Altered frontal pole development affects self-generated spatial working memory in ADHD

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Abstract

Background
Spatial working memory (SWM) dysfunction is a feature of attention deficit hyperactivity disorder (ADHD). Previous studies suggested that behavioral performance in self-generated SWM improves through development in children with and without ADHD. Nevertheless, developmental changes in the neural underpinnings of self-generated SWM are unknown.

Method
Using near-infrared spectroscopy, hemodynamic activity in the prefrontal cortex (PFC) was measured in 30 children with ADHD (9.5 ± 1.6 years-old) and 35 TD children (9.0 ± 1.6 years-old) while they performed a self-generated SWM task. We then investigated correlations between age and behavioral performance, and between age and hemodynamic activity in the PFC for each group.

Results
Both groups showed a negative correlation with age and number of errors [ADHD: r(28) = −0.37, p = 0.040; TD: r(33) = −0.59, p < 0.001], indicating that self-generated SWM improves through development. The TD group showed a positive correlation between age and oxygenated hemoglobin in the frontal pole [10ch: r(33) = 0.41, p = 0.013; 11ch: r(33) = 0.44, p = 0.008] and bilateral lateral PFC [4ch: r(33) = 0.34, p = 0.049; 13ch: r(33) = 0.54, p = 0.001], while no significant correlation was found in the ADHD group. Furthermore, regression slopes for the frontal pole significantly differed between the TD and ADHD groups [10ch: t(61) = 2.35, p = 0.021; 11ch: t(61) = 2.05, p = 0.044].

Conclusion
Children with ADHD showed abnormalities in functional maturation of the frontal pole, which plays a role in manipulating and maintaining information associated with self-generated behavior.