Enhancing Cortical Activity: What's Lying Underneath?

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**Background:** Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation that has been shown to increase cortical activity when applied to certain areas of the brain. Rubber electrodes sit on the scalp and pass a low, continuous current to selected brain regions and cause depolarization of the resting membrane potential allowing for increased cortical activity. tDCS has become popular for the treatment of many psychological disorders, such as depression and schizophrenia, etc., and has recently been shown to improve motor function in healthy and neurologically injured individuals.

It is currently unclear as to how tDCS affects the underlying neurons to enhance motor and cognitive function. Multi-modal imaging techniques such as resting-state functional MRI (rs-fMRI) and magnetic resonance spectroscopy (MRS) are non-invasive tools that may allow us to determine the underlying mechanism of applying tDCS to the brain.

**Purpose:** The current study aims to determine the underlying mechanism involved in the application of tDCS to the motor areas of the brain with the use of rs-fMRI and MRS.

**Methods:** Healthy adults will participate in two 7 Tesla MRI sessions where they will undergo both rs-fMRI and MRS in this single blind, cross over design. Participants are randomized to receive stimulation or sham on their initial visit, and the contrary on their second visit, at least 7 days apart. A baseline rs-fMRI is performed, immediately followed by an additional rs-fMRI, with 2mA of tDCS running concurrently. Each rs-fMRI will last 10 minute, with the stimulation lasting a total of 20 minute. MRS will begin immediately after the 20 minute stimulation, capturing the alteration in metabolites as a result of tDCS. Because simultaneous tDCS in a 7T MRI is a novel protocol, temperature monitoring was completed throughout the duration of the study for all participants.