Uncovering the neural similarities between Tourette syndrome and related disorders: A network mapping approach

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Background:

Most patients diagnosed with Tourette syndrome (TS) have at least one or more co-occurring neuropsychiatric disorders, the most common of which are obsessive-compulsive disorder (OCD) and attention/deficit-hyperactivity disorder (ADHD). Accordingly, it is difficult to decipher whether structural and functional alterations reported amongst TS patients are neurobiological markers of the disorder, compensatory processes related specifically to tics, or whether these relate to co-occurring neuropsychiatric conditions. There is evidence to suggest an overlapping neural network between TS, OCD, and ADHD, however, to our knowledge, this is yet to be directly tested. This study aimed to localize the network of brain regions associated with OCD and ADHD (separately), and then to examine their similarities/differences with a network we previously localized for TS using published coordinates of neuroimaging abnormalities (Zouki et al., 2023, *Brain Comms*.).

Methods:

Separate systematic searches were conducted in Embase and MEDLINE Complete to identify neuroimaging studies reporting coordinates of alterations amongst OCD or ADHD patients compared to healthy controls. Following our previous methods (Zouki et al., 2023), we then applied a network localization technique, termed 'coordinate network mapping' (CNM). This technique leverages a large dataset of normative resting-state scans ($n = 1000$) to assess whether coordinates of abnormalities in idiopathic OCD and ADHD, respectively, map to separate networks. This allowed us to identify neural networks associated with OCD and ADHD, as well as commonalities between these networks and our previously localized TS network.

Results and Conclusions:

Our study provides the first application of CNM to coordinates of neuroimaging findings in OCD. Specifically, alterations in OCD mapped to the bilateral caudate/putamen, left insula, and bilateral claustrum/thalamus (positive connectivity). Neuroimaging findings in ADHD localized to the bilateral precentral gyrus, mid-/anterior cingulate, corpus callosum, thalamus, putamen, and insula (positive connectivity), showing some consistency with previously reported CNM findings in ADHD (Wall et al., 2025). Both disorders primarily showed negative connectivity to the occipital cortex. Network similarity between TS and OCD was shown in the caudate/putamen and insula/claustrum, which may reflect the shared sensory phenomena associated with tics and compulsions, respectively. By contrast, network similarity between TS and ADHD was identified in the anterior cingulate and putamen, which may be associated with shared sensory and impulsivity symptoms.