Neural biomarkers for dyslexia, ADHD and ADD in the auditory cortex of children

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Dyslexia, attention deficit hyperactivity disorder (ADHD), and attention deficit disorder (ADD) show distinct clinical profiles that may include auditory and language-related impairments. Currently, an objective brain-based diagnosis of these developmental disorders is still unavailable. We investigated the neuro-auditory systems of dyslexic, ADHD, ADD, and age-matched control children (N=147) using neuroimaging, magnetencephalography and psychoacoustics. All disorder subgroups exhibited an oversized left planum temporale and an abnormal interhemispheric asynchrony (10-40 ms) of the primary auditory evoked P1-response. Considering right auditory cortex morphology, bilateral P1 source waveform shapes, and auditory performance, the three disorder subgroups could be reliably differentiated with outstanding accuracies of 89-98%. We therefore for the first time provide differential biomarkers for a brain-based diagnosis of dyslexia, ADHD, and ADD. The method allowed not only a clear discrimination between two subtypes of attentional disorders (ADHD and ADD), a topic controversially discussed for decades in the scientific community, but also revealed the potential for objectively identifying comorbid cases.

Noteworthy, in children playing a musical instrument, after three and a half years of training the observed interhemispheric asynchronies were reduced by about 2/3, thus suggesting a strong beneficial influence of music experience on brain development. These findings might have far-reaching implications for both research and practice and enable a profound understanding of the brain-related etiology, diagnosis, and musically based therapy of common auditory-related developmental disorders and learning disabilities.