The effects of methylphenidate on resting-state striatal, thalamic and global functional connectivity in healthy adults

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Abstract
By blocking dopamine and norepinephrine transporters, methylphenidate affects cognitive performance and regional brain activation in healthy individuals as well as those with neuropsychiatric disorders. Resting-state connectivity evaluates the functional integrity of a network of brain regions. Here, we examined how methylphenidate affects resting-state functional connectivity of the dorsal striatum and thalamus, areas each with dense dopaminergic and noradrenergic innervations, as well as global cerebral connectivity. We administered a single, oral dose (45 mg) to 24 healthy adults and compared resting-state connectivity to 24 demographically matched adults who did not receive any medication. The results showed that methylphenidate alters seed-based and global connectivity between the thalamus/dorsal striatum with primary motor cortex, amygdala/hippocampus and frontal executive areas (p < 0.05, corrected). Specifically, while methylphenidate at this dosage enhances connectivity to the motor cortex and memory circuits, it dampens prefrontal cortical connectivity perhaps by increasing catecholaminergic signalling past the ‘optimal’ level. These findings advance our understanding of a critical aspect of the multifaceted effects of methylphenidate on brain functions. The results may also facilitate future studies of the aetiology and treatment of neurological and psychiatric disorders that implicate catecholaminergic dysfunction.