Refining the picture of reduced alerting responses in ADHD - a single-trial analysis of event-related potentials.

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Abstract
In attention-deficit/hyperactivity disorder (ADHD), a reduced phasic alerting response (event-related potential component P3 to cue stimuli) has been reported for different subtypes and task types in a series of studies. In order to get a refined picture of this attentional deficit, which is based on the analysis of averaged event-related potentials, we studied the distribution of single-trial cue-P3 amplitudes and the relation between the cue-P3 and the neural state (EEG spectral analysis) when expecting the stimulus. Brain electrical activity was recorded in children of different ADHD subtypes (combined type, predominantly inattentive) and typically developing children while conducting the attention network test. In children with ADHD of the combined type, smaller cue-P3 amplitudes in the averaged signal were due to a larger portion of single trials with reduced cue-P3 amplitudes whereas maximum amplitudes did not differ from typically developing children. In this ADHD subtype, larger activity in the upper theta/lower alpha range (5.5-10.5Hz) was strongly associated with the range (difference between 0.9 quantile and 0.1 quantile) of the cue-P3 amplitude in single trials (correlation coefficient r=0.77) indicating a suboptimal neural state before stimulus presentation. In children with ADHD of the predominantly inattentive subtype, single-trial P3 amplitudes were comparable at lower quantiles but maximum amplitudes were reduced. This result pattern indicates an intact triggering of the cue-P3 but a reduced capacity of resource allocation for the predominantly inattentive subtype. Though findings are limited by a relative small sample size, the cue-P3 may be considered as a neurophysiological marker of alerting deficits in ADHD reflecting different underlying mechanisms in ADHD subtypes.