UNIVERSITY OF MICHIGAN
Functional MRI Laboratory

Fall 2019 Functional MRI Symposium

Presentation Abstracts
(In order by Speaker)

"Development of MR Fingerprinting"

Yun Jiang
Research Fellow
Department of Radiology
University of Michigan
Email: yunjiang@umich.edu

Abstract:

Quantification of tissue properties has long been a research goal in Magnetic Resonance Imaging (MRI). However, the conventional quantitative method typically estimates one parameter at a time, leading to a prohibitively long acquisition time for the clinic adoption. The recently proposed Magnetic Resonance Fingerprinting (MRF) is a novel framework that simultaneously quantifies multiple tissue properties using pseudorandom acquisition parameters. It breaks the convention of MRI, which acquires a steady-state signal with fixed acquisition parameters. In this talk, three key components of MRF will be introduced: data acquisition, dictionary generation, and pattern recognition, followed by a discussion on how the combination of these components in MRF allows for highly accurate and repeatable estimation of tissue properties. Various clinical studies using MRF in brain and prostate will be presented to illustrate the usage of quantitative information in the disease evaluation.

"Neural Correlates of Working Memory Training: Evidence for Plasticity in Older Adults"

Alex Iordan
Research Fellow
Department of Psychology
University of Michigan
Email: adiordan@umich.edu

Abstract:

Brain activity typically increases with increasing working memory (WM) load, regardless of age, before reaching an apparent ceiling. However, older adults exhibit greater brain activity and reach ceiling at lower loads than younger adults, possibly reflecting compensation at lower loads and dysfunction at higher loads. We hypothesized that WM training would bolster neural efficiency, lowering activity such that the activation peak would shift towards higher memory loads after training. Pre-training, older adults showed greater recruitment of the WM network than younger adults across all loads, with decline at the highest load. Ten days of adaptive training on a verbal WM task improved performance and led to greater brain responsiveness at higher loads for both groups. For older adults the activation peak shifted rightward towards higher loads. These results provide new evidence for functional plasticity with training in older adults and identify a potential signature of improvement at the neural level.

"Childhood Anxiety and OCD: Can Brain guide Treatment?"

Kate Fitzgerald
Associate Professor
Department of Psychiatry & Psychology
University of Michigan
Email: krd@umich.edu

***Abstract**:*

Cognitive behavioral therapy (CBT) is effective for anxiety and obsessive compulsive disorders but, despite this, substantial subgroups of patients do not respond sufficiently well to treatment. In theory, brain-based understanding of treatment response could pave the way for improving treatment effectiveness for more patients. Understanding the neural mechanisms of illness and response to CBT in affected youth may be especially important, given that anxiety and obsessive compulsive disorders often emerge in early life. In Dr. Fitzgerald's talk, she will bring together data from the field and her own laboratory which aims to elucidate biological predictors and mechanisms of symptom change in the anxiety and obsessive compulsive disorders, with particular focus on studies in pediatric populations.

"The Current State of Prediction in Neuroimaging"

Saige Rutherford
Research Area Specialist
Department of Psychology
University of Michigan
Email: saruther@umich.edu

***Abstract**:*

Machine-learning techniques to build brain-behavior predictive models is rapidly gaining momentum in the era of big data and the replication crisis. As Tal Yarkoni states, "an increased focus on prediction, rather than explanation, can ultimately lead us to greater understanding of behavior". In this talk I will unpack Brain-Basis Set (BBS), the brain-behavior predictive model widely adopted within Chandra Sripada's group. I will cover recent applications of this model across a wide range of data sets/types, discuss environments where BBS has succeeded and failed, and introduce where I think predictive modeling of brain behavior relationships has room to grow.

"Characterizing Auditory Responses in Human Low-Level Visual Cortex using ECoG"

John Plass
Research Fellow
Department of Psychology
University of Michigan
Email: jplass@umich.edu

***Abstract**:*

Sounds can facilitate the perception of simultaneous visual events. One mechanism thought to subserve these enhancements is crossmodal phase-resetting of subthreshold oscillations in low-level visual cortex. By placing visual cortex in a high-excitability state before visual input arrives, crossmodal phase-resetting is thought to enhance sensitivity for concurrent visual signals. Using intracranial electrocorticography (ECoG) in human epilepsy patients, we recently observed widespread auditory phase-resetting throughout visual cortex, including pericalcarine (putative V1/V2), lateral occipito-temporal (potentially V5/hMT+), inferior occipito-temporal, and posterior parietal cortex. Here, we sought to further characterize the electrophysiological properties and stimulus selectivity of crossmodal responses in low-level (pericalcarine) visual cortex by analyzing additional indices of neural activity and responses to a wider variety of auditory stimuli. Consistent with research in non-human primates, pericalcarine electrodes exhibiting auditory phase-resetting demonstrated only weak or negligible neural firing, as indexed by high gamma (70-150 Hz) power. At lower frequencies (reflecting neural oscillatory activity), electrodes with the most pronounced phase-resetting effects (measured using inter-trial phase coherence; ITPC) exhibited increased power in the same frequency bands (theta/alpha), while electrodes with weaker ITPC exhibited broad power suppression. These results suggest that sounds primarily influence low-level visual cortex by modulating sub-threshold oscillations, potentially increasing theta/alpha power by synchronizing oscillations in targeted neural ensembles, while reducing neural variability overall. To characterize the stimulus selectivity of these responses, we examined whether they varied with the frequency (pure tones) or complexity of auditory stimuli. Crossmodal responses exhibited variable or no frequency preferences, and similar phase-resetting responses for pure tones, noise bursts, and speech. These results suggest that crossmodal responses in low-level visual cortex may primarily convey stimulus timing with minimal selectivity for stimulus content. Altogether, these results support the hypothesis that sounds enhance stimulus coding in low-level visual cortex by synchronizing subthreshold oscillations to the timing of auditory events.

"Predictive Modeling in Older Adults using Resting-State and Talk Brain Connectomes"

Scott Peltier
Research Scientist
Functional MRI Laboratory
University of Michigan
Email: spelt@umich.edu

Abstract:

Brain network connectivity derived from functional MRI has the potential to characterize normal and pathological aging. A recent analysis technique, Connectome Predictive Modeling (CPM), has shown promise in relating imaging-derived measures to clinical/behavioral observations in patient populations (Finn 2015; Shen 2017; Lake, 2018). We will present results using CPM: 1) in the prediction of a composite memory measure in healthy controls, subjects with mild cognitive impairment (MCI), and subjects with Alzheimer's Disease; and 2) in the prediction of measures of recall and overall cognition in subjects with MCI. These data demonstrate the potential utility of this approach in the characterization of neurodegeneration.