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The Functional Roles of Right Dorsolateral Prefrontal Cortex and Ventromedial Prefrontal Cortex in Risk-Taking Behavior

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Abstract : Risk-taking behavior has been associated with the activity of specific prefrontal regions of the brain, namely the right dorsolateral prefrontal cortex (DLPFC) and the ventromedial prefrontal cortex (VMPFC). While the deactivation of the rDLPFC has been shown to lead to increased risk-taking behavior, the functional relationship between VMPFC activity and risk-taking behavior is yet to be clarified. Correlational evidence suggests that the VMPFC is involved in valuation processes that involve risky choices, but evidence on the functional relationship is lacking. Therefore, this study uses brain stimulation to investigate the role of the VMPFC during risk-taking behavior and replicate the current findings regarding the role of the rDLPFC in this same phenomenon. We used continuous theta-burst stimulation (cTBS) to inhibit either the VMPFC or DLPFC during the execution of the computerized Maastricht Gambling Task (MGT) in a within-subject design with 30 participants. We analyzed the effects of such stimulation on risk-taking behavior, participants' choices of probabilities and average values, and response time. We hypothesized that, compared to sham stimulation, VMPFC inhibition leads to a reduction in risk-taking behavior by reducing the appeal to higher-value options and, consequently, the attractiveness of riskier options. Right DLPFC (rDLPFC) inhibition, on the other hand, should lead to an increase in risk-taking due to a reduction in cognitive control, confirming existent findings. Stimulation of both the rDLPFC and the VMPFC led to an increase in risk-taking behavior and an increase in the average value chosen after both rDLPFC and VMPFC stimulation compared to sham. No significant effect on chosen probabilities was found. A significant increase in response time was observed exclusively after rDLPFC stimulation. Our results indicate that inhibiting DLPFC and VMPFC separately leads to similar effects, increasing both risk-taking behavior and average value choices, which is likely due to the strong anatomical and functional interconnection of the VMPFC and rDLPFC.

Keywords : decision-making, risk-taking behavior, brain stimulation, TMS
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