Integrated analysis of gray and white matter alterations in attention-deficit/hyperactivity disorder


NeuroImage: Clinical (March 2016)
DOI: http://dx.doi.org/10.1016/j.nicl.2016.03.005.
Open Access: http://ac.els-cdn.com/S2213158216300468-main.pdf?_tid=40b20c4ae783-11e5-902b-00000aabc35f&acdnat=1457698841_a686345cef85f9f9e32320b3766057a8

Abstract

Background
Magnetic resonance imaging (MRI) is able to provide detailed insights into the structural organization of the brain, e.g., by means of mapping brain anatomy and white matter microstructure. Understanding interrelations between MRI modalities, rather than mapping modalities in isolation, will contribute to unraveling the complex neural mechanisms associated with neuropsychiatric disorders as deficits detected across modalities suggest common underlying mechanisms. Here, we conduct a multimodal analysis of structural MRI modalities in the context of attention-deficit/hyperactivity disorder (ADHD).

Methods
Gray matter volume, cortical thickness, surface areal expansion estimates, and white matter diffusion indices of 129 participants with ADHD and 204 participants without ADHD were entered into a linked independent component analysis. This data-driven analysis decomposes the data into multimodal independent components reflecting common inter-subject variation across imaging modalities.

Results
ADHD severity was related to two multimodal components. The first component revealed smaller prefrontal volumes in participants with more symptoms, co-occurring with abnormal white matter indices in prefrontal cortex. The second component demonstrated decreased orbitofrontal volume as well as abnormalities in insula, occipital, and somato-sensory areas in participants with more ADHD symptoms.

Conclusions
Our results replicate and extend previous unimodal structural MRI findings by demonstrating that prefrontal, parietal, and occipital areas, as well as fronto-striatal and fronto-limbic systems are implicated in ADHD. By including multiple modalities, sensitivity for between-participant effects is increased, as shared variance across modalities is modeled. The convergence of modality-specific findings in our results suggests that different aspects of brain structure share underlying pathophysiology and brings us closer to a biological characterization of ADHD.