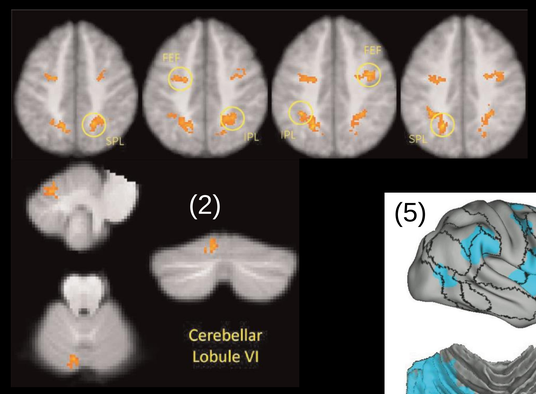
The effects of cerebellar transcranial direct current stimulation (tDCS) on sustained visual attention: Preliminary findings

Nadia L. Botha & Christopher L. Striemer, PhD
Department of Psychology, MacEwan University

Introduction

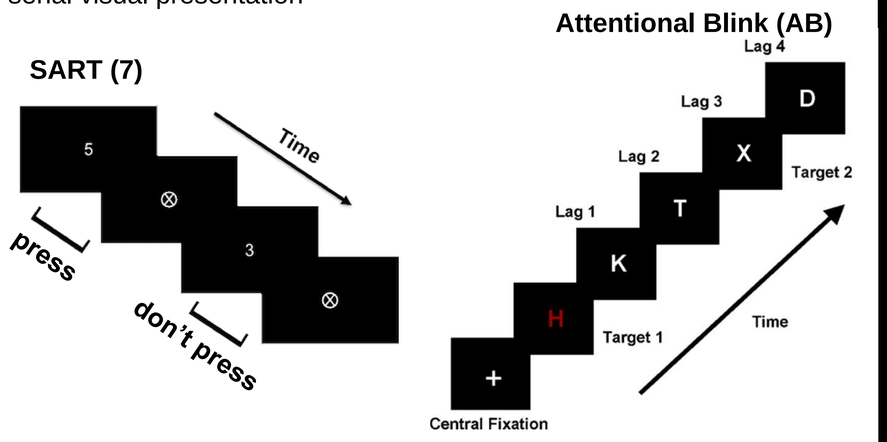
- The cerebellum is primarily known for its role in motor coordination, but recent research indicates that it also contributes to cognitive functions such as working memory, language, emotion, and attention (1-4)
- Recent brain imaging and patient studies implicate **lobule VI, Crus I-II, and VIIB of the left cerebellum** in executive functions and spatial and sustained visual attention (1-4)
- A recent fcMRI study demonstrated that these left cerebellar regions are functionally connected to the fronto-parietal attention network in the right cerebral hemisphere (5)



- In the current study we are investigating the role of the left lateral cerebellum in two sustained attention tasks (SART and AB) using transcranial direct current stimulation (tDCS),- a non-invasive brain stimulation technique (6)
- **If the left cerebellum is involved in mediating sustained attention we should observe changes in the % errors (SART) or AB effect following anodal (+) or cathodal (-) stimulation compared to the sham (i.e. no stimulation) condition**

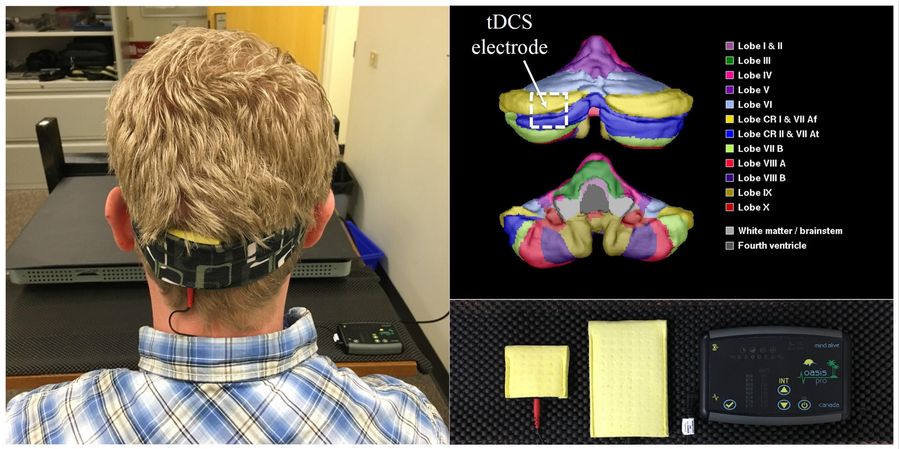
Methods

- Participants (currently n=12) performed both the **sustained attention to response task (SART; 7)** and an **attentional blink (AB) task (4)** before and after receiving anodal (+), cathodal (-), or sham tDCS
- In the SART task participants must respond (via button press) to digits 1-9, but not respond to 3
- In the AB task participants must detect either 1 or 2 targets within a rapid serial visual presentation



tDCS procedure (6):

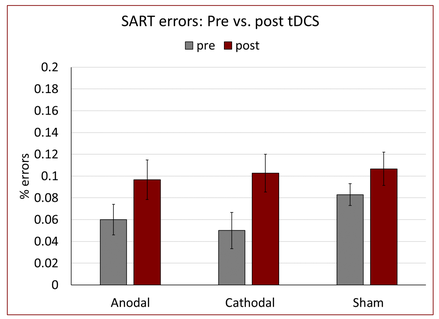
- In separate testing sessions healthy participants (currently n=12) received either anodal (+), cathodal (-), or sham tDCS at 2.0mA for 20 minutes over the left lateral cerebellum
- The active electrode was placed 1cm below and 4cm to the left of the inion roughly in the vicinity of cerebellar Crus I/lobule VII
- The reference electrode was placed on the right shoulder

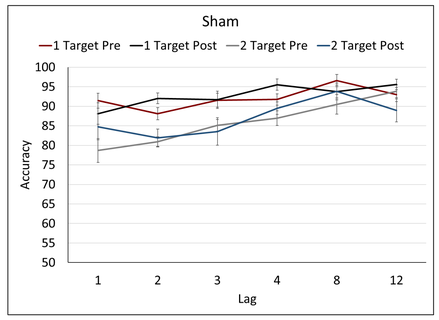


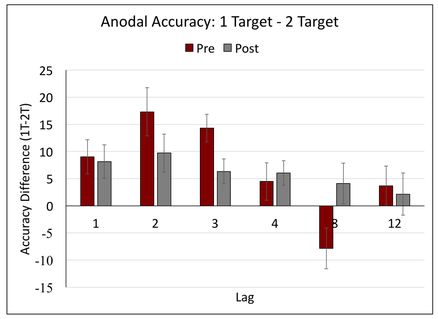
Sequence of events for each testing session:

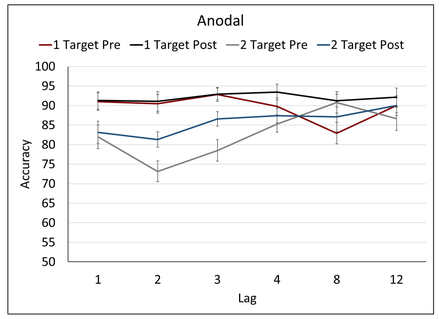
- Pre tDCS sustained attention tasks → tDCS (sham, cathodal, or anodal) → Post tDCS sustained attention tasks

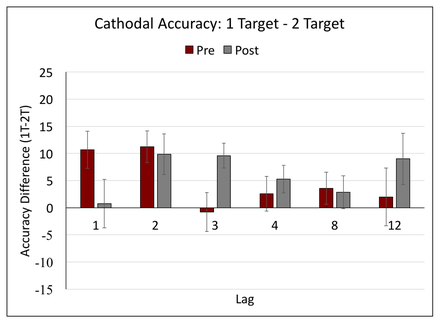
Preliminary Results

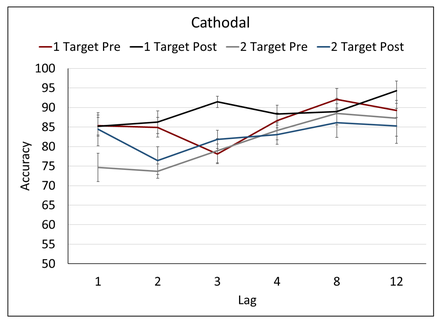












Implications

- If tDCS alters sustained attention it will be some of the first evidence to directly implicate the cerebellum in this function
- Advancing our understanding of how the cerebellum controls attention and how tDCS can modulate this effect may have important implications for treating patients with cerebellar lesions

References

1. Stoodley, J. & Schmahmann, J. (2009). *NeuroImage*. 44. p. 489-501.
2. Striemer, C. et al. (2015). *Neuropsychologia*. 69. p 9-21.
3. Striemer, C. et al. (2015). *Frontiers in Human Neuroscience*. 9(428). p 1-10.
4. Schweizer, T. et al. (2007). *Neuropsychologia*. 45.p 3068-3074
5. Wang, D. et al. (2013). *Journal of Neurophysiology*. 109. p. 46-57.
6. Pope, P. (2014). *Journal of Visualized Experiments*. 96. p. 1-9.
7. Robertson, I. et al. (1997). *Neuropsychologia*. 35. p 747-758