Transcranial electrical stimulation affects adaptation of MT/V5 neurons in awake, behaving macaques

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Session: Motion: Neural mechanisms and models

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Despite widespread use in clinical and behavioral studies, the mechanisms of action of transcranial electrical stimulation (tES) are poorly understood. We partially attribute this to the lack of in-vivo animal models and have started to probe the influence of tES on the well-explored macaque visual system, specifically area MT. Previously we have shown that tES reduces the motion aftereffect in human subjects. This leads to the hypothesis that neurons adapt less during tES.

To test this, we recorded from adapted and unadapted MT cells, with and without tES. In the adaptation condition, we presented an adapter stimulus (dots moving coherently in the cell's preferred direction) for 3s, followed by a 300ms blank period, and then a 300ms test phase (dots moving in one of eight evenly spaced directions). In the stimulation conditions we applied transcranial alternating current stimulation (tACS; 10 Hz, 1 mA) during the adapter stimulus across two electrodes placed extra-cranially on either side of the recording chamber (over area MT). In the control (non-adapted) trials, the adapter was replaced by a noise stimulus consisting of dots moving in randomly chosen directions.

At single cell level, we found that tACS induced statistically significant changes in adaptation as measured by subsequent response to the test stimuli (tuning amplitude, width, and preferred direction). However, these effects were quite heterogeneous across the population, with tACS increasing adaptation of some cells and decreasing adaptation of others. It is not yet clear how these neural changes relate to the behavioral changes we reported in humans. Our approach establishes the awake, behaving macaque as an animal model to study tES. This important step will allow us to relate tES-induced neural changes directly with behavioral changes and provide a mechanistic insight into the neural mechanisms of action of tES.

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