
Neuro-functional development of “cool” and “hot” executive functions and its abnormalities in ADHD

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Abstract

The talk will provide a review on our functional magnetic resonance imaging (fMRI) findings on the development of the neurofunctional networks of “cool” and “hot” executive functions between childhood and adulthood. The findings show that across development, and concomitant with cognitive maturation, there is progressively increased functional activation in task-relevant lateral and medial prefrontal, striatal and parieto-temporal brain regions that mediate “cool” cognitive control functions, such as inhibition, performance monitoring, attention and timing, as well as of ventromedial fronto-limbic neural networks that mediate “hot” reward-associated functions such as temporal discounting or gambling. This process of age-associated activation increase in task-relevant regions appears to be accompanied by progressively stronger functional inter-regional connectivity within these fronto-striatal and fronto-limbic networks, with evidence for progressively stronger top-down control of frontal over posterior and subcortical regions. Negative age associations are observed in earlier developing posterior and limbic regions, suggesting a shift with age from the recruitment of “bottom-up” processing regions towards “top-down” fronto-cortical and fronto-subcortical connections, leading to a more mature, supervised cognition. The impairment of this normal neurocognitive maturation of fronto-striato-parietal and fronto-limbic networks will be illustrated in a child psychiatric disorder that is characterised by a developmental delay of brain structure, i.e. Attention Deficit Hyperactivity Disorder (ADHD). Children and adolescents with ADHD have deficits in the same fronto-striato-parietal and fronto-limbic neural networks of “cool” and “hot” EF that are progressively developing with age between childhood and adulthood, likely reflecting a delay in normal functional brain maturation.

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