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Presentation Abstract

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Abstract: Developmental dyscalculia is associated with difficulty in acquiring arithmetic skills and has an estimated prevalence of 3% to 6% in the population, with resultant effects on educational outcomes. Dyscalculia is a heterogeneous disorder with dissociable cognitive profiles, e.g., math fluency has been suggested to reflect variation in math ability distinct from untimed math performance according to twin studies. Little is also known about potential compensatory neural mechanisms that maintain performance. Thus, the current study aims to examine neural networks underlying timed calculation (TC) aspects of math fluency, as well as networks involved in TC in individuals who showed decreased activity in inferior parietal cortex (IP), a key region mediating TC, but who performed well in TC tasks. All participants in this study were otherwise healthy. Poor math fluency (n=31, 19 females, TC accuracy≤ 60%, mean=48.71%) and normal control (n=33, 17 females, TC accuracy≥ 80%, mean =91.52%) participants did not differ in age, education, IQ, and accuracy on a numerical size judgment task, on a working memory task, and in a simple motor response task. fMRI data was acquired as participants performed an event-related, number processing tasks in a 3-T scanner. We further examined the compensatory mechanism involved in TC on an independent sample of participants who performed well in all number-related tasks. Based on left IP activity during TC, we selected two groups of participants, who showed higher (+ 1 SD above Mean, n=50) and lower (- 1 SD below, n=50) activity in IP during TC. We found that individuals with poor math fluency (relative to normal controls) were characterized by reduced activity in the bilateral inferior parietal and increased activity in the frontal-temporal-subcortical regions (i.e., right parahippocampal, right fusiform, dorsal lateral prefrontal and right caudate) during timed calculation tasks. Dynamic Causal Modeling analysis showed that increased inhibitory effective connectivity from parietal-to-temporal regions and decreased excitatory effective connectivity from temporal-to-parietal regions may also contribute to poor math fluency. Moreover, individuals with good performance in timed calculation but reduced IP activity had increased bilateral fusiform, lingual gyrus, superior parietal and middle occipital activity. In sum, we explored the neural correlates underlying math fluency and possible compensatory fusiform and related brain activity, which may be implicated in neuroplasticity relevant to ameliorating developmental dyscalculia.

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FUNCTIONAL CONNECTIVITY

PARIETAL CORTEX