Quantifying patterns of brain activity: Distinguishing unaffected siblings from participants with ADHD and healthy individuals

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NeuroImage: Clinical (July 2016)
DOI: http://dx.doi.org/10.1016/j.nicl.2016.06.020.

Abstract
Attention-deficit/hyperactivity disorder (ADHD) is one of the most prevalent and heritable psychiatric disorders. While previous studies have focused on mapping focal or connectivity differences at the group level, the present study employed pattern recognition to quantify group separation between unaffected siblings, participants with ADHD, and healthy controls on the basis of spatially distributed brain activations. This was achieved using an fMRI-adapted version of the Stop-Signal Task in a sample of 103 unaffected siblings, 184 participants with ADHD, and 128 healthy controls. We used activation maps derived from three task regressors as features in our analyses employing a Gaussian process classifier. We showed that unaffected siblings could be distinguished from participants with ADHD (area under the receiver operating characteristic curve (AUC) = 0.65, p = 0.002, 95% Modified Wald CI: 0.59–0.71 AUC) and healthy controls (AUC = 0.59, p = 0.030, 95% Modified Wald CI: 0.52–0.66 AUC), although the latter did not survive correction for multiple comparisons. Further, participants with ADHD could be distinguished from healthy controls (AUC = 0.64, p = 0.001, 95% Modified Wald CI: 0.58–0.70 AUC). Altogether the present results characterise a pattern of frontolateral, superior temporal and inferior parietal expansion that is associated with risk for ADHD. Unaffected siblings show differences primarily in frontolateral regions. This provides evidence for a neural profile shared between participants with ADHD and their healthy siblings.