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Retinal And Cortical Effects Of Transcranial Electric Stimulation

Kohitij Kar, Bart Krekelberg
Center for Molecular and Behavioral Neuroscience, Rutgers University

Transcranial electric current stimulation (tES) of the human brain is assumed to affect cortical excitability by invoking subthreshold modulation of neuronal activity. This assumption has been used to interpret clinical studies where tES improved stroke recovery, alleviated chronic pain, or treated depression. Our goal is to understand how electrical stimulation leads to changes in brain and behavior. A recent study has shown that application of transcranial alternating current stimulation (tACS) over the visual cortex induces the perception of flashes of light (phosphenes). The claim that these phosphenes were generated cortically has led to considerable debate. We applied tACS over visual cortex with a reference electrode on the vertex; and measured current thresholds for the detection of phosphenes with a Bayesian adaptive method. Then, we shifted the stimulating electrode over to the temporal lobe; away from visual cortex and towards the retina. This simple manipulation enhanced the efficacy of the stimulation as measured by lower current thresholds. This suggests that stimulation of the retina plays a significant part in the generation of phosphenes by tACS. To investigate whether tES induces behavioral changes that are likely caused by direct cortical stimulation, we investigated whether tES could change motion adaptation. We used a standard 40s adaptation design with 4s top-ups, coherent random dots as the adapting stimulus, and dots with varying coherence to measure the strength of the MAE. Preliminary results show that the strength of motion adaptation was reduced by simultaneous stimulation with an alternating current of 1mA at 10Hz over human MT+. Many mechanisms could underlie this effect. But, if tES affected both active (adapting) and inactive (not adapting) cells equally, one would not expect any influence on the MAE. Therefore, our finding suggests that tES could be targeted at cortical neuronal populations in an activity dependent manner.