



UNIVERSITY OF NEBRASKA -LINCOLN COLLEGE OF ENGINEERING



## Biomedical Engineering Seminar

Friday, October 18, 2024

12:00 - 1:30 PM

**MOLR 169**

### **Advancing the Science and Engineering of Intelligence: From Network Neuroscience to Interventions for Precision Health**

**Aron K. Barbey, Ph.D.**

Mildred Francis Thompson University Professor  
Director of Center for Brain, Biology & Behavior  
University of Nebraska-Lincoln



Research in the psychological and brain sciences has long sought to understand the nature of human intelligence, examining the stunning breadth and diversity of intellectual abilities and the remarkable neural mechanisms from which they arise. Rather than originate from a fixed set of cortical regions or a primary brain network, recent discoveries in Network Neuroscience suggest that intelligence emerges from a rich constellation of networks whose functions are orchestrated in a flexible, goal-directed manner. Although our understanding of neural dynamics and plasticity is guided by insights from the early twentieth century, we are only now beginning to establish methods to target and enhance network function and to accelerate the science and engineering of intelligence through Network Neuroscience. In this presentation, I illustrate how research in this emerging field is uncovering the network architecture of general intelligence and driving innovation in the design of neuroscience-guided interventions to enhance executive functions, with a focus on the network mechanisms of cognitive control. I explain how research in Network Neuroscience: (1) examines the nature and origins of intelligence through a multifaceted lens, calling for a synthesis of research across the cognitive, computational, and brain sciences; (2) establishes multimodal interventions to target multiple pathways for cognitive enhancement, engaging executive, social, and emotional brain networks (through skill-based cognitive training, non-invasive brain stimulation, mindfulness meditation, physical fitness training, and nutritional intervention); (3) applies statistical machine learning methods to engineer personalized training protocols based on multivariate performance phenotypes (derived from cognitive, genomic, and brain imaging data); and, finally, I show how Network Neuroscience:(4) inspires new perspectives about the dynamic and adaptive nature of intelligence, motivating novel insights about how intelligence is cultivated through learning and experience, is enabled by lifestyle choices that promote health and wellness, and is altered by psychiatric illness and traumatic brain injury.

**Biography:** Aron Keith Barbey is the Mildred Francis Thompson University Professor and Director of the Center for Brain, Biology and Behavior, and the Decision Neuroscience Laboratory at the University of Nebraska-Lincoln. He began his career at the Beckman Institute for Advanced Science and Technology at the University of Illinois Urbana-Champaign in 2011, where he was promoted to full professor in 2019. Dr. Barbey's research investigates the neural mechanisms of human intelligence and decision making, with particular emphasis on enhancing these functions through cognitive neuroscience, physical fitness, and nutritional intervention. His research has been supported by the Office of the Director of National Intelligence, the Department of Defense, the White House BRAIN Initiative, the National Institutes of Health, the National Science Foundation, and private industry (Abbott Nutrition, Google Brain, and PepsiCo). Dr. Barbey has received multiple research awards and is co-editor of the Cambridge Handbook of Intelligence and Cognitive Neuroscience and editor of the forthcoming Oxford Handbook of Cognitive Enhancement and Brain Plasticity. In 2023, Dr. Barbey was appointed to the United States Defense Science Study Group at the Institute for Defense Analyses. He earned his doctorate in Psychology from Emory University and completed a research fellowship in Cognitive Neuroscience at the National Institutes of Health.