The Hong Kong Polytechnic University Summer School 2019
Language, Cognition and Neuroscience (LCN)
Dirk den Ouden, PhD (University of South Carolina)

tDCS Workshop I – Wednesday August 7th, 9am – noon

In the first workshop, we will discuss the history of transcranial electrical stimulation in humans, as well as the basic mechanisms and recent developments in this still developing field. Reports of the use of electricity to treat human ailments go back 2000 years, but the use of transcranial brain stimulation to modulate or control neuronal activity has taken new flight in the past 20 years. Leading up to transcranial direct current stimulation to affect (de)polarization of neurons, we will also discuss the technique of transcranial magnetic stimulation to evoke neural firing, and the inherent differences between these methods. Recent developments in tDCS include the use of multiple electrodes in arrays to increase focality and local intensity of electric fields, in High-Density transcranial Direct Current Stimulation (HD-tDCS), as well as the use of alternating currents in brain stimulation. Topics to be discussed include what we currently know about mechanisms, safety, and optimal stimulation parameters.

Literature:

Truong, D. Q., & Bikson, M. (2018). Physics of Transcranial Direct Current Stimulation Devices and Their History. *Journal of Ect*, 34(3), 137-143. doi: 10.1097/yct.0000000000000531

Sarmiento, C. I., San-Juan, D., & Prasath, V. B. S. (2016). Brief history of transcranial direct current stimulation (tDCS): from electric fishes to microcontrollers. *Psychological Medicine*, 46(15), 3259-3261. doi: 10.1017/s0033291716001926

tDCS Workshop II – Wednesday August 7th, 2pm – 5pm

The second workshop will highlight studies using various versions of (HD-)tDCS, with a particular focus on cognition, neurolinguistics and speech. tDCS is used to investigate basic scientific questions on how the brain supports the mind and controls (speech) motor control, but importantly also as a therapeutic tool, for the treatment of a wide range of neurogenic disorders. We will discuss studies in which (HD-)tDCS has been used to boost recovery from aphasia (language impairment) after stroke, and to dampen the effects of neurodegenerative disease, as in primary progressive aphasia.

Literature:

Norise, C., & Hamilton, R. H. (2017). Non-invasive Brain Stimulation in the Treatment of Post-stroke and Neurodegenerative Aphasia: Parallels, Differences, and Lessons Learned. *Frontiers in Human Neuroscience*, 10. doi: 675 10.3389/fnhum.2016.00675

Zoefel, B., & Davis, M. H. (2017). Transcranial electric stimulation for the investigation of speech perception and comprehension. *Language Cognition and Neuroscience*, 32(7), 910-923. doi: 10.1080/23273798.2016.1247970

Enrichment activities: tDCS guided group study – Thursday August 8th

In this session, we will discuss considerations in the design of HD-tDCS research studies, primarily based on student interests. Students will have the opportunity to use modeling software to find optimal electrode configurations for targeting specific brain areas. In addition, we will discuss sample size, stimulation parameters, and other practical matters relevant to the design and execution of HD-tDCS experiments. In preparation, students are asked to think about a research question and, if possible, to consider the hypothesized neural substrate(s) for the cognitive or behavioral function they aim to modulate. The session is informal, so students without a prepared research plan are certainly welcome to attend.

Literature:

Woods, A. J., Antal, A., Bikson, M., Boggio, P. S., Brunoni, A. R., Celnik, P., . . . Nitsche, M. A. (2016). A technical guide to tDCS, and related non-invasive brain stimulation tools. *Clinical Neurophysiology*, 127(2), 1031-1048. doi: http://dx.doi.org/10.1016/j.clinph.2015.11.012