"Omics" in Neuropsychology: Current State and Future Directions

Abstract (250 words)

Scientific investigation of the "Omics" (genomics, transcriptomics, proteomics, metabolomics, connectomics, cognitive and neuropsychiatric phenomics) have burgeoned over the last two decades, carrying the promise that mechanistic paths from "genome" to "syndrome" could be articulated. Initial enthusiasm has been tempered by the complexities involved in spanning levels of analysis. Sobering examples reveal that structural genetic variation explains only a fraction (~25%) of the variance in transcription, and that genetic variants typically explain less than 0.5% of more complex phenotypes, including psychological and neuropsychological phenotypes. Now that whole genome sequencing (WGS) is being conducted on a large scale, and both bioinformatics and healthcare informatics strategies are assembling knowledge and enabling the study of associations across levels of biological processes, we have new opportunities to test hypotheses about the causes of complex disorders of brain and behavior. This process requires new tools for the specification of constructs connecting neural circuits and systems with cognitive and emotional functions. Computational approaches are emerging that go beyond formal descriptions of behavioral outcomes in response to stimulus contingencies, and begin to specify testable hypotheses about mechanistic neural models of cognitive function and dysfunction. The NIMH Research Domains Criteria (RDoC) initiative is evolving to support definitions of new phenotypes that are more closely aligned with neural substrates, holding the ultimate promise that the causes of complex syndromes will be better understood and targeted, personalized treatments will be developed. Neuropsychology is uniquely positioned at the interface of brain and behavior, where the most profound discoveries about the "mind-body" problem may one day be revealed.

Short description

This presentation describes the "omics" transdisciplines that have emerged across biomedical sciences, and focuses on the role of neuropsychology in multi-level models that span the territory from genome to syndrome. The presentation will highlight informatics strategies and computational approaches developed to define new biologically valid dimensions, and ultimately offer an opportunity for scientific inquiry that addresses the "mind-body" problem.

Learning objectives

Attendees will be able to:

- Describe multiple levels of analysis that connect the genome to higher level behaviors and neuropsychiatric syndromes.
- Understand the difference between bioinformatics and healthcare informatics, and say why both are important to advance "omics" for neuropsychology.
- State current directions in "computational" neuropsychology.
- Identify multiple dimensions that have been proposed for study under the aegis of the NIMH RDoC Initiative.