Clinical and Research Application of Transcranial Brain Stimulation

Alvaro Pascual-Leone, MD, PhD, Michael Fox, MD, PhD, Mark Halko, PhD
Beth Israel Deaconess Medical Center and Harvard Medical School
Dr. Pascual-Leone is a world leader in the field of noninvasive brain stimulation where his contributions span from technology development, through basic neurobiologic insights from animal studies and modeling approaches, to human proof-of-principle and multicenter clinical trials. His research has been fundamental in establishing the field of therapeutic brain stimulation.
Mark Halco Project
Motivation to Stimulate Cerebellum

Nearly all known networks of the brain have cerebellar nodes

Modified from Buckner et al 2011
The cerebellum is known for motor function, yet TMS is more likely to impact non motor function (orange: hypothetical TMS coil position, blue/red/green motor areas)
TMS Position and Stimulation

Positions of model TMS coil locations that could impact cerebellum

Intensity of magnetic field reaching default network nodes from each candidate TMS site
Experimental Evidence

Day 1

- Identify target (lateral, midline or sham)

Day 2

- pre-TMS resting state fMRI
- TMS
- post-TMS resting state fMRI
Changing Network Functional Connectivity

Stimulation of ideal default network site changes default network functional connectivity

Default connectivity

Changes in connectivity

Modified from Halko et al 2014
Stimulation of dorsal attention network

Baseline network

Change after stimulation

Modified from Halko et al 2014
Model predicts functional connectivity
Mike Fox Project

Michael Fox, MD, PhD
Assistant Professor in Neurology
Electrodes and Targets
Results of Optimization

Comparison of Current and E Field for 27 and 82 electrodes

Ruffini et al. vs. Guler et al.
Comparison of Approaches

Figure 1: Optimization results for all four ROIs using two optimization criteria and two electrode configurations. Four cortical regions are shown: GPi, STN, SG, and VIM.