22nd Annual Meeting

Cognitive Science Association for Interdisciplinary Learning

Hood River Hotel
Hood River, Oregon
Aug 3 to August 7, 2017

Thursday, August 3

4:30 pm	**Reception and Appetizers**	
4:45 pm	Welcome and Introductory Remarks	
5:00 - 5:30 pm	Joy Geng	*Flexible representations in the attentional template*
5:40 - 6:10 pm	Adam S. Greenberg, Shahd Al-Janabi, Adam J. Barnas	*Object-Based Attention is Strategic and Dependent on Perceptual Organization*
6:20 - 6:50 pm	Ed Vogel	*Sustained spatial attention is not sufficient to elicit the Contralateral Delay Activity*
7:00 – 9:00 pm	**Social hour upstairs at Broder Øst**	

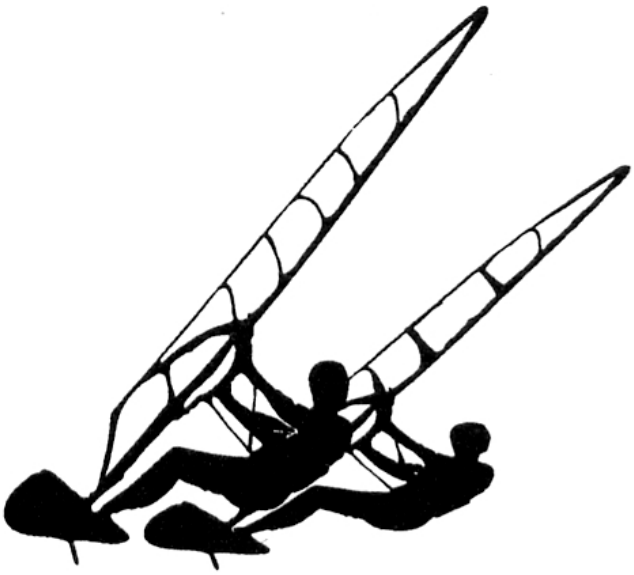
Friday, August 4		
8:30 am	**Breakfast**	
9:00 - 9:30 am	Lauren M. Bylsma	*Neural Correlates of Reward Processing in Youth at High and Low Familial Risk for Depression*
9:40 - 9:55 am	Russell E. Costa, Kelly Mackenzie, Calen Smith, Catherine Konold, Riley Hodgson	*Cognitive Flexibility and Inhibition in Rule Switching Versus Modality Switching*
10:00-10:30 am	Christopher Koch, Gregory Conan	*Semantic and Hue Differences in Stroop Processing*
10:40-10:55 am	Tamar Kolodny, Carmel Mevorach, Lilach Shalev	*Neural markers of efficient response inhibition in parietal cortex*
11:00 am	----------Break until 4:15 pm---------- 	
4:15 pm	**Appetizers**	
4:30 - 5:00 pm	Jenn Lewis, Don Tucker, Madeline C. Rogers, Evan Hathaway	*Dissociative Phenomenon: Altered States of Cognition and Consciousness*
5:10 - 5:25 pm	Grant Shields, D. Doty, R.H. Shields, G. Gower, G.M. Slavich, Andrew Yonelinas	*Recent Life Stress Exposure is Associated with Poorer Long-Term, Working, and Self-Reported Memory*
5:30 - 6:00 pm	Michelle Ramey, Andrew Yonelinas, John Henderson	*Contextual Cueing and Memory for Scenes: Eye movements dissociate conscious from unconscious memory*
6:10 - 6:25 pm	Lauren H. Williams, Trafton Drew	*Individual Differences and the Role of Working Memory in Visual Search*
6:30 - 7:00 pm	Ed Awh, David Sutterer, Josh Foster, Ed Vogel, John Serences	*Tracking the content and latency of LTM retrieval using rhythmic brain activity*
7:10 pm	----------Adjourn for Evening----------	

Saturday, August 5		
8:30 am	**Breakfast**	
9:00 - 9:30 am	Arne Ekstrom	*Human navigation, spatial precision, and geometrical templates*
9:40 - 9:55 am	Callie Brown, Calen Smith, Carly Blasco, Tiffany Perry, Riley Hodgson, Brian Avery, Lesa Ellis	*BDNF Val66Met and differential processing of emotional stimuli in a Dot-Probe task*
10:00-10:30 am	Carly J. Leonard	*On the persistence of visual information over time*
10:40-10:55 am	Paul Dassonville, Jeffrey M. Peterson	*Time course of the rod-and-frame illusion: a tilted frame predictively biases orientation judgments*
11:00 am	----------Break until 4:15 pm---------- 	
4:15 pm	**Appetizers**	
4:30 - 5:00 pm	Sarah Karalunas, Brittany Alperin, Christiana Smith	*Working memory impairment in ADHD: relationship to symptoms and EEG correlates*
5:10 - 5:25 pm	Alannah Wallace, Daniel Tay, Grace Iarocci, John McDonald	*Distractor suppression is impaired in adults with sub-clinical ADHD symptoms*
5:30 - 6:00 pm	Josef Schoenhammer, Stefanie Becker, Dirk Kerzel	*Tuning attention to relative features results in spatial enhancement*
6:10 - 6:25 pm	Daniel Tay, John McDonald	*Attention Capture by Abrupt Visual Onsets*
6:30 - 7:00 pm	Igor Bascandziev, Deborah Zaitchik, Susan Carey	*The role of domain-general cognitive resources in children's construction of a vitalist theory of biology*
7:10 pm	----------Adjourn for Evening----------	

Sunday, August 6		
8:30 am	**Breakfast**	
9:00 - 9:30 am	Dasa Zeithamova, Stefania Ashby, Caitlin Bowman	*Changes in Item Representations Following Category Learning*
9:40 - 9:55 am	Brian Avery	*Teaching foundational quantitative and computational skills to early undergraduates*
10:00-10:30 am	Timothy Vickery, Su Hyoun Park, Marian Berryhill, Adelle Cerreta	*The role of response and executive demands in visual statistical learning*
10:40-10:55 am	Kristen Thompson, John McDonald	*Visual Search is Delayed Following Enumeration of Multiple Visual Objects*
11:00 am	*Rafters, be packed and ready to go with a sack lunch so you can make it to Zoller's before noon. 	
	---------- Break until banquet ----------	
6:30 pm	**Banquet Dinner in conference room (Ahi's Ohana Catering)**	

Monday, August 7

8:30 am	**Breakfast**	
9:00 - 9:30 am	Eve Isham, Cong-huy Le	*Rightward and leftward biases in duration judgment*
9:40 – 9:55 am	Orestis Papaioannou, Steven J. Luck	*The Robustness of Active Maintenance of Working Memory Representations to Interrupting Stimuli*
10:00 - 10:30 am	Sarah S. Shomstein	*Intrusive Effects of Task-Irrelevant Information on Visual Selective Attention*
10:40-10:55 am	Michael James Starrett, Jared D. Stokes, Arne Ekstrom	*Dynamic Evolution of Spatial Representations during Free Ambulation of Novel Large-Scale Virtual Environments*
11:00 am	----------Have a safe trip home!----------	



Roll on, Columbia
Woody Guthrie

Roll on, Columbia, roll on,
Roll on, Columbia, roll on,
Your power is turning our darkness to dawn.
So roll on, Columbia, roll on.

Other great rivers lend power to you,
Yakima, Snake, and the Klickitat too,
Sandy Willamette and the Hood River too,
So roll on, Columbia, roll on.

And on up the river is Grand Coulee Dam,
The biggest thing built by the hand of a man,
To run the great factories and water the land,
So, roll on, Columbia, roll on.

Tom Jefferson's vision would not let him rest,
An empire he saw in the Pacific Northwest,
Sent Lewis and Clark and they did the rest.
So, roll on, Columbia, roll on.

Thursday Evening Abstracts

Flexible Representations In The Attentional Template

Joy Geng
University of California Davis

Theories of attention commonly refer to the "attentional template" as the collection of features in working memory that represent the target of visual search. Many models of attention assume that the template contains a veridical representation of target features, particularly when the target is defined by just one feature (e.g., color). However, recent studies have shown that the target representation can be "shifted" away from the true target value in order to optimize their distinctiveness from distractors and facilitate visual search (Navalpakkam and Itti, 2007; Becker, 2010). For example, the representation of an orange colored target has been found to be "redder" than the true color when it is presented within yellow distractors; this is thought to occur because the "reddish" values in orange are maximally diagnostic of the target within yellow distractors. Despite demonstrations of such a target shift, it remains unclear what conditions produce the change in target representation. Here, I will describe a series of experiments in which we have investigated the size and precision of the shift as a consequence of contextual and individual differences. Our data indicate that the template shift is highly malleable and sensitive to both perceptual (e.g., simultaneous contrast) and attentional pressures (distractor set and probability). Surprisingly, our results also suggest that the shift may not be the result of an optimal search template, but rather a heuristic one: Subjects that have more precise color representations appear to shift less and perform better.

Object-Based Attention Is Strategic And Dependent On Perceptual Organization

Adam S. Greenberg, Shahd Al-Janabi, Adam J. Barnas
University of Wisconsin-Milwaukee

In everyday life, objects are the most common target of attentional resources: our memories, actions, and language all typically direct our effort toward selection of goal-relevant objects in the presence of distracter objects. Most real-world objects are opaque and, therefore, partly occlude one another. Since object-based attention depends on the perceptual organization of the visual scene, it is crucial to understand the effects of perceptual grouping on object-based attention. In a series of behavioral and neuroimaging experiments, we explored the relationship between perceptual object formation and object-based selective attention. We learned that (a) object-based attention is dependent on target-object integration as well as Gestalt grouping cues, (b) the visual field meridians seem to play a role in the efficiency of attentional selection of objects (but not locations), and (c) while re-orienting of spatial attention is observable as early as V1, re-orienting of object-based attention doesn't emerge until at least V3. In this talk, I'll provide evidence of these findings and discuss an emerging theory which suggests that perceptual organization plays a critical role in the strategy by which object-based attention is deployed within a visual scene. This strategic distribution of attention may differentiate object-based selection from spatial or feature-based selection and suggests that the representational basis of attentional selection affords specialized behavior in disparate environments.

Sustained Spatial Attention Is Not Sufficient To Elicit The Contralateral Delay Activity
Ed Vogel
University of Chicago

The Contralateral Delay Activity (CDA) is a popular neural measure used to track storage in visual Working Memory (WM). The amplitude of the CDA increases with the number of memoranda, asymptotes around 3 items, and is sensitive to individual differences in behavior. However, there is still debate about whether the CDA reflects WM contents or sustained spatial attention. WM tasks place high demands on sustained spatial attention, so attention and WM demands have been confounded in previous work. Here, we tested whether the CDA manifests when demands for sustained spatial attention are high, but demands for WM storage are absent. In the WM task, participants performed bilateral change detection for colored squares. In the attention task, participants had to continuously attend to locations that were previously occupied by squares and report the orientation of a rare target line during the blank period. Thus, the squares that served as memoranda in the WM condition, served as spatial cues indicating the likely position of the target in the attention condition. As expected, we found a large, sustained CDA during the WM task. Additionally, there was a set size effect for the WM task, with larger amplitude for set-size 4 than set-size 2. For the attention condition, by contrast, the CDA was entirely absent for both set sizes. In a follow-up experiment, which required finer spatial precision to discriminate the targets, there was also no evidence for the CDA during the attention task. However, during the attention task in each experiment, we observed a known marker of spatial attention (sustained contralateral alpha suppression), which provides positive evidence that subjects were indeed sustaining spatial attention throughout the trial. Given these results, we find no evidence that sustained spatial attention alone can drive the CDA, which supports claims that this activity reflects memory storage.

Friday Morning Abstracts

Neural Correlates Of Reward Processing In Youth At High And Low Familial Risk For Depression
Lauren M. Bylsma
University of Pittsburgh

Depression rates increase dramatically during adolescence (Hankin, 2006), and offspring of depressed parents (high risk youth) are 3-4 times more vulnerable compared to their low risk peers who do not have a parental history of depression (Kessler et al., 2001; Beardselee et al, 1998). Motivation and self regulation deficits have been implicated in risk for depression. The Feedback Negativity (FN) is an event-related potential that reflects the motivational salience of positive and negative environmental feedback related to the flexible selection of actions aimed at pursuing rewards and has been associated with reward sensitivity (Bress & Hajcak, 2013). An attenuated FN has been found in depressed adults (Foti et al., 2009) and youth (Bress et al., 2012), as well as high risk older adolescents (Foti et al., 2011). However, the FN has not yet been examined in younger high risk youth. Youth participants (25 high risk, 20 low risk) were males and females 9-13 years old with no history of depression. Familial depression risk status was determined by the presence of parental history of recurrent unipolar depression. Parents and youth completed clinical diagnostic interviews. Youth completed a reward task where they chose between two doors and were told they could win or lose real money depending on whether they

guessed correctly. Feedback was provided indicating whether they won or lost money. Win and loss trials were randomized such that the chance of winning was set to exactly 50%. The FN was extracted from the time window 220-340ms post-feedback, and a difference waveform was computed for loss-win trials. A one-way ANOVA tested whether group status (high vs. low risk) was significantly associated with FN amplitude. Contrary to expectations, high risk youth exhibited greater FN amplitude in comparison to low risk youth, although the results were only marginally significant (t=1.8, p=.075). Prior work has suggested that an attenuated FN, thought to reflect reduced response to reward receipt, may represent a vulnerability marker for depression (Proudfit, 2015) that has been found in high risk older adolescents before they develop depression. However, in contrast to prior work, we found that high risk youth exhibited a potentiated FN relative to their low risk peers. These results suggest that in younger youth at risk for depression the FN may first be amplified then become blunted over time as youth enter late adolescence, but further longitudinal work is needed to test this hypothesis.

Cognitive Flexibility And Inhibition In Rule Switching Versus Modality Switching

Russell E. Costa, Kelly Mackenzie, Calen Smith, Catherine Konold, Riley Hodgson
Westminster College

The demands of everyday life often require that we switch our attention not only between different task rules, but also between different sensory-perceptual domains. Most empirical investigations of task switching, however, have focused only on switching attention between rules within the same perceptual domain, most often visual (e.g., between the color, shape, direction of motion, or spatial location of visually presented stimuli). In recent work we began exploring how attention switching between perceptual modalities (i.e., from auditory to visual or vice-versa) differs from the more studied within-modality rule switching. Participants were asked to alternate between performing an odd/even judgment or a magnitude judgment (whether a digit was greater or less than five) on a series of digits that were presented both auditory and visually. Participants were instructed which of the two tasks to perform on each trail via a pretrial cue, and the tasks were alternated in a pseudorandom sequence. In all trials, digits were presented to both the auditory and visual modalities simultaneously, requiring participants to attend to the relevant modality, while ignoring the irrelevant. The relevant modality was determined by which modality the pretrial cue was presented to. As expected, we observed a reliable response time cost when switching attention between tasks, and EEG differences were observed in both the pre- and post-stimulus intervals. Interference patterns, as indexed by response time and alpha activity, differed between auditory-to-visual and visual-to-auditory modality switches, with visual information creating more interference during performance of the auditory task than vice versa.

Semantic And Hue Differences In Stroop Processing

Christopher Koch, Gregory Conan
George Fox University

Word information is typically assumed to interfere with naming print color in the Stroop task. The amount of interference has been shown to change with changes in semantic similarity. Changing the type of word presented, however, isolates the impact of the word on color naming and disregards the impact of the color on the task. In this experiment, the semantic variations were examined in addition to changes in color. Experiment 1 was a partial replication of Klein (1964).

The same color and color associated words used be Klein (1964) were used in Experiment 1. Consistent with the original study, there was a significant effect of condition ($F(1, 20) = 25.20$, $p < .001$, $\eta 2 = .56$) and a significant interaction between condition and semantic variation ($F91, 20) = 14.77$, $p < .001$, $\eta 2 = .43$) indicating greater interference for color words than for color associated words. Experiment 2 was similar to Experiment 1 except color alternative words were included. Color alternative words were synonyms for color words (e.g., amber and yellow). There was a significant effect of condition ($F(1, 9) = 29.71$, $p < .001$, $\eta 2 = .77$) indicating Stroop interference. Although there was no effect of semantic variation, the interaction between condition and semantic variation was significant ($F(2, 18) = 8.35$, $p < .004$, $\eta 2 = .48$). Interference was larger for color words than for color associated and color alternative words. Hue was varied in Experiment 3. A standard red, green, yellow, and blue were presented. Two lighter shades of each color were also presented along with two darker shades of each color for a total of five shades per color. Standard color words were used (i.e., red, green, yellow, and blue). There was a significant effect of condition ($F(2, 30) = 47.72$, $p < .001$, $\eta 2 = .76$) indicating typical Stroop interference. An effect of shade was found as well ($F(4,60) = 20.54$, $p < .001$, $\eta 2 = .58$). However, RTs were only different for the lightest shades. All other shades produced similar RTs. Since the lightest shades were the most difficult to discriminate, the results actually indicate that changes in hue have limited effect on Stroop interference. Together, these findings indicate that varying semantic information has a bigger impact on Stroop interference than varying color.

Neural Markers Of Efficient Response Inhibition In Parietal Cortex

Tamar Kolodny[1,2], Carmel Mevorach[3], Lilach Shalev[4]
[1]*Hebrew University of Jerusalem;* [2]*University of Washington;* [3]*University of Birmingham;*
[4]*Tel Aviv University*

Response inhibition, the ability to suppress inadequate but prepotent response tendencies, is a cognitive-motor effortful process. Brain mechanisms typically reported for response inhibition are extensive, and there is an ongoing controversy evolving mainly around the role of frontal regions. In the current study we assessed response inhibition using a novel Go/No-go design and fMRI. Furthermore, we examined participants with attention-deficits/hyperactivity disorder (ADHD), a population with prominent dysfunction of response inhibition, to investigate brain correlates of atypical inhibition.

Using fMRI we recorded brain activity while participants performed a Go/No-go task with frequency manipulation of trial type. Although inhibition is required in all No-go trials, rare-No-go cases (25%) create a prepotent response and a strong demand for inhibition, while prevalent-No-go cases (75%) require very little inhibition effort. Thus, contrasting No-go trials from these different contexts pinpoints inhibition-related brain activation. Furthermore, among participants with ADHD, we assessed behavioral symptom severity using the Adult ADHD Self-Report Scale (ASRS), and examined the relationship between ADHD symptoms and inhibition-related brain activation.

Unlike previous reports, our unique design allowed us to isolate distinct clusters of activation in bilateral intraparietal sulcus (IPS) and left temporoparietal junction (TPJ). These regions showed greater activation to rare-No-go trials than to prevalent-No-go trials in healthy controls. Interestingly, this effect was absent in the ADHD group. Moreover, parietal modulation by

inhibition demand was associated with ADHD symptom severity, such that higher severity corresponded to reduced modulation in parietal cortex.

Results of the current study highlight the contribution of the parietal cortex to inhibitory processes, while casting doubts on the specificity of frontal activation in such processes. Furthermore, we argue that elevated activity in bilateral IPS and left TPJ may serve as a neural marker of efficient inhibition of a pre-potent response and may be useful in identifying atypicalities.

Friday Evening Abstracts

Dissociative Phenomenon: Altered States Of Cognition And Consciousness

Jenn Lewis[1], Don Tucker[2], Madeline C. Rogers[1], Evan Hathaway[1]
[1]*University of Oregon*; [2]*Electrical Geodesics, Inc.*

Dissociation is a cognitive phenomenon associated with detachment of one or more normally integrated processes including sense of self, presence and awareness of the body, emotional experience, memory, and consciousness. This separation can result in an altered experience of consciousness sometimes described as numbing, an out-of-body experience, or a memory lapse. Most commonly contextualized as a response to a traumatic experience and studied from a lens of psychological dysfunction, this phenomenon is something every person may have the ability to experience. Despite being both a prominent feature in psychological disorders and a normative trait, little is known about the neural mechanisms behind dissociation. The current research explores the neural domains of attention, inhibition, and memory in relation to trait levels of dissociation. In particular, I will be reviewing two studies using dense array electroencephalography (EEG) to measure the neural responses of high and low trait-dissociators in response to a modified emotional Stroop task. The first study examined event-related potentials (ERPs) in participants during a divided attention emotional Stroop task and revealed attenuated ERP responses in high dissociators that were not associated with group differences in performance measures, suggesting high dissociators are employing an alternative cognitive strategy, which results in modified cognitive profiles, but no disruptions in performance. The second study is a replication of the first but includes an added selective attention condition, and additional qualitative information regarding the dissociators experience in performing the task. These two studies provide initial evidence into the mechanisms behind a unique cognitive phenomenon and challenge our conceptualizations of attention, memory, and consciousness.

Recent Life Stress Exposure Is Associated With Poorer Long-Term, Working, And Self-Reported Memory

Grant Shields
University of California, Davis

Although research on the effects of stress has grown in recent years, the effects of recent life stress have been relatively understudied compared to acute and chronic stress. This study helps to fill the gap in the literature by examining if recent life stress is associated with long-term memory, working memory, and self-reported memory in a sample of 142 healthy young adults who were assessed at two time points over a two week period. Recent life stress was assessed using the

Stress and Adversity Inventory for Daily Stress (Daily STRAIN), which is an inventory that assesses the frequency of relatively common stressful life events and difficulties over the preceding two weeks. To assess memory performance, in turn, participants completed both long-term memory and working memory tasks. Participants also provided self-reports of memory problems using the Everyday Memory Questionnaire-Revised (EMQ-R). As hypothesized, greater recent life stress was associated with worse long-term and working memory, and more self-reported memory problems. These associations were largely robust while controlling for possible confounds, including participants' age, sex, and negative affect. These findings indicate that recent life stress is broadly associated with worse memory, and subsequent research should consider assessing recent life stress as an important covariate or moderator of memory performance.

Contextual Cueing And Memory For Scenes: Eye Movements Dissociate Conscious From Unconscious Memory

Michelle Ramey, Andrew Yonelinas, John Henderson
University of California, Davis

There is growing evidence that long term memory can impact visual attention by altering how our eyes extract information from complex visual scenes. However, because memory has only been assessed in prior studies using dichotomous measurement contrasts such as recognized/unrecognized, it is not known whether these memory-based attentional guidance effects reflect conscious forms of memory such as the recollection of earlier events, strength-based familiarity effects, or unconscious forms of memory such as visual implicit memory. To address this issue, we presented participants with photographs of scenes and asked them to search for embedded search targets (T or L) over repeated presentations. In addition, we assessed memory for each scene using confidence-based receiver operating characteristics methods. We found that eye movements during visual search were influenced both by conscious recollection and by unconscious memory for earlier repetitions. In contrast, however, we found no evidence for the effects of familiarity-based recognition memory (i.e., memory strength) on attentional guidance. The results indicate that eye movements reveal evidence for both conscious and unconscious memories for the past.

Individual Differences And The Role Of Working Memory In Visual Search

Lauren H. Williams, Trafton Drew
University of Utah

The relationship between working memory (WM) and visual search has been a steady source of debate in the literature. Although most theories of attention propose that WM plays an important role in visual search, behavioral studies have had mixed outcomes (Horowitz & Wolfe, 1998; Kane, et al., 2006; Peterson, et al., 2001; Oh & Kim, 2004; Woodman & Luck, 2004; Woodman, Vogel, & Luck, 2001). Recently, electrophysiological studies have demonstrated that a neural correlate of WM: the Contralateral Delay Activity (CDA), is present during visual search tasks (Emrich, Al-Aidroos, Pratt, & Ferber, 2009; Luria & Vogel, 2011, Woodman & Arita, 2011). The CDA increases in amplitude with the number of items held in WM and plateaus at an individual's WM capacity (Vogel & Machizawa, 2004). The presence of the CDA during search supports theories of attention that propose a tight link between WM and search performance, but it is unclear which process the CDA measures during search. Based on the literature, there are two major theories regarding the

role of WM in search. One theory proposes that mental representations of targets are maintained in WM in order to guide search toward target relevant features in the environment (Duncan & Humphreys, 1989; Desimone & Duncan, 1995). A second theory proposes that WM stores previously rejected distractors in order to guide search toward novel locations (Peterson, et al., 2001). The purpose of the present study was to determine which process the CDA measures during search and to investigate its relationship with search performance. Forty participants searched for novel target objects in a lateralized circular display. The target changed on each trial and was displayed for 500 ms followed by an 800-1000 ms cue that indicated which side of the upcoming array to search for the object. The search array consisted of either 2, 4, or 6 grayscale real world objects positioned on each side of the screen. The search array was visible until the participant made a target present (50%) or target absent (50%) response. CDA was time-locked to the onset of the array. Using a median split of response time, the data was divided into groups of fast and slow searchers. Overall, the CDA amplitude was larger for the fast group of participants than the slow group. This suggests that WM plays an important role in search for novel targets. If CDA reflects the temporary storage of distractors in WM during search, the CDA amplitude should increase with the number of distractors and be largest for target absent trials. However, we found the opposite pattern of results: CDA amplitude was largest for target present trials and decreased as the number of distractors increased. This suggests that the CDA does not measure the storage of previously examined objects during search. Instead, the CDA likely reflects the maintenance of target templates in WM.

Tracking The Content And Latency Of LTM Retrieval Using Rhythmic Brain Activity

Ed Awh[1], David Sutterer[1], Josh Foster[1], Ed Vogel[1], John Serences[2]
[1]*University of Chicago*; [2]*University of California San Diego*

Recent studies have shown that the topography of alpha activity on the scalp can be used to decode spatial representations in working memory and during covert orienting of attention. Here, we exploited this oscillatory signal to track the content and timing of retrieval from long term memory. Subjects memorized the positions of many visual stimuli, and we observed the evolution of spatially-selective alpha responses following the presentation of a shape retrieval cue. Rhythmic brain activity tracking the retrieved position emerged approximately 600 ms after the presentation of the shape cue. The spatial selectivity of this signal tracked the improvements in learning over the experiment, within-subject variations in retrieval accuracy, and the latency with which subjects recalled the associated positions. Finally, this alpha-band signal was temporally coincident with a previously documented event-related potential, the "parietal old/new" component, that has been found to track the recollection of long term memories. These data fall in line with models that argue for the reinstatement of encoding-related activity during long term memory retrieval, and point to a valuable new approach for studying the temporal dynamics of retrieval from long term memory.

Saturday Morning Abstracts

Human Navigation, Spatial Precision, And Geometrical Templates
Arne Ekstrom
University of California Davis
A fundamental problem in neuroscience involves how we represent space when we navigate. Here, we will present a series of experiments suggesting that, rather than having exact, metric knowledge of space, we often use heuristics to organize such representations. In the first set of experiments, we will consider the idea that shapes, such as squares and circles, are a basic organizational feature of how we remember spatial layouts. We will also explore non-regular shapes as a means of understanding representations formed during navigation, which show novel properties of "regression to the mean" representations. In a second set of experiments, we will consider the efficacy of shapes in organizing our spatial knowledge during active navigation and their connection to the accumulation of accurate spatial representations. Finally, we will consider experiments in brain-damaged patients, who demonstrate hitherto unrecognized impairments in spatial precision, while at the same time leaving many other aspects of memory intact. Together, these findings argue that our spatial representations are better thought of as employing heuristics rather than exact metric knowledge.

BDNF Val66Met And Differential Processing Of Emotional Stimuli In A Dot-Probe Task
Callie Brown, Calen Smith, Carly Blasco, Tiffany Perry, Riley Hodgson, Brian Avery, Lesa Ellis
Westminster College

The Val66Met polymorphism of the brain-derived neurotrophic factor (BDNF) gene has been investigated in both animal and human studies as a potential contributor to anxious behaviors, potentially via altered secretion of the BDNF protein. This polymorphism consists of a methionine (Met) substitution for valine (Val) at amino acid 66 and is present in approximately 30% of Caucasian populations. While findings have been mixed, human studies suggest that BDNF Val66Met carriers may exhibit attentional bias for negative stimuli, as evidenced by greater sensitivity to negative stimuli in the environment. Also, Event Related Potential (ERP) studies have reported enhanced Early Posterior Negativity (EPN) effects for emotional vs. neutral stimuli, which are thought to indicate automaticity of processing of emotional stimuli. In a previous study in our lab that utilized an Emotion and Counting Stroop Task, we found that BDNF Met carriers showed significantly greater EPN negative deflections to emotional stimuli (both negative and positive words) than did Val/Val homozygotes. This suggests that Met carriers may show enhanced attentional bias for emotional stimuli, regardless of valence. We have replicated and extended our previous findings using a Dot-Probe task, in which neutral, negative, and positive faces are randomly presented in pairs. The images disappear from the screen, a dot replaces one of the images, and participants indicate the location of the dot with a key press. Individuals with facilitated processing of emotional images have quicker reaction times when the dot appears in the location of emotional faces vs. neutral faces. Ninety eight participants completed the task while ERPs were recorded from 128 scalp locations. In addition, they were genotyped at the BDNF Val66Met polymorphism (rs6265) by PCR and DNA sequencing. We hypothesized that Met carriers would exhibit enhanced attentional processing of emotional stimuli compared to Val/Val homozygotes, as evidenced by both quicker reaction times and greater EPN negative deflections for trials containing emotional stimuli vs. neutral/neutral control pairs.

On The Persistence Of Visual Information Over Time
Carly J. Leonard
University of Colorado Denver

In everyday life, visual perception unfolds naturally over space and time, integrating both current input from across the visual field and information from the recent past. In both domains, specific features of the visual world are often of critical importance. In the laboratory, research on these issues of spatial, temporal, and featural processing has been central to the field. However, a majority of experiments are explicitly designed to assess either how selection occurs on immediate sensory input (i.e., visual attention) or how visual information is maintained over time in the absence of sensory input (i.e., visual working memory). In this talk, I will discuss experiments that examine priming of popout, in which the feature from the previous trial has a lasting impact on selection in the current trial. Support for the idea that individual differences in this type of intertrial carryover effect relate to visual working memory capacity will be reported. These results will be discussed in relation to the larger issue of how to think about featural processes during naturalistic perception.

Time Course Of The Rod-And-Frame Illusion: A Tilted Frame Predictively Biases Orientation Judgments
Paul Dassonville, Jeffrey M. Peterson
University of Oregon

Orientation judgments are made within a reference frame that is greatly dependent on the vestibular system, but the visual system is also able to extract informative cues from a viewed scene (e.g., vertical door frames, horizontal desktops). This becomes dramatically apparent when prominent cues in the scene provide misleading orientation cues, as in the case of the rod-and-frame illusion (RFI, Asch & Witkin, 1948), where a tilted frame causes an enclosed rod to be perceived as being rotated in a direction opposite the frame. Past studies of the RFI have documented the manner in which visual cues are incorporated into an observer's reference frame, but to our knowledge there have been no studies that have examined the time course of this effect. To characterize this time course, we used a variation of the RFI which included a temporal mismatch between the onset of a tilted frame (±15°) and the occurrence of a briefly flashed rod (16ms duration, presented in a range of times from 200ms before to 200ms after frame onset). In otherwise complete darkness, participants compared the tilt of the rod to subjective vertical. We found that there was no effect of the frame when the rod was presented well before (200ms) the frame's onset, and the effect reached a maximum plateau for rods presented simultaneous with the frame's onset or later. In between these extremes, the effect grew in size, becoming significant even for rods presented 100ms before the frame; that is, the perceived orientation of the rod was affected even by a tilted frame whose onset occurred 83ms after the rod was extinguished. These findings suggest that the frame's effects on the egocentric reference frame occur with a latency shorter than the temporal window during which the orientation of the rod is determined.

Saturday Evening Abstracts

Working Memory Impairment In ADHD: Relationship To Symptoms And EEG Correlates
Sarah Karalunas, Brittany Alperin, Christiana Smith
Oregon Health & Science University

Working memory impairments have received extensive theoretical attention as a potential mechanism of symtpom change in ADHD due to consistent, if moderate, association with symptoms and rapid development during childhood and adolscence when ADHD symptoms normatively decline. Despite extensive theoretical speculation, there is relatively little empirical evidence directly linking working memory development to changes in ADHD symptoms. Further, the cognitive and neural mechanisms accounting for working memory impairment are not well-understood. In particular, it remains unclear whether differences in working memory performance in ADHD arise from consistently low memory capacity per se or from weaknesses in attentional control and variabilty in engaging memory capacity. Resolving the relationship of working memory to symptom change and the mechanisms driving impairments will be crucial for the long-term goal of designing effective non-pharmacological interventions. Method. Study 1: 734 children ages 7-12 (384 with well-characterized ADHD) participated in an accelerated longitudinal study with three waves of annual data collection that included a complete clinical evaluation and neuropsychological test battery. Individual differences in working memory development and the relationship to symptom change was evaluated using latent growth curve modeling. Study 2: A subset of 111 children (50 with ADHD) completed additional evaluation of working memory performance between ages 13-17, including EEG recording during a novel version of the well-validated change detection task. Results. Longitudinal growth models identified multiple working memory trajectory classes within the ADHD sample, including a group with persistent working memory impairments and a group whose working memory normalized by early adolescence. Recovery in working memory was related to greater improvement in ADHD symptoms. Additional testing during adolescence indicated that working memory performance in children with ADHD is consistent with a graded attentional control model, suggesting less consistent engagement of working memory capacity accounts for impairments. There were no differences in early visual evoked potentials (P1/N1) between trials with better or worse working memory performance; however, differences in theta and alpha activation in the period preceding the stimulus were related to performance. Conclusion: Results support working memory as a potential mechanism of symptom change in ADHD and further clarify the neurophysiological predictors of performance, which will be critical for developing novel treatments for the disorder.

Distractor Suppression Is Impaired In Adults With Sub-Clinical ADHD Symptoms
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When searching the visual environment, salient-but-irrelevant stimuli can be suppressed to minimize distraction and to bias visual selection towards another object of interest. The ability to suppress salient visual distractors varies substantially across individuals and is compromised in children with clinically expressed ADHD. Here we asked whether the ability to suppress salient distractors varies across the typical adult population as a function of self-reported ADHD symptomatology. Participants drawn from the university population were given an ADHD self-report questionnaire, and individuals scoring high or low on symptomatology were invited to

participant in an additional singleton search task with two colour singletons. ERP components associated with attentional selection (N2pc) and suppression (P_D) were isolated to determine whether ADHD symptomatology was associated with deficits in target selection, distractor suppression, or both. Relative to the low-symptom group, high-symptom participants showed a typical target N2pc but a reduced PD. An enlarged medial-frontal negativity was also observed in the high-symptom group. Together, these results suggest that high-functioning adults with sub-clinical ADHD symptoms are unable to ignore salient-but-irrelevant visual stimuli and adopt different strategies to compensate for this deficit.

Tuning Attention To Relative Features Results In Spatial Enhancement

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In visual search, attention is tuned to the relative target feature (e.g., redder) when target and nontarget features remain fixed (e.g., orange and yellow, respectively). Consistent with this relational account, spatially irrelevant precues captured attention when they matched the relative target color (e.g. a yellow cue among orange contextual cues), but not when they had the opposite relative color as the target (e.g. an orange cue among yellow contextual cues). Attentional capture was measured by spatial cueing effects on response times (RTs). That is, RTs were faster when the cue preceded at the target location than when the differently colored contextual cues preceded the target (e.g., Becker, Folk, & Remington, 2013). Interestingly, cues with the opposite relative target color frequently led to inverse cueing effects. That is, RTs were slower when the cue preceded the target. Because these cues had the opposite relative target color, inverse cueing effects might reflect spatial inhibition. Alternatively, the contextual cues might have captured attention, since they matched the relative target color (e.g., Schönhammer, Grubert, Kerzel, & Becker, 2016).
In our recent studies, we added white cues to the cue displays. We assumed that white would be neither enhanced nor suppressed, or enhanced and suppressed to the same degree. Therefore, the trials, in which white cues preceded at the target location, served as baseline condition. We examined whether the colored cues and contextual cues led to spatial facilitation or inhibition relative to the white cue elements. We found that contextual cues with the relative target color consistently speeded RTs compared to the baseline condition, which indicates that the contextual cues captured attention. In some conditions, cues with the opposite relative target color slowed RTs relative to baseline, which might suggest that these cues resulted in spatial inhibition. However, event related potentials (ERPs) to the cues only provided evidence for attentional capture by the contextual cues with the relative target color, whereas no ERP evidence was obtained for spatial inhibition of the cues with the opposite relative target color.

Thus, RT and ERP measures reliably indicated that contextual cue elements captured attention, when they match the relative target color, and that this mechanism contributed to inverse RT cueing effects. Conversely, it remains unclear whether also spatial inhibition adds to the inverse RT effects.

Attention Capture By Abrupt Visual Onsets

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Salient visual stimuli, such as abrupt onsets, often capture attention but may fail to do so when attention is narrowly focused elsewhere in the visual field. According to salience-driven selection theory, irrelevant abrupt onsets appearing within a hypothetical attentional window (i.e., a region monitored for potential objects of interest) invariably capture attention while abrupt onsets appearing outside of the window can be ignored. The present study investigated abrupt-onset capture within the attentional window using an ERP component associated with attention selection (N2pc). In Experiment 1, participants viewed displays containing a faint grey disk and a more salient red line that appeared within the boundaries of the disk. In separate blocks of trials, the task was to discriminate the size of the disk (attend disk condition) or the length of the line (attend line condition). Experiment 2 was similar except that the disk-discrimination task was replaced by a disk-detection task (the disk was absent on half of the trial, leaving only the abrupt-onset line in the display). In each experiment, the line triggered an N2pc in the attend-disk condition as well as in the attend-line condition, suggesting that it captured attention irrespective of the observers' intentions. However, the N2pc was significantly larger in the attend-line condition than in the attend-disk condition, indicating that task relevance modulates attention capture by abrupt onsets appearing within the attentional window.

The Role Of Domain-General Cognitive Resources In Children's Construction Of A Vitalist Theory Of Biology

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Some episodes of learning are easier than others. Preschoolers can learn certain facts only after one or two exposures, but they require several years to learn what the concept alive means. Learning what alive means is hard because it requires theory construction and conceptual change, whereas learning new facts is easy because they are stated in terms of concepts preschoolers already have. In this talk, I will present a study comparing these two types of learning directly. Specifically, the study investigated whether different domain-general cognitive resources support the two types of learning. Eighty-two 6-year-olds participated in a pre-training/ training/ post-training study. The training targeted an episode of learning involving theory construction and conceptual change (acquisition of theory of vitalism) and an episode of learning involving knowledge enrichment (acquisition of fun facts over concepts that the child already has). In addition, we measured children's executive functions and receptive vocabulary to directly compare the resources drawn upon in the two episodes of learning. This study replicated and extended previous findings highlighting the differences between the two types of learning. Importantly, we found that Executive Functions predict improvement on Vitalism, but not on Fun Facts and that Receptive Vocabulary predicts improvement on Fun Facts, but not on Vitalism. I will discuss this double dissociation in the context of the learning mechanisms involved in these two types of learning.

Sunday Morning Abstracts

Changes In Item Representations Following Category Learning
Dasa Zeithamova, Stefania Ashby, Caitlin Bowman
University of Oregon

Learning about category membership can alter representations of individual items, resulting in increased perceived similarity of items within a category and decreased perceived similarity of items from different categories. The current study aimed to investigate changes in subjective similarity and neural representations of faces before and after category learning. Stimuli were faces constructed as 50/50 blends of never-seen "parent" faces. Across two experiments, two or three parent faces were selected to determine category membership, presented as a family last name. These family name-relevant faces were blended with other parent faces to generate face stimuli for presentation. Pairs of faces could share a parent face relevant for family membership, a parent face irrelevant for family membership, or not share a parent face. Participants first rated the similarity of pairs of faces, then were trained to categorize the faces into families (categories), and then rated their subjective similarity again. Prior to category learning, subjective similarity ratings were the same for pairs of faces from the same category as for pairs of faces from different categories that had a common parent. After category learning, similarity ratings for items within a category increased, while rated similarity of faces that shared a common parent but belonged to different categories decreased. Similarity ratings for faces that had no shared features also decreased. Similar changes in perceived similarity within vs. across categories was observed even for a separate group of participants that were trained to remember item-specific information (face-unique full name) where category information (a common last name) was present but not emphasized. A subset of participants also underwent a functional MRI study in which neural pattern similarity of activation patterns evoked by individual faces was measured during passive viewing before and after category learning. Preliminary fMRI results suggest the behavioral effects may be mediated by the formation of category representations in the ventromedial prefrontal cortex, where distributed neural patterns differentiated faces belonging to different families after learning but not before. These findings elucidate the neural mechanisms underlying the changes in item representations resulting from category learning.

Teaching Foundational Quantitative And Computational Skills To Early Undergraduates
Brian Avery
Westminster College

As the data that we collect dramatically increases in both quantity and complexity, all college graduates will need more quantitative and computational skills to be productive and successful members of society. Neuroscience students are no exception. Instructors are often looking for efficient and exciting (or at least non-off-putting) ways to introduce undergraduates early in their careers to the powerful data analysis tools that they will learn and use later, such as the programming languages, R and Python, without overwhelming introductory students. My question was: what is the most accessible and effective framework for teaching quantitative and computational skills in introductory neuroscience and genetics classes that will meet our learning goals and prepare students for continued development in data analysis and advanced courses? I have developed inquiry based, active learning materials in the Jupyter Notebook system to teach coding and quantitative skills to undergraduate students at several different levels. I will present

our materials and discuss our experience using this open source system as an effective and accessible tool to teach quantitative and computational skills in neuroscience classes. My materials address basic calculation and graphing skills, reproducible data analysis, and basic statistics using R or Python. I will discuss the advantages of Jupyter Notebooks for teaching and learning over using more basic tools such as Excel or systems with a relatively steep learning curve such as Rstudio. The Jupyter Notebook system is relatively easy to install or use in the cloud, and combines text, code, and output all in one place that is easily exportable to HTML and PDF. It is also easy to guide students through solving scaffolded problems with code that they can adapt and modify, and to record and evaluate students' thought processes as they work through everything from simple exercises to complex data analysis projects. I see Jupyter Notebooks as an easily accessible tool to get students at various levels engaged in doing data science related to neuroscience.

The Role Of Response And Executive Demands In Visual Statistical Learning

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Visual statistical learning (VSL) of predictive relationships amongst visual stimuli occurs in the absence of explicit awareness of such contingencies, and thus is often cast as reflecting a continuously occurring process. We found evidence that VSL faces interference from minor variations in response and executive demands, challenging the notion that VSL is a low-level phenomenon. Participants monitored a stream of face and scene images (male/female and indoor/outdoor) and responded whenever an image flickered (Experiment 1) or made a categorical judgment (male/female or indoor/outdoor; Experiment 2). 16 AB pairs were repeated throughout the stream, such that A was 100% predictive of B. Pairs were formed such that items shared subcategorical status (e.g., male→male), shared categorical but not subcategorical status (indoor→outdoor), or crossed category boundaries (female→outdoor). In a surprise recognition phase, subjects were forced to pick the more familiar pairing (foil vs. target pair). Participants were equally proficient at recognizing different types of pairings in Experiment 1, suggesting that categorical differences played no role in learning. In Experiment 2, participants were above-chance at recognizing pairs overall, but significantly less likely to recognize pairs if they involved different responses during training, even if they shared categories (e.g., male→female), and also less likely to recognize pairs that involved changing task rules (e.g., male→outdoor). These results suggest that VSL is subject to interference from high-level demands, such as the requirement to make different responses across sequential trials, and are consistent with the interpretation that VSL, as indexed by recognition, shares mechanisms with general associative learning. Provocatively, an amnesic patient showed the opposite pattern: replicating prior work, she was unable to exhibit VSL in the absence of category-related task demands during exposure. However, when images were linked to responses during exposure, she showed evidence of above-chance learning that scaled positively with task demands. These findings suggest a sparing from the costs of conflict on implicit memory in the presence of damage to medial temporal structures.

Visual Search Is Delayed Following Enumeration Of Multiple Visual Objects
Kristen Thompson, John McDonald
Simon Fraser University

Processing of the second of two targets (T2) is impaired when the time interval between the targets is short (200-500 ms), an effect known as the attentional blink (AB). When T2 appears in a multi-item display, visual search is impaired during the AB interval. Results from several ERP studies indicate that T2 selection is delayed by only ~20 ms, despite much larger behavioural AB effects. Here, we asked whether the magnitude of the T2 selection delay depends on the number of T1 items that must be attended. Participants viewed an RSVP stream consisting of two target displays and several nontarget letters. The T1 display consisted of one, three, or four red disks presented along the vertical meridian, and the T2 display consisted of one red disk (target) and nine green disks (nontargets) arranged around fixation. Participants enumerated the T1 disks and discriminated the orientation of a line contained within the T2 singleton. The N2pc (an ERP index of attentional selection) elicited by T2 was measured as a function of T1 set size and inter-target lag (2 items or 7 items). Consistent with prior AB studies, the N2pc occurred later at Lag 2 than at Lag 7. This N2pc delay increased as a function of T1 set size, indicating that search performance during the AB depends on the availability of attentional capacity.

Monday Morning Abstracts

Rightward And Leftward Biases In Duration Judgment
Eve Isham, Cong-huy Le
University of California Davis

A theory in time perception suggests that our mental representation of time has an underlying spatial component. Such theory predicts that the perceived temporal duration is modulated according to the horizontal mental number line. Consistent with this view, observers experience the illusion that time is longer (i.e., has a higher magnitude) when linked to the right side of the visual space, resulting in a rightward bias. However, the mechanisms of the rightward bias are unclear. One of the questions is whether the right bias generalizes across central and peripheral spaces. In two experiments, participants judged durations of a visual stimulus that was perceived to be in different locations in space (via prismatic adaptation and visual eccentricity procedures). In central space, the judged durations was longer when the object position was perceived to be 3° to the right compared to the left. However, in peripheral space, we instead observed a leftward bias such that duration was judged to be longer in the left space compared to the right. Based on these findings we explore the roles of central and peripheral spaces and how they may contribute to the interaction between spatial information and the mental representation of time.

The Robustness Of Active Maintenance Of Working Memory Representations To Interrupting Stimuli

Orestis Papaioannou, Steven J. Luck
University of California Davis

Visual working memory relies heavily on the active maintenance of representations. However, it is unclear whether this active maintenance can co-occur with other concurrent processing of stimuli. Sparked by this question, we used event related potentials (ERPs) - specifically contralateral delay activity (CDA) - to create a continuous marker of active maintenance of lateralized stimuli during the processing of lexical stimuli. Participants were asked to remember four colored items presented on the right or left side of the screen for a change detection task. A lexical item (psuedoword or consonant string) was presented during the 1500 ms retention interval on a subset of trials. Participants were instructed to either ignore these items and focus entirely on the memory task (single-task condition), or to indicate whether the item presented was a word or consonant string (dual-task condition). A CDA to the lateralized memory items was observed for both conditions prior to, or in the absence of, an intervening stimulus. However, the CDA was disrupted by the processing of the lexical items during the duals task condition, but not the single task condition. A larger N400 - a component associated with semantic and orthographic processing - was found for pseudowords compared to consonant strings in both conditions, indicating that participants differentiated between words and consonant strings in both conditions. Thus, during the single-task condition, the CDA was not disrupted by the lexical stimuli even though the N400 data indicate that these stimuli were discriminated. Taken together, these finding suggest that active maintenance is unimpeded by automatic lexical processing but fails when this same processing must be tied to a non-automated task. Interestingly, behavioral measures show only a minor decrease in change-detection performance in the dual-task condition, providing evidence of a secondary working memory process that can support the memory task when the CDA has been disrupted.

Intrusive Effects Of Task-Irrelevant Information On Visual Selective Attention

Sarah S. Shomstein
George Washington University

The study of attentional selection is often framed in terms of task relevance or salience. In my talk, I will challenge this dichotomy and discuss evidence demonstrating that attentional selection is constrained by non-salient task-irrelevant representations such as object-boundaries, object-size, and object's semantic properties. I will argue that the influence from task-irrelevant aspects of the scene is employing the same neural mechanisms as those described in goal-directed attentional control. Evidence will be drawn from a set of behavioral, eye-tracking, and neuroimaging experiments. Taken together, I will argue that traditional accounts of attentional selection need to be revised to incorporate intrusive effects of task-irrelevant sensory stimuli. I will conclude by outlining challenges that our field will have to face in light of recent findings.

Dynamic Evolution Of Spatial Representations During Free Ambulation Of Novel Large-Scale Virtual Environments

Michael James Starrett, Jared D. Stokes, Arne Ekstrom
University of California, Davis

An important question regards how we use environmental boundaries to anchor our spatial representations. Behavioral and neurophysiological models provide conflicting predictions, and this question has been difficult to answer because of technical challenges with testing navigation in novel, large-scale, realistic spatial environments. To address this issue, participants freely ambulated on an omnidirectional treadmill while viewing novel, town-sized environments in virtual reality on a head-mounted display. Participants performed interspersed judgments of relative direction (JRD) to assay their spatial knowledge and determine usage of environmental boundaries to anchor representations. Pointing accuracy showed no initial directional bias to boundaries although such "alignment effects" did emerge after the fourth block of learning. Pre-exposure to a map in Experiment 2 led to similar overall findings. Our results help bridge the gap between neurophysiological models of location specific firing in rodents and human behavioral models of spatial navigation by emphasizing the experience-dependent accumulation of route-specific knowledge.

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