

Is transcranial alternating current stimulation effective in modulating brain oscillations?

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Transcranial alternating current stimulation (tACS) is a promising tool to modulate brain oscillations, especially regarding possible therapeutic interventions. However, the lack of conclusive evidence for tACS to be able to effectively affect cortical activity still limits its application. The present study aimed at addressing this issue, exploiting on the well-known inhibitory alpha rhythm at posterior parietal cortex in visual perception and attention orientation. Ninety-six healthy volunteers (48 female, mean age 21.7) participated in the study and were randomly assigned to one of four groups of stimulation, each one composed by 24 participants. Each group was tested during a visual stimulus detection (yes/no) and orientation discrimination (leftward/rightward) task. Target stimuli were low-contrast gabor patches at five different contrast levels ranging from 0.034 to 0.052 (Michelson Contrast Index) presented in a random order in the left or right visual hemifield. The central contrast was adjusted at the threshold level estimated in a pilot experiment. All the participants were tested at the baseline and at a selective frequency of tACS, including Sham, 6, 10, and 25 Hz. A small target electrode (16 cm²) was placed, according to the participant group, over the left or right occipito-parietal areas (PO7 or PO8) as determined by the International 10-20 EEG system. The reference electrode was positioned over the vertex CZ. The results, in terms of arcsine-transformed accuracy (% of correct responses), showed a general decrease of visual perception, over both the visual fields, independently by the site of stimulation (ipsilateral vs. contralateral), and this was found in the groups stimulated both at 10 Hz and at 6 Hz. The lack of retinotopically organized effects and the only marginal frequency-specificity force us to be cautious about the effectiveness of tACS to modulate brain oscillations. In conclusion, the present study does not provide strong evidence that tACS induces modulation of occipital brain oscillations during a visual task.