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Inhibitory cortical control in healthy subjects: modulation of beta and gamma oscillations in frontal cortical areas

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Introduction: The inhibition of an ongoing response is a key component of executive control implying the voluntary suppression of inappropriate behaviours [1]. Physiological mechanisms underlying this response are based on an integrated cortical network, including the inferior frontal gyrus (IFG) and the dorsal premotor cortex (PMd) [2]. Inhibition of unwilling actions can be experimentally probed through a standardised paradigm, the Stop Signal Task (SST) [3-4], that requires subjects to start a movement as quickly as possible when a Go Signal is presented and to refrain from it if suddenly a Stop Signal appears during the reaction time (RT). This protocol allows for the assessment of the inhibitory ongoing response, reflected by the Stop Signal Reaction Times (SSRT). Recently, it has been demonstrated in healthy subjects (HS) that the activation of these cortical areas during specific behaviours is reflected by modulations of beta-/gamma- oscillations [5]. These oscillations can be experimentally and noninvasively modulated by transcranial alternating current stimulation (tACS) protocols.

Objective: The aim of this study is to explore the role of cortical beta-/gamma- oscillations in the physiology of inhibitory human behaviours through SST protocol performed during specific tACS paradigms, in HS.

Methods: Six HS performed the SST during three different tACS protocols (β-, γ- and sham-tACS) randomly delivered over the IFG and PMd, bilaterally, over two different days. The coordinates of right and left IFG and PMd were first assessed through neuronavigation. During the SST paradigm we quantified RT and SSRT.

Results: Preliminary results suggest that beta- and gamma- tACS differently modulate action inhibition in HS. A two-way repeated measures Anova revealed a significant interaction among the factors Area (IFG; PMd) and tACS(β; γ). Post-hoc comparisons pointed out a significant difference in γ-tACS modulation among the two areas ($p=.03$); gamma-tACS applied over the IFG decreased RTs, while the stimulation of the PMd increased RTs. Furthermore, gamma-tACS increased SSRTs when applied over both IFG and PMd.

Conclusion: We demonstrated that beta- and gamma- tACS can modulate cortical oscillations underlying physiological mechanisms of inhibitory control behaviours, in frontal cortical areas, in HS. These preliminary results provide the background for future applications in neurological disorders characterised by deficit of inhibitory control, such as Parkinson's Disease.

References:

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