

**Fifteenth Annual Meeting of the  
Cognitive Science Association  
for Interdisciplinary Learning**

**July 30–August 3, 2009  
Hood River Hotel**



**Conference Organizers:**

Pierre Jolicœur  
Bill Prinzmetal  
Michael Sullivan

# CoAL 2009

## PROGRAM

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### Thursday July 30 Evening

4:45           Appetizers  
5:00           Opening Remarks. How to be cool, by Michael Sullivan

— SHORT TALK —

5:10-5:20

**Alexandra List, Ayelet N. Landau, Joseph L. Brooks, Anastasia Flevaris, Francesca Fortenbaugh, Michael Esterman, Thomas M. VanVleet, Alice R. Albrecht, Bryan Alvarez, Lynn C. Robertson, & Krista Schendel;** *Northwestern University, University of California, Berkeley & VA Martinez, University College London, The Johns Hopkins University, & Yale University*

**Object-based attention in patients with unilateral lesions**

— TALKS —

5:30-6:00

**Keisuke Fukuda & Edward K. Vogel;** *Department of Psychology, University of Oregon*  
**Individual difference in release time from attentional capture**

6:10-6:40

**Steven L. Franconeri, Jessica C. Roth, & Jason M. Scimeca;** *Northwestern University*

**Visual spatial relationship representation as a sequence of attentional shifts**

6:50-7:20

**John J. McDonald, Jessica J. Green, Ali Jannati, & Vincent Di Lollo;** *Department of Psychology, Simon Fraser University*

**Dynamic interplay between bottom-up and top-down processes in visual search: an event-related-potential study**

7:30           Adjourn

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## Friday July 31 Morning

8:30 Morning Refreshments

— TALKS —

8:45-9:15

**Jonathan G. Hakun & Susan M. Ravizza;** *Michigan State University*

**Cognitive control: Advance preparation for two types of flexible behavior**

9:25-9:55

**Roy Luria & Ed Vogel;** *Department of Psychology, University of Oregon*

**Visual working memory under load: Part 1: correlations with task-switching strategies. Part 2: selection in visual working memory under low and high perceptual load.**

10:05-10:35

**Philip L. Smith, Rachel Ellis, Bradley J. Wolfgang, & David K. Sewell;** *The University of Melbourne & Defence Science and Technology Organisation*

**Diffusion modeling of masked detection reveals multiple attentional loci**

10:45 Break till 4:45

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# Friday July 31 Evening

4:45           Appetizers

## — POSTERS —

5:00-5:10

**Janel Fergusson & Peter Graf**; *Psychology, University of British Columbia*

**Individual differences in prospective memory: Time flies sometimes**

## — TALKS —

5:20-5:50

**Bill Prinzmetal, Ayelet Landau, Deena Delwan, Allison Shapiro, & Sarah Holtz**; *University of California, Berkeley, & Head-Royce School*

**Voluntary and involuntary attention vary as a function of impulsivity**

6:00-6:30

**Ariel Rokem, Dave Garg, Ayelet Landau, William Prinzmetal, & Michael A. Silver**; *University of California, Berkeley*

**Effects of cholinergic enhancement on attention and learning in the human visual system**

6:40-7:10

**Wei-Chun Wang, Michele Lazzara, Charan Ranganath, & Andrew P. Yonelinas**; *Department of Psychology, University of California, Davis*

**The perirhinal cortex supports conceptual implicit memory**

7:20           Adjourn

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## Saturday August 1 Morning

8:30 Morning Refreshments — TALKS —

8:45-9:15

**Thomas H. Carr, Maggie J. Xiong;** *Department of Psychology, Michigan State University*

**On the organization and operating characteristics of semantic memory**

9:25-9:55

**Susan M. Ravizza;** *Department of Psychology, Michigan State University*

**Why is the left temporoparietal junction engaged in verbal working memory tasks? Storage vs. attention**

10:05-10:35

**George Wolford & Michael B. Miller;** *Department of Psychological and Brain Sciences, Dartmouth College, & University of California, Santa Barbara*

**Individual differences in brain activations in episodic memory**

10:45 Break till 4:45

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# Saturday August 1 Evening

4:45           Appetizers

— SHORT TALK—

5:00-5:10

**Steffen Werner**; *Psychology and Communication Studies, University of Idaho*  
**GoCognitive.net** — Educational tools for cognitive neuroscience

— TALKS —

5:20-5:50

**Edward Ester, John Serences, & Edward Awh**; *University of Oregon and University of California, San Diego*

**Spatially global sensory recruitment during working memory maintenance**

6:00-6:30

**Amy Sue Finn, Carla L. Hudson Kam, Margaret A. Sheridan, Bradley Buchsbaum, & Mark Desposito**; *UC Berkeley, Harvard University School of Public Health, Childrens Hospital Boston, Rotman Research Institute, & Helen Wills Neuroscience Institute*

**The development of neural substrates for verbal working memory and learning**

6:40-7:10

**Alexander Stevens, Suzanne Mitchell, & Sarah Tappon**; *Oregon Health & Science University*

**Momentary decision-making in adolescents: Frontal-striatal loops and the usual suspects**

7:20           Adjourn

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## Sunday August 2 Morning

8:30 Morning Refreshments

— TALKS —

8:45-9:15

**Frederick J. Gallun, Anna Diedesch, & Erin Engelking;** *National Center for Rehabilitative Auditory Research, Portland VA Medical Center, and Oregon Health Sciences University*

**Effects of aging and hearing loss on monaural and binaural auditory discrimination**

9:25-9:55

**Stephen E. Palmer & Karen B. Schloss;** *Psychology Department, University of California, Berkeley*

**Aesthetic Science: WAVES of color, music, and emotion**

10:05-10:35

**Michael A. Webster, Igor Juricevic, Kyle McDermott, & Shernaaz M. Webster;** *Psychology Department, University of Nevada, Reno*

**Consequences of adaptation assessed by adapting images to observers**

10:45 Break till 4:45

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## Sunday August 2 Evening

4:45— — Program note: no appetizers on banquet night and immediate start

### — SHORT TALKS —

4:45-4:55

**Ben Lester & Paul Dassonville;** *Department of Psychology, University of Oregon*  
**Asymmetric visual displays cause the induced Roelofs illusion, not spatial shifts of attention**

5:00-5:10

**John Avery Dewey & Thomas H. Carr;** *Department of Psychology, Michigan State University*

**Did I do that? Distraction and the phenomenology of control**

### — TALKS —

5:15-5:45

**Tim Wifall, Eliot Hazeltine, & Bob McMurray;** *Department of Psychology, University of Iowa*

**Inter-item similarity impairs motor skill learning**

5:55-6:25

**Neil B. Albert, Joseph M. Galea, Chris Miall, & Sian L. Beilock;** *The University of Chicago, Johns Hopkins Medical Institute, & University of Birmingham*

**The role of working memory in motor learning**

6:35          Adjourn

7:00

### — BANQUET —

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# Monday August 3 Morning — NOTE EARLY START!

8:00 Morning Refreshments  
— Program note: early start to accomodate travel constraints  
— **TALKS** —

8:15-8:45  
**Todd Parrish, Xue Wang, & Darren Gitelman; *Northwestern University***  
**Effects of chewing gum on working memory and stress**

8:55-9:25  
**Anastasia V. Flevaris, Shlomo Bentin, & Lynn C. Robertson; *UC Berkeley & Veterans Administration, Martinez, and Hebrew University, Jerusalem***  
**Local or global? Attentional selection of spatial frequency binds shapes to hierarchical levels**

9:35-10:05  
**Christine Lefebvre, Synthia Guimond, François Vachon, Stephan Grimault, & Pierre Jolicœur; *International Laboratory on Brain, Music, and Sound Research, Université de Montréal***  
**Neurophysiological studies of acoustic short-term memory**

10:15 Closing remarks

10:17 Adjourn for the year

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# ABSTRACTS

Alphabetical by first author

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**Neil B. Albert, Joseph M. Galea, Chris Miall, & Sian L. Beilock**

The University of Chicago, Johns Hopkins Medical Institute, & University of Birmingham

## **The role of working memory in motor learning**

When learning to ride a bike, people rely on both procedural and declarative memory systems. Though previously described as distinct, it is becoming increasingly evident that declarative and procedural memory systems operate in a competitive manner. Little is known about what cognitive resources and neural mechanisms might influence this competition. To address this issue, a pair of experiments was completed. Based upon the need to maintain and integrate multiple sources of information to accomplish sensorimotor learning, it seems likely that working memory capacity may influence motor learning. In Experiment 1, working memory capacity is used to account for individual differences in behavioral indications of declarative and procedural memory. In Experiment 2, TMS over the DLPFC is used to manipulate the manner in which recently learned information is consolidated. The results are consistent with the predictions of the Working memory Influenced Memory System (WIMSy) competition model of learning.

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**Thomas H. Carr, Maggie J. Xiong**

Department of Psychology, Michigan State University

## **On the organization and operating characteristics of semantic memory**

“Semantic memory” has been used to refer to many different things — knowledge of the world, knowledge of concepts, knowledge of words, mapping between word forms and concepts. In every case, however, some kind of organization has been attributed to “semantic memory.” Organization is emphasized in theories of learning into this system, activation patterns within this system, retrieval from it, and application of retrieved information during task performance. Three major views of semantic organization have been developed, and they invite comparison, contrast, and integration: semantic memory as associative structure, as taxonomic or category-membership structure, and as attributional or subjective/emotional structure (as in Osgood’s semantic differential or Fiske’s emotional tags). Integrative theories of associative and taxonomic structure are well developed, but efforts at integrating associative/taxonomic structure with attributional or subjective/emotional structure have been less visible. How could we proceed in pursuit of a broader and more fully-integrated theory of semantic memory?

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**John Avery Dewey & Thomas H. Carr**  
Department of Psychology, Michigan State University

### **Did I do that? Distraction and the phenomenology of control**

Discerning control over objects manipulated through interfaces, as people do when driving cars and using computers, requires tracking whether input provided by the person at the controls produces the expected effects. We investigated whether judgments of control on a computer task with visual feedback would also be affected by auditory feedback that participants were instructed to ignore. In Experiments 1–4, auditory distractions reduced judgments of control when they were incongruent with the input or the visual feedback. In Experiment 5, a distracting tone reduced judgments of control when it followed the input at a variable interval, but not when the interval was fixed. The subjective experience of control depends on a holistic integration of expectations and feedback across modalities.

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**Edward Ester, John Serences, & Edward Awh**  
University of Oregon and University of California, San Diego

### **Spatially global sensory recruitment during working memory maintenance**

Recent studies suggest that working memory (WM) maintenance is enabled by sensory recruitment, or sustained stimulus-specific activity in the cortical regions that encode remembered information. Here we examined whether sensory recruitment is restricted to the contralateral visual areas activated in a bottom-up manner by the memoranda, or whether it leads to spatially global activation — in regions both contralateral and ipsilateral to the memoranda. Observers were required to remember the orientation of a grating presented in the left or right visual field. fMRI and multivoxel pattern analysis were used to measure feature-specific activity in early visual regions during memory maintenance. We find that patterns of activity in both contralateral and ipsilateral regions discriminate the remembered orientation, suggesting that visual details are maintained in WM through a spatially global recruitment of early sensory cortex. This spatially global recruitment may enhance memory precision by facilitating robust population coding of the stored information.

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**Janel Fergusson & Peter Graf**  
Psychology, University of British Columbia

### **Individual differences in prospective memory: Time flies sometimes**

Time-based prospective memory is the ability to form a plan and carry it out at the appropriate time in the future. An important part of this ability is time perception. This study examined whether our ability to make estimates of time durations is affected by the nature of an ongoing task. Participants estimated different intervals of time (2 or 5 minutes) and completed an ongoing task requiring them to discriminate tone frequencies (high/low) or durations (long/short). Participants in the duration condition were significantly less accurate in their time estimations. Additionally, accuracy was poorer for longer intervals in both conditions.

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**Amy Sue Finn, Carla L. Hudson Kam, Margaret A. Sheridan, Bradley Buchsbaum, & Mark Desposito**

UC Berkeley, Harvard University School of Public Health, Childrens Hospital Boston, Rotman Research Institute, & Helen Wills Neuroscience Institute

### **The development of neural substrates for verbal working memory and learning**

The primary substrate for working memory — the prefrontal cortex — continues to mature through early adulthood. What are the functional consequences of this for working memory and learning? We show, using a longitudinal design, that during early adolescence (but not later) individuals recruit the hippocampus during verbal working memory function. The hippocampus is also coactive with the prefrontal cortex earlier in adolescence irrespective of task demands or performance. Data indicate that the neural circuit serving working memory is qualitatively different when younger. In a second study, we ask how this difference impacts learning. Younger children are more likely to engage hippocampus while keeping novel vs. learned information in working memory. Older children, however, do the opposite and engage hippocampus for learned more than novel information. Taken together, data show that distinct substrates are used both for working memory and learning earlier in life, informing debates about child and adult learning differences.

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**Anastasia V. Flevaris, Shlomo Bentin, & Lynn C. Robertson**

UC Berkeley & Veterans Administration, Martinez, and Hebrew University, Jerusalem

### **Local or global? Attentional selection of spatial frequency binds shapes to hierarchical levels**

Contrary to the traditional view that shapes and their hierarchical level (local or global) are a priori integrated in perception, recent evidence suggests that the identity of a shape and its level are initially perceived independently, implying the need for shape-level binding to account for normal perception (Hübner & Volberg, 2005). What is the binding mechanism in this case? Using hierarchical letter shapes we provide additional evidence that the left hemisphere (LH) has a preference for binding shapes to the local level while the right hemisphere (RH) has a preference for binding shapes to the global level. More importantly, binding is modulated by attentional selection of higher or lower spatial frequencies (SFs) in a prior compound grating. We demonstrate that attentional selection of higher SFs by the LH facilitates binding at the local level and attentional selection of lower SFs by the RH facilitates binding at the global level.

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**Steven L. Franconeri, Jessica C. Roth, & Jason M. Scimeca**  
Northwestern University

### **Visual spatial relationship representation as a sequence of attentional shifts**

The relative spatial relationships among objects in the world are an important source of visual information. When we judge these relationships among a small number of objects, we have the impression that we simultaneously attend to all objects at once. In contrast, we argue that a flexible system may encode relations across space as a sequence of attentional shifts, in a manner similar to a linguistic description. We demonstrate that despite their intuitions, observers do shift attention between the judged objects, using two techniques: (a) a passive electrophysiological measure of the locus of selection (N2pc), and (b) a behavioral manipulation where the objects appear temporally asynchronously, causing either speeding or slowing of the judgment depending on the order of appearance. Using both techniques, the observed patterns of shifts match either manipulations of stimulus salience, or biases caused by the linguistic framing of the instructions.

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**Keisuke Fukuda & Edward K. Vogel**  
Department of Psychology, University of Oregon

### **Individual difference in release time from attentional capture**

The visual short-term memory (VSTM) capacity for simple objects is known to be severely limited, yet variable across individuals. Last year at CSAIL, we presented ERP evidence that low capacity individuals are more susceptible to attentional capture. Based on that finding, we explored two questions. What kind of attentional capture are low capacity individuals vulnerable to? And what underlies such relationship? Here we found that low and high capacity individuals show equivalent stimulus-driven attentional capture. However on the other hand, high and low capacity individuals show significantly different behavioral and ERP response to contingent attentional capture. More precisely, even though low and high capacity individuals initially show the equivalent contingent capture effect, low capacity individuals show slower recovery than high capacity individuals. These results suggest that individual differences in VSTM may stem from variability in how quickly attention is released from attentional capture by contingent distractors.

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**Frederick J. Gallun, Anna Diedesch, & Erin Engelking**

National Center for Rehabilitative Auditory Research, Portland VA Medical Center, and Oregon Health Sciences University

**Effects of aging and hearing loss on monaural and binaural auditory discrimination**

The auditory abilities of older and hearing-impaired individuals are generally characterized in terms of the ability to detect pure tones in a quiet background. This talk will consider two additional measures of hearing that are also impacted by aging and hearing loss, one monaural and one binaural. The monaural task involves the ability to determine whether or not changes have occurred in the intensity of brief (50 ms) noise bursts presented in a series of three rapid bursts (200 ms onset asynchrony). As reported at CSAIL in 2008, when the standard level is roved from trial to trial, performance is very poor, but there is no reliable effect of age or hearing loss. When the standard level is fixed, however, younger and normally-hearing listeners benefit from the reduction in level uncertainty much more than do older and hearing-impaired listeners. The binaural task involves the ability to determine if a sound has been presented to the left or right of a standard. The effects of age and hearing loss are apparent in this task, as well. These results will be related to the increasing body of literature on the impact of aging on temporal processing.

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**Jonathan G. Hakun & Susan M. Ravizza**

Michigan State University

**Cognitive control: Advance preparation for two types of flexible behavior**

fMRI was used to provide evidence of advance preparation in two forms of task switching — rule switching and perceptual switching. In both conditions, participants were asked to identify an odd-man-out (OMO) target among two possible stimulus dimensions (shapes and letters). Perceptual switching required identification of OMO location in a display of 4 bivalent stimuli (both shapes and letters); rule switching required identification of OMO with memorized stimulus-response (S-R) rules. Throughout the time-course catch-trials were interspersed (these included the cue screen but no subsequent trial). Behavioral analysis demonstrated a greater reduction in shift-cost in rule switching than perceptual switching with longer cue-target intervals. Catch-trials (fMRI) were analyzed in a modified GLM design, where switch and repeat catch-trials were contrasted (separately per condition). In perceptual-switching catch trials, superior temporal gyrus activation (BA 22) was greater in switch-catch than repeat, and none were found more active in repeat than switch. In the rule-switching catch trials, left dorsal lateral prefrontal cortex (DLPFC, BA 45/46) and anterior cingulate (ACC, BA 32) activation was greater in switch catch-trials than repeat and none were found more active in repeat than switch. The presence of the putative “cognitive-control network” activation during rule-switching preparation and the greater reduction in switch-cost suggests an active reconfiguration process during rule switching that is much more limited/non-existent during perceptual switching.

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**Christine Lefebvre, Synthia Guimond, François Vachon, Stephan Grimault, & Pierre Jolicœur**

International Laboratory of Brain, Music, and Sound Research, Université de Montréal

### **Neurophysiological studies of acoustic short-term memory**

In this talk we summarize recent work on the development of an event-related potential (ERP) measure of electrical brain activity specifically related to the maintenance of representations in acoustic short-term memory (ASTM). In several experiments we varied acoustic memory load for simple sounds varying in pitch and found a sustained fronto-central negativity during the retention interval with an amplitude that increased with increasing memory load. When memory load was varied in sequential presentations of the memory set, we also found a strongly increasing negativity during the presentation of the memory set and during the presentation of memory test sequence. Various methods were used to dissociate the ASTM-related ERP from this presentation-sequence negativity (possibly CNV). In particular, we devised a new paradigm in which memory items were presented simultaneously, avoiding long sequential presentations, and we found the same increase in fronto-central negativity with increasing memory load. Control studies involved identical presentations of the sounds prior to the retention interval, but in tasks that did not require encoding and maintaining information in ASTM. We found no increase in fronto-central negativity as we varied the number of presented items for these control conditions, showing that the fronto-central negativity reflects active maintenance in memory rather than non-specific stimulation after effects. We found significant correlations between the estimated memory capacity based on behavioural measures and the estimated change in fronto-central negativity with memory load, providing converging evidence that the isolated ERP is functionally related to ASTM.

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**Ben Lester & Paul Dassonville**

Department of Psychology, University of Oregon

### **Asymmetric visual displays cause the induced Roelofs illusion, not spatial shifts of attention**

The Roelofs effect is a visual illusion in which a large offset frame causes a distortion of the observers subjective midline. Here, we test the hypothesis that shifts of attention toward the frame center drive the distortion of perceived midline. If this is the case, participants perception of straight-ahead should vary as a function of the location of an attentional cue. In Experiment 1, participants perception of midline was distorted by a peripheral flash designed to attract attention, demonstrating that a large offset frame is not necessary to generate the Roelofs effect. However, these results are ambiguous, since the lateralized visual display itself might be responsible for the distortion. Experiment 2 used a predictive endogenous cue while ensuring a balanced display. Under these conditions, participants perception of midline did not vary with the attentional shift. These results demonstrate that an imbalanced visual display drives the Roelofs effect, not shifts of spatial attention.

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**Alexandra List, Ayelet N. Landau, Joseph L. Brooks, Anastasia Flevaris, Francesca Fortenbaugh, Michael Esterman, Thomas M. VanVleet, Alice R. Albrecht, Bryan Alvarez, Lynn C. Robertson, & Krista Schendel**

Northwestern University, University of California, Berkeley & VA Martinez, University College London, The Johns Hopkins University, & Yale University

### **Object-based attention in patients with unilateral lesions**

In 29 patients with unilateral lesions, we examined the effects of object configuration on attention in two separate tasks. The aim was to determine whether patient performance on two very different, but commonly-used, tests of object-based attention reflect influences from a common underlying mechanism. In one task, patients searched for target items presented within two lateralized columns (i.e., objects) on a page. Patients showed object-based neglect in both contralesional and ipsilesional objects. In the second task, patients were presented with a modified version of Egly, Driver and Rafals (1994) cueing study. Uncued targets appeared within cued or uncued objects in the contralesional or ipsilesional fields. Patients showed contralesional object-based neglect and ipsilesional object-based facilitation. These results contribute to the seeming paradox that objects can both exacerbate and ameliorate attention deficits in patients. We found that performance was correlated across the two tasks in the ipsilesional visual field, revealing common object-sensitivity.

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**Roy Luria & Ed Vogel**

Department of Psychology, University of Oregon

**Visual working memory under load: Part 1: correlations with task-switching strategies. Part 2: selection in visual working memory under low and high perceptual load.**

*Part 1.* In 4 experiments, participants switched between parity and magnitude judgments and their taskswitching ability was evaluated by calculating the reduction in switching cost due to active preparation. In Experiment 1, switching probability was 50%, and the results indicated that individuals with high WMC were worse than low WMC individuals in reducing switching cost, leading to a negative correlation between WMC and task switching. In Experiment 2, switching probability was 25%, and WMC correlated positively with task switching. In Experiment 3, switching probability was 75% yielding negative correlation between task switching and WMC. Experiment 4, replicated the design of the second experiment and showed that the correlation between WMC and taskswitching was evident when each task had 8 stimulustoresponse rules, but was absent when the tasks employed only 4 stimulustoresponserules. The results support the idea that high WMC individuals chose different and more adaptive strategies relative to low WMC individuals.

*Part 2.* Our senses are constantly bombarded by information, and we are required to select only the relevant information for the task at hand. Two contrasting mechanisms have been identified in order to accomplish that goal, namely: early and late selection. There is mixed evidence supporting both systems. Load theory argues to solve the early vs. late selection debate by proposing that early selection occurs in situations with high perceptual load, whereas late selection is predicted for situations with low perceptual load. In 2 flanker-like experiments we replicated the behavioral results predicted by load theory. In addition we tracked the contents of visual working memory using electrophysiological measures (i.e., the CDA). The ERP results were in sharp contrast with load theory (i.e., we found high CDA amplitude in the high load condition, and low amplitudes in the low load conditions) but they support a simple selection account that argues that filtering is easy under low perceptual load and difficult when the perceptual load is high.

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**John J. McDonald, Jessica J. Green, Ali Jannati, & Vincent Di Lollo**  
Department of Psychology, Simon Fraser University

**Dynamic interplay between bottom-up and top-down processes in visual search: an event-related-potential study**

When searching the visual environment for an object of interest, the presence of a salient-but-irrelevant distractor creates competition for access to conscious awareness. This competition can be mediated by top-down attentional control strategies aimed at selecting relevant information and ignoring irrelevant information, as well as by bottom-up activation triggered by the stimuli themselves. It is unclear how — and at what processing stage — top-down strategies can override bottom-up activation to enable selection of relevant objects. Some researchers have proposed that top-down control can override bottom-up activation at the earliest, preattentive stages of visual processing; others have proposed that this top-down control can occur only after attention is deployed automatically to the most salient stimulus. Here we resolve this controversy by determining the way in which top-down control overrides bottom-up activation and by pinpointing the processing stages at which this occurs. Using a new event-related potential component called the distractor positivity ( $P_d$ ), we show that information arising from the salient distractor is suppressed early or late, depending on whether or not the observer has advance knowledge of the defining feature of the to-be-ignored stimulus. The finding of early suppression is inconsistent with the idea that salient stimuli capture attention automatically and independently of top-down control.

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**Stephen E. Palmer & Karen B. Schloss**  
Psychology Department, University of California, Berkeley

**Aesthetic Science: WAVEs of color, music, and emotion**

Color preference is an important aspect of human behavior, but little is known about why people like some colors more than others. Recent results from the Berkeley Color Project (BCP) support an ecological valence account, according to which color preferences arise from peoples cumulative emotional responses to environmental objects/events strongly associated with those colors. We will describe our results on preferences for 37 colors of saturated, light, muted, and dark shades, and how average preferences can be predicted by measuring Weighted Affective Valence Estimates (WAVEs) for objects associated with those colors ( $r = .85$ ). We will also describe how colors are associated with classical music and the role emotional response plays in these associations.

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**Todd Parrish, Xue Wang, & Darren Gitelman**  
Northwestern University

### **Effects of chewing gum on working memory and stress**

Many people chew gum because they derive a personal benefit. Current research shows that the behavioral benefit is measurable in studies exploring cognitive performance or assessing mood and stress in laboratory settings. The link between chewing and cognitive or mood benefit is likely to involve complex interactions between biochemical and physiological processes in the oral cavity, the gut and the brain. However, the mechanisms of how chewing affects neural activity in the brain is unclear. In the present study, using functional MRI simultaneously with EEG, we investigated the effects of chewing gum on working memory (WM) and psychological stress. For cognitive testing we compared the 3-back to the 1-back working memory task. The psychological stress was subtracting 7 from a 4 digit number out loud with corrections for incorrect answers. The results suggest that chewing gum may facilitate the process of working memory by enhancing the neural activity in memory and attention-related brain areas.

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**Bill Prinzmetal, Ayelet Landau, Deena Delwan, Allison Shapiro, & Sarah Holtz**  
University of California, Berkeley, & Head-Royce School

### **Voluntary and involuntary attention vary as a function of impulsivity**

There is abundant behavioral and physiological evidence of separate mechanisms for voluntary and involuntary spatial attention. If there are different mechanisms for these two attentional systems, then there should be individual differences such that some subjects exhibit more involuntary attention and others more voluntary attention. The present study examined whether voluntary and involuntary attention manifest differently in people who differ in impulsivity (measured with the Barratt Impulsivity Scale). We used two versions of the spatial-cueing paradigm. In the first method, we compared predictive and nonpredictive spatial cues. We also varied the interval between the cue and target. Involuntary attention has been associated with a nonpredictive spatial cue and short cue-target intervals whereas voluntary attention is associated with predictive spatial cues and long cue-target intervals. The second method used the anti cueing method. In this method, a cue in one location indicates that there is a high probability that the target will be in the opposite location. It has been found that at short cue-target intervals, subjects are faster at the cued (low probability) location where as at longer intervals, subjects are faster at the opposite (high probability) location. We found that participants with high impulsivity scores exhibited larger involuntary attention effects compared to low impulsivity participants, whereas participants with low impulsivity scores exhibited larger voluntary attention effects compared to high impulsivity participants. This finding sheds light on the cognitive processes underlying trait impulsivity. In addition, our results suggest that voluntary and involuntary attention can be modulated independently, contributing to the theoretical distinction between these systems.

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**Susan M. Ravizza**

Department of Psychology, Michigan State University

### **Why is the left temporoparietal junction engaged in verbal working memory tasks? Storage vs. attention**

Lesion studies have suggested that the left temporoparietal junction (TPJ) may play a crucial role in maintaining verbal information for a short period of time. However, activity in the left TPJ in fMRI studies is not consistent with predictions of a putative phonological short-term store. Instead, we suggest that the left TPJ may be important for phonological storage because of its role in bottom-up attention. Using fMRI, we assessed activity in left TPJ in working memory at different stages (i.e., encoding, maintenance and retrieval). If this area is important for bottom-up attention, we predict that the left TPJ will be active during the encoding process and suppressed during maintenance in order to prohibit distracting information from entering short term memory. Our findings are consistent with our predictions and suggest that the left TPJ is part of an attentional network, specifically involved in bottom-up attention to verbal information.

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**Ariel Rokem, Dave Garg, Ayelet Landau, William Prinzmetal, & Michael A. Silver**

University of California, Berkeley

### **Effects of cholinergic enhancement on attention and learning in the human visual system**

Acetylcholine modulates allocation of visuospatial attention and is important for learning. We pharmacologically enhanced the cholinergic system of human subjects with donepezil (Aricept) and measured its effects on attention and learning. To study attention, we used an anti-cueing paradigm in which presentation of a salient cue in one location predicted the appearance of a target in an opposite location in 80% of the trials. For long cue-target SOAs, allocation of voluntary attention resulted in shorter RTs for the location opposite the cue. However, for short SOAs, involuntary attentional capture resulted in shorter RTs for the same location as the cue. Aricept enhanced the effect of cueing (difference in RT for trials in which the target appeared in opposite and cued locations) for long SOA but not short SOA blocks, suggesting cholinergic modulation of voluntary but not involuntary visuospatial attention. To study learning, subjects trained on a motion direction discrimination task. Perceptual learning under cholinergic enhancement was more pronounced and more specific.

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**Philip L. Smith, Rachel Ellis, Bradley J. Wolfgang, & David K. Sewell**  
The University of Melbourne & Defence Science and Technology Organisation

### **Diffusion modeling of masked detection reveals multiple attentional loci**

A number of studies have reported that the attentional effects in spatial cuing tasks are increased when stimuli are masked. Two kinds of theories have been proposed to explain why this should be so. We have argued that masks increase cuing effects because they interrupt the process of forming a visual short-term memory (VSTM) representation of the stimulus. Doshier, Lu, and colleagues have argued that masks increase cuing effects through the action of an external noise-exclusion mechanism, which facilitates extraction of stimulus features from noise. We studied these mechanisms in a cued detection task under four different masking conditions: no masks; simultaneous noise masks (integration masks); backward pattern masks (interruption masks), and both kinds of mask. We found virtually no cuing effects with unmasked stimuli, small effects with integration masks, moderate effects with interruption masks, and large effects when interruption and integration masks were combined. We interpret these results using the theory of Smith and Ratcliff (2009), which links perceptual encoding, visual masking, attentional selection, VSTM, and a diffusion-process model of decision-making in an integrated dynamic framework. Fits to the choice probabilities and RT distributions suggest the action of two kinds of mechanism. One is a gain-dependent, VSTM formation process, which is terminated by backward masks; the other is an increase in the gain difference for attended and unattended locations when stimuli are embedded in noise. The first of these mechanisms is consistent with our theory; the second is consistent with the theory of Doshier and Lu. The results suggest a multiple-locus model of attentional effects.

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**Alexander Stevens, Suzanne Mitchell, & Sarah Tappon**  
Oregon Health & Science University

### **Momentary decision-making in adolescents: Frontal-striatal loops and the usual suspects**

Adolescents are viewed as more likely to engage in risky behavior than adults. Some evidence suggests that integrity of frontal-striatal and frontal-basal ganglia circuits may play a role in developmental changes in assessing risk. 32 adolescents, aged 14–19 years, performed a modified version of the balloon analog risk task (BART) while undergoing event-related fMRI. Subjects held down a button to inflate virtual balloons and released the button to stop inflating it. If subjects held the button too long, the balloon burst. Subjects received points for saved balloons but not for burst balloons. Two different colored balloons were presented each linked to a separate maximum inflation time distribution. A control condition consisted of gray balloons that subjects did not control but were instructed to release the button when they detected the balloon stopped inflating or burst. Regions of interest in basal ganglia and neostriatum were identified by contrasting saved balloons to the control balloons. Correlated activity between subcortical ROIs and prefrontal cortex was identified and then used to predict behavioral performance on BART. Across the whole sample, the strength of connectivity between basal ganglia and right dorsolateral prefrontal cortex was negatively related to how long subjects would press to inflate the balloons, while an area in the ventromedial frontal cortex showed the inverse relationship. Additional results will be discussed within the context of adolescent brain development, risk, and decision-making.

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**Wei-Chun Wang, Michele Lazzara, Charan Ranganath, & Andrew P. Yonelinas**  
Department of Psychology, University of California, Davis

### **The perirhinal cortex supports conceptual implicit memory**

Most current theories of human memory assume that explicit memory for prior events relies on the medial temporal lobes (MTL), which include the hippocampus, the perirhinal cortex, and the parahippocampal cortex, whereas implicit or unconscious memory relies on brain regions outside the MTL. However, some have suggested that prior experience with an item will increase the efficiency with which the item or concept is processed in MTL regions such as the perirhinal cortex, and that this ‘processing fluency’ can be used to support conceptual implicit and explicit memory judgments. Although neuroimaging and patient lesion studies indicate that the perirhinal cortex is critical for familiarity-based explicit memory judgments, whether the perirhinal cortex is critical for conceptual implicit memory is currently unknown. To test the hypothesis that the MTL is critical for conceptual implicit memory, we tested amnesics with damage to the hippocampus and the surrounding MTL regions in two tests of conceptual implicit memory: category exemplar generation and semantic decision. The results of the patient studies indicated that the MTLs are critical for conceptual implicit memory, but suggested that the hippocampus is not directly involved. To identify more precisely the MTL regions involved we scanned healthy young adults while they studied a list of words and then subsequently tested category exemplar generation priming. The results showed that perirhinal cortex activation predicted subsequent conceptual implicit memory performance, indicating that this MTL region is directly involved in supporting implicit memory.

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**Michael A. Webster, Igor Juricevic, Kyle McDermott, & Shernaaz M. Webster**  
Psychology Department, University of Nevada, Reno

### **Consequences of adaptation assessed by adapting images to observers**

Perception varies markedly with the observers state of adaptation, yet how these states naturally vary and their consequences remain unclear. We explored these consequences for color perception in a new way — by adapting images rather than observers to simulate theoretically complete adaptation. This allowed us to probe effects of long-term adjustments over timescales that are difficult to test by adapting observers. The adaptation was modeled as gain changes in the cones and in post-receptoral channels selective for different color-luminance directions. Images were sampled from different environments and rendered after adjusting the gains so that the average response within each channel was equal across two environments. The adapted images suggest how color appearance should vary because of variations in the world, and thus provide clues to how the world might “look” to others. Measures of visual performance with the adapted images also provide novel tests of the theoretical benefits of adaptation.

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**Steffen Werner**

Psychology and Communication Studies, University of Idaho

### **GoCognitive.net — Educational tools for cognitive neuroscience**

The goal of the GoCognitive web project ([www.goCognitive.net](http://www.goCognitive.net)) is the creation of an online center for teaching-related materials in cognitive psychology and cognitive neuroscience that provides teaching resources and limited research support for student projects. Current funding through the Idaho SBOE has enabled the creation of an initial set of interactive demonstrations, video interviews produced by goCognitive, and other sources linked through a unified framework for search and navigation. Apart from solely demonstrating a phenomenon, many of the flash-based programs double up as experimentation shells that can be downloaded and customized to fit the needs for a particular student project. For example, the attentional blink shell will allow students to easily add pairs of images and use the program to measure search times, correct and incorrect clicks, etc. within a simple run-time environment. A set of available demonstrations and available video interviews will be presented during the meeting.

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**Tim Wifall, Eliot Hazeltine, & Bob McMurray**

Department of Psychology, University of Iowa

### **Inter-item similarity impairs motor skill learning**

We used a modified version of the classic chord learning task studied by Siebel (1963) to investigate the role that item similarity and task difficulty play in the acquisition of a motor skill. The task consisted of producing three finger keypresses, similar to producing a chord on a piano. Two experiments were conducted. Results suggest that if difficulty, as indexed by performance on the first session, is held constant more similar chords produce a slower learning rate than dissimilar chords (indexed by the slope of the power law). This difference emerges across practice. In addition, if similarity is held constant hard chords are learned at a quicker rate than easy chords however, this difference became smaller across practice.

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**George Wolford & Michael B. Miller**

Department of Psychological and Brain Sciences, Dartmouth College, & University of California, Santa Barbara

### **Individual differences in brain activations in episodic memory**

There have always been researchers who focus on individual differences, but the overwhelming majority of researchers and studies focus on group statistics. Such is also the case in much of neuro-imaging. I briefly will review problems that could arise in a variety of areas by focusing exclusively on group averages. I will then describe two fMRI studies on episodic memory and show that the group activation maps do not fully capture what happens at the level of the individual subject. I will show that the activation patterns of individual subjects are stable over time even though they differ from the group maps. Finally, I will report some initial attempts to explain the sources of individual differences.

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Name	email address
Neil Albert	neil.albert@gmail.com
Edward Awh	awh@uoregon.edu
Cathy Butterfield	cathy@hoodriverhotel.com
Denise Carr	denisefcarr@mac.com
Thomas Carr	carrt@msu.edu
John Dewey	deweyjoh@msu.edu
Edward Ester	eester@uoregon.edu
Janel Fergusson	janelfergusson@gmail.com
Amy Sue Finn	amyfinn@berkeley.edu
Johathan Hakun	hakunjon@msu.edu
Ben Lester	blester@uoregon.edu
Roy Luria	rluria@uoregon.edu
Anastasia Flevaris	ani@berkeley.edu
Steven Franconeri	franconeri@northwestern.edu
Keisuke Fukuda	keisukef@uoregon.edu
Frederick Gallun	Frederick.Gallun@va.gov
Alexandra List	a-list@northwestern.edu
Roy Luria	rluria@uoregon.edu
John McDonald	jmcd@sfu.ca
Steve Palmer	palmer@cogsci.berkeley.edu
Toff Parrish	toddp@northwestern.edu
Bill Prinzmetal	wprinz@berkeley.edu
Susan Ravizza	ravizzas@msu.edu
Ariel Rokem	arokem@berkeley.edu
Karen Schloss	kschloss@berkeley.edu
Keith Schneider	schneiderkei@missouri.edu
John Serences	jserences@ucsd.edu
Michael Silver	masilver@berkeley.edu
Philip Smith	philipls@unimelb.edu.au
Alexander Stevens	stevenal@ohsu.edu
Edward Vogel	vogel@uoregon.edu
Michael Webster	mwebster@unr.nevada.edu
Shernaaz Webster	shernaaz@unr.edu
Steffen Werner	swerner@uidaho.edu
Tim Wifall	timothy-wifall@uiowa.edu
George Wolford	george.l.wolford.ii@dartmouth.edu
Andy Yonelinas	apyonelinas@ucdavis.edu

Conference home page:  
<http://www.ohsu.edu/csail>