

Collect Your Thoughts: Individual Differences in the Networks Underlying Intelligence

Organizer:

Rhodri Cusack

Trinity College Dublin, Ireland

Intelligence is among the most central of human abilities, predicting a wide range of outcomes across the lifespan. How information is brought together to allow complex, flexible cognition is fundamental to human intelligence. This symposium will focus on the relationship between individual differences in complex cognition and individual differences in network connectivity. It will champion the beauty of novel analysis methods, the brains of neuroimaging, and the brawn of large-scale data analysis. We show that in the first months after birth, fronto-parietal networks are maturely connected and that individual differences in connectivity influence early development. Complimenting these infant data, using structural equation modelling and Bayesian model comparison, we will present a study of adults across the lifespan (18-88 years old) that shows that higher intelligence is mediated by increased processing speed, resulting from stronger structural connectivity, most notably in the frontal lobe's Forceps Minor tract. Using clustering of networks between brain regions and across time, we then show that these brain networks dynamically reconfigure during complex cognition and that individual differences in this reconfiguration modulate performance. Finally, convergent data from three domains in adults—loss of consciousness during anaesthesia, loss of consciousness after severe brain injury, and cognitive performance in healthy individuals— show that the diversity of the functional responses in sensory and fronto-parietal regions to naturalistic stimulation underlies conscious cognition and individual differences in intellectual abilities. Reflecting the growing demand for greater reproducibility in cognitive neuroscience, we report findings from N=1900 participants, to provide a rich window onto the role of neural integration and differentiation in complex cognition.

Symposia Schedule:

8:00-8:15

The Fronto-Parietal Network is Maturely Connected and Influences Developing Behaviour from the First Months

Rhodri Cusack, Trinity College Dublin, Ireland

8:15-8:30

Watershed Models of Intelligence Through the Lifespan

Rogier Kievit, University of Cambridge, Cambridge, United Kingdom

8:30-8:45

Charting Dynamic Interactions Between Large-Scale Brain Networks in Health and Disease

Danielle Bassett, Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States

8:45-9:00

The Neural Machinery of Conscious Cognition: Converging Evidence from Anesthesia-Induced Unconsciousness, Severe Brain Injury and Intellectual Prowess

Lorina Naci, University of Western Ontario, London, ON, Canada

9:00-9:15

Questions and Answers