A longitudinal study on adolescent cognitive control development

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Abstract

Cognitive control is one crucial human ability that develops throughout childhood reaching a mature level not until early adulthood. A network, comprising the anterior cingulate cortex and the dorsolateral prefrontal cortex as relay stations, is meant to orchestrate the sequencing of conflicting information processing. In the present study we focussed on the development of cognitive control within an adolescent sample of 50 healthy subjects (26 females). Participants were investigated at the age of 14 and 16 with an interference-switching paradigm during fMRI. The task included task switching trials (vs. task repetition trials) and incongruent trials (vs. congruent trials). Behavioural data revealed that i) reaction time and ii) error rate decrease over time, iii) subjects - independent of age - are slower in task switch trials relative to task repetition trials and in incongruent trials relative to congruent trials. Imaging data analyses, however, did only show mild changes in neural activation over the 2-year period. The most prominent changes ($p < 0.001$, uncorrected, threshold T=3.11, 15 contiguous voxel) occurred in right middle temporal gyrus (BA21) and right medial frontal gyrus (BA10). To our knowledge, our study is one out of a few investigations analyzing adolescent cognitive control abilities in a longitudinal within-subject design. Counter-intuitively, we could not unveil differences in terms of fundamental changes in neural activation patterns in cognitive control key areas between adolescents aged 14 and 16, even though this period is meant to play a pivotal role in the development of prefrontal cortex functions. More in-depth analyses are certainly necessary.

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