



**NOVEMBER 8-9, 2017**

**VANCOUVER, BC**

**2017 Organizers:**

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## Jeremy M Wolfe, PhD

Professor of Ophthalmology & Radiology,  
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### **Object Perception, visual Attention, and visual Memory: 25 years of work on visual search**

In honor of OPAM's 25th anniversary, I will organize this talk around the three OPAM pillars:

- 1) What are the OBJECTS of visual search? Attention appears to be directed to objects but what does that mean in a scene composed of objects (e.g. trees) that are made up of other searchable objects (e.g. leaves, branches) and that might be occluded by other objects (e.g. cows). How do we search efficiently amidst the routine complexity of natural scenes?
- 2) How do the rules of VISUAL ATTENTION constrain expert search? We evolved to deal with complex natural scenes and then we invented complex artificial scenes like x-rays of baggage or lungs. Experts learn to search these scenes very effectively but they need to use the standard human search engine. Expertise does not build you a new visual system. When does that lead to trouble and what can we do about it?
- 3) Finally, how does search through VISUAL MEMORY interact with search through the visual world? The radiologist or the baggage screener or the kid with a box of Lego may be looking for several things at the same time (e.g. roof pieces, those long red bricks, and alligators). That means they must perform "hybrid search" looking through a visual scene for any of several targets held in memory. It is hard to investigate hybrid search with expert observers so I will tell you about some "use-inspired basic research" where we take this problem from the world and bring it into the lab to learn the fundamental principles that we can later bring to bear on real world problems.



At **Oculus Research** our goal is to make great consumer virtual, augmented, and mixed reality experiences that ship in five to ten years. Virtual reality today is a vast, highly interdisciplinary research space that has only begun to be explored; we are building a team capable of leapfrogging VR forward by bringing together researchers and engineers spanning a wide range of expertise.

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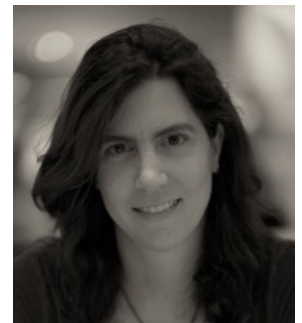
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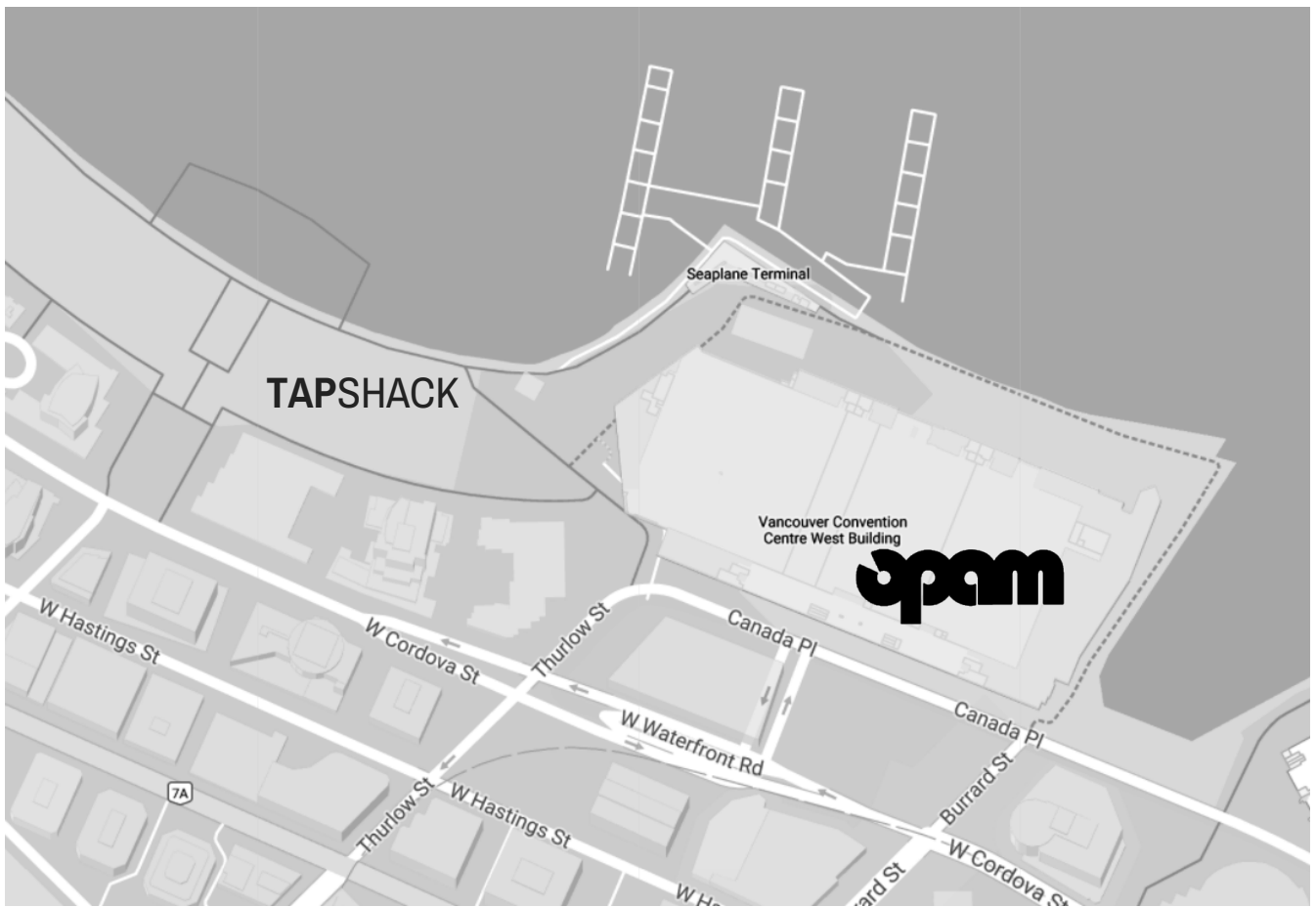
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Moderated by  
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*Northwestern University*



# Program: Wednesday, September 8

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- 4:00pm-4:30pm    Registration | Room 109/110
- 4:15pm-4:30pm    Day 1 Opening Remarks
- 4:30pm-5:45pm    Talk Session 1
- 4:30pm-4:45pm    Mammography to tomosynthesis: Examining the differences between two-dimensional and segmented-three-dimensional visual search | *Stephen H. Adamo, Justin M. Ericson, Joseph C. Nah, Rachel Brem, & Stephen R. Mitroff*
- 4:45pm-5:00pm    Win-attend, lose-ignore: Wagering modulates visual priming | *Greg Huffman, Jason Rajsic, Blaire Weidler, Richard Abrams, & Jay Pratt*
- 5:00pm-5:15pm    Data-driven saliency maps improve search efficiency | *Bo-Yeong Won & Joy J. Geng*
- 5:15pm-5:30pm    Real-world object size affects attentional allocation | *Andrew J. Collegio, Joseph C. Nah, Paul S. Scotti, & Sarah Shomstein*
- 5:30pm-5:45pm    How to find the green ketchup bottle: How non-defining features impact visual search | *Collin Scarince & Michael C. Hout*
- 5:45pm-6:00pm    Coffee Break & Poster Setup
- 6:00pm-7:15pm    Poster Session 1 | West Ballroom B&C
- 7:30pm-10:00pm   Career Blitz / Data Roast social at TAPshack | 1199 W Cordova St

# Program: Thursday, September 9

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6:45am-8:15am	Registration   Room 109/110
7:00am-8:15am	Networking Breakfast (rsvp only)
8:15am-8:30am	Day 2 Opening Remarks
8:30am-9:30am	Talk Session 2
8:30am-8:45am	The effect of episodic memory on active storage in visual working memory   <i>Mark W. Schurgin, Corbin A. Cunningham, Howard E. Egeth, &amp; Timothy F. Brady</i>
8:45am-9:00am	Distinct attention and working memory mechanisms protect internal representations from interruption   <i>Nicole Hakim, Tobias Feldmann-Wüstefeld, &amp; Edward K. Vogel</i>
9:00am-9:15am	Category-specific effects on the contents and confidence of color working memory   <i>Gi-Yeul Bae &amp; Steven J. Luck</i>
9:15am-9:30am	Neural evidence for the contribution of active suppression to efficient visual working memory   <i>Tobias Feldmann-Wüstefeld &amp; Edward K. Vogel</i>
9:30am-9:45am	Quick Break
9:45am-10:45am	Talk Session 3
9:45am-10:00am	The power of top-down salience in data visualizations   <i>Cindy Xiong, Lisanne van Weelden, &amp; Steven L. Franconeri</i>
10:00am-10:15am	Flanker effects reflect initial time until distractor suppression; not post-perceptual response competition   <i>Ricardo Max &amp; Yehoshua Tsal</i>
10:15am-10:30am	Modeling the neural circuitry underlying the behavioral and EEG correlates of attentional capture   <i>Chloe Callahan-Flintoft &amp; Brad Wyble</i>
10:30am-10:45am	Exploring decision biases with ensemble display visualizations   <i>Lace M.K. Padilla, Ian T. Ruginski, Sarah H. Creem-Regehr, Le Liu, &amp; Donald H. House</i>
10:45am-11:00am	Coffee & Snack Break
11:00am-12:45pm	Interdisciplinary Research Panel

# Program: Thursday, September 9

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- 12:45pm-1:15pm    Lunch Break & Poster Setup
- 1:15pm-2:45pm    Poster Session 2 | West Ballroom B&C
- 2:50pm-3:50pm    Talk Session 4
- 2:50pm-3:05pm    Subjective effort and performance metrics predict the choice of attentional control strategies | *Jessica Irons & Andrew B. Leber*
- 3:05pm-3:20pm    Gaze-based indices of mind wandering during real-world scene processing | *Kristina Krasich, Robert McManus, Stephen Hutt, Myrthe Faber, Sidney K. D'Mello, & James R. Brockmole*
- 3:20pm-3:35pm    A test of divided attention: Can you recognize two words at once? | *Alex L. White, John Palmer, & Geoffrey M. Boynton*
- 3:35pm-3:50pm    Learning by using: An ecological framework for determining knowledge of scene-object spatial likelihood | *Ellen O'Donoghue & Monica S. Castelhana*
- 3:50pm-4:00pm    Quick Break
- 4:00pm-4:55pm    Keynote | Jeremy Wolfe
- 4:55pm-5:00pm    Closing Remarks

# 2017 Travel Awards

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Adam Barnas	University of Wisconsin-Milwaukee
Alex White	University of Washington
Alison Campbell	University of Victoria
Andrew Clement	University of Notre Dame
Andrew Collegio	George Washington University
Anna Shafer-Skelton	UC San Diego
Basil Wahn	University of Osnabrück
Bo-Yeong Won	UC Davis
Chloe Callahan-Flintoft	Pennsylvania State University
Christine Salahub	Brock University
David Braun	Lehigh University
Hannah Kim	Texas A&M University
Jason Chow	University of Toronto
Jessica Irons	The Ohio State University
Samoni Nag	The Ohio State University
Sandersan Onie	UNSW Sydney
Sarah Moneer	University of Melbourne
Umay Sen	Bogazici University
Weijia Chen	University of Melbourne
Yoolim Hong	The Ohio State University



- 1 Contrasting episodic-based and template-based guidance during real-world visual search | *Brett Bahle & Andrew Hollingworth*
- 2 Spiking activity and local field potentials in a parametric working memory task in rats | *Shima Talehy Moineddin & Mathew Edmond Diamond*
- 3 Voluntary head or hand movement accelerates visual awareness during Continuous Flash Suppression exposure | *Shogo Kimura & Takako Yoshida*
- 4 Bilingualism's influence on the central dorsal visual system | *Steve Holloway & José E. Náñez, Sr.*
- 5 Does interruption prevalence influence the magnitude of the interruption cost in volumetric medical image search? | *Lauren H. Williams & Trafton Drew*
- 6 Effect of efference signal for the visual search for self-controlling moving object: An fMRI study | *Horita Kazuma & Takako Yoshida*
- 7 Directed forgetting in face orientation judgment task | *Tadashi Taga & Jun Kawaguchi*
- 8 Separable effects of object-based attention: The same-object advantage and the shift direction anisotropy | *Adam J. Barnas & Adam S. Greenberg*
- 9 Summarizing scatterplots: Impact of outliers on trend-line estimates | *Aysecan Boduroglu, Emre Oral, Zeynep Akca, Saliha Celenlioglu, Aybeniz Çetin, & Deniz Hacibektasoglu*
- 10 Between-category semantic associations do not modulate the visual awareness of objects | *Andrew Clement, Cary Stothart, Trafton Drew, & James R. Brockmole*
- 11 Is the internet really a crutch?: An utter failure (and new attempts) to replicate the Google Effect | *John E. DesGeorges & Michael C. Hout*
- 12 Two trackers are better than one: Information about the co-actor's actions and performance scores contribute to the collective benefit in a joint visuospatial task | *Basil Wahn, Alan Kingstone, & Peter König*
- 13 Neural activity in the visual cortex predicts semantic decisions | *Alexandra Theodorou, Olivia Krieger, & Jesse J. Bengson*
- 14 Escaping isolation: Using "big data" to demonstrate trial-by-trial, and session-by-session, influences on cognition | *Michelle R. Kramer, Dwight J. Kravitz, & Stephen R. Mitroff*
- 15 Nonconscious spatial working memory and spatial attention | *Ki Bbum Lee, Eun Hee Ji, & Min-shik Kim*
- 16 Maintaining multiple objects in memory with a flexible resource, a role for attentional control | *Holly A. Lockhart & Stephen M. Emrich*
- 17 Get your head out of the clouds: Performing a visual task makes it harder to think about art than music | *Charles P. Davis, Gitte H. Joergensen, Peter Boddy, Caitlin Dowling, & Eiling Yee*
- 18 The dark side of reappraisal: Understanding how emotion regulation strategies impact attentional performance | *Vera E. Newman, Belinda J. Liddell, & Steven B. Most*

# Poster Session 1

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- 19 Topographic maps in attention control regions mediate frequency-based auditory attention | *Mrinmayi Kulkarni, Wendy E. Huddleston, Edgar A. DeYoe, & Adam S. Greenberg*
- 20 The effect of cognitive load on distractor interference | *Michael King & Brooke Macnamara*
- 21 Feed-forward visual lateralization predicts emotion-related decisional expectancies | *Olivia Krieger, Alexandra Theodorou, & Jesse J. Bengson*
- 22 Does eye gaze produce inhibition of return? | *Takato Oyama & Matia Okubo*
- 23 Availability of face cues modulates nonsocial but not social event segmentation | *Francesca Capozzi, Mikoto Nakajima, & Jelena Ristic*
- 24 Semantic similarity alters visual attentional capture during inattention blindness | *Hikaru Suzuki & Matia Okubo*
- 25 How do task interruptions affect ongoing object processing? | *Lisa M. Heisterberg, Yoolim Hong, & Andrew B. Leber*
- 26 Evidence that divided attention effects in change detection are not due to perception | *James C. Moreland, John Palmer, & Geoffrey M. Boynton*
- 27 Lingering mnemonic biases modulate the precision of visual working memory | *Sol Z. Sun, Maimuna Gias, Noa Magen, Katherine Duncan, & Susanne Ferber*
- 28 Who are you again? Context and not content impairs memory for personal identity | *Effie J. Pereira, Rachel Markham, & Jelena Ristic*
- 29 Electrophysiological evidence for temporal independence of selective attention and object updating in object-substitution masking | *Christine Salahub, & Stephen M. Emrich*
- 30 Modeling the detection response task | *Spencer C. Castro, David L. Strayer, & Andrew Heathcote*
- 31 Context effects on emotional disruption of perception: Distractor frequency does not mitigate emotion-induced blindness | *Jenna L. Zhao & Steven B. Most*
- 32 Finding selective tuning curves in visual working memory | *Chunyue Teng & Dwight Jacob Kravitz*
- 33 Perceived Identities: Systematicity in an unfamiliar face sorting task | *Alison Campbell & James Tanaka*
- 34 The absolute size perception within the reachable space : the dissociation of action and perception | *Saki Fujita, Ayako H. Saneyoshi, & Chikashi Michimata*
- 35 Comparing the roles of perception and decision in spatial selective attention | *Miranda L. Petty, John Palmer, Cathleen M. Moore, & Geoffrey M. Boynton*
- 36 Commonalities between grapheme-color and sound-color synesthetic association in grapheme-color synesthetes | *Lisa Tobayama, Erika Kumakura, & Kazuhiko Yokosawa*
- 37 Attribute amnesia is greatly reduced with novel stimuli | *Weijia Chen & Piers D. L. Howe*

- 1 Value-driven modulation of attentional control based on instrumental conditioning | *Ji Yeong Noh, Sang A. Cho, & Yang Seok Cho*
- 2 Effects of room width on egocentric distance judgments in real-world scenes | *Lindsay A. Houck, Sandra J. Mihelic, & John W. Philbeck*
- 3 Influence of grapheme properties on the number of synesthetic colors for Japanese Kanji characters | *Kyuto Uno, Michiko Asano, & Kazuhiko Yokosawa*
- 4 Attentional modulation of processing architecture | *Sarah Moneer & Daniel R. Little*
- 5 Dissociating the role of selection history and reward history in attentional capture | *Haena Kim & Brian A. Anderson*
- 6 The congruency sequence effect modulated by task difficulty | *Juyoung Park & Yang Seok Cho*
- 7 Task-irrelevant object category information guides attentional allocation | *Paul S. Scotti, Andrew J. Collegio, & Sarah Shomstein*
- 8 Establishing the boundaries of capture for episodic long-term memory attentional control set items | *Geoffrey W. Harrison, Maria Giammarco, Megan St. John, Naseem Al-Aidroos, & Daryl E Wilson*
- 9 Self-relevance speeds visual search responses, but does not improve efficiency | *Gregory L. Wade & Timothy J. Vickery*
- 10 I Can't afford both: An investigation into the relatedness of affordance and action-specific perception | *Michael J. Tymoski & Jessica K. Witt*
- 11 Examining confirmation bias and the low-prevalence effect in visual search with spatially distributed displays | *Stephen C. Walenchok & Stephen D. Goldinger*
- 12 The role of action in priming of pop out in visual search | *Blaire J. Weidler & Richard A. Abrams*
- 13 Grab that face, hammer or line: No effect of hands position on visual memory | *Tomer Sahar & Tal Makovski*
- 14 Emotional inattention blindness effect | *Maria Kuvaldina, Michaela Porubanova, Jason Paul Clarke, & Muge Erol*
- 15 A paradigm to independently look at top-down processes in visual search | *Arnab Biswas, & Devpriya Kumar*
- 16 Individual differences in value-driven attentional capture: roles of learning and reinforcement context | *Michelle M. DiBartolo, Leon Gmeindl, & Susan M. Courtney*
- 17 Object substitution masking reveals a competitive dynamic between levels of categorization | *Jason K. Chow & Michael L. Mack*
- 18 Conscious and unconscious memory differentially alter eye movements: Contextual cueing with real world scenes | *Michelle M. Ramey, Andrew P. Yonelinas, & John M. Henderson*
- 19 Investigating TMS-induced visual suppression using ERP and Neuronavigation | *Evan G. Center, Monica Fabiani, Gabriele Gratton, & Diane M. Beck*

# Poster Session 2

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20 Gender differences in preferring holistic or analytic perception of facial expressions | *Polina Krivykh, Maria Kopachevskaya, & Galina Menshikova*

21 Perfection and satisfaction: A motivational predictor of cognitive abilities | *Rachel A. Orefater, Michelle R. Kramer, & Stephen R. Mitroff*

22 Implicitly-learned spatial contexts bias attention only when they are task-relevant | *Yoolim Hong & Andrew Leber*

23 A test of the holistic processing of composite faces using systems factorial technology and logical-rule models | *Xue Jun Cheng, Callum McCarthy, Tony Wang, Thomas J. Palmeri, & Daniel R. Little*

24 Does emotion-induced blindness tap into attentional bias with less measurement noise than spatial attention tasks? A reliability analysis | *Sandersan Onie & Steven B. Most*

25 Stimulus-driven attentional capture of fearful faces overrides attentional control settings: Memory advantage for fearful faces in change detection | *Hyejin Jade Lee & Yang Seok Cho*

26 How does attentional capture by working memory impact feature binding? | *Samoni Nag, Emma Wu Dowd, & Julie D. Golomb*

27 Even with reduced physical salience, emotional pictures capture attention during multiple object tracking | *Minwoo Kim & James E. Hoffman*

28 Can targets be semantically primed during the emotional blink? | *Alyssa Lompadro, Rachel Metzgar, Olivia Stibolt, & James E. Hoffman*

29 Why Strong Inference can fail within experimental psychology | *Nathan J. Evans*

30 Prosopagnosia results from damage to the coordinate processing system | *Larissa F. Arnold, & Eric E. Cooper*

31 Using neural responses to track feature-based attention in a dynamic virtual environment | *Veronica C. Chu & Michael D'Zmura*

32 The effect of implicitly learned configural prototypes on item precision | *Umay Sen & Aysecan Boduroglu*

33 Connectedness of target and object affects the object-based effect | *Makayla Szu-Yu Chen & Hsuan-Fu Chao*

34 How is scene layout information stored across brief delays? | *Anna Shafer-Skelton & Timothy F. Brady*

35 What most distracts us?: Using "big data" to understand the effect of target-distractor similarity in visual search | *Laura C. Schubel, Patrick H. Cox, Michelle R. Kramer, Dwight J. Kravitz, & Stephen R. Mitroff*

36 Perceiving the rewarded reality: How incentives influence perception of objects in reward-based voluntary task switching | *David Braun & Catherine M. Arrington*

37 A lightweight hybrid model of visual search and target-based saliency | *Dave Schreifels & Shane T. Mueller*



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# Talk Session Abstracts

## Talk Session 1:

**Mammography to tomosynthesis: Examining the differences between two-dimensional and segmented-three-dimensional visual search** | *Stephen H. Adamo, Justin M. Ericson, Joseph C. Nah, Rachel Brem, & Stephen R. Mitroff*

Breast cancer detection is moving from mammography, examining 2D images, to tomosynthesis, examining segmented-3D images. Tomosynthesis reduces false alarms and improves cancer detection, but takes longer to perform. The added time can be costly, so it is important to understand tomosynthesis to inform how it is employed. To examine segmented-3D search, the current project developed a paradigm that explores differences between 2D and segmented-3D search. Testing with radiologists and undergraduates revealed findings that mimicked radiology performance patterns. This paradigm offers a new tool for examining difference between mammography and tomosynthesis and the mechanisms of segmented-3D search.

**Win-attend, lose-ignore: Wagering modulates visual priming** | *Greg Huffman, Jason Rajsic, Blaire Weidler, Richard Abrams, & Jay Pratt*

The attentional system is biased towards previously rewarded stimuli. This has typically been demonstrated using extrinsic rewards. We tested whether an intrinsically rewarding stimulus can bias attention in the absence of extrinsic reward by having individuals place wagers regarding an upcoming stimulus. This stimulus then appeared in a visual search. When individuals placed correct bets (intrinsic reward) visual search was biased towards the bet-upon stimulus. This was the case when extrinsic rewards were given concurrently (Experiment 1) or not (Experiment 2) demonstrating that intrinsic reward is sufficient to bias attention, opening a new avenue of reward and attention research.

**Data-driven saliency maps improve search efficiency** | *Bo-Yeong Won & Joy J. Geng*  
Task-goals and perceptual saliency guide attention in visual search. Here, we adjusted objects' perceptual saliency based on eye-tracking data from different observers engaged in a goal-driven search task. In Experiment 1, subjects searched for a specific target among 128 stimuli and their fixation frequencies were used to calculate the "relevance index". In Experiments 2-3, we adjusted each object's luminance based on the "relevance index" using one of four possible methods. All adjustments improved search performance, but "Enhancement\_with\_suppression" method improved search performance most. This suggests data-driven saliency maps guide attention to a goal-defined target.

**Real-world object size affects attentional allocation** | *Andrew J. Collegio, Joseph C. Nah, Paul S. Scotti, & Sarah Shomstein*

Real-world, canonical object size does not directly correspond to retinal size. While recent evidence suggests canonical size is an organizing property of visual cortex topography, whether canonical size (and related topography) impacts attentional orienting remains unanswered. We measured within-object attentional orienting via manipulating canonical object size (fixed retinal size). Across five experiments, attentional allocation was faster in smaller objects. Crucially, participants' ratings of real-world size directly predicted RT for individual objects - shifts of attention scaled with increased object size. These findings provide strong evidence that attention scales with canonical, not retinal, size, further constraining attentional selection mechanism.

**How to find the green ketchup bottle: How non-defining features impact visual search** | *Collin Scarince & Michael C. Hout*

Our experiment investigated whether non-defining visual features that are repeatedly associated with target stimuli can aid in attentional guidance and target detection. Participants searched for images of real-world objects among similar distractors; objects appeared in one of four colors. Importantly, target items disproportionately appeared in each of the various colors, but color did not define target identity. Results revealed that targets appearing in a color strongly associated with detection were less often missed and more quickly located than targets in other colors, supporting the notion that searchers can use non-defining features to guide search.

## Talk Session 2:

**The effect of episodic memory on active storage in visual working memory** | *Mark W. Schurgin, Corbin A. Cunningham, Howard E. Egeth, & Timothy F. Brady*  
While domain-general knowledge influences visual working memory (VWM), it remains unknown how visual episodic long-term memory (VLTM) might affect the short-term maintenance of information. We investigated whether VLTM penetrates the perceptual maintenance of information in VWM. Participants were given a sequential VWM task. For half the trials participants saw two completely new images to remember, whereas for the other half one image was from a previous VLTM encoding session and one image was new. We observed differences in CDA amplitude for trials containing previously-seen images, suggesting VLTM may alter the active maintenance of information in VWM.

**Distinct attention and working memory mechanisms protect internal representations from interruption** | *Nicole Hakim, Tobias Feldmann-Wüstefeld, & Edward K. Vogel*

We used lateralized alpha suppression, a measure of sustained spatial attention, and Contralateral Delay Activity (CDA), a measure of working memory (WM), to track the impact of task-irrelevant interruption on the maintenance of visual information in WM. Following interruption, lateralized WM representations sustained for several hundred milliseconds, though attention immediately became non-lateralized. At the end of the trial, lateralized WM representations were absent, though participants reoriented their attention back to the attended hemifield. When there was a higher probability of interruption, participants reoriented their attention more quickly to the attended side and maintained lateralized WM representations for longer.

**Category-specific effects on the contents and confidence of color working memory** | *Gi-Yeul Bae & Steven J. Luck*

The present study investigated the effect of color category on the contents and confidence of color working memory (WM). Observers reported the remembered color of a stimulus as a single point (reflecting the content of memory), and they also reported a range of colors that they thought contained the color (reflecting confidence). Shorter range reports were treated as more confident reports. We found that the two reports were positively correlated. More importantly, colors near category prototypes produced more accurate point reports and shorter range reports. These results suggest that both WM contents and WM confidence are influenced by category information.

**Neural evidence for the contribution of active suppression to efficient visual working memory** | *Tobias Feldmann-Wüstefeld & Edward K. Vogel*

Both prioritization of relevant and suppression of irrelevant information are crucial to visual attention. We examined how suppression may also contribute to visual working memory. We adapted a standard change detection task (Luck & Vogel, 1997) to include both relevant items (targets) and to-be-ignored items (distractors). Targets and distractors were systematically lateralized (Hickey et al., 2009), enabling us to isolate ERP components that solely reflect either prioritization or suppression. We found a distractor positivity (PD) that scaled with the number of distractors and correlated with individuals' working memory capacity, suggesting that active suppression contributes to active filtering from working memory.

## Talk Session 3:

**The power of top-down salience in data visualizations** | *Cindy Xiong, Lisanne van Weelden, & Steven L. Franconeri*

The duck-rabbit and Necker cube illusions reveal that the visual system can lock into a single view of a multi-stable percept. Such ambiguity is rare in the natural world, but it is ubiquitous in the artificial world of information visualizations – graphs, for example, contain many perceivable patterns. We told participants stories that explained fluctuations in simulated political polling data, which strongly increased the relevant pattern's visual salience ratings. Critically, they believed that naïve viewers would see the same salient patterns, revealing a 'curse of knowledge' that may underlie failures to effectively communicate data patterns to others.

**Flanker effects reflect initial time until distractor suppression; not post-perceptual response competition** | *Ricardo Max & Yehoshua Tsal*

Identifications of a target flanked by incongruent distractors are typically slower than a target flanked by neutral distractors. Theories of attention have traditionally assumed that flanker effects exclusively reflect post-perceptual time-consuming competitions between simultaneously activated motor responses. We employed the mutation paradigm to behaviorally assess the processing timecourses of targets and distractors, separately. Results revealed that initial suppressions of incongruent distractors lagged neutral distractors by 40 ms, whereas incongruent post-perceptual processing was faster than neutral. We conclude that flanker effects observed reflected the initial time necessary to suppress distractors, rather than post-perceptual competitions, as conventionally assumed.

**Modeling the neural circuitry underlying the behavioral and EEG correlates of attentional capture** | *Chloe Callahan-Flintoft & Brad Wyble*

In our visual world “important” information is a combination of goal-defined (e.g. searching for an exit on the highway), and stimulus driven (e.g. a deer appearing in front of your car) priority. Despite a wealth of behavioral and EEG data, it remains unclear what mechanisms underlie priority computation. To explain how attention makes these decisions, the Reactive-Convergent Gradient Field model proposes neural circuitry to explain how representations compete for attention, producing enhancement and suppression. The model also explains different, sometimes conflicting, findings, such as whether attention is serial or parallel, and the spatial distribution of suppression.

**Exploring decision biases with ensemble display visualizations** | *Lace M.K. Padilla, Ian T. Ruginski, Sarah H. Creem-Regehr, Le Liu, & Donald H. House*

Ensemble displays are a common visualization method used by scientists, which plot multiple data points on a Cartesian coordinate plane (e.g., scatterplots). Research demonstrates numerous scenarios where ensemble displays elicit efficacious and intuitive decisions from viewers. However, fewer studies have examined potential drawbacks to ensemble displays. The aim of this work is to test one case where viewers may overvalue individual ensemble members. In the context of ensemble hurricane forecast tracks, we found that viewers overestimate the influence of a single ensemble member that intersects with a point of interest and the number of members plotted influences this overweighting.

## Talk Session 4:

**Subjective effort and performance metrics predict the choice of attentional control strategies** | *Jessica Irons & Andrew B. Leber*

When searching for objects in the environment, individuals use very diverse attentional control strategies. Here we explore how effort-performance trade-offs influence strategy choice. Participants performed a visual search task using three different strategies – one optimal and two sub-optimal – and rated their subjective effort and performance for each. This was followed by a critical “choice” condition, in which observers could freely choose any strategy. The extent to which individuals made optimal choices was predicted by how effortful and effective they found the optimal strategy. The results underscore an important role for subjective evaluation in goal-directed attentional control.

**Gaze-based indices of mind wandering during real-world scene processing** | *Kristina Krasich, Robert McManus, Stephen Hutt, Myrthe Faber, Sidney K. D'Mello, & James R. Brockmole*

People spend nearly 50% of their time mind wandering as their attention shifts away from task-related thoughts. How is gaze control—a real-time index of the mind's information processing strategies—affected by this shift? Participants studied real-world scenes and indicated if they were mind wandering or attentive. Mind wandering was associated with worse memory; fewer, longer, and more dispersed fixations; and more frequent eye blinks. Thus, theories of gaze control cannot be fully understood without considering off-task attentional states. In terms of application, gaze may facilitate initiatives aimed at detecting and reducing ongoing mind wandering.

**A test of divided attention: Can you recognize two words at once?** | *Alex L. White, John Palmer, & Geoffrey M. Boynton*

To test the limits of parallel processing in vision, we investigated whether observers can recognize two words at once. Observers viewed brief, masked pairs of words and either had to judge the semantic category of just one of the words (with focused attention), or they had to judge both (with divided attention). Accuracy was so much worse in the latter condition that it supported a serial processing model: observers could only recognize one word and had to guess about the other. We will relate our novel results to general models of capacity limits and controversies in the study of reading.

**Learning by using: An ecological framework for determining knowledge of scene-object spatial likelihood** | *Ellen O'Donoghue & Monica S. Castelano*

Object locations are highly predictable within specific scene contexts, but how we learn these locations remains unclear. Gibson (1977) proposed that action is central to perceptual and cognitive processing; moreover, Castelano and Witherspoon (2016) found that object function facilitates prediction of spatial likelihood. Here, we examined the relative benefits of actions on and usage of objects. Participants trained on usage searched more efficiently for studied than novel objects, but participants trained on action did not. Building from Gibson's (1977) perspective, we present a new theoretical framework for understanding the attainment of knowledge of spatial likelihood within a scene context.

# Poster Session Abstracts

## Poster Session 1:

### **1 Contrasting episodic-based and template-based guidance during real-world visual search** | Brett Bahle & Andrew Hollingworth

The completion of real-world tasks involves the strategic guidance of attention. Although multiple sources of information have been established as sources of guidance, their relative priority remains unknown. In the present study, we investigated the relative roles of two sources of guidance in real-world scenes: template- and episodic-based guidance. The results suggested that template-based guidance was active at early stages of the search process, even when an extremely strong episodic guidance representation had been formed. The current presentation discusses these results in terms of implications for theories of visual search.

### **2 Spiking activity and local field potentials in a parametric working memory task in rats** | Shima Talehy Moineddin & Mathew Edmond Diamond

In the setting of a tactile working memory (WM) task, two noisy vibratory stimuli separated by a delay, were applied on rats whiskers. Rats had to compare the amplitude of the two stimuli to make a two-forced choice decision. Through multi-electrode recordings, we separately explored the activity of two brain areas in rats, secondary somatosensory cortex (SII) and hippocampus, to unravel their engagement across different epochs of WM task. In conclusion, sensory coding was mainly observed in SII while choice related activity was observed in both SII and hippocampus.

### **3 Voluntary head or hand movement accelerates visual awareness during continuous flash suppression exposure** | Shogo Kimura & Takako Yoshida

Our previous study found that voluntary head movement facilitates spatially congruent visual awareness using Continuous Flash Suppression (CFS). Here, we investigated whether this effect can also occur with voluntary hand movement. Suppression durations of optic flow masked through the CFS were measured. When the direction of the unseen optic flow followed the movement that was the same as or opposite to participants' voluntary hand movement, interocular suppression was broken more rapidly than passively observing without hand movement. These results implied that voluntary hand movement facilitates visual awareness as head movements and that voluntary action contributes to processing visual signals.

### **4 Bilingualism's influence on the central dorsal visual system** | Steve Holloway & José E. Náñez, Sr.

Individuals who speak multiple languages are referred to as bilingual or multilingual. Research evidence strongly supports the view that the process of learning more than one language, imbues the speaker with enhanced ability in processing a variety of perceptual learning and cognitive tasks. Here we show that bilinguals possess greater ability than monolinguals to process flicker and non-linguistic decoding, two perceptual learning tasks associated with enhanced executive function, that have not been studied in this population before. These findings suggest that all functions of the central dorsal system may experience a benefit when any individual function is strengthened.

### **5 Does interruption prevalence influence the magnitude of the interruption cost in volumetric medical image search?** | Lauren H. Williams & Trafton Drew

Observational studies have shown that radiologists are frequently interrupted during image interpretation. In prior work, we discovered that interrupted cases were searched longer than control cases, but there were no differences in accuracy. The goal of our study was to determine how interruption prevalence changes the magnitude of this time cost. Overall, the time cost between interrupted and non-interrupted cases did not significantly differ based on prevalence group. However, the high-prevalence group spent less time searching each image overall and made more errors. This suggests high-prevalence environments, such as radiology reading rooms, may contribute to diagnostic errors.

### **6 Effect of efference signal for the visual search for self-controlling moving object: An fMRI study** | Horita Kazuma & Takako Yoshida

Self-controlled moving object is visually searched faster than other-controlled one. To examine the effect of efference signal for this phenomenon and its neural correlates, we conducted visual search in fMRI. The visual target reflected the participant's right wrist movement, and the wrist was voluntary/passively moved. When the wrist was voluntary moved, the target was searched faster than passively moved, and then medial frontal superior gyrus was more activated. We suggest attention can use the prediction based on efferent copy, and whether this type of activation can be associated to the tight relationship between attention and agency is discussed.

### **7 Directed forgetting in face orientation judgment task** | Tadashi Taga & Jun Kawaguchi

The directed forgetting is a phenomenon that items followed by a "forget" instruction are recalled worse than those followed by a "remember" instruction. To investigate the mechanisms underlying directed forgetting, the present study examined whether item-method directed forgetting of faces influenced indirect (orientation judgment task of a face) and direct (old/new recognition) memory test. The results showed a significant directed forgetting effect in direct memory test, but not in indirect memory test. These results suggest that item-method directed forgetting influences direct and indirect test in another way.

### **8 Separable effects of object-based attention: The same-object advantage and the shift direction anisotropy** | Adam J. Barnas & Adam S. Greenberg

Attention shifts across the meridians result in a Shift Direction Anisotropy (SDA). We investigated the prevalence of the SDA in individual participants using bootstrapping procedures to estimate confidence intervals and then compared these findings to group results. Significantly larger proportions of participants exhibited SDAs compared to previously reported same-object advantages. However, a minority of participants showed SDAs, suggesting that the SDA is not robust across participants despite being consistently observed at the group level. Taken together, these findings suggest that the SDA and same-object advantage may rely upon dissociable mechanisms of object-based attention.

### **9 Summarizing scatterplots: Impact of outliers on trend-line estimates** | Aysecan Boduroglu, Emre Oral, Zeynep Akca, Saliha Celenlioglu, Aybeniz Çetin, & Deniz Hacibektaşoglu

In this project, we investigated how presence of outliers impacted summarizing trends presented in scatterplots. While it is well known that outliers are rapidly detected, work from our lab has shown that outliers while perceived rapidly, are not incorporated into summaries of studied visual displays. Translating these findings from basic vision research to the graph processing domain, we investigated whether outliers presented as part of scatterplots were incorporated or excluded from trends estimated as a function of relationship magnitude. We found that when processing scatterplots depicting data viewers may include outliers in their summary of the depicted relationship.

### **10 Between-category semantic associations do not modulate the visual awareness of objects** | Andrew Clement, Cary Stothart, Trafton Drew, & James R. Brockmole

Attention is important for the conscious awareness of objects. Although attending to a particular category of objects can modulate visual awareness, it is unclear whether semantic relationships between categories influence awareness. Participants tracked moving images of monkeys or rabbits. On the last trial, an unexpected object from the same category (e.g., a monkey) or a semantically related category (e.g., a banana) moved across the display. Although participants were more likely to notice objects from the same category, they were no more likely to notice objects from a related category. Thus, between-category associations do not modulate visual awareness.

### **11 Is the internet really a crutch?: An utter failure (and new attempts) to replicate the Google Effect** | John E. DesGeorges & Michael C. Hout

We report a failure to replicate Sparrow et al.'s "Google Effect." They suggested individuals automatically think of computers (and search engines) when confronted with difficult informational demands. The researchers primed participants by asking them to answer varying yes/no questions, followed by a "Stroop task" wherein participants were shown a word, and indicated its font color. Longer RTs for computer-related terms (relative to unrelated terms), suggested that accessing information in memory activated concepts pertaining to computer-assisted information retrieval. Despite faithful replication, we failed to duplicate their findings. A second, future attempt is planned.

### **12 Two trackers are better than one: Information about the co-actor's actions and performance scores contribute to the collective benefit in a joint visuospatial task** | Basil Wahn, Alan Kingstone, & Peter König

When humans collaborate, they often distribute task demands in order to reach a higher performance compared to performing the same task alone (i.e., a collective benefit). We tested to what extent receiving information about the actions of a co-actor, performance scores, or receiving both types of information impacts the collective benefit in a collaborative multiple object tracking task. We found that all types of information enable pairs to devise effective division of labor strategies, leading to collective benefits. However, receiving both types of information was most beneficial, enabling pairs to reach their performance plateau earlier.

# Poster Session Abstracts

## **13 Neural activity in the visual cortex predicts semantic decisions** | Alexandra Theodorou, Olivia Krieger, & Jesse J. Bengson

Categorizing incoming visual information from our environment is essential for deciding how to react to situations. Visual search tasks provide evidence that early semantic categorization in the visual cortex occurs soon after the presentation of an image, biasing visual processing in favor of a specific category (Peelen, Fei-Fei & Kastner, 2009). Considering those findings, we incorporated an attentional control paradigm using an arbitrary cue to generate semantic expectancies. Using EEG recording, our results suggest that different magnitudes of activation in the visual cortex soon after the presentation of the arbitrary cue predict decisions to expect a broad semantic category.

## **14 Escaping isolation: Using “big data” to demonstrate trial-by-trial, and session-by-session, influences on cognition** | Michelle R. Kramer, Dwight J. Kravitz, & Stephen R. Mitroff

Most cognitive psychology experiments rely on the false assumption that trials exist independently (with notable exceptions; ex., statistical learning). The current study used a massive dataset to investigate carryover effects to show how quickly the cognitive system optimizes itself based on experience. Evidence accumulation was found to occur both locally (within a sequence of trials) and globally (across distinct testing sessions). Individuals rapidly accumulate contextual information in a sophisticated manner that considers both the proportion and absolute number of prior stimulus occurrences, using it to guide behavior. This has implications for our understanding of learning, experimental design, and statistical inference.

## **15 Nonconscious spatial working memory and spatial attention** | Ki Bbum Lee, Eun Hee Ji, & Min-shik Kim

The current study examined whether nonconscious spatial information in working memory influences spatial attention. Participants had to remember the location of a subliminal square presented using Continuous Flash Suppression (CFS, Tsuchiya & Koch, 2005). Then, a square-wave grating was presented at matching or non-matching location and they had to discriminate the tilt orientation. We found that the stimulus broke through CFS into awareness more quickly in the non-matching condition than that in the matching condition. This suggests that sustained attention was involved to maintain nonconscious spatial information and interfered with unconscious visual processing.

## **16 Maintaining multiple objects in memory with a flexible resource, a role for attentional control** | Holly A. Lockhart & Stephen M. Emrich

Recent evidence demonstrated that visual short-term memory resources (VSTM) could be flexibility prioritized according to the probability that each object would be probed [1]. It was unclear, however, whether individuals were accurately allocating attention on each trial. The current study examined two-probes from a single trial, with the results supporting the conclusion that participants accurately allocated attention across each item. This evidence suggests that multiple goal sets were acted on to prioritize items in VSTM. Individual difference measures related a measure of daily attentional breadth to precision report of low-priority items and capacity to attentional control.

## **17 Get your head out of the clouds: Performing a visual task makes it harder to think about art than music** | Charles P. Davis, Gitte H. Joergensen, Peter Boddy, Caitlin Dowling, & Eiling Yee

Grounded cognition suggests that concept knowledge is represented in the sensorimotor systems with which we perceive the world. We investigated this claim for visually experienced concepts using a visual interference paradigm. Subjects saw an array of shapes while making semantic judgments on words for visually (e.g., art) or non-visually (e.g., rhythm) experienced concepts. They then determined whether a subsequent shape matched one of the shapes from the preceding array. The visual task slowed responses more for visually experienced than non-visually experienced concepts, suggesting that conceptual representations of visually experienced things share resources with the visual system.

## **18 The dark side of reappraisal: Understanding how emotion regulation strategies impact attentional performance** | Vera E. Newman, Belinda J. Liddell, & Steven B. Most

Emotional situations are a common aspect of daily life. How can people maintain attentional control in such contexts? The current work focuses on how distinct emotion regulation strategies, known as “distraction” and “reappraisal”, impact attention in the face of emotional interference. We describe both the beneficial and the costly aspects of using emotion regulation strategies and seek to further understand under which contexts each strategy might be the most adaptive. This work highlights the importance of understanding flexibility in emotion regulation, including in which contexts and for whom certain regulatory strategies might be adaptive or maladaptive.

## **19 Topographic maps in attention control regions mediate frequency-based auditory attention** | Mrinmayi Kulkarni, Wendy E. Huddleston, Edgar A. DeYoe, & Adam S. Greenberg

Visual attention is controlled through spatially organized priority maps in posterior parietal cortex to select relevant sensory information. Here we asked whether auditory attention is mediated through similar topographic priority maps. On each trial, participants were attentionally cued to one of four frequencies within a 20-tone stream. Similar to previous studies, we found attentional modulations within auditory cortex tonotopic maps. Additionally, auditory attention mapping revealed a frequency-based topography within the parietal lobes. This topography may provide a mechanism (mirroring the visual domain) by which auditory frequency-based attentional priority maps bias competition for representation within primary auditory cortex.

## **20 The effect of cognitive load on distractor interference** | Michael King & Brooke Macnamara

When does distraction capture attention, interfering with goal-directed behavior, and when are distractors successfully ignored? Distractor interference may depend on the type of cognitive load being employed. We examined the effects of distraction in three types of cognitive load: perceptual—distractors were presented during memory encoding; short-term memory—distractors were presented during memory maintenance (after encoding, before recognition); working memory—distractors were presented during maintenance and participants were tasked with mentally rotating stimuli. We found that distraction interference increased with load amount for short-term memory and working memory loads, but decreased with load amount for perceptual load.

## **21 Feed-forward visual lateralization predicts emotion-related decisional expectancies** | Olivia Krieger, Alexandra Theodorou, & Jesse J. Bengson

While numerous studies have investigated emotion through presentation of visual stimuli, no study has focused on the role of the visual system during decision-driven emotional expectancies. Early visual representations to an otherwise neutral cue may bias decision-making. To test this hypothesis, we measured EEG activity during an attention task in which individuals responded to neutral cues by endogenously generating happy or sad expectancies. Results indicate that early lateralized visuocortical activity predicted subsequent positive and negative decisional outcomes. These results provide evidence that decision-making, even for abstract emotional categories, is influenced by early visual responses to neutral stimuli.

## **22 Does eye gaze produce inhibition of return?** | Takato Oyama & Matia Okubo

The present study investigated whether or not inhibition of return (IOR) occurred when the gaze cues were used to disengage the attention. We used a gaze cueing paradigm and presented the gaze cues twice so that the second gaze would successfully disengage the attention. Although the gaze cues successfully shift attention at a shorter SOA, IOR did not occur at longer SOAs. Rather, the gaze-triggered attention remained at the first cued location and resisted shifting away. As gaze direction usually corresponds to biologically and/or socially meaningful information, inhibition of return may not easily occur by eye gaze.

## **23 Availability of face cues modulates nonsocial but not social event segmentation** | Francesca Capozzi, Mikoto Nakajima, & Jelena Ristic

Humans parse the environmental content into social and nonsocial events. Here, we investigated how the visibility of facial cues affected this process. Participants viewed a clip of a social interaction, marking social and nonsocial events. The actors' faces were either visible or blurred. In addition to robust social and nonsocial event boundaries, the results also indicated that individual variation in nonsocial segmentation responses was significantly higher when faces were blurred relative to when they were visible. This suggests that in contrast to social segmentation, marking nonsocial events requires the deliberate usage of facial cues.

# Poster Session Abstracts

## **24 Semantic similarity alters visual attentional capture during inattention blindness** | *Hikaru Suzuki & Matia Okubo*

In inattention blindness, the unexpected stimulus belonging to the attended semantic category is detected easier than the one belonging to the non-attended semantic category (Koivisto & Revonsuo, 2007). The present study investigated the effect of semantic similarity in stimulus meaning on attentional capture using an inattention-blindness paradigm (Mack & Rock, 1998). We manipulated similarity between the unexpected stimuli and the attended stimuli. The number of correct responses differed across semantic similarity and the least similar items contributed to the difference. This result suggests that semantic similarity alters visual attentional capture in an abrupt step-like fashion rather than gradual one.

## **25 How do task interruptions affect ongoing object processing?** | *Lisa M. Heisterberg, Yoolim Hong, & Andrew B. Leber*

Interruptions are common occurrences that yield undesirable consequences, yet their impact on cognitive processes is not fully understood. Here, we introduce a task to investigate how interruptions affect the processing and subsequent memory of objects. We had participants search for target objects within RSVP streams, while occasionally interrupting them with basic math problems. Afterwards, we tested participants' memory for the targets. Results tended toward better memory for objects encountered during non-interrupted trials than interrupted trials. Our task thus confirms a detrimental effect of interruptions, and provides novel avenues to further investigate how interruptions affect object cognition and related processes.

## **26 Evidence that divided attention effects in change detection are not due to perception** | *James C. Moreland, John Palmer, & Geoffrey M. Boynton*

Studies of divided visual attention in perception have largely depended on detection and detection-like tasks because they minimize the role of memory and decision. Recently, the change detection paradigm has been used to study divided attention with results interpreted as due to perception. Are the effects of divided attention in change detection due to perceptual limits, or are they "inflated" by the later processes of memory and/or decision? We use simple features in three increasingly complex behavioral tasks to separate perception from later processes and find that divided attention effects emerge only when later processing is emphasized.

## **27 Lingering mnemonic biases modulate the precision of visual working memory** | *Sol Z. Sun, Maimuna Gias, Noa Magen, Katherine Duncan, & Susanne Ferber*

In long-term memory, the precision of fine-grained memory judgments is enhanced following recent novelty detection. Does novelty also influence visual working memory (VWM) precision? Participants remembered the colors of 3 briefly presented disks and after a brief delay, reported the color of one of those disks on a color wheel, providing a measure of VWM precision. We manipulated novelty by presenting a previously studied or novel scene prior to each VWM trial. Preceding novel scenes enhanced VWM precision relative to previously studied scenes, thus VWM in the present moment is influenced by the novelty of recently encountered items.

## **28 Who are you again? Context and not content impairs memory for personal identity** | *Effie J. Pereira, Rachel Markham, & Jelena Ristic*

Encountering individuals outside of their typical context hinders our ability to recognize them, an effect known as the butcher-on-the-bus phenomenon. We investigated whether this memory detriment was driven by how well we know the butcher or the degree to which the inconsistent context of a bus impairs our ability to remember their personal identity information. We assessed memory for faces through recognition and recall performance within identical, conceptually-similar, and contextually-different backgrounds. Memory was more impaired by context rather than personal identity content, suggesting a prominent role of high-level conceptual information in memory for faces.

## **29 Electrophysiological evidence for temporal independence of selective attention and object updating in object-substitution masking** | *Christine Salahub, & Stephen M. Emrich*

Object individuation is important for keeping track of dynamically changing objects in one's environment. Individuation can be achieved through selective attention and object updating processes, wherein new information is incorporated into an existing representation. These processes have been proposed to interact behaviorally in object-substitution masking (OSM). In the current study, the interaction between selective attention (manipulated through set size) and object updating processes (manipulated through masking) was analyzed neurally using event-related potentials. Object updating was also measured using the SPCN, suggesting that object individuation is required for masked items to reach awareness in an OSM task.

## **30 Modeling the detection response task** | *Spencer C. Castro, David L. Strayer, & Andrew Heathcote*

Overloading a person's limited capacity for attention with two simultaneous tasks usually results in a dual task cost. In evidence accumulation models, this overload can be thought of as a maximization of information-processing capacity, which results in a decrease in the rate of information processing for each task. In order to determine how parameters of evidence accumulation models vary with cognitive load, we modeled a distracted driving task. The results demonstrate that a linear model of evidence accumulation accurately predicts response time distributions to an ISO standard and a modified choice "Detection Response Task" (DRT) under cognitive load.

## **31 Context effects on emotional disruption of perception: Distractor frequency does not mitigate emotion-induced blindness** | *Jenna L. Zhao & Steven B. Most*

Emotional distractors can impair perception of subsequently presented targets, a phenomenon called emotion-induced blindness. Do emotional distractors lose their power to disrupt perception when appearing with increased frequency? In four experiments, participants searched streams of images for a rotated target image. A negative or neutral distractor appeared before the target, and participants saw either a higher (75%) or lower (25%) proportion of negative distractors. Consistently, across all experiments, distractor frequency did not modulate emotion-induced blindness. Thus, increased distractor frequency – previously linked with recruitment of proactive control – does not appear to mitigate the impact of emotional distractors on perception

## **32 Finding selective tuning curves in visual working memory** | *Chunyue Teng & Dwight Jacob Kravitz*

The sensory recruitment model of visual working memory (VWM) posits that content is maintained in posterior visual areas. Recent neuroimaging studies have confirmed the presence of maintained information in these areas during VWM, but little behavioral evidence of their direct contribution to the process exists. Here, we show that the strength of interference effects are well predicted by the properties of neural tuning curves in these areas. Participants, while maintaining an oriented line in memory, had to ignore a distractor with varied similarity of orientation to the memory cue. The similarity predicted the strength of the interference on subsequent recall.

## **33 Perceived identities: Systematicity in an unfamiliar face sorting task** | *Alison Campbell & James Tanaka*

Sorting tasks that include multiple face images of the same person require participants to make identity judgments in order to group images of the same person. When the faces are unfamiliar, participants tend to divide images of the same person into multiple piles. No previous work has examined whether participants use the same criteria when sorting images of unfamiliar faces. A cluster analysis of the aggregated sorting data revealed regularity in the images that tended to be grouped and those that tended to be separated, suggesting that participants may perceive the same "identities" in images of unfamiliar faces.

## **34 The absolute size perception within the reachable space : the dissociation of action and perception** | *Saki Fujita, Ayako H. Saneyoshi, & Chikashi Michimata*

We investigated whether the absolute size would be precisely estimated within the reachable space. The participants answered the size of stimulus (disk) by action or verbally. In the result, the gap ratio between the real and the reported sizes was smaller for the action condition than for the verbal condition. Furthermore, the size perception for the action condition was equally accurate for both the within and beyond the reachable space, while the size perception for the verbal condition was larger within the reachable space than beyond the reachable space. The role of the attention in size perception will be discussed.

## **35 Comparing the roles of perception and decision in spatial selective attention** | *Miranda L. Petty, John Palmer, Cathleen M. Moore, & Geoffrey M. Boynton*

When given a spatial cue indicating where a visual target is likely to occur, observers are better at detecting the target when it appears at the likely, cued location than when it appears at an unlikely, uncued location. Two competing hypotheses have been used to account for this cueing effect: selective perception and selective decision. We aim to distinguish these hypotheses by comparing the cueing effect for simultaneous and sequential displays. Selective decision predicts no difference between simultaneous and sequential displays, while selective perception predicts cueing effects for only simultaneous displays. Initial results are consistent with selective decision.

# Poster Session Abstracts

## **36 Commonalities between grapheme-color and sound-color synesthetic association in grapheme-color synesthetes** | *Lisa Tobayama, Erika Kumakura, & Kazuhiko Yokosawa*

In grapheme-color synesthesia, graphemic features are associated with colors. We investigated whether there are common features between graphemes and musical tones that affect synesthetic colors similarly. Results showed that frequency-related features (vowels and pitch) are associated with lightness of color, and waveform-related features (consonants and timbre) induce a particular color. The latter tendency was only observed in grapheme-color synesthetes with high sound-color synesthetic traits. This suggests that sound-color links would be stable for grapheme-color synesthetes who associate sound features with color in a similar way as the phonetic features of letters.

## **37 Attribute amnesia is greatly reduced with novel stimuli** | *Weijia Chen & Piers D. L. Howe*

Attribute amnesia (AA) is the counter-intuitive phenomenon where observers are unable to report a salient aspect of a stimulus (e.g. colour) immediately after its presentation, despite both attending to and processing the stimulus. Almost all previous AA studies used highly familiar stimuli. Our study investigated whether AA would also occur for unfamiliar stimuli. We conducted three experiments using stimuli that were highly familiar (colours or repeated animal images) or that were unfamiliar to the observers (unique animal images). Our results revealed that AA was present for both colours and repeated animals, but was eliminated for unique animals.

## Poster Session 2:

### **1 Value-driven modulation of attentional control based on instrumental conditioning** | *Ji Yeong Noh, Sang A. Cho, & Yang Seok Cho*

The present study examined whether attentional control can be reinforced by reward based on instrumental conditioning with a modified cuing paradigm. In Experiment 1, in which reward was given on valid trials, a larger cuing effect was obtained with the reward cue. However, in Experiment 2, in which reward was delivered on invalid trials, there was no significant difference in the validity effect between reward and no-reward cues. These results imply value-driven modulation of attentional allocation based on instrumental conditioning.

### **2 Effects of room width on egocentric distance judgments in real-world scenes** | *Lindsay A. Houck, Sandra J. Mihelic, & John W. Philbeck*

Distance perception varies depending on environmental context, but the contextual properties driving this effect are unclear. We tested the effect of room width on distance judgments with photographs of 9 real-world indoor environments each with a unique width. Participants ( $n=98$ ) estimated egocentric distances of 14 targets in each environment. Wider rooms elicited larger estimations, especially in farther target distances, with average estimates differing by up to 1.9 meters. This contextual effect could stem from many scene properties affected by room width; accounting for these effects is essential to include in comprehensive models of space and scene perception.

### **3 Influence of grapheme properties on the number of synesthetic colors for Japanese Kanji characters** | *Kyuto Uno, Michiko Asano, & Kazuhiko Yokosawa*

Grapheme-color synesthesia is a condition in which visual letters or characters induce a specific color sensation. We explored the number of synesthetic colors experienced for a character by using Kanji, which is the Japanese logographic script. Results revealed characters that are decomposable into right and left subcomponents (radicals) were associated with a higher number of synesthetic colors than characters that could not be divided, whereas the sounds and meanings of characters had no effect on the number of synesthetic colors. These findings suggest that one determinant of the number of synesthetic colors is the visual decomposability of a character.

### **4 Attentional modulation of processing architecture** | *Sarah Moneer & Daniel R. Little*

Existing models of the distribution of attention in the visual field make assumptions about how the attended information is processed. We manipulated the object affiliation (i.e., same or different objects) of a pair of visual features (saturation and orientation) and the separation between them to investigate how the distribution of attention affects processing architecture. Bayesian hierarchical models and Systems Factorial Technology analyses were used to determine processing strategies. Evidence for parallel processing was found in all conditions, including one in which features were presented in separate objects at a large separation value, supporting a spotlight model of visual attention.

### **5 Dissociating the role of selection history and reward history in attentional capture** | *Haena Kim & Brian A. Anderson*

We examined whether attentional biases driven by reward history and selection history share a common mechanism. Participants completed an extensive training in visual search for a specific colour target, followed by visual search for a shape-defined target in which colour was task-irrelevant. Response times were slower when a former target-colour distractor was present than when it was absent. Neuroimaging results revealed a more right lateralised pattern of activation compared to attentional capture by reward cues. No activation was found in the caudate tail. These results imply that reward history and selection history influence attention via dissociable mechanisms.

### **6 The congruency sequence effect modulated by task difficulty** | *Juyoung Park & Yang Seok Cho*

This study aimed to examine whether the congruency sequence effect (CSE) was modulated by task difficulty with the temporal interval between the onsets of the distractor and the target. Each participant performed a prime-probe task or a flanker-compatibility task with easily discriminable stimuli in Experiment 1 and with hardly discriminable stimuli in Experiment 2. Significant modulation of the CSE by task type was observed in the Experiment 2, but not in the Experiment 1. Thus, the influence of the temporal interval between the onsets of the distractor and the target on the CSE was modulated by task difficulty.

### **7 Task-irrelevant object category information guides attentional allocation** | *Paul S. Scotti, Andrew J. Collegio, & Sarah Shomstein*

Attentional selection is constrained by simple and complex object representations (object-based attention). Objects consist of a set of low- (e.g., boundaries signaled by closure) and high-level (e.g., identity) descriptors. Whether, in addition to low-level constraints, object-based attention is modulated by high-level object properties remains an open question. Here, we elucidate relative contributions of object boundaries and object identity to attentional allocation by systematically reducing high-level information while preserving object boundaries. Object-based effects were strongest when both low- and high-level information were preserved, decreasing with reduced high-level information, suggesting that

### **8 Establishing the boundaries of capture for episodic long-term memory attentional control set items** | *Geoffrey W. Harrison, Maria Giammarco, Megan St. John, Naseem Al-Aidroos, & Daryl E Wilson*

Individuals can adopt attentional control settings (ACSs) based on episodic long-term memory (LTM) representations that cause memory matching stimuli, and only memory matching stimuli, to capture attention. However, whether ACS-driven capture is defined by an exact match between internal representations and external stimuli remains unknown. We examined the specificity of LTM ACSs by manipulating the perceptual and semantic relatedness of distractors to ACS items. Same category exemplars and visually but not semantically related items produced ACS-driven capture, but semantic relatedness on its own did not. The findings highlight both the flexibility, and limits, of episodic LTM ACSs.

### **9 Self-relevance speeds visual search responses, but does not improve efficiency** | *Gregory L. Wade & Timothy J. Vickery*

Merely associating one's self with a stimulus enhances performance in response to that stimulus in a variety of contexts. We elucidated the mechanisms affected by self-relevance by using a visual search paradigm. Self-associated targets were found faster than non-self-associated targets. However, only the intercept, and not the search slope, of the RT x set size function was influenced by label. These results provide evidence against claims that self-relevance enhances the perceptual saliency of a stimulus in a manner similar to physical salience, since physical salience differences between targets and distractors affect search efficiency.

# Poster Session Abstracts

## **10 I can't afford both: An investigation into the relatedness of affordance and action-specific perception** | Michael J. Tymoski & Jessica K. Witt

Some researchers suggest that action-specific perception, or the theory that spatial perception is scaled by information about action capability, is simply the result of scaling spatial judgments by perceived affordances, or supported opportunities for action based on some observer-environment relationship. To determine the relatedness of the two theories we conducted an individual differences design to look for a correlation between an action-specific and an affordance task. Although we found main effects for both tasks, we found no significant correlation between the two, suggesting that action-specific and affordance perception are distinct.

## **11 Examining confirmation bias and the low-prevalence effect in visual search with spatially distributed displays** | Stephen C. Walenchok & Stephen D. Goldinger

Recently, Rajsic et al. (2015) showed that people are biased to seek cued objects in visual search, even when this strategy is inefficient. Might this confirmatory bias be modified when the target cue is made more or less reliable? We varied cue reliability (extremely prevalent, balanced, or rare cued targets), and presented spatially distributed, randomized search displays. When cued targets were rare, search speed was less affected by this target prevalence than expected, suggesting that people perseverated in seeking these rare cued targets. Overall, these results show that confirmation bias in search is partially resistant to the low-prevalence effect.

## **12 The role of action in priming of pop out in visual search** | Blaire J. Weidler & Richard A. Abrams

Priming-of-popout (PoP) occurs when target features (e.g., color) repeat across trials during visual search, speeding RT. To uncover the basis of PoP we interspersed typical PoP trials that required participants to view a visual search array, locate a uniquely colored target, and make an action to indicate its shape with "atypical" trials that omitted some requirements of the task (e.g., locating the target, or making a motor response). Removing either the necessity to attend to the target or to make a motor response reduced but did not eliminate PoP, showing that PoP has multiple dissociable components.

## **13 Grab that face, hammer or line: No effect of hands position on visual memory** | Tomer Sahar & Tal Makovski

The embodied cognition framework postulates that body states and action influence cognition. Accordingly, numerous studies have shown that hands position affects visual perception and attention. However, it is less clear whether this effect could be extended to visual memory. This study examined the consequences of hands position on the memory of items presented near and far from hands. Overall, the results of five experiments testing various stimuli clearly supported a model in which hands position does not impact short- or long-term memory. Thus, we argue that hands proximity has no noticeable long lasting impact on visual memory.

## **14 Emotional inattention blindness effect** | Maria Kuvaldina, Michaela Porubanova, Jason Paul Clarke, & Muge Erol

Inattention blindness is a failure to detect unexpected changes when attention is engaged in another task. In the presented study, we examined how emotional stimuli of varying arousal and valence impact inattention blindness. Participants were engaged in a demanding task while an unexpected emotional image appeared at their fixation. Participants identified emotional photographs to a greater extent in comparison to neutral images, but the identification rate did not differ for emotional categories of different arousal and valence. We conclude that emotional images due to their important evolutionary value are a special type of stimuli that seem to attract attention.

## **15 A paradigm to independently look at top-down processes in visual search** | Arnab Biswas, & Devpriya Kumar

Visual search performance depends upon a combination of i) bottom-up information in the scene, and ii) top-down information related to the task-goal. The current study presents a paradigm to isolate the effects of top-down factors by asking subjects to perform two different search tasks for the same bottom-up information across critical trials. Results suggest a significant difference in response times between the two tasks. Modeling the difference in response time distributions using a Wiener diffusion model points towards different search strategies being used by subjects in spite of identical bottom-up information.

## **16 Individual differences in value-driven attentional capture: roles of learning and reinforcement context** | Michelle M. DiBartolo, Leon Gmeindl, & Susan M. Courtney

Rapid orienting of attention toward stimuli previously associated with reward is known as value-driven attentional capture (VDAC). While VDAC is evident at the group level, large individual differences exist. This study investigated the relationships between explicit learning of cue-value pairings and VDAC in positive- and negative-reinforcement contexts. Results from visual-search tasks and self-reports suggest that explicit awareness of cue-value mapping is linked to increased VDAC magnitude for reward cues, but less so for loss-avoidance cues. Implicit learning may play a greater role in capture for negative than positive reinforcement cues.

## **17 Object substitution masking reveals a competitive dynamic between levels of categorization** | Jason K. Chow & Michael L. Mack

Superordinate-level categorization is typically faster at brief exposures while basic-level categorization is faster at longer exposures. We suggest that this difference is due, in part, to a competition between levels of categorization. Using object substitution masking, we found distinct time courses of masking effects. Basic-level categorization showed marked masking effects, but also spared performance at an intermediate mask offset. Interestingly, the same offset led to impaired superordinate-level categorization. This unique pattern of masking effects supports an account of categorization that depends on the interaction of perceptual encoding, selective attention, and competition between levels of category representation.

## **18 Conscious and unconscious memory differentially alter eye movements: Contextual cueing with real world scenes** | Michelle M. Ramey, Andrew P. Yonelinas, & John M. Henderson

Evidence suggests that memory guides visual attention: for example, the contextual cueing effect shows that learning facilitates search improvement over repeated presentations. However, it is unknown whether this reflects conscious, strength-based, or unconscious forms of memory. To address this, we asked participants to search for targets embedded in scenes over repeated presentations, and assessed memory for scenes before search using a confidence-based response scale. We found that eye movements during search were differentially influenced by conscious recollection and unconscious memory, without effects of familiarity-based memory. The results indicate that both conscious and unconscious memory guide visual attention.

## **19 Investigating TMS-induced visual suppression using ERP and Neuronavigation** | Evan G. Center, Monica Fabiani, Gabriele Gratton, & Diane M. Beck

Visual suppression by single-pulse transcranial magnetic stimulation (TMS) has been attributed to interruptions of either feedforward or feedback activity in the visual stream. To distinguish between these hypotheses, for each subject cortical transmission time was estimated using the C1 event-related potential (ERP) and in another session the same subjects underwent TMS pulses of variable post-stimulus lags in order to suppress the same stimuli that elicited the C1. Results from five subjects are consistent with interruption of feedback, but the timing differences do not exclude the possibility that the visual suppression is due to interference with feedforward mechanisms.

## **20 Gender differences in preferring holistic or analytic perception of facial expressions** | Polina Krivykh, Maria Kopachevskaya, & Galina Menshikova

20 participants (12m, 16f) were presented 30 composite faces and asked to choose an expression name using the list of seven basic emotions. Our data showed that approximately 25% of the participants tend to use holistic eye movement strategies having longer fixations in the nose region, while the other 75% show a clear analytic type with the hottest spots on eyes and mouth. Significant gender differences of AOI were revealed: male participants demonstrated more holistic strategies. The last results on a bigger sample will be presented at the conference.

## **21 Perfection and satisfaction: A motivational predictor of cognitive abilities** | Rachel A. Onefater, Michelle R. Kramer, & Stephen R. Mitroff

Individuals' motivation can influence their cognitive abilities, and an intriguing question is whether different motivational styles align with better or worse cognitive performance. The current study used a large dataset from a mobile game to explore differences between "Perfectionists"—those who strive for errorless performance and "Satisfiers"—those who look to keep progressing, regardless of whether errors were made or not. Perfectionists had better attentional abilities than Satisfiers, evident through more efficient and effective visual search and heightened performance in a separate object sorting task. These results indicate that individual differences in motivation can predict fundamental differences in cognitive performance.

# Poster Session Abstracts

## **22 Implicitly-learned spatial contexts bias attention only when they are task-relevant** | *Yoolim Hong & Andrew Leber*

The visual environment provides many spatial regularities, which can be exploited for behavioral gain. To what extent do we track and prioritize such regularities? First, we presented displays containing repeated spatial arrangements of items on one side and random arrangements on the other side. We manipulated task-relevance of the repeated arrangements as well as the degree to which they were attended. We then tested whether participants were attentionally biased to repeated vs. random display sides. Results showed biases only when arrangements were initially attended and task-relevant, suggesting that such biases emerge only when they can potentially benefit behavior.

## **23 A Test of the holistic processing of composite faces using systems factorial technology and logical-rule models** | *Xue Jun Cheng, Callum McCarthy, Tony Wang, Thomas J. Palmeri, & Daniel R. Little*

The composite face paradigm used often in the face-processing literature suggests that upright faces are processed holistically. However, results obtained from the composite task can also be explained by a failure of selective attention, a phenomenon which is logically and empirically distinct from holistic processing. Using Systems Factorial Technology, we operationalized holistic processing as coactive processing, allowing distinction between holism and a failure of selective attention. We found performance across our four upright and inverted, aligned and misaligned face conditions is best explained by a mixture of serial and parallel processing architectures, and inconsistent with the notion of coactivity.

## **24 Does emotion-induced blindness tap into attentional bias with less measurement noise than spatial attention tasks? A reliability analysis** | *Sandersan Onie & Steven B. Most*

Attentional bias measures that tap into spatial attention (e.g. dot probe; DP) have been shown to have low reliability, perhaps from noise that stems from overlying mechanisms of spatial attention allocation. Recently, we found that emotion-induced blindness (EIB) operates separately from the DP, and therefore continued to investigate the reliability of the EIB. The analysis revealed that EIB had higher test-retest and internal consistency than the DP and other existing attentional bias measures, which tap into spatial attention. This is consistent with the notion that emotion-induced blindness more directly reflects prioritization of emotional distractors.

## **25 Stimulus-driven attentional capture of fearful faces overrides attentional control settings: Memory advantage for fearful faces in change detection** | *Hyejin Jade Lee & Yang Seok Cho*

The change detection paradigm was adopted to investigate whether attentional capture by emotional stimuli is stimulus-driven or affected by attentional control sets. Participants were shown a display of four faces that were either all emotional, all neutral, or two emotional and two neutral. Four faces had an equal chance of being tested and emotion was task-irrelevant information, so allocating attentional resources to emotional over neutral faces was an inefficient strategy. However, memory for fearful faces significantly increased when encoded with neutral faces rather than with other fearful faces. This mixing advantage for fearful faces disappeared when attentional components were controlled.

## **26 How does attentional capture by working memory impact feature binding?** | *Samoni Nag, Emma Wu Dowd, & Julie D. Golomb*

Visual attention can be biased towards items that match the contents of working memory (WM), even when WM is irrelevant to the current task. Here we ask how this attentional capture might impact feature binding—specifically, does WM capture distort feature perception? Subjects remembered a shape across an intervening visual search, where they reported the color of a target item. Critically, although shape was irrelevant for reporting color, the shape of one non-target could match WM. Probabilistic mixture modeling revealed that WM-matching items capture spatial attention, without inducing binding errors or distorting feature perception of the target item.

## **27 Even with reduced physical salience, emotional pictures capture attention during multiple object tracking** | *Minwoo Kim & James E. Hoffman*

It has been claimed that task-irrelevant emotional distractors automatically capture attention. We tested the claim by reducing the salience of the distractors and implementing a difficult multiple object tracking task. Emotional distractor pictures were inserted in either a stream of perceptually similar (non-salient) or dissimilar (salient) background pictures. ERP results showed larger N2 components (reflecting attention capture) for emotional compared to neutral distractors in both salient and non-salient backgrounds showing that reductions in physical salience do not impair capture based on emotional salience. This supports the claim that emotional attention capture is automatic.

## **28 Can targets be semantically primed during the emotional blink?** | *Alyssa Lompad, Rachel Metzgar, Olivia Stibolt, & James E. Hoffman*

We utilized a semantic priming paradigm to examine the interference of task-irrelevant emotional distractors during an attentionally demanding task. By presenting a priming picture in the blink position we evaluated both the behavioral blink of the prime, and the corresponding N400 component elicited by a related vs. unrelated target picture that occurred later. Contrary to what prior findings and models predicted, we found equivalent N400 amplitudes across all distractor conditions, as well as a significant suppression on incorrect trials, suggesting that the mechanism of the blink interferes at an early stage of processing and interrupts priming effects.

## **29 Why Strong Inference can fail within experimental psychology** | *Nathan J. Evans*

Strong Inference has become a dominant method within experimental psychology, and involves contrasting theories through “critical tests”, where certain theories are falsified by the observation of certain patterns of results. I argue that several flaws exist within the framework, where Strong Inference 1) assigns infinite importance to a single aspect of the data, 2) is based on a criteria that doesn't necessarily leads to better models, and 3) can be misleading when measurements contain any source of noise. These flaws suggest that Strong Inference is misleading experimental psychologists, and cast doubt upon its use as a “gold standard”.

## **30 Prosopagnosia results from damage to the coordinate processing system** | *Larissa F. Arnold, & Eric E. Cooper*

The current study examined whether prosopagnosia is a deficit of the coordinate recognition system. This idea is supported by research showing that prosopagnosics are impaired in distinguishing visual stimuli that have the same structural description and differ only in proportions. A previous study compared the ability of a prosopagnosic patient in her 40s to college-aged students, confounding age and diagnosis. In the current study, the previous study was replicated using a healthy age-matched control. Results show that the control performed just as well at recognition tasks as the college-aged students and significantly better than the prosopagnosic patient.

## **31 Using neural responses to track feature-based attention in a dynamic virtual environment** | *Veronica C. Chu & Michael D'Zmura*

Filters for feature-based attention operate throughout the visual field. A consequence is that one can track attention in a centrally-presented task using peripherally-presented flicker. We used SSVEPs generated by peripheral flicker to track attention to particular colors in a detection task presented centrally. The detection task and peripheral flicker were embedded in a virtual environment that was viewed by subjects through a head-mounted display. Results show that one can use EEG to track feature-based attention in dynamic virtual environments and suggest that the methods may be adapted to track attention in real-world situations.

## **32 The effect of implicitly learned configural prototypes on item precision** | *Umay Sen & Aysecan Boduroglu*

Viewers summarize a set of items sets very efficiently while not being able to represent individual items at high resolution. However, item resolution could be facilitated by availability of configural cues and centroid information capturing the summary of a configuration at retrieval (Mutluturk & Boduroglu, 2014). The present work investigated whether prototype information learned across an extended temporal window would similarly facilitate item resolution. Viewers studied spatial configurations that were either members of a family or independent random exemplars and were then probed. When the study configuration was a member of a family, item representations had higher resolution.

## **33 Connectedness of target and object affects the object-based effect** | *Makayla Szu-Yu Chen & Hsuan-Fu Chao*

The Object-based effects (OBEs) refers from part of an object is attended, the others of this object are facilitated (Egry, Driver, & Rafal, 1994). Watson and Kramer's (1999) shows the effects of single uniform connectedness in OBEs. However, there are some inconsistent results in the flanker task. In the this study, we investigated the impact of the single uniform connectedness in the flanker task. The results show that the OBEs in flanker task with certain target location are connected to an object by single uniform connectedness.

# Poster Session Abstracts

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## **34 How is scene layout information stored across brief delays?** | *Anna Shafer-Skelton & Timothy F. Brady*

Surprisingly little work has investigated how scene layout information is maintained in memory. Some previous work that has addressed this uses a scene priming paradigm (e.g., Sanocki & Epstein, 1997), in which different types of previews are presented to participants shortly before they judge which of two regions of a scene is closer in depth to the viewer. Experiments using this paradigm have been widely cited as evidence that scene layout information is stored in memory. However, our experiments are consistent with the idea that scene priming paradigms may primarily pick up on lower-level information rather than scene layout.

## **35 What most distracts us?: Using "big data" to understand the effect of target-distractor similarity in visual search** | *Laura C. Schubel, Patrick H. Cox, Michelle R.*

*Kramer, Dwight J. Kravitz, & Stephen R. Mitroff*

Visual search is a vital task for a series of professions including airport security screening and radiology. Such searches are complex and targets are often accompanied by a diverse and variable range of distractors. The current project looked at how the distractors in a search can affect target detection. Specifically, we looked at distractor frequency using "big data" from the mobile app Airport Scanner to look at a wide variety of distractors of varying frequency. When less frequent distractors were present, targets were detected more slowly and less accurately, suggesting a strong role of distractor familiarity in search performance.

## **36 Perceiving the rewarded reality: How incentives influence perception of objects in reward-based voluntary task switching** | *David Braun & Catherine M. Arrington*

The environment is filled with rewarding stimuli, and attention either selects among or is grabbed by these stimuli in ways that influence behavioral choices. We investigated the interaction between reward and attention by assigning point values to two tasks in a reward-based voluntary task switching paradigm and recording eye movements. Points transitioned between trials to reward effortful choices (task switches) more than easier choices (task repetitions). Participants' use of reward information was modulated by the attention directed to reward values. We argue that attention actively selects relevant reward information to construct choices.

## **37 A lightweight hybrid model of visual search and target-based saliency** | *Dave Schreifels & Shane T. Mueller*

Many simulation models of visual search have focused on mechanics of the visual system. In contrast, imagery-based approaches focus on the scene itself, ignoring constraints of the visual system (e.g., foveation, eye movement, target search) captured by simulation models. We bridge these approaches with a simulation model of target-based visual search that incorporates imagery analysis. Results suggest constraints from both imagery and the visual-motor system are critical for understanding human visual search, such as target-based pop-out effects, and reveal the importance of modeling both imagery and the visual-motor system for predicting visual search.

# Visual Cognition

Editors **Jim Tanaka & Chris Olivers**



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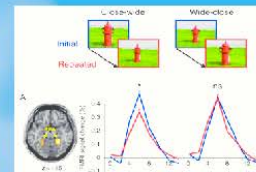
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**Helene Intraub** • Scene perception and memory, spatial representation (vision and touch), view integration and eye movements

**Jared Medina** • Body representations, spatial representations, neglect, TMS, cognitive neuropsychology

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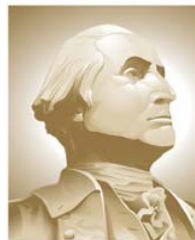
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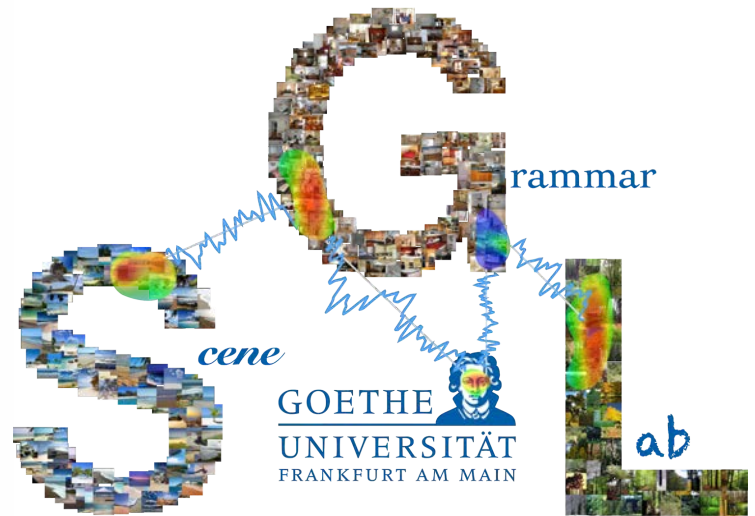
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