Inducing and measuring plasticity in response control mechanisms in the human brain

ABSTRACT:

In our day-to-day experiences, consecutive courses of actions need to be controlled to allow the execution of goal-directed actions. The right inferior frontal cortex (rIFC) plays a pre-eminent and crucial role in action selection and inhibition in humans. The aim of the project was to investigate how the rIFC exerts its influence over action responses and whether this influence can be changed by inducing plasticity of the corticocortical pathways mediating response inhibition. We performed 4 studies in which we investigated the influence of repetitive paired associative transcranial magnetic stimulation (repetitive ppTMS) on the corticocortical excitability and oscillatory dynamics of the rIFC-M1 pathway. In all four studies, participants performed a Go/NoGo task in two task blocks, baseline and expression. Between the baseline and the expression blocks, we applied the repetitive ppTMS protocol at 0.1Hz for 15minutes, which is known to strengthen or weaken connectivity between pre-motor and motor cortex. During performance of the Go/NoGo task, we recorded motor-evoked potentials (MEPs) from the left hand – studies 1 and 2, and EEG activity associated with action control – studies 3 and 4. The results of the studies 1 and 2 confirmed state-dependent changes in the MEPs after the plasticity induction phase. In the go trials the paired rIFC -M1 stimulation led to a facilitatory influence of rIFC over M1. Additionally, the plasticity effect was dependent on stimulation order: repeated stimulation of rIFC before M1 led to strengthening of the rIFC –M1 pathway (study 1), while these effects were not present when M1 was stimulated before rIFC (study 2). In parallel, the results of the studies 3 and 4 showed state-dependent changes in cortical oscillatory dynamics in the beta and theta frequencies, that were also dependent on stimulation order: repeated stimulation of rIFC before M1 led to increases in the theta band (study 3), whereas repeated M1- rIFC stimulation led to decreased theta activity and increased beta power (study 4).

Keywords

Cognitive control, Response inhibition, Cortical plasticity, Neurostimulation

Published Work:

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