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The Influence of Transcranial Direct Current Stimulation on Skill Acquisition in a Complex Motor Task

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Introduction:

- Transcranial direct current stimulation (tDCS) of primary motor cortex (M1) has been shown in numerous studies to improve performance in relatively simple motor tasks performed with the hand and arm[1].
- However, few tDCS studies have examined multi-joint tasks involving whole-body coordination, which could be more applicable to occupational tasks, sports, and activities of daily living.
- Overhand throwing is a difficult motor task that involves the precise timing of finger forces[2], the prediction and utilization of joint interaction torques[3], and strict coordination of agonist and antagonist muscle interactions[4].

Purpose/Aim:

- The purpose of this study was to examine the acute effects of tDCS on skill acquisition in a complex, multi-joint arm movement in healthy young adults..
- To determine the association between tDCS induced increases in cortical excitability and the magnitude of motor skill aquisition.

Methods:

- The study was a randomized, double-blind, sham-controlled, between-subjects design and 22 young males and females were allocated to a tDCS or a SHAM group. Subjects participated in one experimental session that involved overhand throws to a target (1 cm diameter; located 6 meters away on a wall) in a baseline-test block, 5 practice blocks, and a post-test block (10 trials/block).

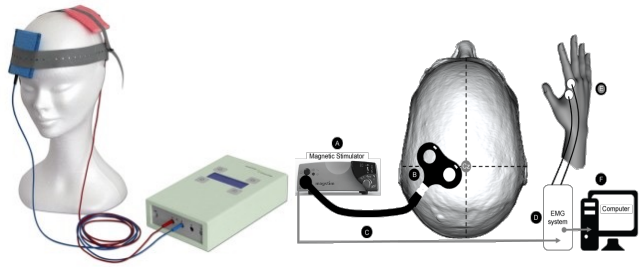

Figure 1 & 2 . Non-invasive brain stimulation.

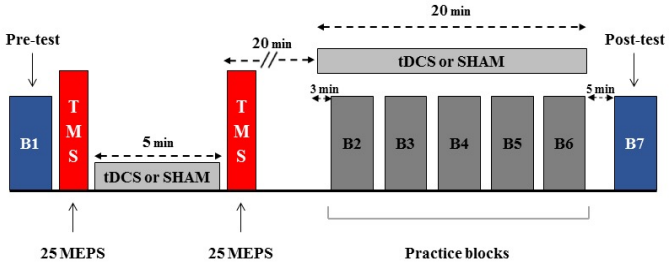

Figure 3. Experimental session protocol.

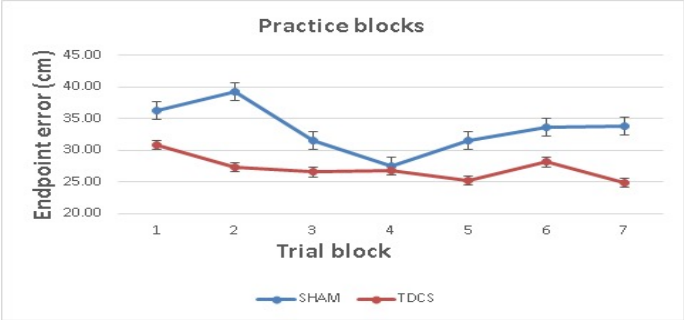

Figure 4. Endpoint accuracy for the tDCS and SHAM Groups.

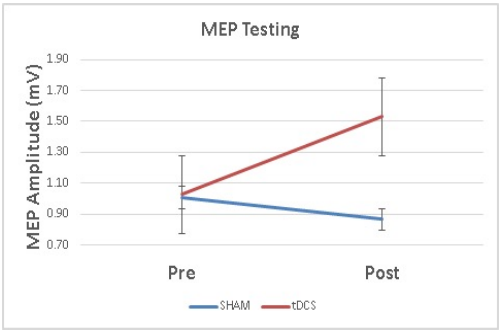

Figure 5. MEP amplitudes before and after 5 mins of tDCS or SHAM stimulation.

Results:

- The percent change in endpoint error (decrease) was greater for the tDCS group compared to the SHAM group, but this difference just failed statistical significance (-16.9 vs. -5.2%; P = 0.127), whereas the percent change in MEP amplitude was significantly greater for the tDCS group compared to the SHAM group (49.7 vs. -13.5%; P = 0.012).

Discussion:

- These findings indicate that a single-session of tDCS enhances cortical excitability and appears to improve motor skill, although there is high inter-individual variability in the response to tDCS.
- However, motor variability in this task is much greater than simple tasks and a power analysis from a recent study in our lab indicates that a sample size of ~ 25 per group may be needed.

Conclusions & Future Research:

- tDCS shows promise in improving complex motor skill learning.