BAMM 2018

Bay Area Memory Meeting

University of California, Davis

August 14th, 2018

8:00am – 5:00pm

Organizing Committee:

Charan Ranganath

Andy Yonelinas

Adam Gazzaley

Anthony Wagner

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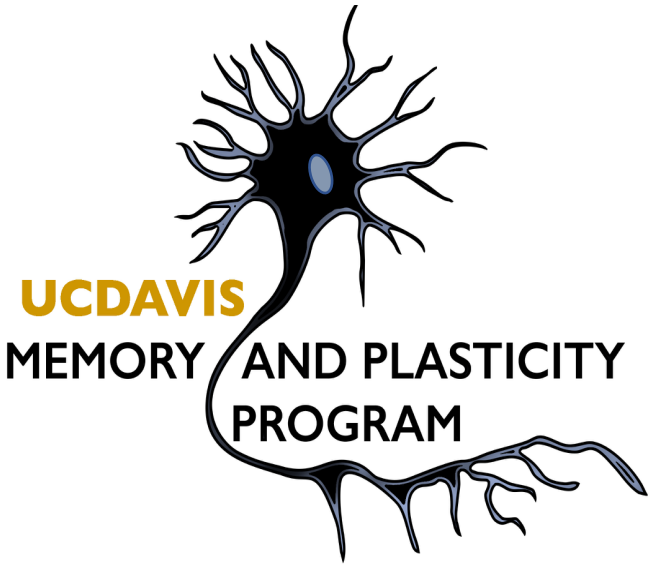

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Tuesday August 14th, 2018

8:00 – 8:55am	**Arrival, Check-In, and Refreshments** Center for Neuroscience 1544 Newton Ct., Room 113 Davis, CA 95618
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9:00 – 10:20am	**Talk Session 1 – On Neuromodulation and Memory Modulation**
9:00 – 9:20	**Alexander Simon, UC San Francisco, Neuroscape Lab** *Frontal and parietal neural markers predict a clinical measure of attention*
9:20 – 9:40	**Jamie Krueger, UC Davis, Wiltgen Lab** *Increases in hippocampal activity are more detrimental to memory retrieval than decreases*
9:40 – 10:00	**Tommaso Patriarchi, UC Davis, Tian Lab** *Genetically encoded sensors for imaging neuromodulators in vivo*
10:00 – 10:20	**Julia Soares, UC Santa Cruz, Storm Lab** *Volitional photography inflates metamemory confidence but still causes an impairment in memory*
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10:50 – 11:10	**Robin Goodrich, UC Davis, Yonelinas Lab** *Medial temporal lobe damage impairs visual working memory for a single item*
11:10 – 11:30	**Elena Galeano-Weber, UC Berkeley, Bunge Lab** *Investigating neurocognitive mechanisms of precision and variability in visual working memory*
11:30 – 11:50	**Ariel Starr, UC Berkeley, Bunge Lab** *Semantic knowledge influences visual working memory capacity*
11:50 – 12:10	**Anne Collins, UC Berkeley, Collins Lab** *Different developmental trajectories for working memory and reinforcement learning contributions to learning in adolescence*
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Deters, Kacie	Stanford - Mormino Lab
Durdle, Courtney	UC Davis - Goodman Lab
Ellwood-Lowe, Monica	UC Berkeley - Bunge Lab
Graham, Jalina	UC Davis - Wiltgen Lab
Hurtado, Mitzi	UC Davis - Imaging Research Center
Karunungan, Krystal	UC San Francisco - Rabinovici Lab
Ota, Yusuke	UC Davis -Wiltgen Lab
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Context-specific sequence representations in the hippocampus

2:10 – 2:30 **Derek Huffman, UC Davis, Ekstrom Lab**
The effect of body-based cues on human neural representations for space following active navigation

2:30 – 2:50 **Seongmin A. Park, UC Davis, Boorman Lab**
Integrating abstract structures and constructing cognitive maps about social hierarchies

2:50 – 3:10 **Brendan Cohn-Sheehy, UC Davis, Ranganath Lab**
Consolidation promotes retention of events that form coherent narrative: Evidence for higher-order structure in episodic memory

3:10 – 3:40pm **Coffee Break**

3:40 – 4:55pm **Talk Session 4 – On Context and Decision Making**

3:40 – 4:00 **Jiefeng Jiang, Stanford, Wagner Lab**
Proactive control in context: Context-cued predictions of control demands facilitate perceptual decisions in virtual environments

4:00 – 4:20 **Tyler Santander, UC Santa Barbara, Miller Lab**
Stable representations of a cautious state of mind: An fMRI study of memory and perceptual decision-making

4:20 – 4:40	**Evan Layher, UC Santa Barbara, Miller Lab** *Criterion shifting in memory recognition is a stable trait*
4:40 – 4:55	**Ben Kubit, UC Davis, Janata Lab** *Involuntary mental replay of music improves retention of incidentally associated episodic knowledge*
4:55 – 5:00pm	**Closing Comments**
5:00 – 7:00pm	**Dinner / Social Event** Sudwerk Brewing Company 2001 2nd St. Davis, CA 95618 **A food truck with vegetarian options will be available*

Frontal and parietal neural markers predict a clinical measure of attention

Alexander J. Simon[1,2,3], Courtney L. Gallen[1,2,3], Joshua J. Volponi[1,2,3], Richard Campusano[1,2,3], Joaquin A. Anguera[1,2,3], David A. Ziegler[1,2,3], and Adam Gazzaley[1,2,3,4,5]

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The test of variables of attention (T.O.V.A.®) is a task designed to assess sustained attention and impulse control, two critical aspects of cognitive control. A singe age- and gender-normalized summary statistic for performance, the attention composite score (ACS), has recently been recognized by the FDA as a clinical marker of attention and as a potential diagnostic marker for ADHD, but no studies to date have examined neural correlates of the ACS. The goal of the present study was to use multivariate methods to determine what neural markers of attention predict the ACS scores in a large sample of healthy young adults (n = 93). We first ran bivariate correlations between the ACS and several EEG measures, including spectral power, spectral inter-trial coherence, and key event-related potentials (ERPs) from multiple electrode locations across multiple time scales. This initial analysis revealed 11 neural markers of attention that were significantly correlated with ACS scores. A factor analysis revealed three distinct clusters among these markers. The strongest neural marker within each cluster (i.e., frontal midline theta on non-target trials of the sustained attention condition, parietal P300 amplitude on target trials during the impulsive condition, and parietal P300 latency on target trials during the sustained attention condition) was then entered into a multiple regression model using a leave one out cross validation procedure to obtain beta values for each variable as well as an intercept, which were used to predict the left out ACS. We found that predicted ACS was highly correlated ($r = 0.535$, $p < 1*10\text{-}7$) with the actual ACS, suggesting that this multivariate method can be used to effectively predict the ACS from EEG data. These findings demonstrate that midline frontal theta, parietal P300 amplitude and latency are critical predictors of ACS and thus provide important new therapeutic targets for interventions aimed at improving attention in impaired populations.

Increases in hippocampal activity are more detrimental to memory retrieval than decreases

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The hippocampus (HPC) is important for spatial and contextual memory retrieval. This was initially demonstrated using lesions or pharmacological inactivation prior to memory testing. Modern tools like optogenetics and designer receptors exclusively activated by designer drugs (DREADDs) are now being used to manipulate HPC activity in a more targeted manner. The goal of the current experiments was to examine the effects of several of these manipulations on neural activity and memory retrieval. To do so, we used contextual fear conditioning and examined c-fos expression following testing as a measure of neuronal activity. To decrease activity, we used CaMKII-hM4di, ArchT, and Halo. To increase activity, we used CaMKII-ChR2, CaMKII-hM3Dq and Syn1-hM4Di. Syn1-hM4Di was recently shown to silence inhibitory neurons and increase overall

activity. Preliminary results indicate that manipulations that reduce activity (e.g., CaMKII-hM4Di) have minor effects on retrieval, while manipulations that increase activity (e.g., CaMKII-ChR2) severely impair retrieval. Interestingly, manipulations that decrease activity in some neurons while increasing activity in many others, also robustly impair memory. Taken together, the data thus far indicate that decreases in HPC activity are often less effective at producing behavioral impairments than increases in HPC activity. The results are discussed in terms of the magnitude of change (net excitation vs. inhibition) vs. the direction of change (increase vs. decrease in activity).

Genetically encoded sensors for imaging neuromodulators in vivo

Tommaso Patriarchi[1], Jounhong R. Cho[2], Katharina Merten[3], Mark W. Howe[4], Aaron Marley[5], Wei-Hong Xiong[6], Robert W. Folk[3], Gerard J. Broussard[1], Ruqiang Liang[1], Min J. Jang[2], Haining Zhong[6], Daniel Dombeck[4], Mark von Zastrow[5], Axel Nimmerjahn[3], Viviana Gradinaru[2], John T. Williams[6], and Lin Tian[1]

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Neuromodulatory systems exert profound influences on brain function. Understanding how these systems modify the operating mode of target circuits requires measuring spatiotemporally precise neuromodulator release. We developed dLight1, an intensity-based genetically encoded dopamine indicator, to enable optical recording of dopamine dynamics with high spatiotemporal resolution in behaving mice. We demonstrated the utility of dLight1 by imaging dopamine dynamics simultaneously with pharmacological manipulation, electrophysiological or optogenetic stimulation, and calcium imaging of local neuronal activity. dLight1 enabled chronic tracking of learning-induced changes in millisecond dopamine transients in striatum. Further, we used dLight1 to image spatially distinct, functionally heterogeneous dopamine transients relevant to learning and motor control in cortex. We also validated our sensor design platform for developing norepinephrine, serotonin, melatonin, and opioid neuropeptide indicators.

Volitional photography inflates metamemory confidence but still causes an impairment in memory

Julia S. Soares and Benjamin C. Storm

Psychology Department, University of California, Santa Cruz, USA

Taking a photo of an object can make someone less likely to remember the details of that object than simply observing it, a phenomenon known as the photo-taking-impairment effect (Henkel, 2014). Recent research has suggested, however, that at least under certain conditions, volitional photo-taking can benefit memory (Barasch, Diehl, Silverman, & Zauberman, 2017). In the current study, participants either chose which objects to photograph (Volitional Condition) or were instructed to take photos of some objects but not others (Assigned Condition). Participants in the two conditions were yoked in such a way that they took photos of the exact same selection of objects. Although volitional photo taking led participants to become more confident in their memory for photographed objects than observed objects (an effect not observed in the Assigned Condition), it did not eliminate the photo-taking-impairment effect.

Medial temporal lobe damage impairs visual working memory for a single item

Robin I. Goodrich[1,2] and Andrew P. Yonelinas[1,2]

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[2]Center for Neuroscience, University of California, Davis, USA

A growing body of research indicates that the medial temporal lobe (MTL) is essential not only for long-term memory, but also for visual working memory (VWM). Specifically, the MTL is critical for VWM when relational bindings are necessary and especially when those bindings are highly complex or very precise. However, the extent to which VWM representational precision demands MTL involvement is unclear. To address this issue, we used a change detection paradigm to examine the effects of MTL damage on VWM for a single item requiring a high level of representational precision by analyzing the receiver operating characteristics of patients with MTL damage and healthy age- and education-matched controls. Compared to controls, MTL patients demonstrated significant reductions in VWM accuracy for a single item. Importantly, the patients were not impaired at making accurate high-confidence judgments that a change had occurred; however, they were impaired when making low-confidence responses indicating that they sensed whether or not there had been a visual change in the absence of identifying the exact change. The results parallel previous work implicating the MTL in sensing-based VWM and, astonishingly, indicate that MTL patients show a VWM impairment for a single item under certain conditions.

Investigating neurocognitive mechanisms of precision and variability in visual working memory

Elena Galeano Weber[1,2,3]

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Visual working memory (WM), or the ability to briefly store and manipulate information online is a central cognitive construct at the interface between visual perception and goal-directed action. In spite of the substantial amount of research on limitations in WM capacity, misconceptions of WM in terms of very simplistic conceptions of behavior still abound. This talk will feature recent findings on neurocognitive mechanisms of visual WM precision and WM variability - memory components that have become increasingly important for understanding visual WM capacity. I will describe two fMRI studies that combined cognitive modeling with univariate and multivariate analyses in healthy adults. These studies implicate the superior intraparietal sulcus (IPS) in stabilizing visual WM performance by reducing the variability of WM precision in the face of higher load (Galeano Weber, Peters, Hahn, Bledowski, and Fiebach, 2016). Further, results suggest that the multivariate pattern of stimulus-related parieto-occipital coupling is critical for establishing visual WM representations with high precision (Galeano Weber, Hahn, Hilger, and Fiebach, 2017). Finally, I will share most recent work on the precision and variability in children's spatial WM based on an intensive microlongitudinal approach with ambulatory assessment using smartphones in real-world contexts. Results demonstrated considerable variability in children's spatial precision across different timescales. In particular, item-to-item variability showed systematic increases with load and age, which emphasizes the important role of transient changes in spatial precision for the development of visual WM (Galeano Weber, Dirk, and Schmiedek, 2018). In sum, these studies highlight the importance to use more fine-grained behavioral measures of WM performance in combination with multivariate techniques to understand the factors that limit visual WM.

Semantic knowledge influences visual working memory capacity

Ariel Starr[1,2], Mahesh Srinivasan[1] and Silvia A. Bunge[1,2]

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How does our knowledge about the world influence what we remember? Are we better able to remember items we are familiar with? Across four experiments, we examined how visual working memory capacity varies as a function of object familiarity in both adults (Experiments 1 and 2) and children (Experiments 3 and 4). In all experiments, we compared memory capacity for familiar real-world objects (pictures of three-dimensional objects selected based on picture labeling data from children aged 4-6 years; Robertson & Kohler, 2007) versus unfamiliar real-world objects (pictures of three-dimensional uncommon and novel objects) using a change detection paradigm. In Experiment 1, we found that while memory capacity increased with encoding duration for both types of stimuli, memory was better overall for familiar objects compared to unfamiliar objects. In Experiment 2, we controlled for the possibility that better memory for familiar objects stems from verbal labeling by having participants perform a simultaneous verbal task. Once again, we found that memory capacity was significantly higher for familiar compared to unfamiliar objects. Next, we tested for this familiarity benefit in children, who have less experience with real-world objects. We found that older children (aged 6-9; Experiment 3) and younger children (aged 4-5; Experiment 4) also exhibited a benefit in terms of working memory capacity for familiar compared to unfamiliar objects. These findings suggest that people may draw on representations of real-world objects in long term memory in order to strengthen representations of these objects in working memory. Together, our data suggest that semantic knowledge influences the capacity of working memory, which challenges traditional views of working memory capacity and development.

Different developmental trajectories for working memory and reinforcement learning contributions to learning in adolescence

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Multiple neurocognitive systems contribute simultaneously to human decision making and learning. For example, the striatum uses dopamine signaling to slowly learn from rewards which choices are most valuable, a form of reinforcement learning. Prefrontal cortex (PFC) executive functions contribute other computations, such as actively maintaining single trial information in working memory or signaling a need to switch strategy. How the systems work together is not well understood. We investigate the developmental trajectory of their contributions to learning across adolescence. We predicted that behaviors dependent on striatal function would stabilize earlier than those dependent on PFC. We collected measures of learning in 180 youth (ages 8-17 years) and 53 adults (ages 25-30) using four reward learning tasks, including a task designed to separate out contributions of working memory from reinforcement learning. We used computational modeling to identify individual markers of working memory and reinforcement learning. Contrary to our prediction, we found no effect of age on working memory. However, we found strong effects of age on reinforcement learning processes: learning rates increased linearly with age. Furthermore, younger participants were also significantly more likely to neglect negative feedback. These results shed new light on the developmental science of learning in adolescence: children showed adult level of working-memory contributions to learning, and their weaker overall performance was linked to reinforcement learning, rather than executive processes.

Context-specific sequence representations in the hippocampus

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[3]Department of Psychology, University of Cambridge, UK

The hippocampus is involved in both episodic and spatial memory. Theories of hippocampal function attempt to bridge these two seemingly separate research lines by proposing either that hippocampus anchors memories to a cognitive map of space (O'Keefe & Nadel, 1978), or that it encodes a multidimensional "memory space" that systematically links related episodes in the same context (Eichenbaum et al., 1999). To test these theories, we created a novel paradigm in which participants use buttons to actively navigate through a series of different animals in two distinct "zoo" contexts, each structured to be analogous to the plus maze used in studies of the rodent hippocampus (e.g., Behar & Shapiro, 2012). Animal images and pairwise sequential associations between the animals were identical across both contexts, but the global configurations were shifted such that the route to navigate from the same start and endpoints varied across the two contexts. During the exploration phase, subjects were oriented to the plus maze layouts and then allowed to explore each zoo by making button presses (Up, Down, Left, or Right) to move to another animal. After participants learned the zoo layout, they were scanned during a task that required them to use button presses to actively "navigate" from a starting animal to a goal animal. We expected that, if the hippocampus represented two-dimensional maps of the contexts, then hippocampal voxel patterns would reflect the current animal participants were viewing during navigation, whereas if the hippocampus represented points along a journey, voxel patterns would differentially represent each animal in a manner specific to the sequence of animals between the start and the goal. Consistent with the latter idea, hippocampal activity patterns were sensitive to the specific zoo context and the context-specific animal sequence participants were traversing on the current trial. Together, these findings suggest that during goal-directed navigation, the hippocampus represents the spatio-temporal relationships between current and future events, rather than the current location in an environment.

The effect of body-based cues on human neural representations for space following active navigation

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Body-based cues, which include vestibular, proprioceptive, and somatosensory input, are hypothesized to play an important role in the neural basis of spatial representations formed during navigation. Alternatively, it may be that navigation-related spatial representations are largely modality independent, and thus body-based input, particularly during retrieval, may be less relevant. Due to technological limitations, however, little is known about the influence of body-based cues on neural representations of space in humans. Here, participants navigated three cities under different levels of body-based cues using novel immersive virtual reality devices: 1) impoverished condition: rotations and translations via joystick, 2) limited condition: rotations via body rotations and translations via joystick, 3) immersed condition: rotations via body rotations and translations via an omnidirectional treadmill. Participants were trained to criterion on a judgment of relative directions (JRD) pointing task on all three cities prior to fMRI scanning. During scanning, all participants performed better than chance on the JRD task for all three cities. Analyses of whole-brain activation and functional connectivity revealed no significant differences during the JRD task for the three levels of immersive encoding, suggesting little influence of body-based cues on retrieval of spatially relevant information during the JRD task. As a positive control, both the activation and functional connectivity analyses revealed significant differences between the JRD task and active baseline and rest conditions, which included brain areas previously implicated in navigation, such as the hippocampus, retrosplenial cortex, parahippocampal cortex, and precuneus. Together, our findings suggest that the absence of body-based cues does not significantly alter spatial representations relevant to navigation, supporting the idea that such representations are largely modality independent during retrieval.

Integrating abstract structures and constructing cognitive maps about social hierarchies

Seongmin. A. Park[1], Douglas. S. Miller[1], Hamed Nili[2], and Erie. D. Boorman[1]

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During navigation, animals' hippocampal-entorhinal circuit integrates path information including location, distance, and direction. Recent findings suggest that this circuit may serve a more general mechanism for constructing the cognitive maps of task environments beyond spatial navigation. Here, we test whether human brains follow the same principles underlying path integration while integrating social hierarchical structures and building a cognitive map of social networks. Participants first learned the social hierarchies of the two groups on two independent social dimensions separately. Second, under each dimension, participants learned the relative hierarchy of one individual in a group against another in the other group, which created a unique associative path across groups per individual in the social network. Last, in the fMRI, participants inferred the relative hierarchy between pairs who had not been compared in the given dimension. We examined whether participants recalled specific individuals whose hierarchy had been compared between groups and used these relevant representations as "hubs" between the two networks to enable the transitive inferences. Behaviorally, we found that the reaction time for inferences not only depends on the different levels of hierarchy between the pairs but also the within-group Euclidean distance from the hub in the two-dimensional social space. Neurally, the within-dimension difference between individuals in hierarchies was encoded in the medial prefrontal cortex (mPFC) and the entorhinal cortex (EC). During inference decisions, mPFC and EC encoded the Euclidean distance from the hub. To test for neural representations of the hub, we adopted trial-by-trial fMRI suppression. While subjects performed a cover task to detect the gender of suppression images, we found suppression in the hippocampus for the specific trials where the pair was followed by their hub compared to other matched hubs that were not theirs. Our findings provide preliminary evidence that the human EC integrates the relationship between abstract and discrete entities into a cognitive map. They further suggest the mPFC retrieves relevant representations from prior experiences to meet current demands and infers social relationships across groups based on the spatial map. These results shed light on how abstract and discrete structures are combined and represented in the human brain, suggesting that general mechanisms in the human EC can be extended to map abstract social networks and used by the mPFC to guide goal-directed inferences, supporting their roles in higher social-cognitive functions.

Consolidation promotes retention of events that form a coherent narrative: Evidence for higher-order structure in episodic memory

Brendan I. Cohn-Sheehy[1,2,3] and Charan Ranganath[1,2,4]

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Many studies have shown that people break up continuous streams of experience into discrete events, a process known as "event segmentation." Although researchers have often focused on the segregation of events from one another, people might link information across multiple events. For instance, if your friend calls and tells you they forgot to turn off the stove, and if at a separate time your friend mentions the fire department was able to access their apartment, information from these two different events might become linked in memory, even though the events were encoded at separate times. Some theories of memory consolidation suggest that memories for related events can be linked into a higher-order structure through offline interactions between the hippocampus and neocortex. We hypothesized that delay-dependent consolidation can promote retention of events that can be linked through a coherent narrative, even if these events are encoded at separate times. To investigate how coherence relates to subsequent recall, we created a new paradigm in which participants encoded four fictional stories that were presented as continuous audio clips. Coherence was operationalized in terms of four side-characters, each appearing in the context of two temporally-disparate story clips centered on one of two main protagonists. Critically, the stories involving the side-characters were not meaningfully related to the surrounding main stories (i.e., "sideplots"). For two side-characters, the sideplot events could be linked into a larger narrative ("coherent sideplot events"), whereas sideplot events for the other two side-characters were unrelated to each other (incoherent sideplot events). Half of the participants recalled the stories immediately after story presentation, and half recalled the stories after a 24-hour delay. Blinded coding of recall revealed that participants from the 24-hour delay group recalled more information from coherent than for incoherent sideplot events ($t(35)=3.79$, $p<0.001$), whereas those in the immediate recall group showed no significant differences in recall between coherent and incoherent sideplot events ($t(35)<1$). Comparison between the groups revealed a significant Delay X Coherence interaction ($F(1,70)=6.32$, $p<0.014$), indicating that the effect of sideplot coherence was significantly larger after a 24 delay. Crucially, events involving main protagonists (i.e. not sideplots) were not recalled differently between the 24-hour and immediate recall groups ($t(70)=0.77$, $p<0.44$). The results are consistent with the idea that coherent events are preferentially consolidated in memory.

Proactive control in context: Context-cued predictions of control demands facilitate perceptual decisions in virtual environment

Jiefeng Jiang[1], Shao-Fang Wang[1], Wanjia Guo[1,2], and Anthony D. Wagner[1,3]

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Human behavior relies on cognitive control to adaptively adjust mental states and behavior to internal goals. Recent studies have shown that, in addition to passively reacting to current task demands, cognitive control can also be regulated proactively based on the predicted forthcoming need for cognitive control. Of central interest is determining the mechanisms through which forthcoming cognitive control demands (CCD) are predicted. In this behavioral study, we tested the hypotheses that (a) CCD can be associated with spatial contexts, such that (b) subsequent encounters with a spatial context can drive the retrieval of its associated CCD and thus enable proactive control. The experiment consisted of 6 runs of 8 blocks each, during which participants needed to draw on selective attention to make perceptual decisions. In each block, participants were cued to navigate to one of four buildings in a virtual 3D environment. They then performed 8 trials of a perceptual decision-making task within a virtual room in the building. Each trial started with the presentation of a task cue, followed by a bivalent image of two overlapping translucent images (one face image and one object image). Based on the cue, participants were required to indicate either the gender of the face or the type of tool. To manipulate the contextual CCD, participants performed mostly face judgments in two buildings and mostly object judgments in the other two buildings. In the analyses, the learning of the association between the spatial contexts (i.e., buildings/rooms) and their corresponding CCD was modeled using reinforcement learners (one per context), which predicted the contextual CCD (i.e., the likelihood of performing the face task vs. the object task) at the trial level. We predicted that proactive retrieval of expectations about the context-associated CCD would facilitate behavioral performance when it matched the actual task demand indicated by the task cue. To control for context-free learning of CCD, an additional reinforcement learner predicting CCD based on trial history (regardless of context) was used as a covariate. A trial-level mixed effect model showed responses were faster when the discrepancy between contextual and actual CCD was smaller. Preliminary fMRI findings will also be presented.

Stable representations of a cautious state of mind: An fMRI study of memory and perceptual decision-making

Tyler Santander, Evan Layher, Puneeth Chakravarthula, Nicole Marinsek, Benjamin O. Turner, Miguel P. Eckstein, and Michael B. Miller

Department of Psychological and Brain Sciences, University of California, Santa Barbara, USA

Successful memory judgments rely on both the available memory evidence and an appropriately biased decision criterion. Recent behavioral research suggests that criterion placement is a stable individual trait across various memory and decision-making tasks alike. However, it is unknown whether neural representations of criterion placement are similarly consistent. To test this, 29 healthy young adults performed recognition memory and perceptual decision-making tasks during fMRI scanning. In each task, criterion placement was manipulated by assigning monetary rewards/punishments to decision outcomes. To induce liberal criterion placement, one condition heavily punished misses; another condition punished false alarms to induce conservative criterion placement. Decision evidence was also manipulated across 'low' and 'moderate' conditions, such that stimuli with moderate memory evidence were repeated multiple times during encoding, and perceptual stimuli had easier/harder targets to detect. As predicted, individuals set decision criteria similarly regardless of task, while discrimination performance (d-prime) was unrelated. We then applied a sparse Bayesian multi-task multi-kernel learning (SBMTMKL) approach to probe whether multivariate neural representations of decision evidence and criterion placement were shared across tasks. Inputs were contrast images (Hits > Correct Rejections) reflecting successful decision-related activity in each task, criterion condition, and low/moderate evidence conditions. Multiple linear kernels were constructed for each input by parcellating the brain according to the 400-region Schaefer atlas. Split-half cross-validation was used to evaluate cross-task classification accuracy (i.e., training on memory data, testing on perception, and vice-versa). SBMTMKL significantly distinguished between liberal/conservative criterion conditions across tasks, with a network of frontoparietal regions providing the strongest contributions to the model. However, we did not identify consistent patterns of activity underlying low/moderate decision evidence across tasks. This suggests criterion placement may have a stable neural representation invariant to decision task, and moreover, that activity related to successful decisions reflects the extent to which one is monitoring evidence through careful criterion placement, not the strength of evidence itself. This research was sponsored by the Army Research Laboratory and accomplished under Cooperative Agreement Number W911NF-10-2-0022.

Criterion shifting in memory recognition is a stable trait

Evan Layher, Anjali Dixit and Michael Miller

Department of Psychological and Brain Sciences, University of California, Santa Barbara, USA

Criterion shifting in memory recognition is highly variable across people. Some individuals shift their decision criteria quite readily while others do not shift at all. Despite this variability across participants, criterion shifting within participants is much more stable. We tested the within subject stability of criterion shifting across 2 separate studies that required participants to conduct memory recognition tasks on 10 different days. We manipulated criterion shifting through payoffs in Study 1 (N=39) and through target rates in Study 2 (N=39). Across the 2 studies, the average session-to-session criterion shifting correlation ($r = 0.77$) greatly exceeded the memory discrimination (d') correlation ($r = 0.52$). Overall, the high test-retest reliability of criterion shifting suggests it is a stable cognitive trait.

Involuntary mental replay of music improves retention of incidentally associated episodic knowledge

Benjamin Kubit[1,2] and Petr Janata[1,2]

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Why is music so effective at evoking memories from one's past? By linking two common musical phenomena: involuntary musical imagery (IMI, commonly called "earworms") and music-evoked autobiographical remembering, we tested the hypothesis that IMI aids in the consolidation of memory for events to which the music has been bound. Participants encoded novel music loops that subsequently served as soundtracks for unfamiliar movies. At delays of 1 – 4 weeks, they recalled movie details, using the soundtracks as retrieval cues. The amount of IMI during the delay period accounted for significant amounts of variance in both the accuracy of the memory for the music itself as well as the amount of recalled movie-knowledge. IMI serves as a spontaneous memory rehearsal mechanism for music and associated episodic information.

Shifting expectations: Criterion shifting mediation of EEG, in a security patrol paradigm

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A criterion is the amount of evidence required to identify a stimulus as previously encountered or belonging to a target group. A liberal criterion requires less evidence, while a conservative criterion requires more evidence. Security personnel looking for a suspicious person could use a more conservative criterion when the target is likely to experience greater harm. Conversely, when the target is only to be questioned, a more liberal criterion could uncover more information. The act of identifying a suspicious person from a photo or artist rendering is a facial recognition task. Aminoff et al. (2015) found conservative criterion placement explains regions in the later prefrontal and parietal cortex associated differential fMRI activity in frontal-parietal regions when correctly identifying targets vs. correctly rejected non-targets (known as the successful retrieval effect). We use event related potentials (ERPs) to explore temporal dynamics criterion shifting mediation of the successful retrieval effect in a military security patrol. We expect to see criterion mediation in a later positive peak, associated with cognitive load (P3), and reduced criterion mediation earlier components related to categorization.

A stimulus-computable model of inferior temporal cortex predicts perceptual demands on perirhinal cortex

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Animals are able to rapidly transform sensory experience into memory. In the mammalian brain, perirhinal cortex (PRC) is thought to play a critical role in this transformation. Situated at the junction of "high-level" sensory cortex and mnemonic structures within the medial temporal lobe, PRC is widely recognized for its role in item-based familiarity judgments. Yet there is an enduring debate around PRC's role in sensory processing. This debate centers on discriminating between "ambiguous" stimuli (e.g., items with many similar features). This work, however, often appeals to informal descriptions of sensory demands. Here, we draw from recent innovations in computer vision in order to formalize the role that PRC may play in visual behaviors. Using recordings from neural populations in macaque Inferior Temporal cortex, we first demonstrate the correspondence between a computational model of object recognition and high-level visual cortex. We then ask: what visual behaviors does this model fail to capture? Presenting humans and model with the same stimuli, they perform a set of within-category visual discrimination tasks argued to recruit PRC. We demonstrate an interaction between (1) time of stimulus presentation and (2) similarity between item-level representations (in both model and neural space). Variance along these two dimensions predicts when human behavior matches and diverges from high-level visual cortex. These results provide a more formal, computational account of the behaviors thought to recruit PRC, and makes explicit the interaction between temporal and representational demands.

Preliminary results of the hippocampal subfields group harmonized protocol for segmenting human hippocampal subfields on 3T MR

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Over the last 15 years, the number of studies using high-resolution MRI to examine the structure and function of human hippocampal subfields has soared. However, the ability to compare findings across studies has been hampered by substantial differences in how subfields are segmented by different research groups. To remedy this issue, the Hippocampal Subfields Group (HSG) was formed in 2013 with the goal of creating a valid and reliable harmonized segmentation protocol grounded in robust histological standards. Over the past 5 years, our efforts have focused on developing a harmonized protocol for high-resolution T2-weighted 3T MRI. Our development approach consists of: 1) collecting histology samples labeled by multiple anatomists to guide the development of an MRI segmentation protocol, 2) holding working group meetings to develop different portions of the protocol (e.g., hippocampal body, head), 3) assessing HSG agreement with boundary rules via a series of online questionnaires, 4) revising boundary rules in response to questionnaire responses, and 5) testing reliability of each rule on multiple MRI data sets. Given substantial differences in the anatomy of the hippocampal head and body, we have approached these regions separately. For both the body and the head, we have completed steps 1 and 2, such that we have developed a preliminary subfield segmentation protocol for each region. Additionally, with respect to the outer boundaries of the body (i.e., the anterior/posterior, medial/lateral, and superior/inferior boundaries), we have completed steps 3 and 4 as well. An online questionnaire describing each of the outer boundary rules was sent to HSG members, with a total of 29 labs participating. Consensus agreement was reached for all rules included in the questionnaire, but slight modifications were made to select rules to improve clarity. We are now in the process of creating and administering additional questionnaires assessing agreement with the inner boundary rules for the hippocampal body (e.g., between the cornu ammonis fields) as well as the boundary rules for the hippocampal head. Upon completion of the assessment/revision process for each set of rules, the final phase – validation testing – will begin. Once completed, the harmonized protocol is expected to significantly impact the field by enabling cross-study comparisons and thus advancing our understanding of the structure and function of hippocampal subfields.

Alzheimer's disease genetic risk factors and cognitive decline in individuals with African ancestry

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Genetic variants in APOE and ABCA7 influence the risk for AD dementia differently in Blacks and Whites. We examined the associations between these genetic AD factors on cognitive decline in an African admixed and European sample, and furthered explored whether the continuum of African ancestry modifies these associations. Genetic ancestry across five super populations (European, African, American, South Asian, East Asian) was determined using Ancestry Informative Markers and SNPweights for 1,669 participants from the Alzheimer's Disease Neuroimaging Initiative (ADNI). We focused on two groups: participants with at least 10% African ancestry that largely identified as Black (n=79; "Admixed African"), and Europeans who had <10% African ancestry and self-identified as non-Hispanic White that were age, sex, education, and diagnosis matched to the Admixed African group (n=79; "European"). Cognitive decline was examined using longitudinal composites for memory and executive function. The effect of APOE4 and ABCA7 on cognitive change was assessed using linear mixed models, controlling for age, sex, education, and diagnosis. The Admixed African group showed a continuous distribution of African ancestry that ranged between 10% and 94%. APOE4 was significantly associated with decline in memory and executive function over time, while ABCA7 was associated with memory decline in the Admixed Africans. Only APOE4 was associated with cognitive decline in Europeans. Within the Admixed African group, the three-way interaction between time, percent African ancestry, and APOE4 status was significant, such that the impact of APOE4 on memory decline was only present among at lower percentages of African ancestry. The effect of APOE4 on memory was mediated by amyloid status in the European sample, but not the Admixed African group. Rather, APOE4 exerted an effect on memory that was independent of Amyloid status within the Admixed African group. APOE4 and ABAC7 are predictors of cognitive decline in participants with admixed ancestry. However, the effect of APOE4 on memory decline was diminished at higher percentages of African ancestry. The amyloid-independent effect of APOE4 on memory decline in the Admixed African group suggests additional pathways are present that promote cognitive decline. Genetic risk factors for AD should be considered with respect to ancestry background.

From child eyewitness to adult memory: Identification responses after 20 years

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Current eyewitness identification research indicates that, under certain conditions, adults' confidence and identification accuracy are positively correlated. Additionally, children have higher rates of falsely identifying someone in a lineup compared to adults. This raises an important question: If a child experiences a criminal act, such as child abuse, would that same person as an adult be able to accurately and confidently identify the perpetrator? This longitudinal study focused on investigations of alleged childhood maltreatment and adult eyewitness memory. At the first time point (Time 1, 1995-1996), children (3- to 16-years-old, M = 7.67, SD = 3.16; N = 120), removed from home in child maltreatment actions, were evaluated by doctors, nurses, and psychologists. These same children, as adults, were contact 20 years later (Time 2, 2015-2017) to evaluate their memories of a subset of the people (a doctor, nurse, and psychologist) with whom they interacted as children. Participants were shown a series of lineups and asked to identify any staff members that they interacted with at Time 1. Results showed that adults' accuracy of identification was statistically at chance. However, there were higher rates of non-selection responses compared to guess and selection choices. Analyses then concentrated on the adults' responses to the lineups, such as rejection, no choice ("I don't know"), and selection. For doctor (n = 92), nurse (n = 98), and psychologist (n = 95) lineups, statistically significant correlations between confidence levels and identification responses emerged, ps $\leq$ .004: After a 20-year delay, greater confidence was associated with rejecting compared to selecting a person in a lineup. Future research should examine individual-difference predictors of identification accuracy, selection, and confidence after long delays in longitudinal studies. This abstract is based upon work supported by the National Science Foundation under Grant No. 1424420. Any opinions, findings, and conclusions or recommendations expressed in this abstract are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Who retains irrelevant information? Exploring individual differences in memory for distractors

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Studies of selective attention typically measure subsequent memory for target information, but not for distracting information that participants were asked to ignore. Here, we sought to explore individual differences in attention and subsequent memory for relevant and irrelevant stimuli. To this end, we had young adults perform a dichotic listening task in which they heard two stories presented simultaneously and were asked to attend to only one of them. They then answered questions about to-be-attended, to-be-ignored, and previously unheard stories. We hypothesized that particular features of their childhood home, including noise level and various stressors, would contribute to differences in attentional allocation. Specifically, we predicted that adults from lower socioeconomic status (SES) families would be predisposed to attend more to seemingly irrelevant stimuli than those from higher SES families, thereby resulting in a lower degree of selective attention. Participants were 71 UC Berkeley undergraduates: 35 with parents who had less than a college degree (lower SES), and 34 with parents who had post-graduate degrees (higher SES). Participants deemed lower SES were more likely to report having had a lower childhood household income ($p<0.001$), living in noisier homes before the age of 10 ($p<0.001$), and experiencing higher levels of childhood neglect ($p=0.003$). On the dichotic listening task, participants across both groups retained less from the distractor story than the target story ($p<0.001$), but slightly more than from the unheard story ($p=0.068$). Living in a noisier home predicted less learning from the distractor story ($p=0.019$) across participants, and higher levels of childhood neglect predicted less learning from the distractor story for higher SES but not lower SES participants (interaction: $p=0.001$). These results suggest that early aspects of children's home environments contribute to the development of selective attention; however, they run counter to our initial predictions. Importantly, our sample of lower SES adults was biased towards highly resilient and successful individuals. In future research, we will test our predictions in a broad community sample.

The role of the ventral hippocampus – amygdala projection during fear memory learning and retrieval

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The hippocampus has a crucial role in storing and retrieving episodic and spatial memories. It is also necessary for the retrieval of contextual fear memories wherein a previously neutral location or context becomes associated with danger. However, since the HPC is not the site of storage for the context-shock association, it must communicate with structures outside the HPC in order to drive memory retrieval. Evidence strongly implicates the amygdala (AMY) as the site of storage for the CS-US association in fear memories. In the case of contextual fear conditioning, it is thought that the HPC provides the contextual information needed by the AMY to form the CS-US association and support its' retrieval. Projections to the AMY from the HPC originate only within the ventral 2/3 of the hippocampal structure and terminate in anterior portions of the BA (basal amygdala); amygdalar nuclei implicated in contextual dependent learning in appetitive and aversive tasks. Mounting evidence suggests that this projection is necessary in the retrieval of contextual fear memories (Luthi 2013 and Mazen poster), causing a deficit in fear memory retrieval after optogenetic manipulation of neurons that project to the BA at the somata (Luthi 2013) or terminals (Jimenez et al 2018). Here, we have confirmed the original finding of Jimenez et al that optogenetic manipulation of VHC neurons can disrupt fear memory retrieval. We also quantify context dependent activity during training and retrieval within the VHC-BA projection using a combination of c-fos imaging and retrograde tracer. Future work will utilize the fos-tta inducible tagging system to enable identification of ensembles reactivated by contextual fear memory retrieval in VHC-BA projecting neurons and restrict optogenetic manipulation to VHC-BA projection of context-activated neurons at both the soma and terminals to determine whether context dependent activity within this projection is either necessary or sufficient to drive context fear memory retrieval.

Prefrontal cortex GABA and temporal order working memory in people with schizophrenia

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GABA is the primary inhibitory neurotransmitter in the brain, and appears responsible for establishing neural oscillations, which coordinate neural activity within and between local brain circuits. GABAergic inhibition generates theta oscillations that predominate within the hippocampus and promote long-term potentiation and memory formation. Because people with schizophrenia (SZ) have prominent relational memory deficits associated with impaired prefrontal and hippocampal memory network function, we hypothesized that they would also show atypical relationships between GABA concentrations and task performance relative to healthy controls (HC). Thirty-nine people with SZ and 49 HC performed a previously validated temporal order working memory (WM) task and also underwent magnetic residence spectroscopy (MRS) to quantify GABA concentrations in a middle frontal gyrus (MFG) region of interest (R01). Correlational analyses revealed predicted positive correlations between MFG GABA and performance on both item memory and temporal order memory task conditions (both $r=.29$, $p<.05$) in HC. In both cases, higher levels of GABAergic inhibition were associated with better WM. Conversely, the SZ group produced negative correlations, with higher GABA levels associated with worse performance on item memory ($r=-.38$, $p<.05$) and on order memory at a trend level ($r=-.27$, $p=.097$). Group contrasts confirmed that r-values were greater for HC than for SZ in both the item memory ($p<.002$) and temporal order memory conditions ($p<.05$). Although preliminary, these results suggest that GABAergic dysfunction may be contributing to the memory impairments that are so detrimental to the daily function of people with SZ.

Physician-reported perceptions of legal, ethical and social risks and benefits of amyloid imaging in a preclinical population

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Alzheimer's disease (AD) biomarkers are central to earlier detection and the development of future disease modifying therapies. Physicians' perspectives on the potential preclinical use of AD biomarker tests may impact their future clinical implementation. Amyloid-positive individuals may be vulnerable to employment or insurance discrimination due to a lack of federal or state anti-discrimination protections. Investigators examined how physicians perceived these and other risks in response to the potential preclinical use of amyloid PET. Semi-structured interviews with 17 physicians (dementia experts). Interview guides assessed physicians' perspectives on the value of preclinical biomarker tests and integrated three hypothetical scenarios to evaluate how physicians would counsel asymptomatic patients seeking amyloid PET. Data were analyzed using the framework method (data immersion, theme identification, indexing, charting, and interpretation). Physicians reported diverse perspectives on the preclinical use of amyloid PET. Identified risks include psychological stress, particularly due to a lack of AD treatment (i.e., not being able to act on a positive amyloid result). Physicians identified risks to employment and insurability based on a positive biomarker status, citing lack of legal protections analogous to GINA. Prognostic uncertainty of amyloid PET raised concern for misinterpretation of results or inappropriate expectations for the future. Reported benefits of the preclinical use of amyloid PET were limited to research. Physicians noted that clinical benefits were conditioned upon the availability of disease modifying treatment. Unconditional benefits included the potential for positive lifestyle changes and future planning. In the hypothetical scenarios, physicians either encouraged or discouraged amyloid PET for asymptomatic patients or remained neutral. Investigators found variations in responses across hypotheticals. Responses reflected physicians' perspectives of the risks and benefits of preclinical amyloid PET and were further guided by patient-specific factors such as employment type. Physicians' perceptions demonstrated a risk-benefit assessment of amyloid imaging in preclinical individuals. Frequently cited risks to employment and insurability highlight the need for legal protections specifically for biomarkers. Furthermore, variations in physicians' recommendations call for standardized approaches to managing requests for amyloid PET. The reported results will contribute to the development of standardized counseling and informed consent methods for AD biomarker testing.

Functional segregation along the proximodistal axis of CA1

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Recent evidence suggests that some functions of the hippocampus (HPC) may be segregated along its transverse axis. For instance, the HPC receives spatial input from the medial entorhinal cortex (MEC) and postrhinal cortex while it receives odor/object-related information from the lateral entorhinal cortex (LEC) and perirhinal cortex. Although these inputs are mixed in dentate gyrus and CA3, they remain segregated in the entorhinal cortex projections to CA1. The proximal (next to CA2) and distal (next to subiculum) segments of CA1 receive direct projections from MEC and LEC, respectively. This suggests that information processing may be functionally distinct along the proximo-distal axis of CA1. To test this idea, we quantified c-fosx expression in proximal and distal CA1 of mice that were either exposed to a novel context, novel objects in a familiar context, or a familiar context without objects. Consistent with previous reports, we found that novel context exposure increased c-fos activity in proximal CA1 while exposure to novel objects resulted in higher c-fos levels in distal CA1 compared to control mice. Using targeted infusions of halorhodopsin, we are currently in the process of silencing distinct regions during testing of spatial and object recognition tasks. We predict that silencing proximal CA1 will impair contextual memory retrieval of a familiar environment. In contrast, we predict that silencing distal CA1 will impair performance on object recognition tasks. Our experiments will further improve the current framework of how the hippocampus forms and retrieves different types of memories.

Retrieval-induced forgetting has low test-retest reliability: Implications for individual differences research

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Retrieving a memory can cause forgetting of other related memories, a phenomenon known as retrieval-induced forgetting (Anderson, Bjork, and Bjork, 1994). With considerable evidence supporting the existence of retrieval-induced forgetting (e.g., Murayama et al., 2014), there has been growing interest in exploring individual differences in this type of forgetting. The magnitude of retrieval-induced forgetting has been found to correlate with many other measures, including working memory capacity, anxiety, and recruitment of the prefrontal cortex. At the same time, however, there is evidence to suggest that these measures have low test-retest reliability (Potts et al., 2012). Here we conducted multiple large sample (n's>100) assessments of the reliability of retrieval-induced forgetting. We also assessed several other measures that have previously been reported to correlate with retrieval-induced forgetting, such as working memory and anxiety. As reported by Potts et al. (2012) we found the reliability of retrieval-induced forgetting to be quite low (r's<.2) and, unsurprisingly, we failed to replicate the published correlations with other measures. Discussion will focus on explanations of why reliability might be so low and the implications that this has on the use of this paradigm to assess individual differences in inhibitory control.

The persistence of cognitive enhancement benefits 6 years later

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Six years ago, we observed that our cognitive enhancing intervention (NeuroRacer) resulted in performance benefits that extended to untrained cognitive control abilities (enhanced sustained attention and working memory), increased midline frontal theta power, and the preservation of multitasking improvement 6 months later (Anguera et al., 2013). Here we tested original participants (n= 31 of 46) six years after their last post visit to probe for any lasting effects of training. Participants were administered the same neuropsychological assessment as six years ago to examine potential changes in mental health, as well as the same behavioral and neural measures that showed positive effects in the original study. The training individuals showed continued greater performance on the NeuroRacer multitasking assessment compared to the control groups six years later ($p=.024$). Neuropsychological testing results suggested that the intervention group may have better overall cognitive function compared to controls (10 out of 11 were still eligible 6 years later, compared to 15 out of 20 control participants). However, there was no continued evidence of transfer to previously untrained tasks ($p> .292$). We will be further examining collected EEG measures to interrogate if previous neural markers of cognitive control show patterns of persistence. While limited in their power, these findings indicate that there may be lasting benefits of adaptive video game training spanning several years.

The effect of a novel simultaneous cognitive-physical training video game on an older adult population

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Both cognitive and physical training can have positive effects on cognitive control abilities (e.g. attention, working memory, goal management). Here we deployed a novel training video game ("Body-Brain Trainer: BBT") for older adults that combines cognitive and physical aspects. Both cognitive and physical task difficulty was adaptive on a trial-by-trial basis (cognitive performance metrics and real-time heart rate measurements, respectively). In this study, cognitively normal older adults (n=21; 55-85 years of age) were asked to train for 24 hours over eight weeks, with cognitive and physical outcome measures assessed prior to and following this training period. An age-matched group of expectancy-matched controls (n=20) played a set of three placebo applications. Preliminary evidence of cognitive control generalization included a group X session interaction suggesting a differential improvement in the training group involving their impulsivity [$p=0.024$]. The training group, unlike the control group, also showed improved working memory fidelity (paired t-test, both in accuracy [$p=0.003$] and response time [$p=0.017$]). On the physical side, training participants showed a significant drop in diastolic blood pressure (paired t-test [$p=0.014$], as well as improved gait speed (paired t-test [$p=0.035$]), with each measure having been independently associated with cognitive performance. These findings provide initial evidence supporting the idea that synergistic effects from the careful combination of these distinct training approaches may be realized on the cognitive side. Ongoing efforts include the examination of other assessments, including EEG, physiological markers, and surveys of daily living, to fully evaluate the magnitude of cognitive and physical benefits from this study.

The more you know: Investigating why adults get a bigger memory boost from semantic congruency than children

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Previous work indicates that semantically congruent information is remembered better than semantically incongruent information. However, few fMRI studies have studied the neural correlates of this congruency effect in typical development. The current fMRI study examines - in a sample of 47 younger children (8-9), 47 older children (10-12), and 30 young adults (18-25) – developmental differences in the neural correlates of episodic memory encoding and retrieval for semantically congruent vs. incongruent object-scene pairs. In the scanner, participants encoded object-scene pairs by judging whether each pair belonged together (i.e., congruent response) or not (i.e., incongruent response), and episodic memory was tested with a source memory test (i.e., which scene was this object paired with?). Consistent with prior work, source accuracy improved with age. Additionally, in all age groups, source accuracy was greater for congruent than incongruent pairs. This congruency effect was greater in adults than both younger and older children. Functional MRI results indicate age-related differences were found in left PFC in both univariate activity and functional connectivity. Moreover, age-related differences in pattern similarity between encoding and retrieval trials (i.e., encoding-retrieval similarity) were also observed in left PFC. Follow-up analyses will examine longitudinal changes in behavior and the brain in children who returned for multiple sessions approximately 1.4 years apart.

Architecture of representations in pre-frontal cortex during credit assignment

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Representations of the causal relationships between behavior and outcome are essential to implementing adaptive goal-directed behavior. The structure of causal relationships in the environment are not always apparent, yet they often must be used to infer relationships from experienced outcomes. In this study we show how the brain represents latent causal relationships when assigning credit for an outcome to its causes and how the brain flexibly updates these representations to maximize reward. Subjects (N=22, 14 Female, Median age = 21) participated in a reward-learning task where they tracked two systems of stimulus-outcome associations. Each system comprised two interrelated stimuli that always led to opposite outcomes, allowing subjects to make inferences about one stimulus from observing the other. In this way subjects learned about directly experienced and inferred associations through knowledge of these interrelations. Behaviorally, we found evidence subjects learned from both directly experienced and inferred past outcomes (experienced: $t(21)>6.95$, $p<0.001$; inferred: $t(21)>3.73$, $p<0.001$). We analyzed the fMRI data using a combination of univariate and multivariate approaches. Specifically, we used a support vector machine to decode representations of the recently chosen stimulus and the interrelated but unchosen stimulus at the time subjects received feedback for their choices. Our results show that areas in the lateral orbitofrontal cortex and ventrolateral prefrontal cortex, lateral occipital cortex, and hippocampus code for the specific chosen stimulus at outcome time. Updates to these representations recruited a network including lOFC, lateral prefrontal cortex, and pre-SMA**.** Finally, medial prefrontal cortex simultaneously coded for a representation of the latent cause – the abstract knowledge about the interrelations between sets of stimuli and outcomes**.** These findings suggest a representational architecture of prefrontal representations for credit assignment.

Distinct ERP and EEG oscillatory mechanisms of memory dysfunction in MCI

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Two electrophysiological measures, the P600 event-related potential (ERP) and oscillatory alpha suppression, have been shown to be sensitive to the effect of word repetition and significantly correlated with the efficiency of verbal learning and memory in healthy elderly and patients with MCI or prodromal Alzheimer's disease (Olichney et al., 2008; Mazaheri et al., 2017). Cross-subject correlation between the two measures (r=.36, p=.03) and their similar temporal profiles, i.e., both sustained in time with a relatively late onset (~0.5 sec after stimulus onset), give rise to the question whether they reflect the same underlying brain activity. In the present study, we extracted single-trial P600 components using an automated denoising method (Ahmadi & Quian Quiroga, 2013), and compared it with alpha suppression on a trial-by-trial basis. The results showed that despite the overall moderate cross-subject correlation, there was minimal trial-by-trial correlation between the two EEG/ERP measures of memory, suggesting that they are unlikely to be generated by the same neural mechanisms. Furthermore, ERPs constructed from bandpass filtered (delta, theta, alpha, beta, or gamma bands) single-trial data revealed that delta band activity (1-4Hz) alone was strongly correlated with the traditional P600 repetition effect constructed by averaging 'unfiltered' EEG signals. ERPs in higher frequency bands, including alpha, did not contribute to the ERP word repetition effects such as P600. Thus, it appears that the vast majority of the P600 word repetition effect is mediated by slow wave activity. The present study highlights the importance of combining ERP and EEG oscillatory measures in order to more comprehensively characterize the likely multiple mechanisms of memory failure in patients with MCI or prodromal AD.

Vascular risk factors predict memory decline independent of amyloid status in participants with African ancestry

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Although Alzheimer's disease risk is influenced by multiple age-related processes, such as the accumulation of amyloid as well as vascular risk factors, the contributions of these risk factors may vary across individuals with different genetic backgrounds. We therefore sought to determine the contributions of these processes to memory decline in participants classified based on genetic measures of ancestry. Genotyping data across 1,669 participants ranging from clinically normal to patients with Alzheimer's disease dementia were obtained from the Alzheimer's Disease Neuroimaging Initiative (ADNI). Participants were delineated into two subgroups; (1) those with ≥10% African ancestry (Admixed African group, n=79), and (2) participants with <10% African ancestry and high European ancestry (European group, n=1,486). A European group matched to the Admixed African group on age, sex, education, and diagnosis was used for further analysis (EURm, n=79). A vascular risk score (VRS) was calculated in which one point was given for the presence of hypertension, lipid disorders, myocardial infarction, TIA/stroke, smoking, diabetes, or atherosclerosis (range 0-7). Amyloid status from PET or CSF analysis were obtained for a subset of participants (Admixed African=55; EURm=57). In linear mixed effects models that controlled for age, sex, education, APOE status, and diagnosis, higher VRS was significantly associated with worse memory over time in the Admixed African group (β= -0.033, SE: 0.014), but not in the matched European group (β= 0.019, SE: 0.0084). There was a significant association between amyloid status and memory decline in the matched European group (β= -0.081, SE: 0.033) but not in the Admixed African group (β= -0.021, SE: 0.023). After accounting for amyloid status, VRS remained a significant predictor of memory decline in the Admixed African group (β= -0.030, SE: 0.014). VRS was not significantly associated with amyloid status in either group. Vascular risk factors may be predictive of memory decline in those with high African ancestry independently of amyloid. These results highlight the importance of examining diverse cohorts to elucidate contributors of memory decline in aging and dementia.