Introduction

- tDCS is a safe and tolerable method.
- There is a high potential for clinical use to treat patients with aphasia. Which stimulation settings and targets provide the greatest therapeutic effect?
- Interhemispheric competition hypothesis:
  - In post-stroke aphasia, involvement of the right hemisphere may be maladaptive and hinder recovery via perilesional left-hemispheric activity.
- Many brain stimulation studies have inhibited the right hemisphere.
- Marangolo et al. (2016) combined this with excitation of the left hemisphere but did not test whether the effect was superior to excitation of the left hemisphere only.

Aim

To investigate the effects of bilateral tDCS in healthy participants, with left excitatory and right inhibitory stimulation as control conditions.

Method

- 49 healthy participants (mean age 22.9, range 18-30), right-handed, native speakers of Russian, no history of neurological or psychiatric disorders, and speech or language disorders.
- Each participant was assigned to one condition:
  - A) Bilateral condition: anodal stimulation to Broca’s area and cathodal to the right hemisphere homologue of Broca’s area (N=15).
  - B) Anodal stimulation of Broca’s area (F7) (N=19).
  - C) Cathodal stimulation of right-hemisphere homologue of Broca’s area (F8) (N=15).
- Two sessions; one with real stimulation (1.5 mA for 20 min.) and one with sham stimulation.

Tasks:

1) Lexical decision task (120 items).
2) Sentence comprehension task (60 items); self-paced reading with complex sentences; each followed by a comprehension question with two response options.
- 2 stimuli list for each task.
- Lists where balanced on important psycholingual variables.
- The lists were counterbalanced across stimulation conditions.

Statistics:

- Linear Mixed-Effect Models: lme4 package in R; p-values obtained via the likelihood ratio test.
- Fixed factors: Stimulation (real vs. sham), Stimulation site (left anodal vs. right cathodal vs. bihemispheric), Linguistic condition (word/ non-word or sentence type), Session (day 1 or 2).
- Random factors: Subject (random intercept and slope), Item (random intercept).

Results

Sentence Comprehension Task

Reading time:

<table>
<thead>
<tr>
<th>Stimulation Site</th>
<th>Sentence Type</th>
<th>Mean (sec)</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anodal</td>
<td>Word</td>
<td>1.36</td>
<td>0.19</td>
<td>0.63</td>
</tr>
<tr>
<td>Cathodal</td>
<td>Word</td>
<td>1.39</td>
<td>0.19</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Question accuracy:

<table>
<thead>
<tr>
<th>Stimulation Site</th>
<th>Sentence Type</th>
<th>Mean (%)</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anodal</td>
<td>Word</td>
<td>94.00</td>
<td>0.16</td>
<td>0.69</td>
</tr>
<tr>
<td>Cathodal</td>
<td>Word</td>
<td>94.00</td>
<td>0.16</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Lexical decision accuracy:

At ceiling; 97.98% across all conditions.

Discussion

- What are the effects of bilateral tDCS in healthy participants compared to the two control conditions; left anodal stimulation and right cathodal stimulation?
- No improvement; in reading time on the sentence comprehension task and in response time and accuracy on the sentence comprehension task and lexical decision task.
- No support for the interhemispheric competition hypothesis or for beneficial effects of tDCS overall.
- Stimulation parameters; sensitivity of tasks.
- Underlying neuronal mechanisms not yet fully understood.
- tDCS effects overrated due to publication bias?
- Is tDCS effective in patients with aphasia who have a disturbed language network?