BECKMAN INSTITUTE POSTDOCTORAL RESEARCH ASSOCIATE IN HUMAN CONNECTOMICS

The Decision Neuroscience Laboratory is accepting applications for a **Postdoctoral Research Associate in Human Connectomics**, beginning Fall 2017. The goal of this fellowship is to conduct state-of-the-art functional and structural MRI studies of the human connectome with an emphasis on characterizing the topology and dynamics of human intelligence.

Network Topology. Scientific discovery and insight into the biological foundations of human intelligence have advanced considerably with progress in neuroimaging. In the past decade, functional connectivity, a metric of coherence in activation across brain regions, has been used extensively to probe cognitive function and to reveal the network architecture of the human brain. Intrinsic connectivity networks are characterized by their micro- and macro-level topology. Micro-level topological properties describe local features of the network (e.g., node degree). In contrast, macro-level topological properties reflect the large-scale architecture and global organization of the network (e.g., organization of network modules). Goal-directed, intelligent behavior is known to depend on the learnability of macro-level network structures. Specifically, hubs play a central role in the formation of macro-level network structures and mediate many of the long-distance connections between brain modules. Hub regions form a strongly interconnected network, called the "rich club." Hubs within the rich club network demonstrate a significant degree of task-specific interactions with a wide variety of cognitive and sensory networks, modulating their connectivity and supporting a diversity of cognitive tasks. Furthermore, interactions between rich club regions play an important role in determining global efficiency of communication in a network, as demonstrated by evidence indicating that almost 70% of the shortest paths through a whole brain network pass through the rich club. Given the role of efficiency of network communication in intelligence, hubs within the rich club play a primary role in the coordination of functional brain networks for intelligent behavior.

Network Dynamics. While the contributions of intrinsic functional connectivity networks have been widely established in their associations with intelligence, research at the frontiers of human connectomics further investigates how dynamic functional connectivity states contribute to intelligence. Dynamic variability in functional connectivity is critical for the diverse range of cognitive abilities underlying intelligence, and recent work on dynamic brain connectivity has shed light onto how these dynamic networks relate to static functional connectivity networks and intelligence. Variability in functional interactions between nodes gives rise to a large set of functional network states that are strongly fluctuating over time, and which may differ from commonly defined static networks. Recent evidence indicates that the default mode network passes through multiple meta-stable states and that these short-lived functional connectivity states are reproducible across participants and represent a central feature of brain network function. Furthermore, research demonstrates that the fronto-parietal network is made flexible through its composition of hubs, which rapidly modulate their pattern of global functional connectivity according to task demands.

The Decision Neuroscience Laboratory provides ample opportunity for the development of innovative, focused research and a broad collaborative cognitive neuroscience experience through affiliations with the Cognitive Neuroscience Division of the Department of Psychology at the University of Illinois, the Intelligence, Learning, and Plasticity Initiative at the Beckman Institute for Advanced Science and Technology, and the National Center for Supercomputing Applications. The Decision Neuroscience Laboratory is funded by the White House BRAIN Initiative, the NIH, the NSF, and private industry, and utilizes a Siemens Magnetom Prisma, state-of-the-art, 64-channel MRI scanner with 80 mT/m gradients, along with a 64-channel head coil.

This research fellowship is designed as a three-year experience that includes a speaker series, journal article discussions, laboratory presentations and discussions, tutorial training, and the teaching of skills necessary to conduct original cognitive neuroscience research. Ph.D.'s with a strong background in human connectomics, computer science, and engineering are encouraged to apply. Salary and benefits are competitive and commensurate with NIH guidelines. For further information, contact Aron K. Barbey, Ph.D., Director, Decision Neuroscience Laboratory, at Barbey@Illinois.edu and see www.DecisionNeuroscienceLab.org/. To apply, send CV and three recommendations to Barbey@Illinois.edu by February 15, 2017. The University of Illinois is an equal opportunity employer committed to creating a diverse, cooperative work environment. Women, members of under-represented minority groups, and individuals with disabilities are encouraged to apply.

Aron K. Barbey, Ph.D.