Institute for Mind and Brain
2016 Conference

Neuroscience of Attention

UNIVERSITY OF SOUTH CAROLINA

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Poster Session

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3	Bobby Gibbs	Optimizing the analysis of speech glimpses in noise
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5	Jessica Klusek	Autonomic Dysfunction is associated with Pragmatic Language Impairments among Women with the FMR1 Premutation and the Broad Autism Phenotype
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10	JP Ginsberg	Attention and Immediate Memory in Combat Veterans with PTSD: The Role of Heart Rate Variability
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12	Jenn Olejarczyk	Oculomotor Capture Despite Contextual Cueing in Scenes

Program Overview

8:45 - 9:00 am	Welcome and Opening Remarks - Doug Wedell
9:00 – 10:00 am	**Doug Munoz**, *Queen's University* Neural circuits for saliency, priority, and orienting
10:00 – 10:30 am	**Troy Herter,** *U of SC Dept of Exercise Science* Visual search and attentional contributions to motor learning
10:30 – 11:00 am	Break
11:00 – 12:00 pm	**Scott Johnson**, *University of California, Los Angeles* Development of social attention in infancy
12:00 – 12:30 pm	**John Richards**, *U of SC Department of Psychology* Infant attention modulates infant face-sensitive brain areas responses to faces
12:30 – 1:00 pm	Lunch
1:00 – 2:00 pm	Posters
2:00 – 3:00 pm	**John McDonald**, *Simon Fraser University* Dealing with distraction in a cluttered visual world
3:00 – 3:30 pm	**Jessica Green**, *U of SC Department of Psychology* Individual differences in top-down attentional control
3:30 – 4:00 pm	Break
4:00 – 5:00 pm	**Matthew Pontifex**, *Michigan State University* From chronic to acute, the relation between physical activity behaviors and cognition
5:00 – 5:30 pm	**Robert Davis Moore**, *U of SC Dept of Exercise Science* The persistent influence of sport-related concussion on behavioral and neuroelectric indices of attention

Talk Abstracts

NEURAL CIRCUITS FOR SALIENCY, PRIORITY, AND ORIENTING

Douglas P Munoz

Centre for Neuroscience Studies, Queen's University

Understanding how humans perceive and act upon complex natural environments is one of the most pressing challenges in neuroscience. However, the study of the neural basis of active vision, how visual stimuli gives rise to eye movements, and how these eye movements influence vision under diverse task conditions, has largely been restricted to simple laboratory stimuli presented to subjects performing stereotypical tasks. In this presentation I will highlight recent evidence contrasting neural processing of saliency and priority in stereotypical lab tasks and natural free viewing by contrasting responses recorded from early visual cortex and the midbrain superior colliculus. These data show how specific features may be extracted by the visual cortex and fed to the superior colliculus to compute a saliency map to guide orienting. I will also highlight the role of the superior colliculus in coordinating saccade and pupil components of the orienting response.

VISUAL SEARCH AND ATTENTIONAL CONTRIBUTIONS TO MOTOR LEARNING

Troy M. Herter

Department of Exercise Science, University of South Carolina

Humans learn to perform a broad range of motor tasks, such as driving, cooking and sports, that use skilled eye movements (visual search) to actively gather information that guides planning and execution of skilled limb movements. Recent studies have demonstrated that improvements in visual search contribute to motor learning, but we have a poor understanding of the sensory, motor and cognitive processes that underlie these improvements in visual search. In this talk, I will present evidence that improvements in visual search and limb-motor control contribute stable increases in task performance. I will also discuss some of the processes that underlie improvements in visual search and how these change with aging and stroke. Finally, I will show that modifying visual input to manipulate visual attention produces systematic changes to visual search and task performance.

DEVELOPMENT OF SOCIAL ATTENTION IN INFANCY

Scott P. Johnson

University of California, Los Angeles

Social attention is the process of perceiving visual features that specify conspecifics and other animate entities, and it is vital to our ability to observe, understand, and participate in social interactions. Research on infant perception of faces and biological motion has revealed early-developing biases to attend to social information that are shaped by experience. Hence a currently popular view is that innate preferences for faces and biological motion become tuned to specific features of social content that are present in the infant's immediate social environment, facilitating rapid identification and categorization of social information that is most relevant and appropriate for social interactions. This talk will present recent and new work—on face detection in cluttered scenes, attention to own- and other-race faces, and perception of sex differences in biological motion—that is difficult to accommodate by this view, and raises important questions about the role of experience in shaping infants' social attention. Broader implications for theories of social development will be discussed.

INFANT ATTENTION MODULATES INFANT FACE-SENSITIVE BRAIN AREAS RESPONSES TO FACES

John E. Richards, Margaret W. Guy, Nicole Zieber, Wanze Xie, & Jane E. Roberts.
Department of Psychology, University of South Carolina

Sustained attention in infants represents the arousal system of the brain energizing brain systems. Cognitive processing during sustained attention is faster, more efficient, and represents a period of active information processing. Sustained attention affects a wide range of cognitive processing in infants in the first year. One cognitive process that shows dramatic development over the first year of life in infants is the processing of faces. This includes the onset of cortically-driven familiarity, second-order configural face processing, experienced-based brain changes, and race/species face differentiation. We have studied infants event-related-potentials (ERPs) in responses to faces and toys in infants from 3 to 12 months of age. The ERP changes in amplitude to faces for the P1 and N290 components, and the face/toy distinction in the ERP increases over this age range. This differentiation is amplified when infants are engaged in sustained attention. The cortical source analysis of the ERP responses shows these changes occurring in the posterior areas for the P1 and in the fusiform gyrus, and ventral-anterior temporal areas, for the N290. The effect of sustained attention amplifies the current density activity in these cortical areas. These results and prior work describe the excitatory effect of sustained attention on the secondary perceptual/cognitive areas involved in stimulus processing.

ATTENTION AND DISTRACTION IN A MULTISENSORY WORLD

John McDonald
Simon Fraser University

People are frequently confronted with potentially distracting sounds and lights in today's cluttered environments. Such distractors can attract attention, gain access to limited-capacity memory systems, and disrupt performance on ongoing tasks. Observers can deal with this sensory overload in two ways: (i) by attending to specific aspects of the environment, such as a particular colour or a particular region of space, in order to enhance processing of certain objects, and (ii) by actively ignoring irrelevant objects that might otherwise be distracting. In this presentation, I will describe some event-related potential (ERP) research that has led to a better understanding of the neural processes underlying our abilities to attend and to deal with distraction. I will also highlight the latest research on distraction, which shows considerable variability across individuals in the ability to suppress irrelevant visual distractors.

INDIVIDUAL DIFFERENCES IN TOP-DOWN ATTENTIONAL CONTROL

Jessica J. Green
Department of Psychology, University of South Carolina

The neural correlates of voluntary spatial attention have been well documented – frontal and parietal lobe control processes followed by preparatory modulations of sensory cortex, including both enhancement of the to-be-attended location and suppression of to-be-ignored locations. There can, however, be large variation between subjects in both behavioural and neural measures of attentional control. Based on one prominent theory of dyslexia that postulates that reading deficits stem from abnormalities in the attention system, we hypothesized that some of this variability may be related to between-subject differences in reading ability. In this presentation I will discuss my recent work showing that even in a high-functioning university student population, variability in reading skills can account for a large portion of the differences in basic attention processes and their neural correlates.

FROM CHRONIC TO ACUTE, THE RELATION BETWEEN PHYSICAL ACTIVITY BEHAVIORS AND COGNITION

Matthew B. Pontifex
Michigan State University

As epidemiological investigations within industrialized societies have revealed increases in the prevalence of sedentary behaviors during childhood, a greater understanding of the extent to which physical activity relates to brain health and cognition during development is of increasing importance. Leveraging insights provided through recordings of electrophysiological activity, we have examined the association and effects of physical activity behavior and attributes as it relates to neural processes associated with the allocation of attentional resources and action-monitoring. In ongoing research, we have specifically focused on 1) how these processes are influenced by a lack of chronic physical activity, 2) the effect of a single dose of physical activity on these processes, and 3) the neurobiological mechanisms that regulate the relationship between physical activity and these neural processes. Our results highlight the importance of physical activity, with greater cardiovascular health relating to a greater ability to allocate attention and modulate action monitoring processes. Further, our results indicate a single dose of physical activity may be particular beneficial for attentional processing in those children with poorer cognitive abilities and attention-related impairments — such as ADHD.

THE PERSISTENT INFLUENCE OF CONCUSSIVE INJURIES ON THE NEUROELECTRIC AND BEHAVIORAL INDICES OF ATTENTION

R. Davis Moore[1], Charles H. Hillman[2] & Dave Ellemberg[3]
[1]University of South Carolina, [2]Northeastern University, [3]University of Montreal

Concussive injuries are an increasing public health concern. Indeed, contrary to the traditional clinical belief that concussions are transitory in nature, mounting scientific evidence suggests that these injuries can and do lead to persistent deficits in brain and behavioral health. Furthermore, although concussions are heterogeneous in nature, they do appear to disproportionately influence specific aspects of higher neurocognition, such as attention and cognitive control. Accordingly, this presentation will provide evidence from child and adult concussion studies which illustrate the persistent, detrimental influence of concussive injuries on multiple attention-related processes. This presentation will also provide evidence of physiological and demographic factors which may moderate the strength of attentional dysfunction following concussion. Lastly, suggestions for future research will be discussed. The information presented herein will serve as both a general introduction to concussion for interested researchers and clinicians, as well as an in-depth look at the neuroelectric and behavioral indices of attention in those with a history of concussion.

Poster Abstracts

THE NECESSARY ROLE OF THE PRIMARY MOTOR CORTEX IN LITERAL AND METAPHORIC ACTION VERB PROCESSING

Olivia Howerton, Megan Reilly, & Rutvik Desai

Department of Psychology, University of South Carolina

There is ample evidence that the motor cortex is involved in reading sentences that contain an action verb ("The lengthy spike was hammered into the ground"). However, multiple interpretations of this effect have been proposed. Amodal views assume that motor cortex activation reflects motor imagery, but that it does not play a necessary role in action verb processing. Embodied views assume that the motor cortex is necessary, even when literal action is absent, i.e., in a metaphor ("The weak army was hammered again in battle"). We used TMS to investigate whether disruption to motor areas affects literal and metaphoric sentence comprehension. In the primary motor cortex, stimulation 300 ms post-verb presentation impairs comprehension to both literal and metaphor sentences relative to control sentences, supporting an embodied view of semantic cognition. We are collecting data on a follow-up study on a secondary motor integration area, the anterior inferior parietal lobe. Pilot data suggests that TMS to this higher-order motor region selectively inhibits metaphor processing.

REFERENTIAL INDEXING: THE ROLE OF SPACE IN LANGUAGE

Cameron M. Smith[1] & Amit Almor[1,2]

[1]Department of Psychology, University of South Carolina; [2]Department of Linguistics, University of South Carolina

Two experiments tested the hypothesis that spatial representations are used for reference tracking during language comprehension. Participants listened to two characters introduce themselves from distinct spatial locations and responded to an auditory probe from one of the two spatial locations. In E1, probes were character names and participants indicated whether they were the correct answer to questions they read. In E2, probes were beeps that preceded or followed references to characters and participants responded with a button press. E1 showed a spatial direction compatibly effect indicating that referent representation include a spatial component. E2 only showed an effect of introduction order (right-to-left or left-to-right) that also interacted with the direction the beep was played from and whether it was played before or a er the reference. Together, these results suggest that spatial representations are used for reference tracking but may not be automatically activated by repeated reference.

OPTIMIZING THE ANALYSIS OF SPEECH GLIMPSES IN NOISE

Bobby Gibbs & Daniel Fogerty

Dept of Communication Sciences and Disorders, University of South Carolina

Speech "glimpses" occur during time intervals when speech is sufficiently above the level of the competing noise. These glimpses may be characterized according to the rate, proportion, or duration of available speech information. Such glimpse parameters reflect varied temporal distributions of potential information for the recognition of speech in noise. The present study investigates how glimpse criteria may be optimized for modeling intelligibility under a variety of masking conditions. Masking noise was amplitude modulated by the temporal modulations present in natural speech. Masker modulations were then time-compressed or expanded to vary the temporal modulation rate relative to the unprocessed target speech. Speech intelligibility was also assessed at different masker presentation levels. The present study seeks to clarify the interaction between the overall signal-to-noise ratio and temporal properties of the masker when predicting intelligibility from glimpse parameters. Glimpse optimization

analyses investigated parameters that were most associated with the perceptual data in an effort to explain how listeners adaptively utilize glimpses in real life environments. Overall, results indicate a high degree of correlation between the different glimpse metrics when they are most associated with intelligibility.

EFFECT OF ATTENTION AND PITCH CUES TO THE PERCEPTUAL SEGREGATION OF MULTIPLE TALKERS

Rachel Miller & Daniel Fogerty

Communication Sciences and Disorders, University of South Carolina

Cognitive and perceptual abilities determine how individual listeners are able to parse out a target talker from a competing talker or noise source. Previous studies have examined the effect of global pitch differences, but have preserved instantaneous pitch contour differences. This study also examined the contribution of local pitch differences between the two talkers. Perceptual factors related to speech audibility and modulation masking were examined. In addition, the competing talker paradigm was completed under selective and divided attention task constraints to examine the contribution of cognitive abilities to task performance. Young normal hearing listeners were tested on eight conditions that examined these perceptual and cognitive factors. Listeners attended to two talkers speaking similarly structured sentences, both of which contained a color and number cue. Listeners were required to select the color and number cue associated with the target talker. The identity of the target talker was disclosed either before (selective attention) or after (divided attention) presentation of the stimulus. Preliminary results suggest that attentional abilities and a combination of perceptual factors determine a listener's ability to recognize speech in the presence of a competing talker. Results will be discussed in the context of auditory training and expertise.

AUTONOMIC DYSFUNCTION IS ASSOCIATED WITH PRAGMATIC LANGUAGE IMPAIRMENTS AMONG WOMEN WITH THE FMR1 PREMUTATION AND THE BROAD AUTISM PHENOTYPE

Jessica Klusek[1] & Jane E. Roberts[2]

[1]Communication Sciences and Disorders, University of South Carolina; [2]Department of Psychology, University of South Carolina

Introduction: Impairments in pragmatic language (i.e., social language) are seen at increased rates in the FMR1 premutation. Yet, the mechanisms underlying pragmatic impairments in this group have not been identified. The present study examined autonomic dysfunction as a potential cause of pragmatic language deficits. Methods: Participants included 43 mothers with the FMR1 premutation, 27 control mothers of typical children, and 24 mothers of children with autism who are at risk for pragmatic impairment as part of the broad autism phenotype. Baseline cardiac activity was sampled and estimates for heart rate (indexing general arousal) and respiratory sinus arrhythmia (reflecting parasympathetic "rest and restore" function) were derived. Pragmatic violations were coded from a 20-min conversational interview using the Pragmatic Rating Scale. Results. Respiratory sinus arrhythmia was a significant predictor of pragmatic ability ($p<.001$), with no significant effect of group or its interaction ($p's>.886$). Discussion: Dampened respiratory sinus arrhythmia, marking reduced parasympathetic control, was associated with worse pragmatic language skills across all groups. Findings implicate autonomic dysregulation in pragmatic language variation seen across both typical and atypical populations, which sheds light on physiological bases of behavior that may inform mechanistic targets for pharmacological/behavioral intervention studies relevant to autism and fragile X-associated conditions.

THE CORTICAL SOURCES OF FACE SENSITIVE ERP COMPONENTS IN INFANCY

Maggie Guy, Nicole Zieber, & John Richards

Department of Psychology, University of South Carolina

In the current study of infant face processing, event-related potentials (ERPs) were recorded and corresponding neural sources were investigated with cortical source analysis methods using realistic infant head models. Developmental changes in the amplitude and latency of infant ERP components (i.e. N290, P400, Nc) were measured in response to the mother's face, a stranger's face, a familiar toy, and a novel toy at 4.5, 6, and 7.5 months of age. N290 amplitude was greater in response to faces during periods of attention than toys during attention. P400 amplitude was greater in response to toys than faces. The neural regions responsible for ERP components' activation were identified through the application of cortical source localization methods that included current density reconstruction (CDR), realistic head models from individual MRIs, and age-appropriate infant head templates. Source analysis of the N290 revealed significant activation in the middle and anterior fusiform gyrus, parahippocampal gyrus, and temporal pole, which increased with age. Results during the time window of P400 and Nc components revealed activation in the orbitofrontal gyrus, posterior cingulate, ventral anterior cingulate, anterior and middle fusiform gyrus, parahippocampal gyrus, temporal pole, lingual gyrus, medial inferior occipital gyrus, and the inferior middle temporal gyrus.

MODALITY GENERAL AFFECTIVE REPRESENTATIONS OF VIDEOS AND MUSIC FROM FMRI DATA

Jongwan Kim, Svetlana V. Shinkareva, & Douglas H. Wedell

Department of Psychology, University of South Carolina

This study tested for neural representations of valence that are shared across visual and auditory modalities referred to as modality-general representations. On a given trial participants (n = 20) made either affective or semantic judgments of short silent videos or music samples. For each modality valence was manipulated at three levels, positive, neutral, and negative, while controlling for the level of arousal. Whole-brain crossmodal identification of affect indicated the presence of modality-general valence representations of signed (positive vs negative) and unsigned (positive/negative vs. neutral) valence. These results generalized across the two tasks. Brain regions that were sensitive to valence states in the same way for both modalities were identified by searchlight analysis of fMRI data by comparing the correlation of voxel responses to the same and different valence conditions across the two modalities. Seven clusters were identified and subsequently validated using crossmodal identification of valence and multidimensional scaling: precuneus for signed valence, bilateral mPFC and STS/postcentral, and MFG for unsigned valence, and STS/MFG and thalamus for both.

ELECTROPHYSIOLOGICAL STUDY OF AUDIOVISUAL INTEGRATION OF AFFECT

Chuanji Gao[1], Jessica J. Green[1], Douglas H. Wedell[1], Chunyan Guo[2], Svetlana V. Shinkareva[1]

[1]Department of Psychology and Institute for Mind and Brain, University of South Carolina, [2]Beijing Key Laboratory of Learning and Cognition, Department of Psychology, Capital Normal University

Much of the research on the audiovisual integration of affective stimuli has focused on the emotional perception of face-voice pairs rather than the experience of affect itself. The current study recorded EEG from 66 channels while participants viewed dynamic naturalistic silent videos and music to quickly elicit brief affective states differing in valence (positive, neutral, or negative) while equating for arousal. Stimulus trials were either unimodal (silent video or music with a blank screen) or multimodal (video combined with music). Multimodal stimuli

were either congruent (same valence in two modalities) or incongruent (different valence in two modalities). Participants (n=24) evaluated valence and arousal of the stimuli for each trial using a 9x9 grid. The effect of multimodal integration on visual processing was evaluated by subtracting the ERPs for the unimodal auditory (A) waveforms from the multimodal (AV) waveforms and then comparing this difference to the unimodal visual (V) ERPs. Early ERP components (N1, P2, N2) and a late component (LPP) were modulated by audiovisual integration. In particular, the amplitudes of N1 and P2 were enhanced and speeded up in the AV-A condition compared to the V condition, suggesting that audiovisual integration of affect is processed faster than unimodal representations, which might be related to saliency and attention.

DOSE DEPENDENT EFFECTS OF ETHINYL ESTRADIOL ON NOREPINEPHRINE LEVELS AND OBJECT RECOGNITION MEMORY IN FEMALE RATS

Jean Simone, Nathan Drew Farr, & Phil V Holmes

University of GA Neuroscience

Norepinephrine underlies working memory by potentiating attentiveness to novelty, which can be measured by performance on object recognition tests (ORT). Ethinyl estradiol (EE), a norepinephrine reuptake inhibitor, was shown by our lab to have a dose-dependent effect on ORT suggestive of a change in noradrenergic tone. In this experiment, Sprague-Dawley female rats received 21 days of EE (10 or 30 µg/rat/day) or vehicle followed by testing in novel object (non-spatial, cortical) and context (spatial, hippocampal) recognition. Elisas performed were serum 17β-estradiol, norepinephrine, and norepinephrine reuptake transporter (NET). All subjects were low in 17β-estradiol, at the time of testing. A dose-dependent response was seen in both ORT, with the EE-30µg group, learning better than the 10µg group in the novel object, but significantly worse than control in the novel context test. Concordantly, when compared to control, EE-30µg treated rats' tissue norepinephrine levels were elevated in the prefrontal cortex—an area necessary for recent memory retrieval and attention to novelty. While levels were decreased in the hippocampus, where spatial memory is predominantly dependent. Our findings of divergent dose-dependent actions of EE on norepinephrine and cognitive attention, suggest a required limit to the minimal dose of ethinyl estradiol used in contraceptive hormone regimens.

ATTENTION AND IMMEDIATE MEMORY IN COMBAT VETERANS WITH PTSD: THE ROLE OF HEART RATE VARIABILITY

JP Ginsberg & Melanie Berry

Dorn VA Medical Center

BACKGROUND: Although PTSD has been associated with reduced heart rate variability (HRV, or 'cardiac coherence) and with deficits in attention and immediate memory in separate studies, the co-occurrence of reduced coherence and cognition in combat veterans (CV) with PTSD has not been studied. Therefore, a pilot study was undertaken to assess the covariance of coherence and information processing in CV's. In addition, we studied the effects of HRV biofeedback (HRVB) on coherence and information processing in these veterans. METHODS/DESIGN: A small two-group (CV's with and without PTSD), pre-post study of coherence and information processing study was conducted at our VA Medical Center outpatient mental health clinic. INTERVENTION: Participants met with an HRVB professional once weekly for 4 weeks and received HRVB coaching. OUTCOME MEASURES: Cardiac coherence, word list learning, commissions (false alarms) in a go-no go continuous performance test, digits backward. RESULTS: Cardiac coherence was achieved by all participants, and the increase in coherence ratio was significant post-HRVB training. Significant improvements in the information processing indicators were also achieved. CONCLUSION: Increase in cardiac coherence was the likely mediator of cognitive improvement. Cardiac coherence indexes strength of parasympathetic influence on cardiac deceleration and has cardinal importance for attention and immediate memory.

MODALITY INDEPENDENT RECRUITMENT IN THE OCCIPITAL LOBE: A META-ANALYSIS OF EARLY-BLIND AND SIGHTED FMRI AND PET STUDIES.

William J. Brixius & Jessica J. Green

Dept of Psychology and Institute for Mind and Brain, University of South Carolina

Occipital cortex is classically considered vision-specific, with the exception that visual loss results in recruitment for non-visual tasks. However, crossmodal and multisensory processing research suggests that occipital activity is modulated by non-visual inputs, particularly when vision is degraded or temporarily limited. One possibility is that occipital regions receive inputs from multiple sensory modalities (vision, audition, touch), with vision the most informative for tasks recruiting occipital areas, therefore dominating occipital processing. Thus, when visual input is removed, non-visual occipital responses can be “unmasked”. To investigate occipital recruitment by non-visual stimuli, we conducted activation likelihood estimation meta-analyses on fMRI and PET studies reporting early-blind and sighted participant neural activations for auditory and tactile tasks. Analysis of early-blind>sighted contrasts revealed an early-blind activation network comprising bilateral cuneus, lingual and inferior occipital gyri, and right-lateralized middle occipital and inferior temporal gyri. These results support the notion that similar occipital areas are recruited in the early-blind for non-visual spatial information as those recruited in sighted participants during visual tasks. In a second analysis, we examined auditory and haptic task>rest and task>task coordinates reported for early-blind participants and sighted participants with temporarily restricted vision. The conjunction of early-blind and sighted participant activity revealed common activation in bilateral cuneus and inferior parietal lobule, right lingual, postcentral, and superior/inferior temporal gyri, and left insula, middle temporal, and medial frontal gyri. The consistent inclusion of lingual gyrus and cuneus across modalities suggests that auditory and somatosensory modalities can recruit occipital cortex for non-visual processing, even in sighted individuals. The similarity of the recruited areas in sighted individuals and those whose vision was lost early in life further suggests that occipital cortex may be organized for specific functions (e.g., spatial localization, object identification, motion processing) in all modalities, but that these tasks are most easily accomplished using visual input.

OCULOMOTOR CAPTURE DESPITE CONTEXTUAL CUEING IN SCENES

Jenn Olejarczyk

Dept of Psychology and Institute for Mind and Brain, University of South Carolina

Every day we are faced with distractions. For example, an abrupt onset of an object disrupts visual search performance. However, onsets may fail to capture attention when irrelevant or if a saccade has already been planned. This study used a contextual cueing paradigm and the final two search blocks introduced a one degree red square onset that appeared 100ms after central fixation or during a saccade landing more than two degrees from center. Results showed both fixation and saccade onsets captured attention compared to baseline measures in previous blocks without the onset. Similar results across novel and repeated searches suggest memory for a known target location does not eliminate attentional capture of an irrelevant onset.

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This conference is made possible by funding from the College of Arts and Sciences. The Institute for Mind and Brain coordinates interdisciplinary research efforts in cognitive neuroscience across the University of South Carolina; identifies and leverages opportunities for collaboration and external funding; presents a cohesive face for research efforts in cognitive neuroscience to the outside world; and generally serves as a hub for research and doctoral student training in human cognitive neuroscience on the University of South Carolina – Columbia campus.