

The Effect of Repeated Prefrontal Cortex Stimulation on Antisocial and Aggressive Behavior

NCT02674516

January 7, 2022

## **Study Protocol**

The objective of this study is to test whether stimulating the prefrontal cortex using transcranial direct current stimulation (tDCS) reduces aggressive behavior.

### **tDCS Intervention**

tDCS was administered by trained study personnel using a battery-driven, constant-current stimulator (TCT Research) during three lab visits on three consecutive days. Two anodal electrodes were placed over the DLPFC bilaterally (F3 and F4) according to the International 10-20 EEG system. A constant current of 2mA (1mA to each DLPFC site) was applied for 20 minutes through saline-soaked sponge electrodes (5x5cm). A single extracephalic cathodal electrode (5x7cm) was placed at the posterior base of the neck in order to minimize unintentional effects of inhibitory stimulation on brain activity.

Following standard tDCS protocol, stimulation commenced after a 30-second ramp-up period. The current was ramped down over the last 2 seconds. The tasks performed during tDCS are understood to influence the behavioral after-effects of stimulation (Gill et al., 2015). Thus, during the stimulation session, all participants performed the Psychology Experiment Building Language (Mueller and Piper, 2014) version of two cognitive tasks that are known to engage the DLPFC, the Psychomotor Vigilance Task (Dinges and Powell, 1985; Cui et al., 2015), followed by the Iowa Gambling Task (Bechara et al., 1994; Ernst et al., 2002). Although participants in both intervention arms received the same electrode placement and ramp-up/down times, stimulation for the sham control group was discontinued after 30 seconds. This has proven to be effective for blinding as participants habituate to the sensation of stimulation within seconds of current initiation (Gandiga et al., 2006).

## **Blinding**

Participants and experimenters were blind to the tDCS condition assignment. The trial adhered to established procedures to maintain separation between staff that conducted the stimulation and staff that engaged with the participant. In each experimental session, only one experimenter who set up the tDCS procedure had knowledge of the participant's allocation. To further ensure blinding, all participants were kept blind to the objective of the study and outcome measures were not taken in the presence of research staff as they could lead to biased results.

## **Aggression**

The voodoo doll task is a reliable and validated behavioral analog measure of aggression (DeWall et al., 2013). In this task, participants were shown a computer-based image of a doll that represented a partner or a close friend. They were told that they were given the opportunity to release their negative energy to that individual by inserting as many pins (0-51) in the doll as they wished. Instructions did not use the word "voodoo". Stabbing the doll with more pins indicated higher levels of aggression.

## **Statistical Analysis**

One-way ANCOVA was used to test group differences in aggression. Baseline measures were examined as possible covariates: variety of crime throughout the lifetime, aggression, GPA, trait anxiety, social adversity, psychopathy, the lack of premeditation and sensation-seeking dimensions of impulsivity, and self-control.

## References

- Bechara A, Damasio AR, Damasio H, Anderson SW (1994) Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition* 50:7-15.
- Cui J, Tkachenko O, Gogel H, Kipman M, Preer LA, Weber M, Divatia SC, Demers LA, Olson EA, Buchholz JL (2015) Microstructure of frontoparietal connections predicts individual resistance to sleep deprivation. *NeuroImage* 106:123-133.
- DeWall CN, Finkel EJ, Lambert NM, Slotter EB, Bodenhausen GV, Pond RS, Renzetti CM, Fincham FD (2013) The voodoo doll task: Introducing and validating a novel method for studying aggressive inclinations. *Aggressive Behavior* 39:419-439.
- Dinges DF, Powell JW (1985) Microcomputer analyses of performance on a portable, simple visual RT task during sustained operations. *Behavior Research Methods* 17:652-655.
- Ernst M, Bolla K, Mouratidis M, Contoreggi C, Matochik JA, Kurian V, Cadet J-L, Kimes AS, London ED (2002) Decision-making in a risk-taking task: a PET study. *Neuropsychopharmacology* 26:682-691.
- Gandiga PC, Hummel FC, Cohen LG (2006) Transcranial DC stimulation (tDCS): a tool for double-blind sham-controlled clinical studies in brain stimulation. *Clinical neurophysiology* 117:845-850.
- Gill J, Shah-Basak PP, Hamilton R (2015) It's the thought that counts: examining the task-dependent effects of transcranial direct current stimulation on executive function. *Brain stimulation* 8:253-259.
- Mueller ST, Piper BJ (2014) The psychology experiment building language (PEBL) and PEBL test battery. *Journal of neuroscience methods* 222:250-259.