The brain's cognitive control network is used in a more effective way by adults than by adolescents

Sarah Rodehacke*[1] and Michael N. Smolka[1]

[1]Neuroimaging Center, Department of Psychiatry, Technische Universität Dresden – Germany

Abstract

In order to address the question concerning developmental differences in conflict monitoring between adolescents and adults, we analysed behavioural (i.e. reaction time, error rate) and fMRI data of 184 14-year-olds (93 female) and 28 adults (12 female) while performing an interference and switch task. fMRI data analysis was limited to brain regions of interest relating to the cognitive control network (i.e. ACC, dlPFC, preSMA, PPC). Groups did not differ in reaction time, but adolescents made significantly more mistakes compared to adults. On imaging level we only found a higher increase in neural activation in adults in the left superior parietal cortex (BA 7, $p < 0.001$ uncorrected, 25 contiguous voxels) irrespective of trial type. We further extracted the mean of the time course from this region: Mean error rate correlated significantly with the standard deviation ($\rho = 0.186$, $p = 0.007$), but not with the mean ($\rho = -0.111$, $p = 0.106$). Moreover the time course's standard deviation in the left BA 7 is higher in adolescents than in adults. The superior parietal cortex was associated with attention in prior studies. We assume that there exists an "error probability threshold" within the activation of the left BA 7: If the activation or attention, respectively, falls below this threshold, it is more likely to make a mistake. Due to their overall lower brain activation and due to their higher time course's standard deviation, adolescents have a higher probability to make mistakes than adults.

*Speaker