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Resting-State Brain Activity and Connectivity in Individuals with High Cognitive Abilities

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Introduction
Recent investigations point to a link between intelligence and more efficient neural processing, suggesting that people with higher cognitive performance tend to have stronger integration among key brain areas and reduced redundant activity (Jung & Haier, 2007). Grounded in this concept of neural efficiency, the current study examines resting-state functional activity and connectivity in individuals with above-average cognitive abilities compared to those with average IQ, aiming to shed light on how brain organization differs according to intelligence level.
Objective
To explore whether resting-state brain activity, as measured by amplitude of low-frequency fluctuations (ALFF) and functional connectivity, differs according to intelligence levels. Specifically, the study examines differences in brain connectivity between individuals with high cognitive abilities and those with an average IQ.
Participants
The sample consists of 10 women and 10 men, with an average age of 20.1 years. All of them students of the ULL
Method
Resting-state functional magnetic resonance imaging (rs-fMRI) was used to analyze brain activity and connectivity.
Participants were classified into two groups based on their IQ scores:
● High cognitive ability group (IQ ≥ 120)
● Average cognitive ability group (IQ 90–119) The sample consisted of 10 participants per group,all university students from Universidad de La Laguna. ALFF was measured in key brain regions, including the ACC, left frontal pole (lFP), and subcallosal cortex, to assess spontaneous neural activity. Functional connectivity analyses were conducted to examine relationships between these regions and other cortical and subcortical structures.
Results
The study revealed differences in brain activity and connectivity between individuals with high and average intelligence.
● Higher intelligence was associated with increased ALFF in key brain areas, indicating greater neural efficiency.
● Differences in connectivity patterns were observed, suggesting variations in the way brain networks communicate and integrate information.
● Regions linked to executive functioning and emotional regulation showed notable distinctions between the groups, reinforcing the idea that intelligence influences brain organization.
Conclusion
The findings highlight key differences in spontaneous brain activity and connectivity between individuals with different intelligence levels.
● Higher IQ individuals exhibited stronger brain activity in cognitive control regions.
● They demonstrated more efficient functional connectivity, particularly in prefrontal networks.
● The results support the neural efficiency hypothesis, suggesting that intelligence is associated with optimized
brain function.
These findings contribute to a better understanding of how intelligence shapes brain organization, emphasizing that intelligence is not simply about higher activity in specific areas but about the efficient integration of multiple networks. Future research could further explore how these neural differences relate to cognitive performance in complex tasks.

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