

Title: 7 Tesla 1H MR Spectroscopy of the Motor Cortex following Transcranial Direct Current Stimulation

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Structured Abstract:

Introduction: Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation that has been recently studied as a way of modulating human behaviour, cortical excitability and metabolite concentration. Literature has shown positive behavioural outcomes with the application of tDCS after cortical injury caused by stroke and other neurological disorders. However, the exact mechanism of action, both during and after stimulation and its associated effects on motor and cognitive faculties are largely unknown. The purpose of the current study was to determine whether changes in metabolite concentration occur immediately after M1-SMA, bihemispheric tDCS using ultra high-field (7T) MRS. To our knowledge, this is the first study to examine the metabolic changes after bihemispheric tDCS at an ultra-high field. Based on previous studies, we hypothesized that 2mA of bihemispheric tDCS would enhance synaptic and metabolic activity. As such, metabolites involved in neurometabolism such as NAA and creatine would be altered by stimulation.

Methods: In this single-blind, randomized, cross-over design, fifteen healthy adults aged 21-60 participated in two sessions on a 7T Siemens MAGNETOM, head-only MRI, where metabolite concentrations were measured immediately after 20 minutes of bihemispheric tDCS to the motor network. We applied the anode to the right supplementary motor area (SMA) and the cathode to the left primary motor cortex (M1).

Results: We observed a significant increase in tNAA/Cr concentration under the stimulating cathode following tDCS compared to sham. No other changes in any other metabolite were observed between stimulation and sham

Discussion: By enhancing neural activity, there is an increase in neural metabolism. Both tNAA and creatine are important markers of neurometabolism. Our findings provide novel insight into the modulation of neural activity and point towards a potential mechanism of action of the after effects of tDCS