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Brain Perfusion and Neurocognitive Tasks in Patients with Primary Progressive Aphasia

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Introduction

Cerebral blood flow (CBF) or brain perfusion of a specific brain area is considered a marker of local neuronal activity and has been associated with performance in language and domain-general functions (Leeuwis et al. 2017, 2018). Neurodegeneration in patients with Primary Progressive Aphasia (PPA) decreases blood flow in damaged tissue affecting both language and domain-general performance (Gorno-Tempini et al. 2011, Themistocleous et al. 2021). This study aims to model language vs. domain-general performance in PPA on frontal, parietal, and temporal brain areas based on their perfusion.

Methods

To investigate CBF in frontal, parietal, and temporal brain areas, we conducted perfusion analysis in 38 patients with PPA (13 with the logopenic PPA variant, 19 with the non-fluent PPA variant, 6 with the semantic PPA variant). MRI scans were performed on a 3-Tesla MRI scanner using an 8-channel head coil (Philips Healthcare, Best, Netherlands). We generated pseudo-Continuous Arterial Spin Labeling (pCASL) MRI images using ASL-MRICloud, the Johns Hopkins University's cloud based on Arterial Spin Labeling analysis software (Li et al. 2019) and calculated the Relative CBF by dividing the CBF within a brain region with the value of CBF over the entire brain.

Results

Core language areas of the left hemisphere (i.e., IFG triangularis, IFG opercularis, SMG, STG) correlated only with language tasks (BNT, SOAP, word fluency and spelling). Domain-general areas of the left hemisphere belonging to the multiple demands network (i.e., MFG, MFG_DLPFC, AG) correlated with both domain-general tasks (Trail A and B, Digit span forward and backwards, word fluency and RAVLT) and with language tasks (BNT, sentence repetition, SOAP, and spelling).

Conclusions

The results show that areas in frontal, parietal, and temporal cortex representing the multiple demands network are associated with both domain-general and language functions, but core language areas are associated mostly with language functions. Also, the results highlight the multifunctional role of the multiple demand network in both domain-general and language functions and can lead to improved intervention strategies in PPA and other communication disorders.

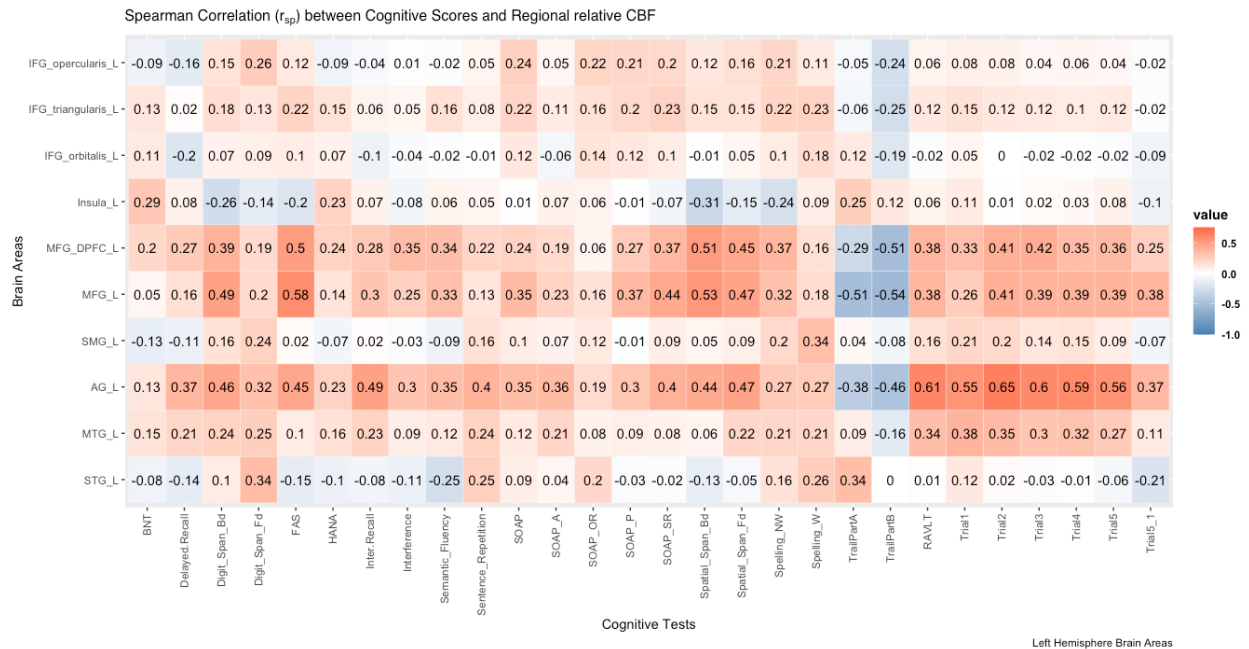


Figure 1 Spearman correlation (r_{sp}) of cognitive scores and regional relative CBF of the left hemisphere Inferior Frontal Gyrus (IFG) orbitalis, IFG opercularis, IFG triangularis, Insula, Middle Frontal Gyrus (MFG), MFG Dorsal Parietal Cortex (DPFC), Angular Gyrus (AG), Superior Temporal Gyrus (STG), and Middle Temporal Gyrus (MTG). $r_{sp} = \pm 1$ perfect correlation; 0.7 strong correlation; 0.5 moderate correlation; 0.3 weak correlation; 0 no relationship.

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