21st Annual Meeting

Cognitive Science Association for Interdisciplinary Learning

Hood River Hotel
Hood River, Oregon
July 28 to August 1, 2016

Thursday, July 28

4:30 pm	Reception and Appetizers	
4:45 pm	Welcome and Introductory Remarks	
5:00 - 5:30 pm	Eve Isham, Camille Mejia, Krystal Wulf	*The role of consciousness during simple and difficult decision-making tasks*
5:40 - 6:10 pm	James Blackmon	*Independently conscious brain hemispheres: a plurality of minds*
6:20 - 6:50 pm	Michael Pitts, Gray Davidson, Phoebe Bauer	*Isolating neural signatures of conscious perception with perceptually bistable stimuli*
7:00 pm	---------- Adjourn for Evening ----------	

Friday, July 29		
8:30 am	Continental breakfast downstairs in conference room	
9:00 - 9:30 am	Viola Stoermer, Alannah Wallace, Steven Hillyard, John McDonald	*Salient sounds enhance visual-cortical processing: Interplay between reflexive auditory-evoked activation and top-down voluntary attentional preparation*
9:40 - 9:55 am	Jeffrey Peterson, Avinash Bala, Terry Takahashi, Paul Dassonville	*A crossmodal Roelofs Effect reveals a shared frame of reference for visual and auditory localization*
10:00-10:30 am	Jessica Green, Allison Pierce, Spencer MacAdams	*Integration of simple audio-visual stimuli is modulated by feature similarity to audiovisual speech*
10:40-10:55 am	Spencer MacAdams, Jessica Green	*Retinotopically-mapped visual cortical activity in response to sounds: Evidence from human electrophysiology.*
11:00 am	---------- Break until 4:15 pm ---------- 	
4:15 pm	Appetizers	
4:30 - 5:00 pm	Daryn Blanc-Goldhammer, Maria-Alejandra De Araujo Sanchez, Paul Dassonville	*Both perception and action are biased by local motion when reporting the location of a moving target*
5:10 - 5:25 pm	Chris Graulty, Oliver Chesley, Enriqueta Canseco-Gonzalez, Michael Pitts	*The timing of synesthetic color processing and its influence on attention during visual search*
5:30 - 6:00 pm	Steven Hillyard	*Using steady-state visual evoked potentials to analyze mechanisms of attention*
6:10 - 6:25 pm	Diego Fernandez-Duque	*The 'Unit Asking' Effect for charitable donations: Cognitive and affective mechanisms*
6:30 - 7:00 pm	Ed Awh	*Rhythmic brain activity tracks the timing and content of online spatial representations*
7:10 pm	---------- Adjourn for Evening ----------	

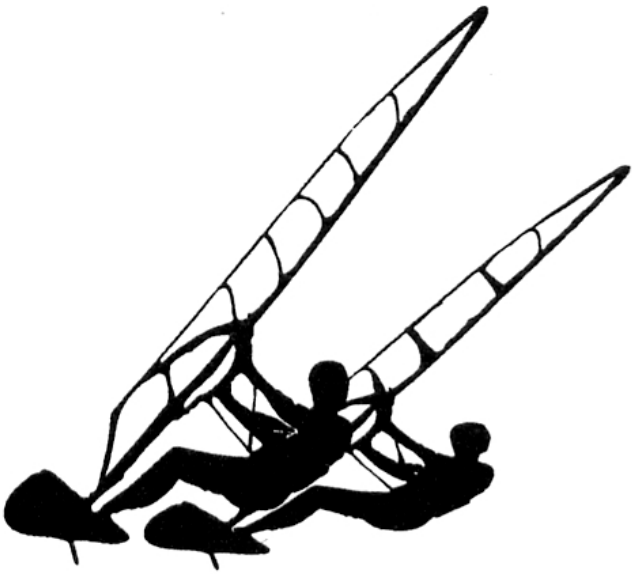
Saturday, July 30

8:30 am	Breakfast	
9:00 - 9:30 am	Katherine K.M Stavropoulos, James McPartland	*Autistic traits and affective images modulate activation of the reward system*
9:40 - 9:55 am	Inbar Marton, H.Z. Gvirts, M. Karklinsky, S.G. Shamay-Tsoory	*Are individuals with autism able to synchronize with a group?*
10:00-10:30 am	Sherry-Ann Brown, Iftikhar Kullo	*Analysis of human behavior identifies individuals as interconnected nodes for health promotion in social networks*
10:40-10:55 am	Lauren Williams, Trafton Drew	*Lost in space: The cost of interruption during search through volumetric medical images*
11:00 am	---------- Break until 4:15 pm ---------- 	
4:15 pm	Appetizers	
4:30 - 5:00 pm	Olav Krigolson, Cameron Hassall, Bruce Wright	*Thinking fast, thinking slow, thinking alpha?*
5:10 - 5:25 pm	Chad Williams, Boaz Saffer, Robert McCulloch, Olave Krigolson	*One is the loneliest number, but also the most valuable*
5:30 - 6:00 pm	Arne Ekstrom	*Navigating human memory: Inspiration and divergence from rodent models*
6:10 - 6:25 pm	Orestis Papaioannou, Steve Luck	*Automatic processing of the emotional content of visual stimuli during high visual working memory*
6:30 - 7:00 pm	Kate Arrington, Katlin Reiman, Starla Weaver, Glenn Wylie	*Sequence encoding during the task span and memory span paradigms*
7:10 pm	---------- Adjourn for Evening ----------	

Sunday, July 31		
8:30 am	Breakfast	
9:00 - 9:30 am	Francois Maquestiaux	*Can we perform two tasks at once? The effects of ideomotor compatibility and advancing age on dual-task performance*
9:40 - 9:55 am	Andrew Lowery, Richard Wright, John McDonald	*Using event-related potentials to investigate the relation between Stroop interference and attention capture*
10:00-10:30 am	Josef Schoenhammer, Stefanie Becker, Dirk Kerzel	*Guidance of attention by feature relationships*
10:40-10:55 am	Jenn Lewis, Katia Krane, Don Tucker	*Engagement through disengagement: Dissociation as a cognitive strategy in divided attention conditions*
11:00 am	---------- Break until 4:50 pm ---------- *Rafters, be packed and ready to go with a sack lunch so you can make it to Zoller's before noon.	
	No Appetizers on Banquet Night	
5:00 - 5:30 pm	Brad Wyble, Chloe Callahan-Flintoft	*Understanding the mechanisms of distractor inhibition through concurrent simulation of behavior and EEG*
5:40 - 5:55 pm	Allison Pierce, Jessica Green	*Electrophysiological evidence of inhibition of return in visual search*
6:00 - 6:30 pm	Nicholas Gaspelin, Steven J. Luck	*Suppression of attentional capture by salient stimuli*
6:40 pm	---------- Adjourn for Banquet Dinner ----------	
7:00 pm	**Banquet Dinner at Cornerstone Cuisine**	

Monday, August 1

8:30 am	Breakfast	
9:00 - 9:30 am	Andrew M. McCullough	*Costs and benefits of stress: An empirical and meta-analytic examination of effects of acute stress on episodic memory*
9:40 – 9:55 am	Maia Scarpetta, Michael Pitts, Enriqueta Canseco-Gonzalez	*Neural correlates of auditory attention in an exogenous orienting task*
10:00 - 10:30 am	Dasa Zeithamova, Anthony Resnick, Alejandra de Araujo Sanchez, Caitlin Bowman	*Distinct representations form in parallel to support memory specificity and the ability to generalize*
10:40-10:55 am	Mikjel Gjernes, Werner Sævland, Elisabeth Norman	*Translation-based generation effect: Does imageability matter?*
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 Abstracts

The role of consciousness during simple and difficult decision-making tasks

Eve Isham, Camille Mejia, Krystal Wulf
University of California Davis

Previous work suggests that a decision is initiated unconsciously, and consciousness is needed to "veto" the action (Libet, 1985). According to this theory, the veto window is measured from the earliest moment of awareness to act (time "W') to the time of action (i.e., motor response or "MR"). The role of the W-MR window, however, is not thoroughly understood. In the current study, we examined the W-MR period as a function of decisional difficulty. We employed a modified Libet paradigm and measured the W-MR period for simple and complex naturalistic decisions (e.g., I like red more than blue; I would sacrifice a child to save the village). If W-MR were to serve solely as a veto window, then W-MR should not vary with decisional difficulty. On the other hand, if W-MR also served as a deliberative process, we would anticipate W-MR to be longer for the difficult decisions than for the easy choices. However, this is not what we found. Instead, we observed W-MR was shorter for the more deliberative decisions compared to the W-MR period for the simple decisions. The results provide insights into the involvement of consciousness during decision making.

Independently Conscious Brain Hemispheres: A Plurality of Minds

James Blackmon
San Francisco State University

Minds, or at least robustly conscious entities, sometimes survive the permanent or even temporary loss of a functioning brain hemisphere. We know this because of two medical procedures which have existed for many decades: the hemispherectomy and the Wada test. In an anatomical hemispherectomy, one hemisphere is removed from the cranium and discarded, yet survivors of this radical procedure can emerge with a memory of who they are and what it was once like to have lived with that other hemisphere. In a Wada test, hemispheres are successively anesthetized while the other hemisphere performs language and memory tasks for the sake of preoperative diagnosis. Despite the understandable cognitive impairment resulting from such situations, we have every reason short of other-minds skepticism (medical, scientific, and practical reasons) to consider patients under these conditions to be conscious. And yet that which survives the loss of the left hemisphere is obviously not that which would have survived the loss of the right. I argue that these medical realities and others are best explained by the postulate that our brains host many conscious entities--some of them deserving to be called minds. I argue further that there is something it is like to be a hemisphere that loses (and, in the case of the Wada test, regains) functional interaction with another hemisphere. Some ethical implications are considered.

Isolating neural signatures of conscious perception with perceptually bistable stimuli

Michael Pitts, Gray Davidson, Phoebe Bauer
Reed College

Bistable stimuli refer to a unique category of physically unchanging stimuli that elicit two mutually exclusive percepts, one-at-a-time in alternation (e.g. Necker cube, face-vase, binocular

rivalry). With such stimuli, physical input can be held constant while perceptual experience changes, allowing for a relatively clean separation between low-level sensory processing and higher-level perceptual organization. For these reasons, bistable stimuli have been a popular choice for studies aimed at measuring neural correlates of conscious perception (NCCs). In this talk, I will first review how presenting bistable stimuli intermittently (on-off-on-off) allows for the acquisition of temporally-sensitive measures of neural activity. I will then explain how certain perceptual reporting tasks and control conditions allow for three types of contrasts in the analysis of neural data (1) percept A vs. B, (2) reversal vs. stability, and (3) perceptual vs. physical alternation. After arguing that only the first two contrasts are relevant for identifying NCCs, I will review some of our previous ERP experiments that have made these contrasts, including a newer study which explored bistable perception in the auditory domain. In all cases, neural differences between percept A and B precede those between perceptual reversals and stability, while the timing and scalp distributions of these ERP differences depend on the particular stimuli employed. Finally, I will argue that despite consistent patterns of results from our lab as well as others, it remains unclear which neural signatures reflect pre-cursors to conscious perception (e.g. attention, preconscious perceptual organization), which reflect post-perceptual operations (e.g. memory updating, reporting one's percept), and which are most closely linked with the conscious percept itself. Promising new approaches including "no report paradigms" and manipulations of top-down attention will be previewed.

Friday Morning Abstracts

Salient sounds enhance visual-cortical processing: Interplay between reflexive auditory-evoked activation and top-down voluntary attentional preparation

Viola Störmer[1], Alannah Wallace[2], Steven Hillyard[1], John McDonald[2]
[1]University of California San Diego; [2]Simon Fraser University

Salient sounds attract attention involuntarily and subsequently enhance processing in visual cortex. In electrophysiological recordings, this enhancement is observed in a slow positive event-related potential (ERP) over the occipital scalp that is larger contralateral to the sound (the auditory-evoked contralateral occipital positivity, ACOP) starting at about 200ms after sound onset. This ACOP is accompanied by a decrease of the occipital alpha rhythm (8-14Hz), which has been associated with enhanced visual processing. Here, we sought to determine whether these sound-induced occipital activations can be modulated by the voluntary deployment of spatial attention. In several experiments, a lateral noise burst was used as a spatial cue prior to the appearance of a masked visual target (cue-target SOA was 1200 ms). The target always appeared at the same location as the sound (predictive cue condition) or at a mirror-symmetric location on the opposite side of fixation (counter-predictive cue condition). Participants were asked to attend to the anticipated target location and to discriminate the identity of the target as quickly as possible. Across both conditions, the sound elicited an ACOP (~200-450 ms post sound onset) in parallel with a drop in alpha-band activity measured over the contralateral occipital scalp. While this initial alpha reduction was greater contralateral than ipsilateral for both predictive and counter-predictive sounds, this pattern reversed in the later time interval, consistent with the voluntary deployment of attention to the anticipated target location. These data suggest that the voluntary deployment of spatial attention does not affect the initial visual enhancement triggered by a salient sound but modulates visual processing in a task-dependent manner only at a later time point.

A Crossmodal Roelofs Effect Reveals a Shared Frame of Reference for Visual and Auditory Localization

Jeffrey M. Peterson, Avinash Bala, Terry T. Takahashi, Paul Dassonville
University of Oregon

When a large frame is presented offset from an observer's objective midline, the observer's egocentric reference frame becomes distorted, with the perceived midline biased in the direction of the frame's offset (Dassonville & Bala, 2004). This distortion, in turn, causes mislocalizations of both the frame (the Roelofs effect, Roelofs, 1936) and visual probes located within the context of the frame (the induced Roelofs effect, Bridgeman et al., 1997a). A search for an auditory analogue of the Roelofs effect indicated that auditory contextual information is capable of causing a mislocalization of auditory probes (Bridgeman et al., 1997b), but these results have been interpreted as being contrast effects occurring in an allocentric reference frame, rather than being caused by a distortion of the egocentric reference frame (Getzmann, 2003). If an auditory Roelofs effect does not in fact exist, it is unclear whether this is because auditory contextual information is incapable of causing a distortion of the egocentric reference frame, or because auditory probes are localized within a reference frame that is immune to the effects of Roelofs-inducing contextual information, whether visual or auditory in nature. To address this ambiguity, we employed a crossmodal Roelofs design in two experiments: 1) localization of auditory probes in the presence of an offset visual frame; and 2) localization of visual probes in the presence of an offset auditory scene. Auditory and visual probes were found to be equally susceptible to the induced Roelofs effect caused by a visual frame, supporting models of a shared egocentric reference frame for encoding the location of stimuli in both sensory domains. In contrast, the lateral offset of an auditory scene had no effect on visual localization, indicating that auditory context, unlike visual context, may not contribute to the establishment of the egocentric reference frame.

Integration of simple audio-visual stimuli is modulated by feature similarity to audiovisual speech

Jessica Green, Allison Pierce, Spencer MacAdams
University of South Carolina

Accurate integration of auditory and visual information is essential for our ability to communicate with others. In our daily lives we are continually integrating speech sounds with the coordinated lip movements and facial expressions of those we converse with. Although we do integrate non-speech audiovisual information, some previous studies have suggested that speech is a special type of event, resulting in much wider temporal windows over which audio-visual stimuli will be integrated together into a coherent percept. Here, we used pure tones inside and outside the typical frequency range for human speech and visual gratings inside and outside the spatial frequency range for human faces to examine how multisensory integration processes differed for simple stimuli based on their feature similarity to audiovisual speech. The temporal window of integration was modulated by both sound frequency and spatial frequency, with the widest integration window occurring when both stimuli fell within the audiovisual speech range. Our results suggest that even if audiovisual speech integration does tap into a special speech-processing mode, part of the "specialness" observed for speech may come from the differential processing of low-level features that our brains have been trained to integrate through a lifetime of experience with human language and face perception.

Retinotopically-mapped visual cortical activity in response to sounds: Evidence from Human Electrophysiology

Spencer MacAdams, Jessica Green
University of South Carolina

Electrophysiological studies have shown that salient sounds activate visual cortex, as reflected by an event-related potential (ERP) component known as the auditory-evoked contralateral occipital positivity (ACOP). Visual areas in occipital cortex are known to be retinotopically mapped, however the ACOP has previously been elicited by only two sound sources positioned to the left and right of the observer. Thus, it is unclear whether the ACOP reflects spatially specific activity in visual cortex or more general, spatially non-specific modulations of visual activity. Using a multi-speaker array we presented task-irrelevant sounds from peripheral locations in both upper and lower visual fields, while brain activity was recorded using an electroencephalogram. Three phases of lateralized occipital activity in response to the sounds were observed: 1) a very early phase occurring within 75 ms of sound onset, 2) a mid-latency phase occurring around the time of the auditory N1, and 3) a late phase beginning around 250-ms post-sound (the ACOP). The second phase was a general contralateral positivity that was similar for both upper and lower sound locations. The very early phase and the ACOP, however, were modulated by speaker location, with larger amplitude positivities for the sounds emanating from the lower visual field speakers. The modulation of the ACOP by visual field location is similar to that seen in the N2pc component, suggesting that these later activations of visual cortex by salient sounds may reflect spatially specific responses that are driven by visual attention. In contrast, the early phase may reflect the rapid and automatic modulation of retinotopically-mapped visual cortical activity in response to sounds.

Friday Evening Abstracts

Both perception and action are biased by local motion when reporting the location of a moving target

Daryn Blanc-Goldhammer, Maria-Alejandra De Araujo Sanchez, Paul Dassonville
University of Oregon

When seen in the periphery, the perceived trajectory of a moving target is altered by the presence of local motion within the target (Tse & De Valois, 2006). In spite of this dramatic perceptual effect, there is evidence that targeting movements of the eye and hand are either less affected by the illusion (Lisi & Cavanagh, VSS 2014, 2015), or altogether unaffected (Lisi & Cavanagh, *Current Biology* 2015). However, it remains unclear whether this apparent dissociation reflects fundamental differences in the processing of visual motion for perception and action, or rather differences in the task requirements, since the perceptual tasks required the observer to report on the target's *trajectory* (or the *allocentric* relationship between the motion path's start and end), while the action tasks involved movements guided to the target's *egocentric location*. In two experiments, we assessed the accuracy of the perceptual and action systems in indicating the location of the start and end of a target's motion path. In Experiment 1, participants were asked to indicate these locations with either a saccadic eye movement, or by using a mouse to move a cursor. In both conditions, responses were significantly affected by the illusion, with reports of the end location biased in the same direction as the local motion, while reports of the starting location were biased in the opposite direction. In Experiment 2, subjects were asked to perceptually compare the location of the start or end of the motion path with a flash that preceded or followed

the motion, respectively. As in Experiment 1, the perceived end of the motion path was biased in the same direction as the local motion, while the perceived start was biased in the opposite direction. These findings indicate that both perception and actions are fooled by the illusion when indicating the target's location.

The timing of synesthetic color processing and its influence on attention during visual search

Chris Graulty, Oliver Chesley, Enriqueta Canseco-Gonzalez, Michael Pitts
Reed College

Individuals with Grapheme-color synesthesia experience consistent associations between graphemes (letters or numbers) and colors. Recent studies in our lab have addressed two questions: (1) What is the timing of neural events related to synesthetic color processing? (2) Are synesthetic color associations processed pre-attentively, or is focused attention required? In order to investigate these questions, electrophysiological and behavioral data were collected from twelve grapheme-color synesthetes and twelve matched controls. Participants completed the Eagleman synesthesia battery to confirm their status as synesthetes (or not) and to allow for individual tailoring of the stimuli. In experiment 1, participants performed a 1-back task while stimuli from 4 categories were presented in random order: (1) physically uncolored letters with synesthetic color associations, (2) physically uncolored letters without synesthetic color associations, (3) physically colored letters, and (4) physically uncolored false fonts. By comparing stimulus categories 1 vs. 2, and 1 vs. 4, an ERP component liked with the neural processing of synesthetic grapheme-color associations was isolated. In experiment 2, participants performed a visual search task to find a target letter amongst 7 heterogeneous distracter letters. For each synesthete, 2 letters that shared the same color association (e.g. both red) were designated as potential targets while the distracter letters were each associated with a different (e.g. non-red) color. Hence, although the stimuli (physically uncolored letters) and task (find a target letter and report it) were identical for synesthetes and controls, synesthetes were likely to utilize color associations to guide them to the target letter. ERPs were compared between electrode sites contralateral vs. ipsilateral to the target to measure the "N2pc" component (200-300 ms), allowing for a direct comparison of selective attention in synesthetes vs. controls during a visual search task.

Using steady-state visual evoked potentials to analyze mechanisms of attention

Steve Hillyard
University of California San Diego

A flickering visual stimulus elicits an oscillatory electrical response in the visual cortex at the flicker frequency. This Steady-State Visual Evoked Potential (SSVEP) is a frequency tagged brain response that can be used to study the allocation of attention among multiple, continuously present stimuli in the visual field. Changes in the SSVEP amplitude over time can reveal the speed with which attention is shifted from one stimulus to another.

The 'unit asking' effect for charitable donations: cognitive and affective mechanisms

Diego Fernandez-Duque
Villanova University

When requesting a hypothetical donation toward children in need, asking participants to first consider how much they would donate to a single child leads to increased donations for the whole group, a finding known as the Unit Asking effect (UA). In 3 experiments, I explored possible cognitive and affective mechanisms underlying this effect. I show that the UA effect is insensitive to group size (Exp 1, n = 1101), is independent of feelings of sympathy (Exp 2, n = 740) and is robust to memory distractions (Exp. 3, n = 220). I conclude that that the UA effect is instantiated as a simple categorical rule: 'if I give X to one child, I should give more than X to a larger group'. I discuss these results in terms of their theoretical significance as well as their applied value.

Rhythmic brain activity tracks the timing and content of online spatial representations

Ed Awh
University of Chicago

A substantial body of evidence suggests that neural activity in the alpha frequency band (8-12 Hz) covaries with the locus of covert spatial attention, such that attention to one visual field yields a sustained decline in alpha power at contralateral electrode sites. In our work, we have exploited this covariation by using an inverted encoding model to reconstruct spatial response profiles (termed channel tuning functions, or CTFs) based on the topography of alpha activity on the human scalp. Thus, in a task that required the storage of locations in working memory, we observed a graded profile of activity across spatial channels that peaked at the stored location during both the encoding and delay periods of the task. These spatial CTFs provide an opportunity to quantify the basic tuning properties of online spatial memories to examine how the precision of neural representations changes with manipulations of the probability of storage or the number of items stored. In addition, I'll show that the same method can be used to track the locus and timing of covert attention following the presentation of symbolic orienting cues and during active visual search. Moreover, we demonstrate that dynamic changes in the selectivity of spatial CTFs provide a sensitive measure of the latency of covert orienting during visual search. These findings demonstrate the integral role that alpha band activity plays in the online representation of space, and provide a powerful new approach for tracking these representations during online storage and covert orienting.

Saturday Morning Abstracts

Autistic traits and affective images modulate activation of the reward system

Katherine K.M. Stavropoulos[1], James McPartland[2]
[1]University of California Riverside; [2]Yale University Child Study Center

Background: Alterations of the neural reward system have been implicated in individuals with autism spectrum disorder (ASD), but relationships among subthreshold levels of autistic symptomatology and reward anticipation is poorly understood. Previous investigations of reward anticipation in neurotypical adults have utilized S1-S2 paradigms in which S1 predicts the content of S2. However, no previous studies have explored whether anticipatory neural activity occurs if S1 is presented too quickly to reach conscious awareness.

Objectives: The current study explored the neural underpinnings of conscious and non-conscious perceptions of affective images in typically developing adults with varying levels of autistic traits, as measured by the Broader Autism Phenotype Questionnaire (BAP-Q). We investigated the relationship between autistic traits and reward anticipation using event-related potentials (ERPs).
Methods: In 14 typically developing adults, we measured an ERP index of reward anticipation in the dopaminergic reward system (Stimulus Preceding Negativity; SPN). We utilized an S1-S2 paradigm in which S1 was a word that predicted the content of the image in S2. The predictive stimulus (S1) was presented either (a) sandwich masked and too quickly to reach conscious awareness (b) not sandwich masked and thus able to reach conscious awareness.
Results: Individuals with low levels of autistic traits exhibited a larger SPN component prior to both positively and negatively valenced highly affective images (e.g. cute animals, pictures of injuries), but this difference was mediated by presentation speed. In particular, for positively valenced affective images, the SPN was significantly larger when S1 was consciously presented compared to non-conscious presentations. However, this relationship was reversed for negatively valenced images (e.g. the SPN was larger when S1 was non-consciously vs. consciously presented). No effect of presentation speed was observed for individuals with high BAPQ scores.
Conclusions: Anticipatory brain activity prior to both positive and negative affective images is mediated both by image content and by presentation speed of predictor stimuli. The current study indicates that differences in SPN magnitude are associated with subthreshold autistic symptomatology. Individuals with lower levels of autistic traits were more affected by experimental manipulations. Overall, the current study presents two novel findings: (1) The SPN can be elicited even when the predictor stimulus does not reach conscious awareness, and (2) reward anticipation, already understood to be affected in ASD, is also influenced by level of autistic traits. These results suggest common mechanisms underpinning reward system function relate to social performance in both clinical and normative populations.

Are individuals with autism able to synchronize with a group?

Inbar Marton, H.Z. Gvirts, M. Karklinsky, S.G. Shamay-Tsoory
University of Haifa, Israel

Joint synchronized actions such as throwing and catching a ball, conversing and even walking together along the street are merely simple examples of how interpersonal synchrony comprise a great deal of our everyday lives. Previous researches have established the importance of synchrony in inflicting a range of positive social outcomes such as affiliation, cooperation and rapport, emphasizing its role in the formation of effective social interaction. In this study, we tested the hypothesis that impairment in the ability to synchronize with other members of the group characterizes individuals with high autistic traits. We used a novel computerized task in which a group of participants, represented as different colored ball shaped figures on a computer screen, were instructed to move on the screen. The level of synchrony of each participant with the group was tested in two conditions: (i) spontaneous synchrony (free movement) and (ii) instructed synchrony. Autistic traits severity was measured using AQ questionnaire. We found significant negative correlation between Autism Spectrum Disorder (ASD) traits, the ability to synchronize with other members of the group and the distance maintained from other players, in the instructed synchrony condition. Furthermore, ASD symptom severity was also negatively correlated with the participants' overall and maximal interpersonal coordination. These results suggest that the difficulty of individuals with ASD to synchronize with others is particularly evident in the context of group behavior. Moreover, employing a paradigm that measures interactions of individuals within a group provides a highly ecological setting to study social

behavior in ASD and may offer novel insights into the mechanisms that underlie the profound behavioral disturbances observed in ASD.

Analysis of human behavior identifies individuals as interconnected nodes for health promotion in social networks

Sherry-Ann Brown, Iftikhar Kullo
Mayo Clinic

Background**:** We investigated whether objective and subjective measures of electronic health record (EHR) access can identify individuals as central nodes of information exchange in social networks following receipt of their genetic risk score (GRS) for developing coronary heart disease (CHD).
Methods: The Myocardial Infarction Genes study randomized 203 participants aged 45-65 years and at intermediate risk for CHD to receive their conventional risk score (CRS) alone or also their 28-variant GRS. Risk was disclosed in sessions with a genetic counselor and then with a physician. EHR login was objectively quantified. Surveys were also administered to assess information exchange. Survey data were adjusted for patients' age, sex, education, family history for CHD, and baseline CRS, which could all bias information processing. Data were expressed as odds ratio (OR) with 95% confidence intervals.
Results: A higher frequency of quantified EHR login was observed in those who reported using the patient portal to access information related to their CHD risk (these individuals were denoted central nodes) than those who did not report accessing the patient portal for this purpose (70±10 versus 36±5, p=0.0023). Prior to risk disclosure, in the GRS group, central nodes were more likely to use the internet to learn about CHD (OR 3.65, CI 1.29-10.69, p=0.02), and trended towards being more likely to have friends/family with whom they discussed health (OR 4.07, CI 0.93-29.06, p=0.06). Post-disclosure, GRS central nodes were more likely than CRS central nodes to have friends/family with whom they discussed health (OR 15.74, CI 2.06-333.45, p=0.006). High GRS central nodes were more likely to use the internet to learn about CHD (OR 9.78, CI 2.27-54.2, p=0.002) than central nodes with low GRS.
Conclusions: EHR access can be quantified and used to identify central nodes of information exchange in social networks following receipt of a GRS for CHD. Further studies are needed in cognitive neuroscience and psychology (regarding communication, decision-making, social cognition, and information processing theory) to determine the substrates underlying these behavioral manifestations impacted by GRS disclosure.

Lost in space: The cost of interruption during search through volumetric medical images

Lauren Williams, Trafton Drew
University of Utah

In recent years, radiology has transitioned from primarily 2D to 3D imaging techniques, such as computerized tomography. CT scans are volumetric representations of internal structures created from hundreds of cross-sectional images. For every 10 minutes spent reading a CT scan, there is a 59% chance of being interrupted by a phone call (Yu, et al., 2011). The current studies examine how interruptions affect search through large volumetric images using behavioral and eye-tracking measures. Participants searched through 20 chest CT scans for nodules, which "pop" in and out of view as the participant scrolls through depth. Between 30 to 60 seconds after search onset, half of the trials were interrupted by a series of true or false math equations. Accuracy was not affected by the interruptions. However, search duration was 14.4 seconds longer in

interruption trials. A follow-up study replicated the time cost associated with interruption and revealed that this effect is not modulated by the difficulty of the math equations. Eye-tracking measures provided information on the source of this time cost. In order to determine how faithfully search is resumed after an interruption, we compared the last pre-interruption fixation to the first post-interruption fixation. These fixations were in different quadrants of the lung in 76% of trials, compared to a 28% quadrant change during equivalent time periods for control trials. In addition, the post-interruption time period had a significantly greater refixation rate than the equivalent time period for control trials. These results suggest that interruptions impair memory for which regions of the lung were examined before the interruption. Previous evidence has suggested that memory for where we have searched is quite poor (Horowitz & Wolfe, 1998; Wolfe, Drew, Vo, 2014). The current study suggests that this limitation may be exacerbated by interruption. In addition, it may be particularly difficult to maintain these mental representations in volumetric images. In future work, we will use targeted interventions, such as eye-tracking feedback, with the goal of mitigating these costs in radiology.

Saturday Evening Abstracts

Thinking fast, thinking slow, thinking alpha?

Olav E. Krigolson, Cameron Hassall, Bruce Wright
University of Victoria

Throughout our daily lives we make a myriad of decisions -ranging from what to eat to whom to date. Scientific evidence suggests that human decisions are the product of two distinct systems within the human brain (Kahneman, 2011). The first, or "fast" system, relies on well known or reflexive answers - for example answering "two plus two is…". The second, or "slow" system, supplies more deliberative answers such as the response to "the square root of three hundred and twelve is…". Here we used electroencephalography (EEG) in an attempt to find a neural marker that identified whether or not a participant was making a System I or System II decision during performance of a perceptual learning task. In our first experiment, participants learned to classify "blobs" - pseudo-randomly generated shapes into four distinct families. At the mid-point of the experiment, when participants could accurately classify blobs, we removed two of the familiar blob families and introduced two new families. Thus, at the mid-point of the experiment participants faced decisions we hoped would either engage System I - identifying familiar blobs, or System II - identifying the recently introduced novel blobs. Interestingly, we observed increased alpha activity over parietal electrode sites when participants classified familiar relative to unfamiliar blobs - a result that we believe suggests participants were using System I decision processes when classifying familiar relative to unfamiliar blobs. Conversely, we observed an increase in theta power over frontal electrodes when participants classified unfamiliar blobs - thus making frontal theta a potential marker for System II decisions. Extending from this initial work, we have now run several other experiments focused on human decision-making and found that alpha and theta appear to index System I and System II decisions, respectively.

One is the loneliest number, but also the most valuable

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The scarcity heuristic is a mental shortcut that directs learning and decision making in that rare objects are perceived to be inherently more valuable than abundant objects. In the present study, we sought to determine whether the perception of rarity impacted reward evaluation within the medial-frontal cortex. In a reinforcement learning paradigm, participants gambled upon scarce and abundant "cards" while electroencephalographic (EEG) data were recorded. Unbeknownst to participants, reward outcome and frequency was random and equivalent thus only a perception of scarcity was true. Our results suggest that the perception of scarcity enhanced the P300 - an event-related potential that reflects reinforcement learning processes sensitive to reward magnitude. Our data demonstrate a top-down influence of the scarcity heuristic on reward evaluation, and specifically the processing of reward magnitude, within the human medial-frontal cortex.

Navigating human memory: Inspiration and divergence from rodent models

Arne Ekstrom
University of California Davis

Cartographic maps have frequently been employed as a metaphor for how we represent our spatial environment during navigation (O'Keefe and Nadel, 1978). While this metaphor is often used to describe how a specific brain region (the hippocampus) codes spatial-related variables, it does not capture many of the important features of the neural basis of human spatial memory. The talk will focus on findings aimed at disentangling what we can learn from decades of work using extracellular recordings from rodents based on similar such recordings from the human brain. fMRI and lesion evidence will also be presented that suggest both similarities and differences from the rodent "model" of spatial navigation. Our current data suggest vision plays a more fundamental role physiologically in human spatial navigation than appreciated in previous models such as the cognitive map theory.

Automatic processing of the emotional content of visual stimuli during high visual working memory

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Previous studies have shown that task relevant stimuli presented during the retention interval of a visual working memory task disrupt the active maintenance of the memory items, as indexed by the disruption of the CDA and the loss of predictive power in EEG decoding. However, despite the absence of active maintenance, working memory performance was only minimally impacted, with participants apparently relying on a different working memory process. We propose that this process is a passive maintenance system, where information is stored briefly after being active in working memory. Such a system would be necessary when active working memory is reallocated to a new task, such as when people are processing new task relevant stimuli, but would not be recruited in cases where active maintenance is undisturbed, such as when a task irrelevant stimulus is processed. Consistent with this, task-irrelevant stimuli do not disrupt the active maintenance of information in working memory. The goal of the present experiment was to determine whether these task-irrelevant stimuli are actually discriminated when presented

during the maintenance interval of the working memory task. Preliminary data show that task-irrelevant stimuli are indeed discriminated, with participants showing electrophysiological evidence of a differentiation between words and non-words and between emotional versus neutral images. These results support and refine the dual maintenance model by characterizing which processes can occur concurrently with active maintenance and thus do not require the reliance on passive maintenance.

Sequence encoding during the task span and memory span paradigms

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A sequence of tasks may be encoded into memory for later execution, such as encoding instructions on how to assemble a piece of furniture. Alternatively, the tasks may be encoded into memory for later recall, such as encoding instructions so that you can tell your husband how to assemble the furniture. In this talk, we will consider how the encoding process differs when encoding for performance versus simple retrieval. Logan (2004) developed the task span procedure to investigate the trade-off between working memory and executive control during task performance. For the task span, subjects encode a sequence of task cues and then perform those tasks on a subsequent series of targets, which can be contrasted to standard memory span procedures where a sequence of cues is encoded for simple retrieval. Across several studies, we explored the nature of encoding in the task span vs memory span paradigms. When performing the task span relative to memory span, individuals both encoded sequences of cues more slowly and selected simpler task sequences in a voluntary version of the task. Individual difference in working memory and executive function were more closely correlated to performance in the task span relative to the memory span. Neural engagement of frontal and parietal structures was overall greater and more sensitive to sequence complexity when encoding during the task span than during the memory span. Finally, when sequence encoding occurs in advance of a cue indicating what version of the paradigm (task span or memory span) will be relevant during the test phase, encoding processes are more similar to that seen during blocks of the task span than during blocks of the memory span, suggesting that subjects are more engaged during encoding to prepare for the possibility of having to perform the more difficult task span. Together these results paint a picture of increased control during encoding for situations when the individual expects to carry out the more executively demanding process of task performance compared to simple memory retrieval.

Sunday Morning Abstracts

Can we perform two tasks at once? The effects of ideomotor compatibility and advancing age on dual-task performance

Francois Maquestiaux
Universite Bourgogne Franche-Comte

Ideomotor-compatible tasks can be defined as tasks for which the sensory feedback from a response closely resembles the eliciting stimulus, such as when pressing a left or right key to a visual stimulus representing a left or right-pointing arrow. The issue of whether ideomotor-compatible tasks can bypass the central attentional bottleneck in dual-task situations has been heatedly disputed, with Anthony Greenwald offering evidence that ideomotor-compatible tasks

can proceed without central attention (e.g., Greenwald, 2003) but with Mei-Chen Lien's group offering evidence that they cannot (e.g., Lien et al., 2003). In current talk, I will present data from recent research project attempting to make some progress on this issue, using a new approach that we have developed in order to provide direct evidence of whether a task can really proceed without central attention (i.e., automatically), through bottleneck bypassing (Maquestiaux et al., 2008; Ruthruff et al., 2006). I will also present some recent data investigating the effects of advancing age on how ideomotor-compatible tasks are performed in dual-task situations. Finally, I will preview some preliminary data from experiments in which we examined whether extensive training helps older adults to automatize ideomotor-compatible tasks under dual-task situations.

Using event-related potentials to investigate the relation between Stroop interference and attention capture

Andrew J. Lowery, Richard D. Wright, John J. McDonald
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The Stroop effect has been ascribed to the automaticity of word reading. By this account, the Stroop words are read in an obligatory fashion (despite the fact that they are task-irrelevant), and the meanings of those words are extracted without necessarily attending to the words. However, some results suggest that the magnitude of Stroop interference depends on attention. For example, Stroop interference is reduced by the concurrent presentation of a response-irrelevant stimulus, such as a string of identical letters (e.g., "XXX"). This reduction of Stroop interference was hypothesized to occur because the second stimulus interferes with attentional processing of the color word, implying further that the Stroop effect itself depends on the ability of the color word to capture attention. In the present study, we recorded event-related potentials (ERPs) to determine whether (i) task-irrelevant color words capture attention in the non-integrated variant of the Stroop task, and (ii) the magnitude of Stroop interference depends on the strength of attention capture. On each trial, a colored rectangle (red, green, or blue) was presented at fixation and was flanked by a color word ("RED", "GREEN", or "BLUE") on one side and a length-matched string of Xs on the other side of fixation. Participants were required to identify the color of the rectangle and to press a corresponding button as quickly and as accurately as possible. Consistent with previous findings, response times were slightly but significantly longer on incongruent trials than on congruent trials. Color words were found to elicit the N2pc component, demonstrating that the words were attended despite the fact that they were irrelevant. However, the amplitudes of these ERP components did not correlate with the magnitude of Stroop interference. These findings indicate that while the color words captured attention reflexively, such attention capture may not underlie the interference found in the Stroop task.

Guidance of attention by feature relationships

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Our ability to select task-relevant information from cluttered visual environments is widely believed to be due to our ability to tune attention to the particular elementary feature values of a sought-after target (e.g., red, orange, yellow). By contrast, recent findings showed that attention is often tuned to feature relationships, viz., features that the target has relative to nontarget features (e.g., redder, yellower; Becker, 2010).
For example, imagine an orange target presented among several yellow nontargets. Theories that assume that attention is tuned to the particular target feature predict that attention will be tuned

to orange. Consequently, any orange item will gain highest attentional priority and will be selected. By contrast, the relational theory (Becker, 2010) considers the orange target as redder, since it differs from the yellow nontargets in the direction of red. Accordingly, it predicts that only those items will be selected, which show the same relative color, viz., items that are redder than their surround. In support of the relational theory, we (e.g., Schönhammer, Grubert, Kerzel, & Becker, 2016) found that spatially irrelevant cues ("distractors") only captured attention, when they were redder as the target, even when they had a different physical color (e.g., a red cue among orange context items). Additionally, cues with the opposite relative color did not capture attention, even when they had the same physical color as the target (e.g., an orange cue among red contextual elements, which would be yellower). In sum, such results undisputedly demonstrate that attention can be tuned to other properties than the specific target feature.
In the first part of our talk, we will review the basic findings that support the relational theory, and we will summarize the conditions under which attention was tuned to the feature relationship of the target. Additionally, we will also review the boundary conditions under which attention was tuned to the specific feature of the target. In the second part, we will present recent experiments that tested the relational account against other theories of attentional selection. Finally, we will discuss the implications of our experiments for the understanding of feature-based attention and its influence on selective attention.

Engagement through disengagement: Dissociation as a cognitive strategy in divided attention conditions

Jenn Lewis[1], Katia Krane[1], Don Tucker[2]
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Defined by a lack of integration between thoughts, feelings, identity, and or experiences, dissociation recognized as a learned or habituated dysfunctional response to environmental experiences, particularly those signaling stress or threat. However, a small body of behavioral research has suggested that dissociative tendencies may hold a cognitive advantage in specific situations, such as divided attention conditions, where division of attention is necessary for enhancing performance and/or subjective experience. Despite having an effect on multiple domains of cognition (attention, memory, and executive control), little is known about the neural mechanisms behind dissociation or how dissociation may affect overall executive functioning. The current experiment explores dissociation's effect on neural responses to highly charged stimuli and its' relation to behavioral measures of executive processes. In particular, the study seeks to explore the situations for which dissociation may hold an advantage for an individual to act adaptively. Using dense array EEG to record neural responses, researchers examined event-related potentials (ERPs) in participants ranking high or low on dissociation during a divided attention emotional Stroop task. Distinct between group differences were identified in ERPs related to attention and semantic processing, including medial frontal negativity (MFN) and the P300, where high dissociators presented with particularly attenuated ERPs compared to low dissociators. Despite presenting with seemingly blunted neural responses, high dissociators performed at equivalent levels in several behavioral domains compared to low dissociators including memory and response time, showing no alteration in performance. In other words, despite differences in neural processing, individual with high or low dissociation performed similarly well during emotional, divided attention tasks. These results suggest that high dissociators are employing an alternative cognitive strategy, which is not only effective in divided attention conditions and responses to charged stimuli, but potentially advantageous.

Sunday Evening Abstracts

Understanding the mechanisms of distractor inhibition through concurrent simulation of behavior and EEG

Brad Wyble, Chloe Callahan-Flintoft
Penn State University

We know much about the neural and behavioral correlates of the inhibitory processes associated with attention, but we still lack a clear understanding of a mechanism that bridges the gap between these behavioral and neural forms of evidence. I will present a new model of stimulus-triggered attention that implements a reactive inhibitory system that compares favorably against a broad range of behavioral and neurophysiological data involving combinations of targets and distractors. The neural network simulates attentional cueing and capture effects in both accuracy and reaction time. Furthermore, simulated neurons in the model provides a direct simulation of the N2pc and Pd EEG components that are traditionally understood to be correlates of attentional deployment and distractor suppression respectively. The model is constrained by broad set of pre-existing data sets and contributes a neural intuition for the mechanisms underlying these EEG components as well as predictions to guide future research. Additionally, the model clarifies the long-running debate related to whether attention is restricted to one location only or can be divided. According to the model, the divisibility of attention depends on the timing and relative importance/salience of the two stimuli.

Electrophysiological evidence of inhibition of return in visual search

Allison Pierce, Jessica Green
University of South Carolina

Inhibition of return (IOR) refers to the effect in which participants are slower to respond to a target at a previously attended location compared to a previously unattended location. This effect is often discussed in terms of its importance as a facilitator of efficient visual search. However, IOR has traditionally been studied using tasks that do not require visual search. The present study examined this effect behaviorally and electrophysiologically using four locations in a visual search paradigm. Previous studies have linked this slowing of responses to a reduction in the N2pc event-related potential (ERP) component, which is thought to reflect an attentional bias away from the previously attended location. Our results showed that reaction times were slowed and the N2pc component was reduced when the target appeared in the same visual hemifield as the previous target compared to when it appeared in the opposite hemifield. Within a hemifield, reaction times were faster when the target appeared in the same compared to a different location. This was associated with an increased P1 for repeated locations, which was interpreted as a priming effect. These results suggest that within this type of visual search paradigm, IOR occurs across, but not within, hemifields, and that both IOR and priming may be present at the repeated target location.

Suppression of attentional capture by salient stimuli

Nicholas Gaspelin, Steven J. Luck
University of California Davis

Researchers have long debated the nature of cognitive control in the guidance of visual attention. Stimulus-driven theories claim that salient stimuli automatically capture attention, whereas goal-

driven theories propose that an individual's intentions determine whether salient stimuli capture attention. Problematically, both theories make the exact opposite prediction about when to expect capture in the real-world. To remedy this conflict, we propose a hybrid model called the signal-suppression model, which claims that all stimuli automatically generate a bottom-up "attend-to-me" signal. However, this signal can be actively suppressed by top-down attentional mechanisms. The current research provides converging evidence for the signal suppression hypothesis using behavioral, eyetracking, and event-related potential (ERP) methods. All approaches showed that-under appropriate conditions (feature search mode)-the processing of a salient distractor is suppressed below the baseline of non-salient distractor objects.

Monday Abstracts

Costs and benefits of stress: An empirical and meta-analytic examination of effects of acute stress on episodic memory

Andrew M. McCullough
University of California Davis

Most people typically think of stress as a bad thing, but recent evidence suggests that stress can be beneficial for some aspects of cognition. Understanding exactly when and how stress will impair or enhance cognitive performance is an important topic of research. Recent studies have shown that acute stress can both enhance and impair various aspects of memory, such as encoding, retention, and retrieval. I will describe empirical evidence that an acute stressful experience shortly after encoding is beneficial for subsequent long-term memory performance, suggesting that stress influences the stabilization or consolidation of recently-formed memories. I will further describe how post-encoding stress differentially impacts cognitive processes that support episodic memory (i.e., recollection and familiarity), how the effects on memory are related to the physiological stress response, and how the effects on memory are related to changes in brain activity of medial temporal lobe regions known to support encoding and retrieval. These results provide important contributions to understanding the cognitive and neural mechanisms by which stress influences memory. Moreover, a broad survey of the literature reveals many inconsistencies with respect to the effects of acute stress on different phases of memory (i.e., encoding, retention, retrieval). Thus, I will also present findings from a meta-analysis of the effects of acute stress on different phases of memory. The results synthesize a vast and diverse literature, and illuminate a variety of moderators of effects of acute stress on encoding, retention, and retrieval. I discuss how these results broadly support, but in some cases challenge, present comprehensive theories of the mechanisms by which acute stress influences human memory.

Neural correlates of auditory attention in an exogenous orienting task

Maia Scarpetta, Michael Pitts, Enriqueta Canseco-Gonzalez
Reed College

In an exogenous orienting task, attention is increased to the target stimulus if the cue validly predicts the target's location and the cue and target occur in quick succession. With a longer interval between the cue and target, the opposite effect occurs: attention is inhibited for validly cued targets. These attentional phenomena are known as facilitation, and inhibition of return (IOR), respectively. Both effects have been extensively explored in vision but less so in the auditory domain. The visual N2pc, an attention-related event-related potential (ERP) component

has been used to examine the neural correlates of IOR (McDonald et al., 2009; Yang et al., 2012), but recently, an auditory analog of the N2pc was discovered, known as the N2ac (Gamble & Luck, 2011). To our knowledge, no previous study has explored the neural basis of exogenous attentional facilitation and IOR in the auditory modality. The present study sought to fill this gap using the N2ac as a neural marker of auditory spatial attention. Brain activity was recorded from nineteen participants while they performed a Posner exogenous auditory orienting task. We compared the ERPs elicited by the target stimulus for short (200 ms) cue-to-target intervals (facilitation), and long (700 ms) cue-to-target intervals (IOR). We observed behavioral and electrophysiological evidence of attentional facilitation, and a behavioral trend of IOR, but no apparent electrophysiological evidence of IOR. This study demonstrates that the N2ac is enhanced by exogenous attention during the facilitation phase of the cue-to-target interval, but remains unaffected during the later IOR phase. These findings suggest some similarities as well as some differences between this newly discovered ERP component (N2ac) and its visual analog, the N2pc.

Distinct representations form in parallel to support memory specificity and the ability to generalize

Dasa Zeithamova, Anthony Resnick, Alejandra de Araujo Sanchez, Caitlin Bowman
University of Oregon

Memory-based cognition requires both the ability to remember specific past events and the ability to link information across events, forming abstract knowledge generalizable to novel situations. Whether specificity and generalization depend on a single memory system (predicting co-occurrence) or competing memory systems (predicting trade-off) has been debated. We tested individual differences in memory specificity and generalization across three paradigms where they were independently measured: acquired equivalence, category learning, and paired associate learning with a hidden category structure. In all three tasks, individual differences in memory specificity and generalization were uncorrelated, except for a subset of participants using exemplar strategy during categorization, where they were positively correlated. Preliminary neuroimaging data provide additional evidence for the parallel formation of both specific and generalized memory representations that are accessed depending on the task demand. These findings are consistent with multiple memory systems view but without a necessary trade-off between memory specificity and generalization.

Translation-based generation effect: Does imageability matter?

Mikjel Gjernes, Werner Sævland, Elisabeth Norman
University of Bergen

The generation effect refers to people's tendency to show relatively higher retention for solutions which are generated by oneself, than for solutions that are merely presented. The solutions should follow a specific rule in response to a stimuli, and previous studies have empirically identified a generation effect using several different rules for generation of target stimuli (e.g., rhyme, synonym, association, sentence completion, calculation, word fragments; for a meta-analysis covering several typical generation rules, see Bertsch et al., 2007). The focus of the current study is on the "translation-based" generation effect, which relies on translation of words from one language to another (Slamecka & Katsaiti, 1987). Previous studies have reliably found translation-based generation effects in that the instruction to generate target translations of stimuli words increases subsequent retention of the target words, as compared to simply reading both the stimuli and translation words (Bertsch et al., 2007). However, these studies have used highly

imaginable words, and the effect has only been identified using incidental, but not intentional, learning instructions. Moreover, in previous studies the characteristics of the stimuli and target words used have not been emphasized, and the majority of studies have used highly imaginable words as stimuli for generation. The aims of the current study were to explore whether the translation-based generation effect could be identified when using a word-pool of low imageability words, and whether retention would be modulated by intentional or incidental learning instructions. Only words rated as low-imageability in a separate pre-test, were included as stimuli. Forward translation from English (L2) to Norwegian (L1) was used as the rule for generation. Participants (n=40), all native Norwegian psychology students, were given a list of 20 english words and either given the most common Norwegian translation to copy ("read" condition) or asked to translate the words by themselves ("generate" condition). All participants were then tested on target word retention (free recall and recognition) of the translated words. Half of the participants were informed about the retention test in advance (intentional learning instructions), while the other half were not (incidental learning instructions). Findings will be presented and discussed at the conference.

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