Amplitude variability over trials in hemodynamic responses in adolescents with ADHD: The role of the anterior default mode network and the nonspecific role of the striatum

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Abstract

It has been suggested that intra-individual variability (IIV) in performance on attention and other cognitive tasks might be a cognitive endophenotype in individuals with ADHD. Despite robust IIV findings in behavioral data, only sparse data exist on how what type of brain dysfunction underlies variable response times. In this study, we asked whether ADHD IIV in reaction time on a commonly-used test of attention might be related to variation in hemodynamic responses (HRs) observed trial-to-trial. Based on previous studies linking IIV to regions within the “default mode” network (DMN), we predicted that adolescents with ADHD would have higher HR variability in the DMN compared with controls, and this in turn would be related to behavioral IIV. We also explored the influence of social anxiety on HR variability in ADHD as means to test whether higher arousal associated with high trait anxiety would affect the neural abnormalities. We assessed single-trial variability of HRs, estimated from fMRI event-related responses elicited during an auditory oddball paradigm in adolescents with ADHD and healthy controls (11-18 years old; N=46). Adolescents with ADHD had higher HR variability compared with controls in anterior regions of the DMN. This effect was specific to ADHD and not associated with traits of age, IQ and anxiety. However, an ADHD effect of higher HR variability also appeared in a basal ganglia network, but for these brain regions the relationships of HR variability and social anxiety levels were more complex. Performance IIV correlated significantly with variability of HRs in both networks. These results suggest that assessment of trial-to-trial HR variability in ADHD provides information beyond that detectable through analysis of behavioral data and average brain activation levels, revealing specific neural correlates of a possible ADHD IIV endophenotype.