



Exploring the Cognitive and Behavioral Mechanisms of Neuromodulation in Obsessive-Compulsive Disorder

Flavia Spiroiu, M.A., Duncan Cameron, Ph.D., Michael Amlung, Ph.D., Karen Rowa, Ph.D., C.Psych., James MacKillop, Ph.D., Randi E. McCabe, Ph.D., C.Psych., Noam Soreni, M.D.

Abstract
Transcranial direct current stimulation (tDCS) has shown promise in alleviating symptoms of obsessive compulsive disorder (OCD). Its mechanisms of action, however, are currently unknown. This study examines the cognitive and behavioral mechanisms of action of tDCS in a sample of patients with OCD undergoing cognitive behavioral therapy (CBT) with exposure and response prevention (ERP).

Introduction
OCD is characterized by the presence of recurrent obsessions and/or compulsions that cause marked anxiety and that interfere with daily functioning¹. The gold-standard behavioral treatment option for OCD is cognitive behavioural therapy (CBT), which involves exposure and response prevention (ERP). However, many patients do not respond to this treatment¹. Cognitive skills such as decision-making under uncertain conditions play a key role in the efficacy of exposure and response prevention¹. Successful ERP is associated with functional changes in OCD-related brain circuits, and an emerging field of neuromodulation research is focused on assessing how these functional changes might affect treatment outcomes. Transcranial direct current stimulation (tDCS) is one such technique². It is a safe and minimally invasive procedure that modulates cortical function by delivering a weak electrical current over the scalp. **Primary Research Question.** What are the cognitive and behavioral mechanisms of action in tDCS in the context of CBT for OCD? **Objective & Hypotheses.** To investigate whether a single active session of in-lab, bilateral tDCS will be associated with 1) improved decision-making and 2) increased willingness to engage in exposure and response prevention (ERP).

Methodology
Participants. A clinical sample of 60 adult patients ($N = 30$ Active, 30 Sham) with a principal diagnosis of OCD, who undergo a virtual course of CBT for OCD through the Anxiety Treatment and Research Clinic. **Materials and Procedure.** Patients will complete several baseline measures prior to administration of the 20-min tDCS. OCD symptom severity will be assessed by the Yale Brown Obsessive Compulsive Scale (Y-BOCS)³ and willingness to

Methodology...cont'd
engage in ERP by an Exposure Feedback Form (EFF). To assess baseline differences between groups while minimizing practice effects, participants will complete the Balloon Analogue Risk Task⁴—a measure of decision-making under uncertainty that will serve as an analogue to the cognitive outcome variable (i.e., Iowa Gambling Task⁵ [IGT]). An active or sham tDCS will then be administered using a NeuroConn DC-Stimulator PLUS device. Electrode placement was selected based on evidence that bilateral tDCS applied over the dorsolateral prefrontal cortex (DLPFC) elicits positive effects on decision-making in OCD². Cathodal and anodal electrode placement will be over areas F3 (left [DLPFC]) and F4 (right DLPFC), respectively. In both active and sham conditions, the current will gradually increase from 0 to 2mA over a period of 30s. In the Active condition, the current will remain at 2mA for the remainder of the 20-minute session, whereas its intensity will immediately decrease back to 0mA in the Sham condition. To measure immediate effects, the IGT—a measure of decision-making under uncertainty and the cognitive outcome variable in the study—will commence 10 minutes into the tDCS session. Upon completion of the tDCS and IGT, participants will once again complete the behavioral outcome measure of their willingness to engage in ERP (i.e., the EFF). The EFF will be repeated two days after the tDCS session.

Results and Discussion
Thus far, results have been obtained from 13 patients; however, study recruitment and testing has been temporarily halted due to the COVID-19 pandemic. Analysis and outcomes of results to date cannot yet disclosed in order to maintain the double-blind design of the study. Resumption of recruitment and data collection is expected in Fall, 2021 – Winter, 2022. Discussion and dissemination of final results will ensue following study completion.

Conclusions
This novel experiment will explore the potential for advanced multi-modal interventions that combine neuromodulation with CBT. Evidence of tDCS effects on key cognitive and behavioral aspects of ERP can provide a compelling rationale for the subsequent development and administration of a clinical trial of efficacy. (References – next page).



Biography

I am currently a 2nd year PhD student in the Neuroscience Graduate Program at McMaster University in Ontario, Canada. My primary research interests involve the etiology, neurobiology, phenomenology, and treatment of obsessive-compulsive disorder (OCD) and anxiety disorders. My doctoral thesis focuses on the clinical neuropsychology of OCD, specifically the effects of transcranial direct current stimulation on cognition and behavior in patients with OCD undergoing cognitive behavioral therapy (CBT) with exposure and response prevention (ERP). I completed my M.A. in Clinical Psychology at Lakehead University in Ontario, Canada, where I examined the role of intolerance of uncertainty in social anxiety disorder (SAD) and its implications for the interpretation of ambiguous social information. I may be contacted at spiroiuf@mcmaster.ca.

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