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Laterality effects of mental-attentional capacity in adults: a task-based fMRI study

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Working memory (WM) is a well-established concept and its neural correlates have been documented with neuroimaging. However, little is known about the lateralization of neural correlates related to solving WM tasks with multiple levels of difficulty. Tasks of mental attention have multiple levels of difficulty [1]. The laterality index (LI) [4] is one way to assess hemispheric dominance in a variety of cognitive tasks, and the changes in laterality with difficulty level of the task. The present study investigates lateralization of brain activations as a function of difficulty using functional magnetic resonance imaging (fMRI).

Twenty-nine young adults (20-30 years, 15 females) participated in the study. MRI acquisition was performed on a 3T Philips scanner. High resolution anatomical images were obtained using a T1-weighted sequence, and functional images were collected while children completed Color Matching Task (CMT) [2]. MRI data preprocessing and analyses were conducted using AFNI [3]. Statistical maps were generated for each participant, which represent task-related signal associated with each difficulty level by subtracting it from the signal associated with control blocks. Whole-brain activity was examined via general linear model (GLM) analyses. Finally, laterality indices (LI) were calculated for each region of interest (ROI).

Mental attention was found to be expressed in frontoparietal regions, which is consistent with the past research on working memory. Importantly, analyses revealed the effects of hemispheric variation and spatial extent across difficulty levels. For instance, at the first two levels of difficulty participants relied primarily on the left middle frontal gyrus (MFG) and the right intraparietal sulcus (IPS), whereas at the 3^{rd} and 4^{th} levels the right MFG was found to be dominant. Interestingly, at the most difficult 5^{th} and 6^{th} levels left MFG was found to be dominant, and IPS showed bilateral activations. Overall, results highlight that lateralization of MFG and IPS exists, and it is varied by cognitive load.

References

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