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# What's in a brain? Why networking might be the key to intelligence

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What makes some people more clever than others? One of the central aims of cognitive neuroscience is to understand how the make-up of our brains dictates our intelligence – the general mental capability by which we reason, think abstractly and learn from experiences. Recent research shows the links between brain regions may be the key.

Human intelligence is closely linked to outcomes in education, socioeconomic status and health. Differences in IQ between individuals have so far tended to be attributed to structural variations in specific brain regions. However, a study by researchers based in Frankfurt suggests it may in fact be the functional interactions within and between those regions – the way they are wired – that explain individual differences in cognitive ability.

# The impact of modular organisation on how we process information

Previous brain imaging studies have linked general intelligence to the structure and function of the frontal and parietal cortexes. But less attention has been paid to the clustering of functional connections into subnetworks, known as modules or communities, which have dense internal connections but are only weakly connected with the rest of the brain network.

Understanding how differences in this modular organisation affect information processing is important in understanding the neurobiological mechanisms that underlie cognitive ability. While brain networks are characterised by modularity, it is unclear if or how this modular organisation is associated with general intelligence.

The EU grant to L POP has helped the research along. Findings recently published in 'Nature', set out the researchers' hypothesis that the connectivity profile of the frontal and parietal brain regions may shape aspects of information processing, allowing information to be communicated quickly and efficiently.

To explore this, they applied graph analyses to functional magnetic resonance imaging (fMRI) resting-state data, and characterised the modular brain network organisation in a large and representative sample of healthy adults. Participants' intelligence was measured using the Wechsler Abbreviated Scale of Intelligence, a test designed to assess specific and overall cognitive capabilities.

Their findings show that general intelligence is associated with connectivity within and between modules in node clusters in frontal, parietal and other cortical and subcortical regions. These regions have

previously been suggested as localised neural substrates of intelligence. Topological properties of global modular network organisation, on the other hand, are not linked with intelligence. They propose, therefore, that the embedding of intelligence-related brain regions provides advantages for information processing that benefit cognitive ability.

The team also observed negative associations between regions, suggesting that certain regions may behave in a way that shields cognitive processes from interference. This aligns with previous findings that both higher and lower levels of integration and segregation can be beneficial for cognitive performance.

The L POP (Language-Processing by Overlapping Predictions: A Predictive Coding Approach) grant is helping to establish the connection between fundamental neural computations and language processing.

**More information:** For more information, please see cordis.europa.eu/project/rcn/189855_en.html

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