed at specifying the circumstances under which people show such bias. Two sources presented information that was expected for one source and somewhat unexpected for the other. At test, participants decided whether items had been presented by Source A or by Source B or were new. We examined the time course of source bias with a response-signal technique (Reed, 1973) and multinomial modeling techniques that separate memory from bias. Source bias was observed only when asymptotic old–new recognition was low. The time course of source bias followed an exponential growth function. Implications for theories of source monitoring are discussed.

• **REPETITION/PRIMING EFFECTS** •

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**Scene Typicality Influences the Mere Exposure Effect in Affective Judgments.** KEN MATSUDA & TAKASHI KUSUMI, *Kyoto University*—We examined how scene typicality influences the mere exposure effect in affective judgments. Participants were shown photographs of Buddhist temples 0, 1, 3, or 6 times, followed by a recognition test. Before the test, they were also asked to rate typicality, familiarity, liking, beauty, and nostalgia for each photograph, using a 9-point scale. The results indicated that as compared with the high- and low-typical stimuli, the stimuli with medium typicality produced a significantly stronger mere exposure effect. Structural equation modeling revealed that the typicality of the stimuli and the frequency of exposure had a positive influence on the formation of prototypes, which, in turn, promoted positive affect either directly or via nostalgia. These results in-

licated that prototypes of scenes generated by repeated exposures of exemplars are tied to conceptual and affective memory representations.

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**Repetition Priming From Pictures and Visual Mental Images.** PASCALE MICHELON & JEFFREY M. ZACKS, *Washington University*—Judgments about words or pictures typically are performed more efficiently after prior exposure to the tested stimulus, a phenomenon known as priming. Priming from pictures in perceptual tests is a robust effect, and weaker priming has been demonstrated from mental images. This accords well with the view that mental images are depictive representations like physical pictures, but weaker and more transient. Here, we show that under the right conditions, mental imagery can, in fact, lead to greater priming than does perception. Although perception led to greater priming when the test judgment was not conducive to imagery (picture–name verification), imagery led to greater priming when the test judgment benefited from imagery (relative size judgments). The results suggest that, contrary to the view that imagery is simply a weak reproduction of perceptual processes, perception and imagery are each effective sources of priming to the degree that they overlap with processing in the criterion test.

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**Context Primes Abstract Concepts Through Constraint Activation.** KATJA WIEMER-HASTINGS & BRENT MUNOZ, *Northern Illinois University*—Context availability theory predicts that context eliminates concreteness effects on lexical processing by providing abstract concepts with required context information. Tests of this theory have yielded inconsistent findings, perhaps due to the variation of the experimental contexts used as primes. Stronger predictions may be derived from the more specific contextual constraint theory, according to which context priming of abstract concepts depends on the presence of concept-specific constraints. Constraints are contextual aspects associated by necessity with abstract concept occurrence. We present support for the prediction that the number of constraints mentioned in context is related to context priming effects. In a lexical decision task for abstract concepts, significant response time differences were obtained for the number of constraints mentioned in contexts of identical length. This supports the view that abstract concepts are associated with specific context constraints and that their contextual priming is mediated by the activation of these constraints.

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**Negative Priming in Visual Search: Evidence for Episodic Retrieval?** HENNING GIBBONS & THOMAS H. RAMMSAYER, *University of Göttingen*—In a series of two experiments, the effect of target–distractor reversal on visual search performance was investigated. Participants had to decide whether or not a deviant stimulus (target) was presented among a large number of identical distractor stimuli in a given display. Response times were recorded as dependent variables. Negative priming (NP) was defined by slower responses to displays where the deviant stimulus had served as distractor on the immediately preceding display, as compared with a control condition where both target and distractor had not been presented on the preceding trial. NP effects observed with the visual search task provided supporting evidence for the notion of NP as a basic phenomenon of information processing that can be found with many cognitive tasks. A recent influential account of NP represents the episodic-retrieval theory. Our results support the assumption of several independent determinants of NP and, thus, challenge the episodic-retrieval view of NP.

(690)

**Same–Different, Cue Validity, and Detection Tasks Fitted by a Parallel Race Model: The Ubiquitous Presence of Priming.** DENIS COUSINEAU & CHRISTINE LEFEBVRE, *Université de Montréal*—The same–different task (Bamber, 1969) is one of the simplest tasks used to study the recognition of visual patterns. Yet, the response times (RTs) obtained are among the most enigmatic in cognitive psy-

chology (Sternberg, 1998). RTs to respond “different” seem to comply with a serial, self-terminating comparison model. However, RTs for “same” responses are shorter than any “different” responses. This rules out serial exhaustive processing when the two objects are identical. We present a model of priming that accounts simultaneously for both “same” and “different” responses. This approach suggests that priming tasks and same–different judgment tasks are identical. Furthermore, the results from a detection task, from a cue validity task and, of course, from a priming experiment are all identical to Bamber’s “same” data. This suggests that priming, or decay of it, also explains these results. This approach thus synthesizes a large body of classic results in cognitive psychology.

• PICTURE MEMORY/PROCESSING •

(691)

**Generalizing Object Recognition From Familiar to Novel Views Using Interpolation.** CHUN-NANG WONG & WILLIAM G. HAYWARD, *Chinese University of Hong Kong*—Some view-based theories of object recognition propose that an interpolation process provides for enhanced recognition of novel views that fall between studied views of an object. To test this claim, 125 university students, across four experiments, studied one or two views of a target object and then made a same/different decision for a test image, which showed either the target or a distractor. Results showed a general facilitation in recognition performance for test views that fell between the two studied views, although not in all conditions. With a large angular disparity between the two studied views, such internal facilitation was evident only if both studied views showed the same object features (i.e., there was no self-occlusion). With a small angular disparity, performance was similar to the condition with only one studied view. Results supported and extended accounts of object recognition that rely on interpolation mechanisms.

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**The Role of the Frame of Reference in the Scene Rotation Task.** CHIE NAKATANI, *Riken Brain Science Institute*, & ALEXANDER POLLATSEK, *University of Massachusetts*—The role of reference frames in the scene rotation task was examined by changing the background of a scene. Subjects were asked to judge whether two consecutive scenes with multiple objects were the same (possibly from different viewpoints). The objects were placed on a square desktop, the ground, or a uniform black background (no background), and the second scene was rotated around one of three orthogonal axes with respect to the first. In the desktop condition, RT increased linearly with the angle of rotation; for the ground and no-background conditions, the increase was negatively accelerated in the vertical axis rotation condition. Moreover, the intercept of the rotation function was greater in the no-desk condition than in the other two conditions. The results suggested that a local frame of reference (desktop) helped processing of the rotation around the vertical axis, and that the solid surface, (ground) facilitated the overall processing.

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**Where’s the Donut? Factors Influencing Spatial Reference Frame Use.** HOLLY A. TAYLOR & DAVID N. RAPP, *Tufts University*—Describing the location of one object relative to another requires a reference frame. When multiple frames exist, however, the resultant description can be ambiguous. Our studies examined influences on reference frame use. Participants viewed pictures of a donut and an object with intrinsic sides (e.g., car). Participants had to determine whether a spatial term (right, left, front, back) could be used to describe the donut’s location. We varied instructions about possible reference frames, timing between picture presentation and the spatial term, and relative location and orientation of the objects. Results showed that without instructions describing object-based (intrinsic) and ego-based (relative) reference frames, participants ignored the relative frame. With instructions, participants still performed worse

when the spatial term relied solely on the relative frame. Timing of stimulus presentation, intrinsic object orientation, and relative object placement also affected reference frame use. Taken together, these findings indicate multiple influences on reference frame use.

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**Prior Frameworks for the Recall of Unfamiliar Objects.** MATTHEW J. SHARPS, AMY VILLEGAS, MICHAEL NUNES, & TERRI BARBAR, *California State University, Fresno*—The theory of gestalt/feature-intensive (G/FI) processing predicts that prior category frameworks may enhance recall in the visual-spatial as well as the verbal realm. This hypothesis was tested in three experiments with 55 collage-aged respondents, who were asked to recall unfamiliar items from each of five categories that themselves differed in familiarity, using a list-recall format. Results indicated that prior category framework familiarity did significantly enhance recall of unfamiliar visual stimuli, consistent with the hypothesis advanced and with the tenets of G/FI theory.

• LETTER/WORD PROCESSING •

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**Basic Reading Processes: Comparing Naming and Decision Tasks in fMRI.** WILLIAM J. OWEN, RON BOROWSKY, & GORDON E. SARTY, *University of Saskatchewan*—Basic visual word recognition research has often utilized overt naming tasks to examine reading processes. Recent advances in image analysis have allowed researchers to use overt naming tasks for fMRI (e.g., Sarty & Borowsky, 2001). The present study focused on the issue of task-specific differences in neuroimaging results. In particular, performance during decision tasks (e.g., Pugh et al., 1996, used line, case, rhyme, and category tasks) designed to isolate basic reading processes (e.g., feature, orthographic, phonological, and semantic levels, respectively) were compared with overt naming tasks. The overt naming task can be argued to provide a more natural window into basic reading processes. A comparison of overt naming and decision tasks in fMRI is presented.

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**Mapping Orthography to Phonology: More Evidence for Non-selective Cross-Language Activation.** ANA I. SCHWARTZ, *Pennsylvania State University*, JUDITH F. KROLL, *Pennsylvania State University, Pittsburgh*, & MICHELE DIAZ, *Duke University*—The present study examined whether bilinguals activate spelling–sound correspondences from the first language while performing word naming and translation tasks in the second language. The critical materials were cognates sharing similar lexical form and meaning. By manipulating the degree of orthographic and phonological similarity of the cognates and their translations, we hoped to determine the extent to which lexical information in the nontarget language is active even when bilinguals perform a task in one language only. In Experiment 1, bilinguals named cognates and noncognate controls in separate language blocks. Naming latencies for cognates were a function of the match between orthographic and phonological similarity. When the orthographic input was ambiguous, there were inhibitory effects of competing phonology across languages. In Experiment 2, bilinguals translated the same set of words. The results demonstrate a persistent effect of cross-language phonology. Results are interpreted within a resonance framework of word recognition.

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**Getting a Fix on Fixations: Decomposing Distributions of Reading Fixations.** GARY FENG, *Duke University*, & KEVIN MILLER, *University of Illinois, Urbana-Champaign*—A mathematical approach to decomposing distributions of eye movement fixations in reading will be presented. Distributions of reading fixation durations can be well fit by a mixture of three log-normal distributions, one involving very rapid fixations (with a peak around 70 msec), one consisting of moderately long fixations (with a peak around 180 msec), and one consisting of long fixations (with a peak >250 msec for adults reading

normal text). Changes in distributions with development and as a function of changes in text are presented. Implications for psychological models of reading processes are discussed.

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**Investigating the Interaction of Semantics and Phonology in Visual Word Recognition.** MARK YATES, LAWRENCE LOCKER, JR., & GREG B. SIMPSON, *University of Kansas*—In the present research, we demonstrate the joint influence of semantic and phonological factors in the lexical decision task. In the first experiment, we show that words with large semantic neighborhoods (e.g., scar) are responded to faster than words with sparse neighborhoods (e.g., nail). In Experiment 2, subjects performed lexical decisions with pseudohomophones as nonword foils. Pseudohomophones varied according to the size of the semantic neighborhood of their basewords. Pseudohomophones with basewords having large semantic neighborhoods (e.g., skar) were responded to more slowly than those derived from words with sparse semantic neighborhoods (nale), the opposite of the pattern seen with words. These effects demonstrate an interactive relationship between semantic and phonological factors and are discussed in terms of distributed models of visual word recognition.

(699)

**Syllable Processing in Alphabetic Korean.** HYEWON KANG, *Sung Kyun Kwan University*, & GREG B. SIMPSON, *University of Kansas*—The native Korean script (Hangul) prints alphabetic characters in syllable blocks. Four experiments investigated whether the syllable has a special processing status in Korean, independent of lexical and sub-syllabic sources of information. When controlled for syllable frequency, syllables having independent lexical status (free syllables) are named no faster than are those without such status (bound syllables), and there are no naming differences between high- and low-frequency free syllables. That is, lexical variables have no effect when syllable characteristics are controlled. However, bound syllables do show a frequency effect, and bound syllables are named faster than pseudosyllables, showing that syllable-level variables influence processing in the absence of lexical status. These results indicate a syllable processing influence that is independent of word-level characteristics.

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**Masked and Unmasked Priming of the Syllable in Mandarin Chinese Speech Production.** JENN-YEU CHEN, *National Chung-Cheng University*, & LUDOVIC FERRAND, *CNRS and Université René Descartes*—The syllable's role in Chinese (Mandarin) speech production was investigated using word naming and translation tasks with masked and unmasked primes. The character prime shared the first few segments (CV or CVG, but not the tone) with the beginning of the target word. There were two types of related primes, a CV or a CVG syllable, and two types of targets, a CV–GV or a CVG–CVX word. When the prime and the target were related, the segmental overlap either corresponded to a syllable or did not. The primes were masked in the naming task and unmasked in the translation task. Fillers were added in the latter task to decrease the predictability of the targets from the primes. A crossover interaction of the prime by target type was observed in both tasks, supporting the view that the syllable (lacking the tone) plays an independent role in word production in Chinese.

(701)

**Bilinguals Detect Letters in Orthographies That Appear in Both Languages.** SETH GREENBERG & JESSICA ZUEHLKE, *Union College*—Past research has shown that people can use trajectory forms to recognize events. Only a frontoparallel perspective has been investigated, thus far. People view events from many different perspectives. However, the visual components change when events are viewed from different perspectives and the projected form of the trajectory changes. Does event recognition exhibit perceptual constancy? Participants were familiarized with five different trajectory forms. They then had to identify the same events viewed from three different perspectives.

Participants showed perceptual constancy across viewing perspectives. Events can also have paths with different shapes. We investigated perceptual constancy for the following conditions: events with different path shapes, events that vary in the speed profile along a curved path, and events that change in both paths and speed patterns. The results showed that adults exhibit perceptual constancy in all conditions.

• PSYCHOLINGUISTICS •

(702)

**Mrs. Malaprop's Neighborhood: Using Word Errors to Reveal Neighborhood Structure.** MATTHEW GOLDRICK & BRENDA RAPP, *Johns Hopkins University*—Lexical retrieval in spoken word production involves the activation not only of the target word, but also of words related to the target (neighbors). Research into the influence of neighbors on processing (Vitevitch, 1997) has typically stipulated a definition of neighborhood. We pursue an alternative approach using empirical findings to reveal neighborhood structure. We examine malapropisms that arise during lexical retrieval in a brain-damaged individual (e.g., picture of mitten named as “muffin”). These word errors represent nontarget words that are active during the retrieval process—that is, they are neighbors of the target words. We examine the relationships between word errors and targets to infer specific factors that determine neighborhood structure. We find evidence for the influence of phonological and grammatical factors, suggesting a new definition of neighborhood. Analyses based on this empirically derived definition reveal that words in high-density neighborhoods are produced less accurately than words in low-density neighborhoods.

(703)

**Age Differences in Descriptions Intended for Self and for Others.** MICHIKO NOHARA-LECLAIR, *University of Kansas*—Young and older adults described nonsensical drawings. Half of the participants were asked to describe the drawings so that they could match their own descriptions to the drawings at a later date (intended for self). The other half of the participants were asked to produce descriptions that another individual could use to identify the drawings (intended for others). Young adults' descriptions intended for others were lengthier than those intended for self. However, older adults' descriptions were equally short in both cases. When the participants returned a month later to match the same drawings to descriptions from various sources, they were most successful when matching the drawings to their own descriptions. All participants were least successful matching the drawings to descriptions produced by older adults, regardless of whether the description was intended originally for self or for others.

(704)

**Perceptual Effects of Native and Non-Native Assimilation.** DAVID W. GOW, JR., *Massachusetts General Hospital and Salem State College*, & AARON J. M. IM, *Massachusetts General Hospital*—Previous studies have shown that spontaneous regressive assimilation facilitates the perception of postassimilation context by native speakers. This result has alternatively been attributed to perceptual grouping phenomena acting at the featural level and higher level language-specific statistical or inferential mechanisms. Two experiments are presented to distinguish between the predictions of these accounts. In the first, phoneme monitoring was used to determine whether native Korean speakers show facilitated monitoring for targets following instances of regressive labial to velar place assimilation, a phonological process that occurs in Korean, but not in English. In the second, participants who spoke English but not Korean replicated the task, using the same Korean stimuli. The results are discussed in reference to an emerging theory of the role of feature parsing in the perception of spoken words.

(705)

**Tracking the Lexical Activation of Onset-Embedded Words.** ANNE PIER SALVERDA, DELPHINE DAHAN, & JAMES M. McQUEEN, *Max Planck Institute for Psycholinguistics*—Participants' eye move-

ments were recorded while they listened to sentences including a word with an onset-embedded word (e.g., “hamster” containing “ham”). Participants saw four pictured objects on a computer screen and were instructed to move the picture that corresponded to the word mentioned in the sentence. There were more fixations to a picture representing the embedded word (ham) when the first syllable of the target word (hamster) had been replaced by a recording of the embedded word than when it came from a different recording of the target word. This effect was modulated by (1) the nature of the following acoustic context in which the embedded word had been recorded and (2) the durational difference between the embedded word and its corresponding syllable in the target word. The word-recognition system appears to use subtle acoustic information in the speech signal to favor the correct interpretation of lexically ambiguous spoken input.

(706)

**How a Lexically Guided Parser Processes Syntactically Ambiguous Information in a Moving Window.** BEVERLY COLWELL ADAMS, NORIKO HOSHINO, & SARAH E. ANDERSON, *Randolph-Macon Woman's College*—In three experiments, college students read syntactically ambiguous sentences that varied by the transitive/intransitive compound verb order in the preposed clause. Each sentence was presented via a phrase-by-phrase moving-window procedure on a computer screen, and the time to respond to comprehension questions and accuracy was assessed. In Experiment 1 (After the Indians// prayed [begged] and prayed [begged]// the pilgrims// smoked// the peace pipe), speed-accuracy tradeoff results demonstrated that the parser is most disrupted by the intransitive+transitive (prayed+begged) structure and is least disrupted by the other three (I+I, T+I, T+T). In Experiment 2 (After the Indians prayed [begged] and// prayed [begged]// the pilgrims// smoked...) and Experiment 3 (After the Indians prayed and// begged the pilgrims// smoked...), RTs to the comprehension questions were slower and the accuracy poorer than in Experiment 1, and the pattern of results was different. These results suggest that a lexically guided parser may be sensitive to presentation chunks.

(707)

**How Can Vocabulary Acquisition Mediate Working Memory Effects on Grammatical Category Learning?** ANATOLIY KHARKHURIN, *College of Staten Island, CUNY*, VERA KEMPE, *University of Stirling*, & PATRICIA J. BROOKS, *College of Staten Island, CUNY*—In a study of implicit gender learning, Kempe, Brooks, and Kharkhurin (1999) showed that verbal working memory (WM) capacity predicted incidental vocabulary learning, which, in turn, predicted successful generalization of adjective-noun gender agreement patterns to novel nouns. In enhancing vocabulary learning, does WM capacity aid in extracting grammatical categories based on similarities between words or does it merely facilitate maintenance of long-distance agreement patterns? To answer this question, we tested explicit learning of gender categories, rather than implicit learning of gender agreement patterns. Native English speakers were taught to categorize masculine and feminine Russian nouns without additional gender agreement cues. Learners' proficiency in languages with gender systems similar to Russian and their incidental vocabulary learning predicted successful gender category generalization. The latter finding supports the idea that WM effects are mediated by the acquisition of a critical mass of vocabulary, which serves as a database for discovering morphophonological regularities among words.

(708)

**Do Eye Movements Reflect the Spread of Semantic Activation During Spoken Word Recognition?** EILING YEE, JULIE SEDIVY, & MICHAEL J. TARR, *Brown University*—It has been suggested that there is a direct relationship between eye movements and lexical activation (e.g., Allopenna et al., 1998). If this is true, eye movements should reflect the spread of activation to words semantically related to a given spoken word. We tested this prediction in two experiments. In Experiment 1, subjects were shown an array of four pictures and were in-

structured to point at one of them (the target). The target (key) was presented either with a semantic associate (lock) and two unrelated items or with three unrelated items. Subjects were more likely to fixate on the associate than on the unrelated items. Experiment 2 asked whether eye movements would reflect the activation of an item semantically associated with an unpictured phonological competitor of the target (i.e., would subjects look at key when asked to point at logs even if lock was absent?). Pilot data suggest that they do.

(709)

**Metaphors Communicate More Effectively Than Do Similes.** URI HASSON, *Princeton University*, ZACHARY ESTES, *University of Georgia*, & SAM GLUCKSBERG, *Princeton University*—Why would people use a metaphor such as “my lawyer is a shark” instead of the explicit simile “my lawyer is like a shark”? According to our dual-reference attributive category model of metaphor, the categorical assertion refers directly to the metaphorical shark, whereas the simile refers directly to the literal shark. The literal shark has more irrelevant distinctive properties than does the metaphorical shark (e.g., the literal shark has fins, but the metaphorical shark does not). Therefore, according to Tversky’s contrast model of similarity, the similarity of the metaphor topic (e.g., lawyer) to the metaphor vehicle (e.g., shark) should be greater following a metaphor than following a simile. This prediction was confirmed. Metaphors are thus more effective than similes in communicating metaphor-relevant properties, as well as metaphor-induced similarity.

• LANGUAGE/DISOURSE PROCESSING •

(710)

**Processing a Foreign Language: Sentence Comprehension Mechanisms as Revealed by ERPs.** ANJA HAHNE, JÖRG D. JESCHENIAK, & ANGELA D. FRIEDERICI, *Max Planck Institute for Cognitive Neuroscience*—We measured event-related brain potentials (ERPs) while participants listened to sentences in their second language. Native speakers of Russian, Japanese, or French who learned German as a foreign language were tested. We used three types of German sentences that ended with a target word that was correct, semantically incorrect (selectional restriction violation), or syntactically incorrect (phrase structure violation). Participants were asked to perform an acceptability judgment. Behavioral results revealed that foreign language learners made more errors than did native speakers but performed clearly above chance level. The ERP data pattern varied systematically as a function of L2 proficiency. Semantic integration processes were the first to achieve a status similar to that in native listeners. With increasing proficiency, late syntactic processes came into play, whereas a component taken to reflect early automatic parsing procedures was not observable in any of the L2 groups.

(711)

**Noun Phrase Complexity Versus Word Retrieval Fluency in Sentence Production.** RANDI C. MARTIN & CHIN-LUNG YANG, *Rice University*—Smith and Wheeldon (1999) argued for a phrasal scope of planning in that onset latencies were longer for producing sentences beginning with a complex noun phrase (complex/simple; e.g., “The fork and the kite move above the dog”) than for producing matched sentences beginning with a simple noun phrase (simple/complex; e.g., “The fork moves above the kite and the dog”). Martin, Vu, and Miller (2000) showed that a patient with a semantic short-term memory deficit demonstrated a greatly exaggerated effect. However, the onset advantage for the simple/complex sentences might be due to the redundancy of the second content word (“move” or “moves”) in this condition. In the present experiment, college students were tested on two types of materials: (1) the original sentences and (2) sentences in which the second noun was always modified by “yellow.” The onset latency difference was virtually identical in both conditions, supporting the phrasal planning hypothesis.

(712)

**Metaphor or Simile? Apt or Conventional? And What Changes?** DAN CHIAPPE, *California State University, Long Beach*, & JOHN M. KENNEDY, *University of Toronto*—A literal base theory holds that figurative claims are modeled on literal forms, neglecting some properties. Metaphors (“rumors are weeds”) and similes (“rumors are like weeds”) are like literal categorization and similarity claims. Accordingly, we find metaphors less reversible than similes, much as category claims are less reversible than similarities. Also, increased aptness (capturing key features of topics) led to preference for the metaphor form, whereas conventionality (how strongly the relevant meaning is associated with vehicles) did not predict preference. Our explanation is that a category claim (“That’s an apple”) is used when the object possesses all the essential properties of a vehicle, whereas the similarity form is used (“That’s like an apple”) when it only has some. Since the function of the expression is to raise the common properties in relevance, the expression modifies the literal meanings of the topic and vehicle terms to the same extent.

(713)

**How the Two Brain Hemispheres Process Causal Inferences in Text: A Multiple Process Theory of Comprehending Causality.** ROBERT A. MASON & MARCEL ADAM JUST, *Carnegie Mellon University*—Using fMRI, cortical activity was examined in three functional networks (left- and right-hemisphere language networks, and a bilateral dorsolateral prefrontal cortex network) during the processing of two-sentence passages varying in their degree of causal relatedness. Myers, Shinjo, and Duffy (1987) found that although reading times increased linearly as relatedness decreased, the relationship between relatedness and memory for the text was best expressed as a quadratic function. They proposed that the better memory for the moderately related passages than for the distantly or highly related passages was a result of a causal inference’s being incorporated into the reader’s text representation. The present study shows that the proposed inferencing process can be broken down into two distinct components, generation and integration, which are subserved by two distinct cortical networks. Furthermore, these two cortical networks are separate from the traditional left-hemisphere language network, and the integration process is predominantly a right-hemisphere language process.

(714)

**Visuospatial Resources Are Required for Predictive Inferences, but Not for Bridging Inferences.** REBECCA FINCHER-KIEFER & PAUL R. D’AGOSTINO, *Gettysburg College*—Fincher-Kiefer (2001) has demonstrated that situation model construction is impaired when readers are given a perceptual memory load, but not a verbal memory load. Experiment 1 tested the hypothesis that predictive inferences are represented within a reader’s situation model. When readers were presented with a sentence that contradicted a prior predictive inference, a contradiction effect (slower reading time) was found with a verbal memory load, but not a visuospatial memory load. This supports the proposal that predictive inferences require visuospatial resources and are involved in the construction of a reader’s situation model. In Experiment 2, texts prompted bridging inferences, and a contradiction effect was present with both a verbal and a visuospatial memory load. This suggests that bridging inferences do not require visuospatial resources and may be used in the construction of a different level of text representation.

(715)

**Code Switching in Bilingual Preschool Children.** ZEHRA F. PEYNIRCIOĞLU & MEGAN REILLY, *American University*—Using more than one language either within a sentence (intrasentential) or between sentences (intersentential) is called code switching. In this study, we explored code-switching behavior in preschool Spanish–English bilingual children as a function of age, linguistic proficiency, degree of balance in bilingualism, medium of presentation (pictorial or verbal), and language of presentation (Spanish, English, or mixed language).

Intrasentential switching was influenced by degree of bilingualism and was used less often than intersentential switching. Both types of switching were independent of age as well as proficiency. Overall, more dominant (L1) to weaker (L2) language switching was observed than vice versa; however, the opposite was observed when the presentation language was L2. Direction of the switches was also influenced by degree of bilingualism, especially with verbal materials.

(716)

**Detecting and Processing Inconsistencies During Text Comprehension.** BARBARA KAUP & DONALD J. FOSS, *Florida State University*—In two experiments, we investigated whether the detection and processing of inconsistencies is affected by the type of inconsistent property. Participants read texts each introducing a target object with several properties. Depending on the version of the introducing paragraph, the text's final paragraph was either consistent with the prior text or not, and the inconsistency either concerned a direct property of the target object or a relation between it and some other entity. An analysis of the final paragraph's reading times revealed a strong inconsistency effect for both types of properties, with the effect being stronger for relational than for direct properties. Interestingly, however, property type did not affect the rates with which inconsistencies were detected in an explicit rating task. The results will be interpreted in light of different text comprehension theories, and the implications for models of inconsistency detection will be discussed.

• SOCIAL/PERSONALITY PROCESSES •

(717)

**The Social Ontogeny of Internet Virtual Teams.** DONNA LEE, *Our Lady of the Lake University, San Antonio*, & BARRY GOETTL & ALAN R. S. ASHWORTH, III, *US Air Force Research Laboratory, San Antonio*—The social interaction of individuals engaged in day trading on Internet asynchronous discussion boards was observed. To study these virtual team-like environments, several theoretical frames were useful in examining the developmental pattern of self-disclosure between team individuals, the deindividuation phenomenon, group immersion, and in-group favoring. Individuals were observed to form in-groups and to exhibit team-like behaviors and reported development of friendships within these teams in a systematic progression. Observations are discussed in the context of four theories of social cognition: the social penetration theory (SPT), the group development theory (GDT), the social identity theory (SIT), and the social identity model of deindividuation phenomenon (SIDE). Results have implications for understanding the development and performance of virtual teams engaged in a common task.

• INDIVIDUAL DIFFERENCES •

(718)

**Retention Interval and Learning Style Preference Effects on False Memories.** DONNA J. LAVOIE & HEATHER K. MERTZ, *Saint Louis University*—In previous research (LaVoie & Mertz, 2000), we have demonstrated that a person's preferred learning style moderates the modality effect on false memory, with a match between study modality and learning style preference producing more distinctive encoding and reduced false memory susceptibility than did a mismatching condition. For example, after auditory presentation of study lists, identified visual learners produced more false memories than did identified auditory learners. The principal question addressed in our present research is whether this effect would change with an increased retention interval. We predicted that there should be a greater reliance on the processes that lead to the production of false memories after a 30-min study–test delay, relative to an immediate test condition. We hypothesized that equivalent false recognition rates would be observed in all participants after this delay, regardless of preferred learning style and modality of list presentation during study. Results partially supported this prediction.

(719)

**Spatial and Semantic Inhibition of Return: Individual Differences Related to Attention Deficit Hyperactivity Disorder.** HOLLY WHITE, WILLIAM MARKS, & GINA WILKINSON, *University of Memphis*—Attention deficit hyperactivity disorder (ADHD) is characterized by attentional and inhibitory impairments in goal-directed behavior. The nature of these inhibitory deficits is not entirely clear; however, they are thought to be related to executive processing impairments (Barkley, 1995). In the present study, two experiments assessed inhibitory mechanisms associated with posterior and anterior attentional networks (Posner & Peterson, 1990). Individuals scoring high or low on an adult scale of ADHD were compared on tasks involving spatial and semantic inhibition of return (IOR). Both groups showed IOR on the spatial task, as indicated by a slowed response to targets that followed spatially congruent primes. However, only the low-scoring (non-ADHD) group showed IOR on the semantic task, as indicated by slowed response to targets that followed semantically related primes. These results are consistent with ADHD-related inhibitory deficits associated with the anterior attentional system.

(720)

**Recollective Experience in Individuals With High Dissociative Tendencies.** JIANJIAN (J. J.) QIN & MARCIA K. JOHNSON, *Yale University*—We examined recollective experience in individuals with high dissociative tendencies. Participants with high or low dissociation viewed a set of pictures and either read or generated a title for each picture, under either full- or divided-attention condition. Participants then received an unexpected reality-monitoring test in which they decided whether they had read or generated a title for each picture and rated the confidence of their reality-monitoring decisions. Observed individual receiver-operating characteristic (ROC) curves were fitted to functions that are predicted by continuous and threshold (discrete) models. The results indicated that under the full-attention condition, a higher proportion of high- than of low-dissociation participants had ROCs that fit the threshold model, suggesting that dissociation affects the nature of recollective experience.

(721)

**Measurement of Chronic Neck Pain.** PAULA GOOLKASIAN, *University of North Carolina, Charlotte*, ANTHONY H. WHEELER, *Charlotte Spine Center*, & STEPHANIE S. GRETZ, *Georgia School of Professional Psychology*—This research established test–retest reliability and construct validity for the Neck Pain and Disability Scale (NPAD: Wheeler, Goolkasian, & Baird, 1999). Two groups of patients with neck pain completed the NPAD. The first group filled out the scale twice prior to treatment, whereas the second completed it together with a number of other outcome measures once a month for 4 months to evaluate treatment with injections. The reliability coefficient ( $r^2 = .93$ ) calculated on the data from the first group of patients indicated high test–retest reliability. Construct validity was demonstrated from the second group when the changes in scale scores following treatment were found to be correlated to the patient's assessment of improvement and to changes in muscle tenderness. A principal components analysis of the pre/post-treatment changes showed one underlying factor, and the NPAD loaded heavily on that factor. The NPAD can be relied on to provide a stable measure for patients with neck pain.

• ANIMAL COGNITION •

(722)

**Retrospective Confidence Judgments by Rhesus Monkeys.** WENDY E. SHIELDS, *University of Montana*, J. DAVID SMITH, *SUNY, Buffalo*, & DAVID A. WASHBURN, *Georgia State University*—Recently researchers have begun to explore the possibility of metacognitive abilities in nonhuman animals. The present study adds to existing information on this topic by offering evidence for retrospective confidence judgments by rhesus monkeys. Monkeys were tested in a psychophysical density discrimination task. They chose between the responses

“dense” or “sparse” but did not receive feedback about their accuracy until an additional response was made. This second response controlled the magnitude of reward or punishment received for a correct or incorrect density discrimination choice. One alternative offered a large reward for a correct dense/sparse choice, but a lengthy time-out for an incorrect choice (high risk). The other alternative offered a smaller reward for a correct choice, but a brief time-out for an incorrect choice (low risk). Monkeys chose the high-risk alternative on trials that were more easily discriminated and the low-risk alternative on trials that were more difficult.

(723)

**The Representation of Time of Day.** MATTHEW J. PIZZO & JONATHON D. CRYSTAL, *University of Georgia*—We tested ordinal, interval, and circadian mechanisms of solving a time–place task. Rats searched for food twice in the morning and once in the afternoon (group AB-C,  $n = 5$ ) or once in the morning and twice in the afternoon (group A-BC,  $n = 5$ ) in a box with four food troughs. The location with food depended on time of day in a 12:12-h light:dark cycle. Acquisition was documented by food-site inspections at the correct locations prior to food availability. On nonrewarded probes, the time of the middle search (B) was shifted late (for group AB-C) or early (for group A-BC). The rats visited location B at chance, contrary to an ordinal mechanism. When the posttesting meal and light–dark transitions were omitted, the rats visited each correct location at above chance levels on nonrewarded probes, contrary to an interval mechanism. The results are consistent with a circadian representation of time.

(724)

**Object Recognition in the Bottlenose Dolphin: How Vision and Echolocation Interact.** HEIDI E. HARLEY, *New College of Florida and Disney Epcot’s Living Seas*, & ERIKA A. PUTMAN, *Disney’s Epcot’s Living Seas*—Bottlenose dolphins can recognize objects across modalities—that is, given a sample object visually or echoically, a dolphin can identify that object echoically or visually, respectively. Dolphins may perform this task through (1) learned association of their visual and echoic experiences or (2) recognition of equivalence of object features available to both modalities. Data from a bottlenose dolphin performing a three-alternative crossmodal matching task in which identical (Object A to Object A) or conditional (Object B to Object C) matches were reinforced suggest that the dolphin performs this task on the basis of recognition of equivalence; the dolphin consistently matches on the basis of object identity, regardless of reinforcement for conditional matches. Data with object sets that varied on a single dimension (i.e., shape, texture, material, size) suggest that some object features are easier to discriminate than others in a cross-modal task. The dolphin’s strengths and confusions shed light on its object recognition system.

(725)

**How Rats Process Spatiotemporal Information in the Face of Distraction.** CHRISTINA M. THORPE & DONALD M. WILKIE, *University of British Columbia*—How rats process spatiotemporal information in the face of distraction was assessed. Rats were trained on a time–place learning task in which the location of food availability depended on the amount of time elapsed since the beginning of the training session. In each training session, each of four levers provided food pellets on an intermittent schedule for 5 min. In probe sessions interspersed with the final training sessions, the rats were presented with a second food source—a piece of cheese—at various times into the session. Rats chose the correct lever after the cheese distraction, but it appeared that their internal clock had stopped during the cheese consumption period. Thus, rats’ internal clock, like that of pigeons, displays the properties of “stop” and “restart.” Rat–pigeon differences in timing processes may be restricted to circadian or time-of-day timing.

(726)

**A Test of Object Permanence in Cotton Top Tamarins (*Saguinus Oedipus*).** JULIE NEIWORTH, ERIC STEINMARK, CATHERINE DEHART, & FRANCES STEELY, *Carleton College*—A total of 7 adult cotton top tamarins (*Saguinus Oedipus*) were tested in nine separate tasks to determine their representational level of object permanence. The nine tasks were developed to test visible and invisible displacement, the preservation error, and tasks in which a simpler strategy (i.e., picking the cup last touched) would result in failure. All 7 subjects passed criterion levels of performance for all visible displacement tasks. In addition, all 7 succeeded in a task of single-cup invisible displacement. However, the preservation error task for invisible displacement led to marked differences between individual animals, with some succeeding, whereas others reverted to location biases and failed. The results suggest that the mental flexibility required to represent objects invisibly displaced may vary across individuals.

(727)

**Rule Flexibility in Rats: Transfer to Reversed and Dispersed Patterns.** JAMES D. ROWAN, *Wesleyan College*, & SHANNON M. A. KUNDEY, *Yale University*—This study was designed to examine whether rats, like humans, can modify abstract rule-representations of a serial pattern. Rats learned 10 repetitions daily of either a 24-element, 3 elements per chunk pattern (3E) or a 16-element, 4 elements per chunk pattern (4E) for 28 days. Half of the rats were then transferred to a reversed 3 elements per chunk pattern interleaved with a simple repeating pattern (3E–RI), and the remaining rats were transferred to a reversed 4 elements per chunk pattern with the interleaved repeating pattern (4E–RI). Rats transferred from the 3E to the 3E–RI showed savings in comparison to all other groups. The results support the idea that rats form a flexible representation of the rules that express the original structured pattern and can modify this representation to learn a novel but similar pattern.

• CATEGORIZATION •

(728)

**Knowledge Partitioning in Categorization.** LEE-XIENG YANG & STEPHAN LEWANDOWSKY, *University of Western Australia*—Knowledge partitioning is a theoretical construct that holds that knowledge is not always integrated and homogeneous but is often separated into independent parcels that may contain mutually contradictory information. To date, evidence for knowledge partitioning has been obtained in research on expertise and function learning (see paper by Kalish, Lewandowsky, & Kruschke at this meeting). One characteristic of knowledge partitioning is that once people choose a particular knowledge parcel to solve a problem, they completely ignore knowledge contained in other parcels. We investigated knowledge partitioning in categorization and examined whether people will create independent knowledge parcels if a common categorization problem is presented in different contexts. We report three experiments that consistently support the presence of knowledge partitioning. The results showed that people learn different strategies for categorization in different contexts and that the strategy used in one context is unaffected by knowledge that is demonstrably present in other contexts.

(729)

**Categorization as Causal Reasoning Versus Similarity Matching.** BOB REHDER, *New York University*—A theory of categorization is presented in which knowledge of causal relationships between category features is represented as a Bayesian network. Referred to as causal-model theory, this theory predicts that objects are classified as category members to the extent they are likely to have been produced by a category’s causal model. On this view, people have models of the world that lead them to expect a certain distribution of features in category members (e.g., correlations between feature pairs that are directly connected by causal relationships) and consider exemplars good category members when they manifest those expectations. These ex-

ceptions include sensitivity to higher order feature interactions that emerge from the asymmetries inherent in causal relationships.

(730)

**Feedback Effects on Cost–Benefit Learning in Perceptual Categorization.** COREY J. BOHIL, W. TODD MADDOX, & JEFFREY L. DODD, *University of Texas, Austin*—With asymmetric categorization payoff matrices, the reward-maximizing and accuracy-maximizing decision rules are different. When instructed to maximize reward, human observers use a suboptimal decision rule intermediate between the accuracy- and the reward-maximizing rules, thus placing greater importance on accuracy than is optimal. Maddox and Bohil (1998) offered a competition between reward and accuracy (COBRA) hypothesis to account for this result that states that observers place importance on accuracy and reward maximization. Maddox and Bohil (in press) compared objective classifier feedback (the objectively correct response) with optimal classifier feedback (the optimal classifiers response) on the observer's ability to maximize reward, while sacrificing accuracy when the cost of an incorrect response was zero. Performance was superior for optimal classifier feedback, and model-based analyses indicated that less weight was placed on accuracy maximization. The present study included payoff matrices with negative costs. The feedback effect was replicated, although several interesting feedback by payoff matrix interactions emerged.

(731)

**Comparative Judgment in Color Categories.** ZACHARY ESTES, *University of Georgia*, & JAMES A. HAMPTON, *City University, London*—The traditional model of apparent color assumes that perception of a target stimulus occurs in isolation. But colors are not perceived in isolation, and furthermore, the judgment of one color may be affected by the presence of another. We conducted a series of experiments that measured the judgment (“Is it *blue*?”) of a borderline hue (i.e., a hue on the borderline between *blue* and *violet*) in the presence of a context hue of varying similarity either inside or outside the target category. The probability of positive categorization of the borderline hue linearly decreased when context hues were from within the target category (i.e., *blue*) and linearly increased when context hues were from outside the target category (i.e., *violet*). This linear contrast effect was not due to the typicality of the context hue but, rather, was attributable to the similarity between the context and the target hues, suggesting a comparative judgment process.

(732)

**Single-System Accounts of Categorization and Recognition Dissociations.** SAFA R. ZAKI & ROBERT M. NOSOFSKY, *Indiana University*—This research evaluates a single-system exemplar account of various observed dissociations between categorization and recognition. In previous research, amnesic patients performed at normal levels in a categorization task involving stimuli with discrete features but showed impaired recall of the features. These results were taken as evidence of the existence of separate memory systems for categorization and recognition/recall. Our results suggest that participants use only a few of the dimensions in the categorization task, whereas they must use many dimensions in the recall task. Therefore, different memory demands across the two tasks may be responsible for the observed dissociation. To distinguish between single-system and multiple-system accounts, we tested patients with memory disorders (early Alzheimer's disease patients) on a more demanding categorization task. Whereas these patients exhibit the classic dissociation on easy categorization tasks, they exhibit a categorization deficit on the more challenging task.

• MUSIC PERCEPTION/COGNITION •

(733)

**Napster Meets Psychophysics.** KENNETH M. STEELE, KRISTIN M. SAUNDERS, & ANGELA M. REID, *Appalachian State University*—“MP3” refers to an audio compression algorithm (MPEG-1, Level 3)

that is used to reduce the size of an audio file. The algorithm can produce a 10:1 compression ratio by a series of techniques collectively termed “perceptual encoding.” Perceptual encoding works by deletion of portions of the music that are assumed to be inaudible at a particular moment. Surprisingly, there has been almost no empirical work examining this assumption. The amount of compression, and thus loss of the original information, is controlled by the encoding “bit-rate,” the number of bits allocated to represent a segment of the music signal. A lower bit-rate produces more elimination of music information. The purpose of this research was to examine the relationship between bit-rate level and a person's ability to detect the difference between a musical selection and the MP3 version of that selection in a typical listening situation.

(734)

**Auditory Feature Integration in Music and Speech Stimuli.** MICHAEL D. HALL, *University of Nevada, Las Vegas*—The visual search literature has established that object perception requires a process that integrates features. Evidence for this integration process has come from demonstrations of illusory conjunctions, the perception of incorrect combinations of registered features. Recent findings of musical illusory conjunctions suggest that there is a corresponding auditory process. However, auditory models that estimate illusory conjunction rates have excluded certain perceptual errors, and the validity of these models has not been adequately tested. Two experiments addressed these issues, using musical and speech stimuli. In Experiment 1, listeners searched pairs of simultaneous, lateralized tones to identify a timbre from a target set and its pitch. Experiment 2 used an analogous task for synthetic speech, where listeners identified a target vowel and its pitch. Probability models (derived from those in vision) assessed whether errors reflected illusory conjunctions or guessing. Implications for speech/nonspeech processing and models of auditory search performance are discussed.

(735)

**Musical and Visual Priming of Visualization and Mental Rotation Tasks.** LAWRENCE M. PARSONS & MICHAEL J. MARTINEZ, *University of Texas Health Science Center, San Antonio*, EDWARD L. DELOSH, *Colorado State University*, ANDREA R. HALPERN, *Bucknell University*, & MICHAEL H. THAUT, *Colorado State University*—Passive listening to music is reported to enhance performance in an immediately following paper-folding-and-cutting test, a visualization task requiring some mental rotation. The present experiments evaluated several aspects of this phenomenon. Is such enhancement differentially due to particular components of music (rhythm, melody)? Is it produced by nonmusical auditory stimuli? Is it produced by viewing a shape spatially modulating in a variable rhythm? Does it differ for tasks with different proportions of mental rotation and visualization? The results suggest that the enhancement, which ranged from 10% to 25% better than various controls ( $p < .001$ ), is not produced by music per se. Rather, it occurs with rhythmic auditory (even nonmusical) stimuli, as well as dynamic rhythmic visual stimuli. The results also suggest that the enhancement involves operations underlying mental rotation more than those underlying visualization. A new hypothesis about the neural basis of this enhancement is discussed.

(736)

**An Application of Signal Detection Analysis to the Tritone Paradox.** MAGDALENE H. CHALIKIA, *Minnesota State University, Moorhead*, & VERLIN B. HINSZ & PHILLIP GUNDERSON, *North Dakota State University*—The tritone paradox is observed when listeners hear two octave-complex tones, separated by a half-octave (tritone) interval, successively. When the tones are created under various spectral envelopes, different listeners can perceive the same two-tone pattern as ascending or descending. It is hypothesized that perceptual judgments are based on a pitch class circle template formed by an individual's early exposure to language, whereby pitch classes in the top half of the circle are perceived as high and those in the bottom half are per-

ceived as low. We tested this hypothesis with data from 75 Midwestern listeners, using a signal detection analysis that involved the computation of  $d'$  scores based on predictions from each participant's pitch class template representation. Analysis of the  $d'$  values showed that the adequacy of the template model for our listeners is greater for stimuli created under low envelopes, relative to those under high envelopes.

(737)

**Activation of the Inferior Frontal Cortex in Musical Priming.** BARBARA TILLMANN, PETR JANATA, & JAMSHED J. BHARUCHA, *Dartmouth College*—Behavioral studies have provided evidence that the processing of a musical target is faster and more accurate when it is harmonically related to the preceding prime context. We investigated the neural correlates of processing related and unrelated musical targets that were presented at the end of musical sequences. Participants were scanned with functional magnetic resonance imaging (fMRI) while performing speeded intonation judgments on the targets. Behavioral results acquired in the scanner replicated the facilitation effect of related over unrelated targets. The fMRI signal linked to the targets revealed activation of bilateral inferior frontal regions (i.e., inferior frontal gyrus, frontal operculum, insula) that was stronger for unrelated than for related targets. Results suggest that the inferior frontal regions are implicated in processing and integrating temporal information. We discuss our findings with regard to activation patterns observed for semantic and syntactic processing and for repetition priming in language.

• METACOGNITION •

(738)

**Reversal of the Cue Frequency Effect in Metamemory: Further Explorations of the Cue Familiarity Hypothesis.** THOMAS A. SCHREIBER & DEBORAH K. EAKIN, *University of Kansas*—When people predict whether they will be able to retrieve previously learned target words, they are influenced by preexperimental familiarity with the cue provided (Schreiber & Eakin, 2000). Cue words higher in printed frequency yield more positive predictions than do those lower in printed frequency. In the present study, we show that the effects of preexperimental familiarity depends on how and when the cue is encoded. In fact, we show that under some conditions, the effect of cue familiarity can be exactly opposite to the basic effect described above (i.e., cue words lower in frequency yield more positive predictions than do those higher in frequency). We identify the conditions that produce these dissociative effects, and we argue that these effects cannot be explained by current theories of metamemory predictions focusing on JOLs or FOKs (e.g., by accessibility, fluency, cue recognition, or competition hypotheses). We also suggest ways current views can be supplemented.

(739)

**Generating Keywords Improves Metacomprehension Accuracy and Comprehension.** KEITH THIEDE, MARY ANDERSON, & DAVID THERRIAULT, *University of Illinois, Chicago*—Models of

self-regulated learning suggest that metacognitive monitoring affects regulation of study and that this affects overall learning (test performance). We manipulated monitoring accuracy by instructing participants to generate a list of five keywords that captured the essence of each text. Accuracy was greater for a group that wrote keywords after a delay (delayed-keyword group) than for a group that wrote keywords immediately after reading (immediate-keyword group) and a group that did not write keywords (no-keyword group). The superior monitoring accuracy produced more effective regulation of study. Specifically, the delayed-keyword group chose to reread the least-learned texts over the better-learned texts to a greater extent than did the other groups. Differences in monitoring accuracy and regulation of study, in turn, produced greater overall test performance (reading comprehension) for the delayed-keyword group versus the other groups. The results are framed in the context of a discrepancy reduction model of self-regulated learning.

(740)

**Encoding Fluency Effects on Judgments of Learning.** CHRISTOPHER HERTZOG & EMANUEL ROBINSON, *Georgia Institute of Technology*, & JOHN DUNLOSKY, *University of North Carolina, Greensboro*—We investigated the effects of fluency in forming a mediator for new associations on metacognitive judgments about that associative learning. Thirty-six participants were instructed to learn a randomly intermixed list of abstract and concrete paired associates (e.g., dog–spoon) by using interactive imagery. They pressed a key as soon as the image was formed. Encoding time was longer for abstract items and was positively related to judgments of learning (JOLs) even when controlling for item type. Analyses suggested that a major component of JOL accuracy in predicting associative learning may be based on the cue of whether one forms a mediator and, if so, how rapidly that mediator is generated. However, encoding fluency alone is not a sufficient explanation for accuracy in predicting later associative recall.

(741)

**Judgments of Learning Are Not Based on Retrieval: The Fast Don't Know Effect.** LISA K. SON, *Columbia University*—This paper challenges the widely accepted notion that judgments of learning (JOLs) are based on the retrieval of target information. In two experiments, after studying cue–target pairs, people were asked either to make JOLs or to explicitly retrieve and then make JOLs. Each participant's reaction times were plotted as a function of JOL. The retrieval hypothesis predicted that the reaction time functions for making JOLs alone would parallel those for when the participants retrieved first. Contrary to this prediction, these reaction time functions showed different patterns. Reaction times when people were retrieving increased steadily as JOL level decreased. However, when people made JOLs only, the reaction time function was nonmonotonic: very fast responses were given for low JOLs (i.e., items that participants knew that they did not know). These findings suggest that JOLs for “Don't Know” items may be based on a mechanism other than simple retrieval.

**Human Learning: Associative Processes**  
**Coronado H, Sunday Morning, 8:00–9:55**

*Chaired by Helga Noice, Elmhurst College*

**8:00–8:15 (742)**

**Cognitive Skill Learning: Races, Mixtures, and Humps in the Power Law.** JOHN CERELLA & WILLIAM J. HOYER, *Syracuse University* (read by William J. Hoyer)—The power law of skill learning is attested by the linearity of group-level  $\log(\text{RT})-\log(N)$  and  $\log(\text{SD})-\log(N)$  plots. Logan's race model affirms the law by assuming that multiple traces race for retrieval in memory. Recently published group curves show substantial "humps" in log-log coordinates, both for RTs and SDs. Rickard showed that the humps can be accounted for by the formula for a statistical mixture, on the assumption that slow computations are gradually displaced by fast memory retrievals. We used probes to verify subjects' solution strategies for artificial arithmetic problems and tested college-aged and elderly adults. Logan's race model could account for the RT and SD humps and for the probe data by adding a fast computation to the race. The race model solution was bimodal at the 50%–50% strategy point, matching the observed distributions. Elderly subjects required that the frequency of trace formation be reduced, reflecting lessened memory efficiency.

**8:20–8:35 (743)**

**Human Memory as Semi-Faithful Data Compression.** STEPHEN R. SCHMIDT, *Middle Tennessee State University*—Cognitive processes may be guided by a search for representational "simplicity." According to this point of view, the memory representation should be the simplest possible encoding of the perceptual input. The metaphor for memory processes should be "information compression," and the goal of the memory researcher should be to determine the nature and dynamics of the compression algorithms employed by human information processors. This approach is similar to Miller's (1956) view of memory coding but reflects recent advances in computational theory and applies to LTM as well as to STM. In addition, memory compression may be "lossy," retaining the gist of the input while discarding undesirable complexity. The "memory as compression" view is compared with schema theory and fuzzy trace theory and is applied to two well-known memory phenomena: false memory and the impact of distinctiveness on memory.

**8:40–8:55 (744)**

**Effects of Prolonged Work on Data Entry Speed and Accuracy.** ALICE F. HEALY, CAROLYN J. BUCK-GENGLER, JAMES A. KOLE, & LYLE E. BOURNE, JR., *University of Colorado, Boulder*—In two experiments, under conditions promoting fatigue, subjects entered four-digit numbers in one session divided into two halves with five blocks of 64 different numbers in each half. Each number occurred five times in Experiment 1, but once in Experiment 2. In Experiment 1, accuracy worsened, but response times improved both across and within session halves, reflecting an increasing speed-accuracy trade-off. In Experiment 2, the (largely cognitive) time to enter the first digit of each number improved over the first half of the session but worsened over the second half. Accuracy worsened, but time to enter the remaining digits improved across though not within session halves. The (purely motoric) time to press the "enter" key improved across and within session halves. Thus, through a combination of practice and fatigue, prolonged work affects the component cognitive and motoric processes of data entry differentially and at different points in time.

**9:00–9:10 (745)**

**Temporal Dynamics in Counting Span and Reading Processes.** SARAH RANSDELL & STEVEN A. HECHT, *Florida Atlantic University*, & C. MICHAEL LEVY, *University of Florida*—Two possible mechanisms for the link between counting span and early reading comprehension skill are tested. A resource tradeoff explanation predicts that a small-final condition will be remembered equally well to

a long-final condition because the memory loads are identical. If, on the other hand, the small-final condition is remembered better than the long-final because the retention interval is shorter in the small-final, then a task-switching explanation is supported (i.e., Towse, Hitch, & Hutton, 1998). Counting span recall and reaction time were better in the small-final condition. Further support for the importance of task switching is shown by the finding that reliable variance in reading comprehension was accounted for in the large-final condition (the typical span condition), but not in the small-final. Implications for the importance of temporal dynamics in span measures are discussed.

**9:15–9:30 (746)**

**Associative and Statistical Effects in the Extinction of Predictive Judgments.** HELENA MATUTE & SONIA VEGAS, *Universidad de Deusto*, & PIETER-JAN DE MAREZ, *University of Leuven*—Associative and statistical theories of learning make opposite predictions concerning trial-order effects. We tested these predictions using an acquisition-extinction design. According to associative theories, extinction (i.e., recency effects) should be observed; according to statistical theories, trial order is irrelevant, and a response that integrates the two stages, rather than extinction, should be observed. In three experiments, the results showed one or the other effect as a function of several variables: response mode (trial by trial vs. global), contextual manipulations (testing participants in the context in which the extinction phase took place or in a different context), or instructions to integrate the two training phases. These results are interpreted as participants' acquiring different associations for each phase and then using one or the other, or the two of them, as a function of the demands imposed by the environment.

**9:35–9:50 (747)**

**Why Does Active Learning Work?** DAVID BURROWS, *Beloit College*—Learning is improved by active engagement during the presentation of new information. The effectiveness of active learning may result from enhancements in response learning, depth of processing, time attending to task, elaboration of material, interest in the task, feedback, or schema formation. A theoretical understanding of the contributions of these factors has implications for a precise definition of active learning and for designing effective learning strategies. An action-orientation learning framework and taxonomy for understanding these effects are presented and evaluated. The importance of the mode of responding and of the relationship between conditions of learning and conditions of response is discussed.

**Phonemic Effects II**

**Coronado L, Sunday Morning, 8:00–9:55**

*Chaired by Greg B. Simpson, University of Kansas*

**8:00–8:15 (748)**

**Filler Type Effects in Naming: Control of Pathways or Time Criterion?** SACHIKO KINOSHITA, *Macquarie University*, & STEPHEN J. LUPKER, *University of Western Ontario*—Filler type effects in naming have traditionally been interpreted within the dual-route framework. Lupker, Brown, and Colombo (1997) proposed an alternative account of these effects based on the notion of a flexible time criterion for initiating articulation. Although this account has been used to explain blocking effects (changes in naming latency as a function of whether a block of trials comprises only one stimulus type or a random mix of two stimulus types), it has not been used to explain the modulation in the size of a stimulus type effect (e.g., regularity, frequency) when the target items are embedded among different fillers. Data from the present series of experiments suggest that the time criterion framework, rather than the dual-route framework, is better able to explain these effects as well.

**8:20–8:40 (749)**

**Coordination of Alphanumeric Processing Across Hemispheres: Neuropsychological Evidence.** UYEN LE, MICHAEL McCLOSKEY,

& ARGYE HILLIS, *Johns Hopkins University* (read by Michael McCloskey)—Stroke patient W.S. shows dramatic dissociations between verbal and manual responses to left visual field (LVF) stimuli, including letters, digits, words, and geometric figures. For example, when a digit (e.g., 4) is presented tachistoscopically in the LVF, W.S. often denies having seen it or names it incorrectly (e.g., stimulus 4, response “one”). Yet under the same stimulus conditions, he is highly accurate when responding by holding up fingers (e.g., holding up four fingers in response to 4), even when he responds with his right hand. The verbal-response impairment cannot be attributed to a language production deficit, because W.S. accurately names RVF stimuli. We present neuroanatomical and behavioral evidence that W.S. suffers from a partial hemispheric disconnection—for example, in tasks with aurally presented stimuli, his left and right hands frequently make simultaneous but conflicting responses. We discuss the implications of W.S.’s performance for issues concerning written language processing, interhemispheric interaction, and consciousness.

#### 8:45–9:00 (750)

**The CV-Structure of Printed Words: Evidence From the Stroop Task.** IRIS BERENT & MICHAL MAROM, *Florida Atlantic University*—There is strong evidence that speakers are sensitive to the abstract arrangement of consonants and vowels in spoken language (CV-structure). Here we examine whether this knowledge extends to the representation of print. Using a variant of the Stroop task, we demonstrate that color naming is facilitated when the CV-structure of a color name matches that of a printed novel word that shares none of its letters or phonemes. For instance, participants name the color black (CCVC) faster when it is presented with the novel word GROF (CCVC) than with the novel words GROFT (CCVCC) or GOF (CVC). Conversely, participants name the color red (CVC) faster when it is presented with the novel word GOF (CVC) than with GLOF (CCVC). These findings demonstrate that skilled readers encode the abstract CV-structure of printed words. The representation of print is thus shaped by phonological competence.

#### 9:05–9:20 (751)

**Phonemic Repetition and Syntactic Ambiguity Resolution During Silent Reading.** SHELIA M. KENNISON, *Oklahoma State University*—Two self-paced reading experiments investigated whether the processes involved in the reanalysis of syntactically ambiguous sentences are influenced by phonemic repetition. Prior research has shown that sentences containing phonemic repetition are processed more slowly than those that do not (Haber & Haber, 1982; McCutchen & Perfetti, 1982; Zhang & Perfetti, 1993, and others). It has been proposed that during reading comprehension, phonemic repetition causes confusion in working memory that must be resolved before comprehension can proceed (Perfetti & McCutchen, 1982). Since structural reanalysis is likely to involve working memory, an important question is whether the presence of phonemic repetition in sentences will cause syntactic reanalysis to be more difficult. The results of both experiments indicated that phonemic repetition did not increase the processing difficulty associated with syntactic reanalysis. The effect of phonemic repetition temporally followed the effect of syntactic ambiguity, occurring two presentation regions downstream.

#### 9:25–9:35 (752)

**The Brain Recognizes Familiar Phonotactics in a Foreign Environment.** ELISABET SERVICE, *University of Helsinki*, ISTVAN WINKLER, *University of Helsinki and Hungarian Academy of Sciences*, & TEIJA KUJALA, SINI MAURY, & RISTO NÄÄTÄNEN, *University of Helsinki*—Allowed sequences of phonemes—phonotactics—vary between languages. Knowledge of transitional probabilities between syllables is used, for instance, in the detection of word boundaries. We recorded electrical brain responses to phonotactically legal and illegal nonwords (according to Finnish rules) from participants who ignored these speech sounds. We found evidence for automatic phonotactic analysis by the brain: detecting a familiar language in a foreign-language en-

vironment. Native Finnish speakers showed a response sensitive to potential words in their language when these appeared infrequently (10%) among phonotactically illegal nonwords (90%), simulating a foreign-language background. No response was detected for 50% of legal sequences or when the legal sequences dominated (90%). The results suggest that speech stimuli undergo phonotactic analysis even when attention is not focused on the sounds. The ERP response bears some resemblance to a formerly discovered component, phonological mismatch negativity, thought to signal early phonological processes in word recognition.

#### 9:40–9:50 (753)

**Feedback Consistency Effects on Oral Reading and Spelling in Dyslexia.** BRENDAN S. WEEKES, *University of Sussex*, ANNE CASTLES, *University of Melbourne*, & MICHAEL THOMSON & JESSICA MORELAND, *University of Kent*—The mappings between orthography and phonology in the English script are characterized by both feedforward and feedback inconsistency. Most models of word recognition in English accommodate feedforward consistency effects only. Some interactive models of word recognition allow for feedback processes, but as yet few have incorporated reported effects of phonological feedback on orthographic processing. We compared the effect of feedback consistency on the oral reading of children with and without reading difficulties to test the hypothesis that children with reading difficulties will have more problems reading feedback-inconsistent words. We also examined the effects of consistency on spelling to test interactive accounts of written word production. The results revealed feedforward and feedback effects on reading and spelling by children with reading difficulties only. These results will be discussed in terms of the implications for the core phonological deficit hypothesis of dyslexia and also for models of word recognition in English.

#### Psychophysics

#### Monterrey, Sunday Morning, 8:00–10:05

Chaired by J. Scott Jordan, *Illinois State University*

#### 8:00–8:15 (754)

**Effects of Remoteness of Association on Distance and Semantic Congruity Effects in Symbolic Comparisons.** WILLIAM M. PETRUSIC & DEREK A. HARRISON, *Carleton University*—Let A denote a set of lines, and B, C, and D sets of nonsense syllables (CVCs). The A–B, B–C, C–D paired-associate chaining paradigm was used to establish three degrees of remoteness of the CVC labels from the elements in set A. Subsequently, symbolic comparisons of line length within and between each of the sets of CVCs were obtained. Generally, distance and semantic congruity effects were enhanced with increasing remoteness. Finally, participants compared CVCs in each of the sets with percepts not previously encountered. RTs and percent correct varied with the distance between the comparison line and the line represented by the symbol. For participants showing a remoteness effect, the findings provide support for the noisy-analogue-evidence accrual view of symbolic comparisons and are incompatible with propositionally based additive stages models. However, additive stage models are supported for the strictly symbolic comparisons for participants not showing a remoteness effect.

#### 8:20–8:35 (755)

**Benchmarking the Timing Characteristics of Tools Used by Behavioral Scientists.** RICHARD R. PLANT & NICK HAMMOND, *University of York* (sponsored by Walter Schneider)—The timing of events in studies of human performance increasingly relies on the use of software tools running within complex software and hardware environments. With National Research Council backing, we have established the Experimental Timing Standards Laboratory and formulated recognized benchmarks for testing the timing characteristics of tools used by behavioral scientists for chronometric studies. We outline these benchmarks and discuss our findings in relation to some of the commonly used packages.

8:40–8:55 (756)

**Are You Talkin' to Me?? Perceiving the Facing Direction of Acoustic Sources in Reverberant and Anechoic Spaces.** JOHN G. NEUHOFF, *College of Wooster*—Almost every study of auditory localization to date has employed sound sources that point directly at the listener. There are obviously good reasons to hold the facing direction of a loudspeaker constant relative to the listener when investigating localization. Still, it is curious that the perception of acoustic facing direction itself has received little or no attention in the literature. In the present experiments, listeners heard speech from a loudspeaker enclosure that was rotated in the horizontal plane. The task was to determine the terminal facing orientation of the loudspeaker. Listeners performed significantly better at closer listening distances and when dynamic rotation cues were present. Listeners were only marginally better in anechoic environments. The results suggest that multiple acoustic cues may be used to determine the facing angle of an acoustic source, including interaural level differences, monaural intensity change, and the ratio of direct to reflected sound.

9:00–9:20 (757)

**Lightness and Depth Perception: An Update.** ALAN L. GILCHRIST, *Rutgers University*, & DEJAN TODOROVIC, *University of Belgrade*—Experiments on depth and lightness reported 25 years ago (Gilchrist, 1977) displaced the view, current then, that lightness depends on low-level mechanisms, prior to depth processing. Subsequent work has confirmed the role of depth, but several recent reports, which we critique, have claimed the opposite. The first to show a clear influence of depth on lightness was Kardos (1934), a brilliant but unknown Gestalt psychologist. We announce a translation of his monograph *Object and Shadow*, and we report the replication of a classic Kardos experiment. A target disk of constant luminance and visual angle appeared almost white in a far depth plane, but almost black in a near depth plane, despite identical retinal images. In summary, (1) lightness does depend strongly on depth, (2) brightness does not, (3) depth effects are graded, not all-or-none, and (4) adjacency between coplanar surfaces is not necessary.

9:25–9:40 (758)

**Stimulus Onset-to-Onset Time Determines the Dichotic Temporal Order Threshold.** HARVEY BABKOFF, ELISHEVA BEN-ARTZI, & LEAH FOSTICK, *Bar-Ilan University* (read by Elisheva Ben-Artzi)—Dichotic temporal order discrimination was measured using two short-duration stimulus tones of identical frequency presented to the two ears at interaural time differences (ITD) ranging from 5 to 250 msec. All ITDs were presented in random order. ITD was measured from the offset of the first stimulus to the onset of the second stimulus. Dichotic temporal order threshold, identified as the ITD at which a subject reached 75% correct discrimination of order, was determined for five stimulus durations—10, 15, 20, 30, and 40 msec. The dichotic temporal threshold decreased linearly as a function of stimulus duration. The slope of the linear decrease was equivalent to the increase in duration—that is, 10-msec decrease in threshold for every 10-msec increase in duration. These results indicate that stimulus onset-to-onset time is the relevant variable in dichotic temporal order discrimination.

9:45–10:00 (759)

**Lower Region: A New Cue for Figure–Ground Segregation.** SHAUN P. VECERA, *University of Iowa*, EDWARD K. VOGEL, *University of California, San Diego*, & GEOFFREY F. WOODMAN, *University of Iowa*—Figure–ground segregation is an important visual process because figures underlie many visuomotor processes; humans recognize, attend, and act upon figures, not backgrounds. There are many visual cues for figure–ground organization—notably, the classic gestalt cues of area, symmetry, and convexity. Here we present a new cue to figure–ground segregation called lower region: Regions in the lower part of a figure–ground stimulus appear more figure-like than regions in the upper part of the stimulus. We demonstrate that (1) this lower-region bias is not due to contrast or eye movements, (2) lower regions are perceived

as figure for longer durations than upper-field regions and undergo fewer figure–ground reversals than do control displays, (3) voluntary visuospatial attention alone does not cause the lower-region figural preference, and (4) “lower region” is defined relative to the stimulus display. We discuss our results in terms of the environmental depth cues that this figure–ground cue may reflect.

### Picture Memory/Processing

Durango, Sunday Morning, 9:00–11:15

Chaired by Thomas Sanoeki, *University of South Florida*

9:00–9:20 (760)

**Using Reverse Correlation to Infer the Representations Mediating Facial Judgments.** MICHAEL C. MANGINI & IRVING BIEDERMAN, *University of Southern California* (read by Irving Biederman)—Participants categorized, in different tasks, faces appearing in sinusoidal noise as male/female, happy/unhappy, or two individuals (Tom Cruise/John Travolta). Unbeknownst to the subjects, in each task, the underlying face stimulus (or base image) was identical on every trial, consisting of a midpoint between the particular categories—for example, the average of a sample of male and female faces, and so forth. Therefore, all variations in the stimuli within a task—and the subjects' responses—could be attributed to the noise. The correlation of the subjects' responses with the noise patterns was used to compute a “classification image,” which can be interpreted as a linear approximation to a subject's decision dimensions. After only 390 trials, the average of the noise images for the different classes yielded quite clear exemplars of the classes. We compare the representations used by a prosopagnosic with those of normal observers.

9:25–9:45 (761)

**It's Dennis Quaid; Oops, It's Tom Cruise: Perceptual Interference in Face Recognition.** GEOFFREY R. LOFTUS, *University of Washington*—Bruner and Potter (*Science*, 1964) measured observers' ability to recognize pictures of objects, initially seen blurred, then gradually focused. Pictures initially seen very blurred were harder to eventually recognize than pictures initially seen moderately blurred. I report research that replicates this “perceptual interference effect,” using recognition of celebrity faces. This work is an offshoot of the idea that a distant face can be represented by blurring: Combining face size, face distance, and the human modulation transfer function allows construction of a theoretically equivalent filtered (blurred) face. Therefore one can visually represent a face seen at any given distance, by either shrinking it to simulate the visual angle or blurring it to simulate the spatial-frequency composition corresponding to the distance. Representing distance by either blurring or shrinking produced the perceptual interference effect: Faces beginning at 500 feet away needed to move closer for eventual recognition than faces beginning at 250 feet away.

9:50–10:05 (762)

**Gustave Caillebotte, the Impressionist Canon, and Mere Exposure.** JAMES E. CUTTING, *Cornell University*—The French Impressionist canon consists of late 19th century images that Gustave Caillebotte, a painter and collector of some of his colleagues' most renowned works, played a major role in establishing. In a naturalistic investigation of the effects of mere exposure to these and related paintings, I found that generally naive undergraduate observers prefer Impressionist images that occur more frequently in the Cornell University libraries. I claim that counts from these books act as proxy for the likelihood of broader cultural exposure. The 132 images used appeared nearly 4,000 times in almost 800 different books. Viewer recognition was correlated with occurrences in introductory art history textbooks and encyclopedias, viewer preferences were correlated with differences in frequency in all books, but their recognition and preferences were unrelated. Results suggest that mere exposure may be a strong force in maintaining an artistic canon.

**10:10–10:30 (763)**

**Semantic Interference From Object Recognition on Visual Image Generation and Inspection.** TOBY J. LLOYD-JONES & DAVID J. VERNON, *University of Kent*—A new technique for examining the processes involved in visual image generation and inspection is reported. This technique, the “image–picture interference” paradigm, requires participants to generate and make a response to a mental image of a previously memorized object, while ignoring a simultaneously presented distractor picture. Responses in two imagery tasks (left/right higher spatial judgements and responding when a coherent image is formed) are longer when a simultaneous picture distractor is categorically related (e.g., image, *bicycle*; distractor, *TRUCK*) relative to unrelated and neutral conditions. In contrast, performance is not impaired in this way when the distractor is a related word, when a semantic categorization decision is made to the target, or when distractor and target are visually, but not categorically, related to one another. These findings suggest that the locus of categorical interference is in the process of image generation. Finally, we briefly examine hemisphere differences in the image–picture interference effect.

**10:35–10:50 (764)**

**The Body Inversion Effect.** CATHERINE L. REED, SENIA BOZOVA, VALERIE E. STONE, & JAMES TANAKA, *University of Denver*—Researchers argue that faces are recognized differently from other objects. An important behavioral finding supporting this claim is the face inversion effect, where the recognition of faces is impaired relative to the recognition of nonface objects. Human bodies, like faces, convey biologically and socially relevant information. Thus, they too may be processed differently from other objects. We investigated whether a body inversion effect exists and, if so, what factors contribute to it. In Experiments 1 and 2, the processing of faces, bodies, and houses are compared using a forced-choice, same–different paradigm for upright and inverted stimuli. In contrast to houses, faces and bodies produced inversion effects. Experiments 3 and 4 investigated whether the body inversion effect is modified by changes in configurational relations among body parts. Only manipulations of basic body part relationships weakened the effect. These results have implications for current theories of the inversion effect and object recognition.

**10:55–11:10 (765)**

**Eye Movements, Viewing Task, and Scene Memory.** MONICA S. CASTELHANO & JOHN M. HENDERSON, *Michigan State University* (read by John M. Henderson)—What is the influence of task on the degree to which detailed representations are generated and stored during scene viewing? We examined this question by presenting a difficult memory test following scene memorization and visual search tasks. In the memorization task, participants viewed scene photographs to memorize visual detail. In the visual search task, participants searched the scenes for a target object. Eye movements were recorded in both tasks. A memory test for scene detail was given after all scenes had been viewed. The tested region did not include the search target for the search task. Participants were reliably above chance for memory of scene detail in both viewing conditions, provided that the tested region had been fixated during initial scene viewing. The results suggest that a relatively detailed scene representation is stored in memory from attended regions even when such memory is incidental to the viewing task.

**Mental Processes****Yucatan, Sunday Morning, 8:00–9:35***Chaired by Daniel Gopher, Technion-Israel Institute of Technology***8:00–8:15 (766)**

**Inferences About Cheating.** FRANZ SCHMALHOFER, *University of Osnabrück*, & ROBINSON ASCHOFF, *University of Heidelberg*—In three experiments, subjects read texts that furthered the inference that two of the portrayed persons were cheating a third person, as well

as control texts that would not promote such an inference. The subjects were asked to read these texts from a particular perspective: They were in the role of either a superior or a peer of the potential cheater (Experiments 1 and 2); alternatively, they were in the role of either a friend of the cheater or a friend of the cheated person (Experiment 3). The results showed that the readers inferred the relatively complex motivations behind the cheating actions and generated the thematic inference of cheating for the experimental, but not for the control, texts. The readers’ perspective had relatively little effect on this inference, but it affected the readers’ decision of whether or not they would raise a complaint against the potential cheater.

**8:20–8:40 (767)**

**Good Comprehenders Focus on Faults When Everyday Devices Break Down.** ARTHUR C. GRAESSER, BRENT OLDE, & SHULAN LU, *University of Memphis*—We tested a model of inquiry that predicts that question asking and eye movements are directed by cognitive disequilibrium. Cognitive disequilibrium occurs when there are obstacles to goals, anomalous events, contradictions, and salient contrasts. The model was tested by observing eye movements and questions when a device breaks down. Eye fixations and questions were predicted to focus on the faults that explain the breakdown. College students read illustrated texts about devices and subsequently received breakdown scenarios (e.g., in the context of a cylinder lock, the key turns, but the bolt does not move); during this time, they generated questions, and eye-tracking data were recorded. Participants later completed a device comprehension test and a battery of cognitive tests. The questions and eye movements of deep comprehenders supported the model’s predictions, whereas shallow comprehenders displayed more random patterns. The results are discussed in the context of alternative computational models.

**8:45–9:05 (768)**

**Spatial Reasoning and Learning in Virtual Reality.** JOHN R. PANI, THOMAS E. DAWSON, & JULIA H. CHARIKER, *University of Louisville*—Most people have strongly ingrained intuitions about spatial relations such that some rotational motions are easy to imagine and reason about, whereas others are extremely difficult. We attempted to determine the most effective forms of experience for improving people’s spatial understanding so that they can reason effectively about all forms of rotation. Using a rich interactive virtual reality system, we compared the effectiveness of three learning conditions. In all three conditions, there was reasoning about the outcomes of rotations, feedback, and exploration (i.e., control and observation) of the motions. This procedure alone constituted the control condition. In a second condition, the exploration of the motions included a computer visualization of the appropriate geometric analysis of the motions. A third condition presented an insightful model of the motions by generating a visualization of the integrated path of the motion as the rotation took place. Results of this comparison are presented and discussed.

**9:10–9:30 (769)**

**Reliability of Expert Testimony Based on Fingerprint Evidence.** LYN HABER & RALPH N. HABER, *University of California, Santa Cruz and University of California, Riverside*—Most fingerprint specialists are qualified to testify as experts by a court on the basis of their initial training, years of experience, and present employment. Virtually never are they asked in court to describe how reliable and accurate their conclusions have proven to be, based on empirical assessment. In this paper, we describe the theory of fingerprint matching, the typical procedures used by experts, and new computer matching programs. We then present the research history of fingerprint-matching reliability and accuracy. We conclude that there is an insufficient research base to justify qualifying fingerprint specialists as experts. More seriously, there is some evidence that accuracy levels may not reach the thresholds suggested by the U.S. Supreme Court for the admission of evidentiary-based expert testimony.

**Decision Processes in Memory**  
**Coronado A, Sunday Morning, 9:00–11:05**

*Chaired by D. Stephen Lindsay, University of Victoria*

**9:00–9:20 (770)**

**A Two-Dimensional Signal Detection Model of Remember–Know Judgments.** CAREN M. ROTELLO, *University of Massachusetts, Amherst*, NEIL A. MACMILLAN, *Brooklyn College, CUNY*, & JOHN A. REEDER, *University of Massachusetts, Amherst*—The one-dimensional signal detection theory (SDT) model of the remember–know paradigm postulates that “remember” responses are merely high-confidence “old” judgments. A meta-analysis of 276 experiments, extending that of Donaldson (1996), shows that the ROC curves predicted by this model have the wrong slope. We present a new two-dimensional SDT model in which old items differ from new ones in both general and specific memory strength: The “old” versus “new” response is based on a weighted sum of these dimensions, and the “remember” versus “know” judgment is based on a weighted difference. The model accurately describes existing remember–know data and makes predictions about several novel kinds of ROC curves that distinguish it from both the one-dimensional model and the dual-process model of Yonelinas. Data from two experiments support the two-dimensional model.

**9:25–9:40 (771)**

**Evidence for Within-List Criterion Changes in Recognition Memory.** WILLIAM E. HOCKLEY, *Wilfrid Laurier University*, MARTY W. NIEWIADOMSKI, *University of Toronto*, & KENDRA A. HUGHES, *Wilfrid Laurier University*—Wixted and Morrell (2000, Psychonomic Society annual meeting) suggested that subjects have a “remarkable reluctance” to adjust their decision criterion within lists in tests of recognition memory. We present evidence that two phenomena of recognition memory may be due to within-list changes in decision criteria—the revelation effect and environmental or global context effects. For the former, we show that the revelation effect is obtained for very rare words tested in pure lists but is not found for such words when they are tested in mixed lists with common words, although the revelation effect is still observed for common words. For the latter, we show that context effects found between comparisons of old versus new colored backgrounds are not observed when a black and white context is introduced at test. We argue that these effects observed in isolation disappear when there are competing influences on criterion changes.

**9:45–10:05 (772)**

**Multidimensional Signal Detection Analysis of False-Fame Effects.** WILLIAM P. BANKS, *Pomona College*—A multidimensional signal detection representation of memory predicts “false-fame” effects quite precisely. False fame is the incorrect identification of a previously learned nonfamous name (or face) as being that of a famous person. Dual-process models attribute false fame to familiarity created by the learning episode when recollection of list membership is not strong enough to overcome it. The multidimensional analysis predicts false fame for names and faces from measures of source and old–new discrimination. The gender bias effect in false fame can be attributed largely to differential memory strength for male and female names. Age differences in false fame are accounted for by differential loss of source memory with age. In this and other memory paradigms, source and item memory seem more intuitive components of memory than familiarity and recollection, as well as being measurable quantities. Furthermore, the multidimensional detection model makes no high-threshold assumptions in its predictions.

**10:10–10:25 (773)**

**Eye Movements in Face Recollection.** TIMO MÄNTYLÄ, *Umeå University*—This study examined dissociations between components of recollective experience in relation to eye movements. Subjects studied unfamiliar faces that were presented either upright or upside down. Subsequently, when recognizing an inverted or noninverted test face,

subjects indicated whether their decision was based on explicit recollection (“remembering”), assessment of familiarity (“knowing”) or unspecific recollection (“guessing”). Subjects’ eye movements were registered during both study and test. The results showed a dissociation between remember and know judgments, so that inversion during study impaired remembering without affecting knowing, whereas inversion during test showed the opposite pattern of results. Furthermore, the eye movement data supported the notion that inversion affects configural processing and that judgments of recollective experience reflect different gaze patterns.

**10:30–10:45 (774)**

**The Increasing Confidence of Falsely Remembered Words: The Fish That Got Bigger With Each Retelling.** ARTHUR J. FLEXSER, *Florida International University*—Confidence ratings of falsely remembered words were investigated using a forced recall procedure involving three tests on a 50-word list over a 2-week period. Subjects were to supply a word for each blank on the test sheet and assign a judgment of remember, know, or guess, in addition to rating confidence of the word’s list membership. Falsely remembered words were defined as intrusions that received a non-guess rating. In some conditions, subjects additionally performed elaboration activities, generating associates or sentences involving the words they supplied. The results are considered in relation to eyewitness memory, in which witnesses are encouraged to elaborate during multiple recall attempts.

**10:50–11:00 (775)**

**The Role of Effort in Eyewitness Confidence Judgments.** JOHN S. SHAW, III, *Lafayette College*—This study was conducted to test the proposition that extra effort by witnesses during a memory test can lead to higher confidence ratings without any accompanying changes in accuracy. Participant-witnesses answered 12 multiple-choice questions about a classroom visitor who had spoken 5 days earlier. In the high-motivation condition, participants could earn prizes on the basis of their test performance; in the low-motivation condition, there were no special incentives. Participants reported how hard they worked on the 12 test questions, and they were categorized into high- and low-effort groups. Participants in the high-effort group gave significantly higher confidence ratings than those in the low-effort group, yet response accuracy did not differ for the two groups. These findings have important implications for understanding how pressures to perform well in the courtroom can affect eyewitness confidence.

**Repetition/Priming Effects**

**Coronado H, Sunday Morning, 10:10–11:55**

*Chaired by Kay Livesay, University of San Francisco*

**10:10–10:25 (776)**

**A Rational Analysis of Cognitive Control in a Speeded Discrimination Task.** MICHAEL C. MOZER, MICHAEL COLAGROSSO, & DAVID HUBER, *University of Colorado*—We are interested in the mechanisms by which individuals monitor and adjust their performance of simple cognitive tasks. We model a speeded discrimination task in which individuals are asked to classify a sequence of stimuli (Jones, Braver, Cho, Cohen, & Nystrom, 2001). Response conflict is created when one class is infrequent relative to another, resulting in more errors and slower response times for the infrequent class. How do control processes modulate behavior based on the relative class frequencies? We explain performance from a rational perspective that casts the goal of individuals as minimizing a cost that depends on both error rate and response time. With two additional assumptions of rationality—that class prior probabilities are accurately estimated and that inference is optimal subject to limitations on rate of information transmission—we obtain a good fit to overall RT and error data, as well as trial-by-trial variations in performance.

**10:30–10:45 (777)**

**Negative Priming and Perceptual Facilitation.** DAVID L. STRAYER, FRANK A. DREWS, & ROBERT W. ALBERT, *University of Utah*—Negative priming is reliably obtained with repeated items, but not with novel items. We discuss why these stimulus repetition effects are problematic for theories of negative priming based on episodic retrieval. Neill and Joordens (submitted) developed an alternative account of these data in which the novel prime-trial distractor (1) activates an internal perceptual representation of the stimulus and (2) creates an instance in memory. According to this account, episodic retrieval impedes performance on the probe trial; however, this is offset by the persistent activation of the perceptual representation of the distractor. We provide evidence casting doubt upon the claim that perceptual facilitation masks the effects of episodic retrieval with novel items. We conclude that a more straightforward interpretation of these stimulus repetition effects is one based on activation-sensitive inhibition.

**10:50–11:05 (778)**

**Social Category Priming Affects Recall on Explicit Memory Task.** EVA DREIKURS FERGUSON & JOEL HAGAMAN, *Southern Illinois University, Edwardsville*—Democratic, autocratic, and laissez-faire interaction patterns were portrayed in paragraphs that served as primes. Following each paragraph, participants were given a list containing words representing these three categories plus a neutral category. Social-affective content had a significant effect on explicit memory: For words immediately following the primes, the social category words showed better recall in line with the prime. Results were compared for explicit and implicit memory, and social categories were analyzed for their affective value.

**11:10–11:30 (779)**

**Reduced Semantic Priming From Prime Repetition: Expectancy or Semantic Matching?** JAMES H. NEELY, KEITH A. HUTCHISON, & JEFFREY D. JOHNSON, *SUNY, Albany*—For lexical decisions, immediate masked repetition priming of an unmasked prime reduces strategy-based semantic priming from that prime—that is, reduces priming only when prime–target SOAs are 300 msec or longer and when semantic priming from a nonrepeated prime increases with an increasing proportion of semantically related primes and targets (Hutchison, Neely, & Johnson, in press). Here, with a 500-msec SOA, we show that prime repetition reduces both forward and backward semantic priming for lexical decisions, but not forward priming for pronunciation. Also, pronunciation yielded no backward priming at all, replicating prior research. Thus, the reduction in forward semantic priming produced by prime repetition seems to be due to prime repetition’s impairing semantic matching, rather than impairing expectancy.

**11:35–11:50 (780)**

**A Compactness Hypothesis of the Odd / Even Effect.** TERENCE M. HINES, *Pace University*—When subjects make judgments in which they must compare two or more digits, odd digits generate longer RTs than do even digits. When judgments do not involve a comparison, such as deciding whether a stimulus is a digit or a letter, RTs to odd digits are not longer. A new hypothesis for this effect is proposed: Representations of even digits are more compact, or closer together, in some representational space than are the representations of odd digits. This hypothesis predicts that odd digits will prime other odd digits less than even digits will prime other even digits. Two priming experiments are reported that supported this hypothesis. Implications of the compactness hypothesis are discussed.

**Syntactic Effects**

**Coronado L, Sunday Morning, 10:10–11:55**

*Chaired by Charles Clifton, Jr., University of Massachusetts, Amherst*

**10:10–10:25 (781)**

**Dividing the Labor Between Syntax and Semantics: An Account of Verb Production Deficits.** GARY S. DELL, *Beckman Institute,*

*University of Illinois, Urbana-Champaign,* & JEAN K. GORDON, *University of Iowa*—To say the right word at the right time, a speaker must consult his or her intended meaning (semantics) and keep track of where he or she is in the sentence (syntactic/sequential state). We present a connectionist model of production that uses learning to determine the relative contribution of semantics and syntax to the accessing of words. Lesioning the model’s semantic-to-lexical weights impairs the access of complex or “heavy” verbs, whereas a syntactic lesion affects “light” verbs more. Aphasic patients with verb retrieval deficits also exhibit this double dissociation.

**10:30–10:50 (782)**

**Lexical Contributions to Sentence Formulation: Effects of Lexical Repetition on Syntactic Priming.** MARTIN J. PICKERING, JANET F. MCLEAN, HOLLY P. BRANIGAN, & LIESBETH TIMMERMANS, *University of Edinburgh*—We report a series of experiments using the confederate-scripting method (Branigan et al., 2000) that investigated the effects of lexical repetition on the tendency to repeat the syntactic structure of utterances that have just been heard in dialogue (using “dative-alternating verbs” like “give”). This tendency was greatly enhanced when prime and target shared all noun phrases; differences in closed-class items did not affect this tendency; strong priming still occurred when prime and target shared surface form but differed with respect to grammatical analysis; but repetition of a single prepositional phrase did not lead to the enhanced priming effect. Our results indicate that lexical access is implicated in the process of syntactic choice. We hypothesize that our final result reflects the incremental nature of production: Because structure is built up left to right, lexical repetition influences syntactic processing in early word order positions only, before syntactic structure has been wholly determined.

**10:55–11:10 (783)**

**Semantic Analyzability and Syntactic Flexibility in Idiom Recognition.** P. TABOSSI, R. FANARI, & K. WOLF, *University of Trieste*—Semantically, idioms have traditionally been characterized as strings whose interpretation is not a direct function of the meanings of their components. Syntactically, it is well known that they can occur only in limited constructions. Recently, it has been suggested that idioms do not form a homogeneous class: Whereas the components of some idioms do not seem to contribute to the meaning of the string, the components of other idioms do contribute to the overall meaning. Likewise, whereas some idioms allow very few operations, others are almost completely unconstrained. These differences have been claimed to determine the ease with which idioms are identified. However, the empirical evidence in support of this claim is still unclear. In this study, we present new evidence on the effects of analyzability and flexibility on idiom recognition. The relevance of these findings for theories of idiom processing is discussed.

**11:15–11:30 (784)**

**The Induction of Implicit Categories in an Artificial Language.** ROMAN TARABAN, *Texas Tech University*—Reliable morphological, phonological, or semantic cues that are intrinsic to lexical items are central to acquiring syntactic categories (e.g., noun gender); however, these cues may not be necessary. Adults learned an artificial language in which totally arbitrary (i.e., lacking reliable intrinsic cues) pseudo-nouns formed two gender-like classes based on pseudo-prepositions that were used with the pseudo-nouns to form phrases (cf. Brooks, Braine, Catalano, Brody, & Sudhalter, 1993). In generalization tests involving old and new pseudo-nouns, participants demonstrated the induction of gender-like categories if the noun–preposition phrases associated with each pseudo-noun had been presented sequentially, not randomly, during learning. The benefit of sequential presentation is attributed to the formation of underlying representations in a multilayered connectionist network with recurrent connections. The findings imply that the proximal occurrence of words with associated elements from the same syntactic category can support the induction of implicit syntactic categories.

11:35–11:50 (785)

**Verb Argument Structure Rapidly Guides Visual Attention While Listening.** JULIE E. BOLAND, *University of Michigan*—Effects of argument structure, but not plausibility, were found in a spoken language eye movement paradigm. Participants viewed a four-photo array depicting the subject, direct object, and either a typical or atypical recipient/instrument/location for sentences containing dative, transitive action, or intransitive verbs. A dative example is “The book was challenging, so the teacher assigned it as homework to the class/firemen.” The only task was to answer comprehension questions. We analyzed participant gaze during an interval immediately following verb onset, prior to the PP containing the target (recipient, instrument, or location). Looks to the sentential subject predominated initially, then rapidly declined in dative and transitive conditions. Beginning about 500 msec after verb onset, recipients attracted more looks than instruments and locations. In contrast, there was no effect of target plausibility. Clearly, listeners used verb argument structure rapidly to focus their attention on relevant aspects of the visual scene.

**Perception II****Monterrey, Sunday Morning, 10:15–12:05***Chaired by Shlomo Bentin, Hebrew University of Jerusalem*

10:15–10:30 (786)

**Visual Binding in the Standing Wave Illusion.** JAMES T. ENNS, *University of British Columbia*—When two video-frames are shown in alternation, one with a central bar and the other with two flanking bars, the central bar becomes invisible at intermediate rates of alternation (50–100 msec per frame). The present experiments show that the determining factor in this illusion is not the extent of the contour that is shared by bars in each frame but, rather, the shape and surface similarity of the central and flanking bars. This illusion therefore presents an excellent opportunity for studying recursive interactions between higher level object representations and lower level contour processes.

10:35–10:55 (787)

**Retuning of Perceptual Template Via Perceptual Learning.** ZHONGLIN LU, *University of Southern California*, & BARBARA A. DOSHER, *University of California, Irvine*—We applied the perceptual template model approach (Doshier & Lu, 1999; Lu & Doshier, 1998) to investigate mechanisms of perceptual learning in the fovea: Observers judged the orientation of a Gabor patch as tilted clockwise or counterclockwise (8°) of 45° in 10 practice sessions. External noise was superimposed on the Gabor. Contrast thresholds were measured at two performance levels for each external noise. Perceptual learning resulted in substantial improvements in performance in high noise, with no significant improvement in zero and low external noise. PTM modeling identified a pure mechanism of external noise exclusion for perceptual learning, reflecting retuning of the perceptual template. This study provides the first empirical demonstration of an isolable mechanism of perceptual learning.

11:00–11:20 (788)

**A Dynamical Model for Self-Organized Motion Pattern Formation.** HOWARD S. HOCK & CYNTHIA L. PARK, *Florida Atlantic University*, & GREGOR SCHÖNER, *CNRS, Marseille*—A dynamical model explores the integration of locally detected motions to form either unidirectional or oscillatory motion patterns, depending on interelement distance and frame duration. A model reproducing these percepts is based on nonlinear dynamical equations that represent contributions of the stimulus to local detector activation and contributions of each detector to the activation of other detectors through excitatory and inhibitory interactions that depend nonlinearly on the detector’s activation level. Interelement distance influences pattern formation through its effect on local motion detector activation and frame duration through the time scale of the dynamics and differences in the activation dependence of excitatory and inhibitory interactions. All combine to deter-

mine whether the residual activation of leftward versus rightward detectors at the end of each frame favors motion in the same or the opposite direction during the next frame. There is no need for the stimulus specification of global patterns for patterns that are self-organized.

11:25–11:45 (789)

**Measuring Illusory Line Movement With Central and Peripheral Attention Cuing.** ERIC RUTHRUFF, JAMES C. JOHNSTON, & ROGER W. REMINGTON, *NASA Ames Research Center* (read by James C. Johnston)—The phenomenon of illusory line movement (ILM; a line of simultaneously displayed points appears to move outward from the focus of attention) suggests the hypothesis that spatial attention increases the processing rate early in the visual system. However, Downing and Treisman (1997) have argued that ILM is actually caused by “impletion,” a variant of apparent motion. We tested whether ILM can occur under conditions unfavorable for impletion: central cuing of attention and peripheral cuing of attention without presenting new objects. The task of discriminating small letter targets surrounded by distractors was used to induce tightly focussed attention. Results show strong ILM with both peripheral and central cuing, supporting attention as the cause of ILM. A nulling technique (how much real motion is required to just offset ILM) provides a plausible quantitative estimate of how much the processing of visual stimuli can be speeded up by focused spatial attention.

11:50–12:00 (790)

**Perceptual Effects of Action Planning During Joint Action.** J. SCOTT JORDAN, *Illinois State University*, & GÜNTHER KNOBLICH, *Max Planck Institute for Psychological Research*—We investigated transformations of perceptual space produced by the need to anticipate the actions of others during joint action. Either alone or as a member of a pair, participants controlled the progression of a dot stimulus back and forth across a computer monitor. They did so via right and left buttonpresses that incremented the dot’s velocity rightward and leftward, respectively. Participants in the individual condition controlled both buttons. Those in the group condition controlled only one. As participants slowed the dot to change its direction of travel, it unexpectedly disappeared. Participants indicated the perceived vanishing point. In all conditions, perceived locations were displaced beyond the actual vanishing point. In addition, the magnitude of the displacement increased as the need to anticipate the actions of another increased. The data are consistent with a growing body of data that indicate that perceptual space and action planning utilize common mechanisms.

**Selection****Yucatan, Sunday Morning, 10:10–11:40***Chaired by Veronica J. Dark, Iowa State University*

10:10–10:25 (791)

**The Duality of Selection: Excitatory and Inhibitory Processes in Auditory Selective Attention.** ROBERT D. MELARA, APARNA RAO, & YUNXIA TONG, *Purdue University*—Differences in the processing of targets versus distractors were studied in an auditory selective-attention paradigm. Behavioral and event-related potential (ERP) measurements were made during task performance, both before and after a series of inhibition or discrimination training sessions. Distraction caused poor perceptual sensitivity, conservative responding, and slow reaction times relative to baseline (no distraction). Physiologically, distraction led to a frontal enhancement of ERP components occurring 100–250 msec after the onset of attended signals and to the virtual elimination of the P300 response to targets. Training ameliorated behavioral interference from distraction, particularly for participants receiving inhibition training. Physiologically, these participants showed improved inhibitory processing of distractors, an effect which peaked approximately 200 msec after distractor onset. In a proposed model, distinct excitatory and inhibitory mechanisms work interactively to

maintain sensitivity to environmental change in the face of disruption from the contextual integration of irrelevant events.

**10:30–10:50 (792)**

**Pushing Around the Locus of Selection.** STEVEN J. LUCK, EDWARD K. VOGEL, & GEOFFREY F. WOODMAN, *University of Iowa*—Many studies have shown that attention may operate at different stages of processing under different conditions, but most of these studies have used very different experimental paradigms to demonstrate different loci of selection. Here, we show that a very small parametric manipulation—a change in the cue-to-target delay interval—can dramatically shift the locus of selection. In a spatial cuing paradigm, a central cue occurred either simultaneously with the target or prior to the target. When the cue preceded the target, both behavioral accuracy and an ERP measure of semantic analysis were suppressed on invalid trials, relative to valid trials. When the cue and the target were simultaneous, accuracy was again lower on invalid trials, but there was no suppression of semantic analysis. Thus, attention operated to suppress perception when the cue preceded the target, but attention operated only at postperceptual stages when the cue and the target were simultaneous.

**10:55–11:10 (793)**

**Large Similarities and Small Differences Between Selective and Divided Attention.** J. TOBY MORDKOFF, *Pennsylvania State University*—The patterns of results that are observed in both selective- and divided-attention tasks show a strong dependency on whether the rele-

vant stimulus variations involve only one or more than one dimension (e.g., shape only or color and shape). However, small differences in the specific stimulus values that have been employed make links between these two tasks problematic. I will present the results from several experiments that eliminate these small differences.

**11:15–11:35 (794)**

**Assessing the Boundary Conditions of the Attentional Blink.** EDWARD AWH, *University of Oregon*, JOHN T. SERENCES, *Johns Hopkins University*, & PAUL LAUREY, HARPREET DHALIWAL, MACHI MATSUKURA, & PAUL DASSONVILLE, *University of Oregon*—Previous research has demonstrated a robust limitation in the ability to process two visual targets in rapid succession. When a single visual target is identified, there is a period of several hundred milliseconds afterwards when the processing of subsequent targets is impaired, a phenomenon labeled the attentional blink (AB). AB interference has been demonstrated with a wide variety of stimulus classes, including letters, numbers, words, geometric shapes, and colors. Consequently, most published models of this phenomenon assume that the identification of a visual target temporarily occupies a limited attentional resource that is essential for conscious visual perception of all classes of stimuli. The present research suggests that there is at least one exception to this rule. Face stimuli presented during the attentional blink period can be discriminated without any trace of impairment. We argue that models of AB interference should acknowledge stricter boundary conditions than those suggested by previous research.