Dopamine, Corticostriatal Connectivity, and Intertemporal Choice

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Abstract

Value-based decisions optimize behavioral outcomes. Because delayed rewards are discounted, an increased tendency to choose smaller, immediate rewards can lead to suboptimal choice. Steep discounting of delayed rewards (impulsivity) characterizes subjects with frontal lobe damage and behavioral disorders including substance abuse. Correspondingly, animal studies and indirect evidence in humans suggest that lower dopamine in the frontal cortex contributes to steeper discounting by impairing corticostriatal function. To test this hypothesis directly, we performed a randomized, double-blind, counterbalanced, placebo-controlled study in which we administered the brain penetrant catechol-O-methyltransferase inhibitor tolcapone or placebo to healthy subjects performing a delay discounting task. Tolcapone significantly increased choice of delayed monetary rewards, and this tolcapone-induced increase covaried with increased BOLD activity in the left ventral putamen and anterior insula. Tolcapone also changed corticostriatal connectivity: specifically, by inducing a decrease in the coherence between ventral putamen and pregenual cingulate cortex. These results indicate that raising cortical dopamine levels attenuates impulsive choice by changing corticostriatal function.

Reference