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Investigating Brain-Behavior Architecture Using Graph-Based Network Analysis: Preliminary Insights from Resting-State fMRI

Friday, September 12, 2025 11:45 AM (15 minutes)

Introduction: Network analysis provides a systematic, quantitative approach to modeling and understanding complex systems, and it has gained traction in both neuroscience and psychology. However, interdisciplinary collaboration between these fields from a network analysis perspective remains limited. In trying to bridge this gap, we investigated how the network structure of seven cognitive domains is interrelated to the topology of the brain's resting-state functional connectivity (rs-FC). Methodology: Exploratory graph analysis was performed on the available cognitive and behavioral data of 379 healthy young individuals of the Human Connectome Project. Seven separate but related clusters were extracted: Mental Health, Externalizing problems, High-level Cognitive Functions, Basic Cognitive Functions, Substances use/abuse, Reward Delay Discounting and Pain. For the rs-FC data, graph theory metrics—clustering coefficient, participation coefficient, nodal strength, and betweenness centrality—were computed to capture both network segregation and integration. Generalized additive models were then performed to link the cognitive network's clusters with the rsFC topology data. Results: Findings revealed that each cognitive-behavioral cluster is influenced by connectivity patterns between several brain networks. Specifically, higher segregation within the Default Mode Network (DMN), and greater integration in the Frontoparietal and Ventral Attention networks, were linked to adaptive cognitive functions. Conversely, increased integration of the DMN and Sensorimotor networks, along with greater segregation of Dorsal Attention systems, were associated with maladaptive behaviors such as impulsivity and substance abuse. Conclusions: These findings underscore the tight link between the architecture of the brain and the cognitive network, highlighting the value of network analysis in understanding brain-behavior dynamics.

If you're submitting a symposium talk, what's the symposium title?

Mapping the Mind: investigating the relationships across Psychometric and Neural variables through Network Science

If you're submitting a symposium, or a talk that is part of a symposium, is this a junior symposium?

Yes

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