Can Transcranial Direct Current Stimulation Douse Fear Generalization?

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Abstract

Background: Transcranial direct current stimulation (tDCS) directly effects the fear learning and memory processes. However, the impact of tDCS on fear generalization has not received much attention. tDCS targets cortical excitability and is highly variable in humans. Several notable factors that may affect the tDCS outcomes include the magnitude of current, placement of the electrodes, duration of tDCS administration, the timing of administration, and the nature of stimuli used in the fear learning and memory process, which requires further investigation. The current study aims to explore the appropriate tDCS parameters and their effect on fear generalization.

Method: G*Power analysis will be used to determine the sample size for the study. A two-day fear generalization paradigm will be employed using ten rings of gradually increasing size, with the largest and the smallest rings as the CS+ and CS- and the intermediate rings as generalization stimuli (GS). Unconditioned stimulus (UCS) will be an aversive image. On Day 1, the participants will be assigned into three groups: cathodal, anodal, or sham, and 1.5 mA tDCS at the left dorsolateral prefrontal cortex will be applied during the generalization or acquisition phase for 12 minutes. The effects of fear generalization will be tested and analyzed on Day 2 (24 hours after acquisition) through a testing phase. Multi-measure assessment through standardized questionnaires, UCS expectancy ratings, behavioural avoidance, skin conductance response, heart-rate variability, and respiratory rate will be used to measure fear.

Expected Outcomes: We expect that anodal tDCS may enhance generalization because of its excitatory effect, and cathodal tDCS may interfere with the learning process and dampen fear generalization due to its inhibitory properties.

Conclusion: This study will explore the effect of tDCS on fear generalization and establish appropriate protocols for tDCS administration.