



Transcranial Direct Current Stimulation as a Possible Intervention Tool for Emotion Regulation in Depression



Evangelia G. Chrysikou, Ph.D.¹, W. Jake Thompson,¹ Gavin. K. Hanson,¹
Laura E. Martin, Ph.D.², & Rick E. Ingram, Ph.D.¹

¹Department of Psychology, University of Kansas

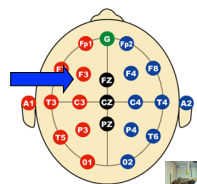
²Department of Preventive Medicine & Public Health, Hoglund Brain Imaging Center
University of Kansas Medical Center



Background & Significance

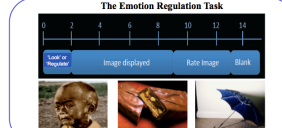
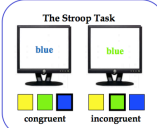
- Unipolar depression is associated with negative affect, rumination, decreased motivation, and limited productivity.
- Due to its massive individual and societal costs, much effort has been focused on the development of pharmacological and psychological interventions to alleviate the symptoms of depression. Although these treatments are effective for some patients, others fail to respond to such interventions alone.
- **Transcranial direct current stimulation (tDCS)** is a novel noninvasive, painless, neuromodulation method, involving application of weak direct currents (1-2 mA) through electrodes on the scalp. A limited but growing number of studies suggest that tDCS—particularly over prefrontal cortex—holds promise for the treatment of depression and has useful characteristics such as low cost, ease of use, and reliable sham methodology (Chrysikou & Hamilton, 2011; Dell'Oso et al., 2010; Drevets, 2000; Ferrucci et al., 2009).
- In this study, we combine tDCS and functional magnetic resonance imaging (fMRI) to investigate the effects of neurostimulation on frontal cortical excitability during emotional thought regulation in depressed patients and healthy control subjects.

Design & Methods



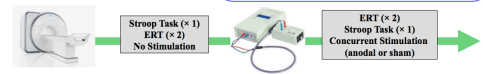
Stimulation parameters:
Anodal (excitatory) tDCS
(1.5 mA) over left DLPFC
or Sham stimulation

Reference electrode:
behind contralateral ear



Visit 1: Clinical evaluation (SCID-II), exposure to tDCS, and task training
Visit 2: fMRI with concurrent tDCS scanning session at Hoglund Brain Imaging Center, followed by behavioral evaluation.
Participants (recruitment is ongoing):

- Seven ($n = 7$) patients with unipolar depression receiving anodal tDCS over F3.
- Eight ($n = 8$) control participants receiving anodal tDCS over F3.
- Eight ($n = 8$) control participants receiving sham tDCS over F3.



Preliminary Results

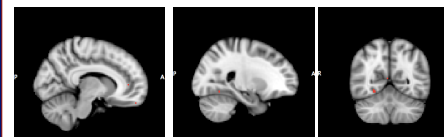
Decrease Negative vs. Look Negative Trials

Post-stimulation by Condition



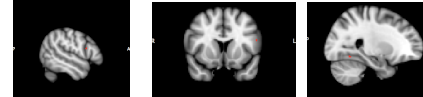
Controls Active > Controls Sham

($z = 2$, uncorrected; Local Maxima = Frontal pole, temporal pole, left amygdala)



Patients Active > Controls Sham

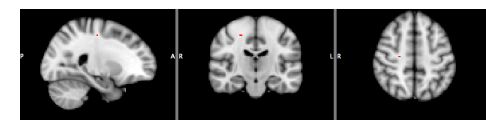
($z = 1.9$, uncorrected; Local Maxima = OFC, Temporal Pole, Occipitotemporal Cortex)



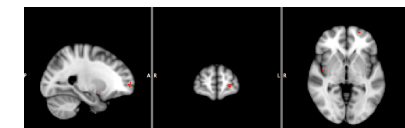
Patients Active > Controls Active

($z = 2$, uncorrected; Local Maxima = BA45 [IFG], Occipitotemporal Cortex)

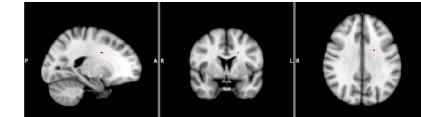
Post-stimulation > Pre-stimulation



Controls Sham ($z = 2.5$, uncorrected; Local Maxima = superior frontal gyrus)



Controls Active ($z = 2.5$, uncorrected; Local Maxima = L frontal pole)



Patients Active ($z = 2.5$, uncorrected; Local Maxima = L Anterior Cingulate gyrus)

Conclusions & Current Directions

1. Data collection continues, particularly for patients currently diagnosed as depressed according to the SCID-II.
2. Our preliminary behavioral results suggest moderate effects of stimulation on participants' evaluation of their emotional responses during the emotion regulation task. Our preliminary fMRI results suggest that active anodal stimulation increased activity in left frontopolar regions for control participants and frontal, medial, and occipitotemporal regions for depressed patients during negative emotion regulation trials.
3. This project contributes to our understanding of the efficacy of tDCS as a possible treatment for depression and can guide future studies that will focus on the optimization of tDCS treatment approaches for individual patients.

References

- Chrysikou, E. G., & Hamilton, R. H. (2011). Electrical stimulation in the treatment of aphasia: Exploring interhemispheric relationships and their implications for neurorehabilitation. *Restorative Neurology & Neuroscience*, 29, 375-394.
- Dell'Oso, B., Priori, A., & Altamura, A. C. (2010). Efficacy and safety of transcranial direct current stimulation in major depression. *Biological Psychiatry*, 69, e323-e24.
- Drevets, W. C. (2000). Neuroimaging studies of mood disorders. *Biological Psychiatry*, 48, 813-829.
- Ferrucci, R., Bortolomasi, M., Vergari, M., Tadini, L., Salvoro, B., Giacomuzzi, M., et al. (2009). Transcranial direct current stimulation in severe, drug-resistant major depression. *J Affect Disord*, 118, 215-219.

This research is supported by the Heartland Institute for Clinical and Translational Research-CTSA Frontiers Pilot & Collaborative Studies Funding Program: 8 UL1TR000001-02 and NIH grant S10RR029577 to Hoglund Brain Imaging Center.

