Functional Decoding and Meta-Analytic Connectivity Modeling in Adult Attention-Deficit/Hyperactivity Disorder

Samuele Cortese, F. Xavier Castellanos, Claudia R. Eickhoff, Giulia D’Acunto, Gabriele Masi, Peter T. Fox, Angela R. Laird, Simon B. Eickhoff

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Abstract:

Background
Task-based fMRI studies of adult Attention-Deficit/Hyperactivity Disorder (ADHD) have revealed various ADHD-related dysfunctional brain regions, with heterogeneous findings across studies. Here, we used novel meta-analytic data-driven approaches to characterize the function and connectivity profile of ADHD-related dysfunctional regions consistently detected across studies.

Methods
We first conducted an activation likelihood estimation (ALE) meta-analysis of 24 task-based fMRI studies in adults with ADHD. Each ADHD-related dysfunctional region resulting from the ALE meta-analysis was then analyzed using functional decoding based on ~7,500 fMRI experiments in the BrainMap database. This approach allows mapping brain regions to functions not necessarily tested in individual studies, thus suggesting possible novel functions for those regions. Additionally, ADHD-related dysfunctional regions were clustered based on their functional co-activation profiles across all the experiments stored in BrainMap (meta-analytic connectivity modeling).

Results
ADHD-related hypoactivation was found in left putamen, left inferior frontal gyrus (pars opercularis), left temporal pole, and right caudate. Functional decoding mapped the left putamen and the left temporal lobe to cognitive aspects of music perception/reproduction and language semantics, respectively; both these regions clustered together based on their meta-analytic functional connectivity. Left inferior gyrus mapped to executive function tasks; right caudate mapped both to executive functions tasks and music-related processes.

Conclusions
Our study provides meta-analytic support to the hypothesis that, in addition to well-known deficits in typical executive functions, impairment in processes related to music perception/reproduction and language semantics may be involved in the pathophysiology of adult ADHD.