LONG TERM EFFECTS OF A NEUROPSYCHOLOGICAL INTERVENTION WITH TRANSCRANIAL DIRECT CURRENT STIMULATION (tDCS) IN ANOMIC APHASIA

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INTRODUCTION

Impaired language functioning is commonly found in patients that have suffered an Acquired Brain Injury (ABI). These difficulties often manifest in the form of an inability to name objects whilst being able to access their meaning. This impends the natural flow of language and is perceived as highly frustrating by the patients.

ANOMIC APHASIA

Altered ability to name objects; whilst the rest of the language functions (expressive speech, comprehension and repetition) remain relatively intact. [1]

TRANSCRANIAL DIRECT CURRENT STIMULATION (tDCS)

Non-invasive technique of neuro-modulation that can lead to changes in cortical excitability, and thus, to long term neuro-rehabilitation effects. [2]

AIM OF THIS STUDY

Can the ability of naming objects be modulated via the application of **bipolar tDCS** over **frontotemporal areas** in a patient with anomic aphasia caused by and ABI?

Evidence supporting the efficacy of **tDCS application in the treatment of anomic aphasia** is growing, leading to extensive reviews on the effects of tDCS application on the naming abilities of patients with post-stroke aphasia.[3] Contrary to most findings underlining a positive effect of anodal stimulation on the left frontotemporal areas; Monti et al. (2008) found improved accuracy in a naming task after cathodal stimulation over left frontotemporal areas. [4]

METHOD

PARTICIPANT (n=1)

Patient with anomic aphasia. Male, 56 years old. *Neuroimaging*: alteration of the cortical-subcortical signaling in the left temporal lobe with involvement of the hippocampus and peri-insular region.

INTERVENTION

- **8 sessions** of **tDCS** application where conducted (20 min. each) using a direct current stimulator (DC-Stimulator Plus from NeuroCare) with the following setup (see **Fig. 1**):
  - **Cathode** placed over **left frontotemporal areas** (between F7 and T3)
  - **Anode** placed over **right frontotemporal areas** (between F8 and T4)
- **Simultaneous presentation of stimuli** to be named with the following procedure:

Free naming → SFA* → Phonetic Clue

*__Semantic Feature Analysis__: the patient was prompted to describe different aspects of the target object (e.g.: smell, texture, taste, preparation, etc.) in order to stimulate alternate access paths towards said word. [5]

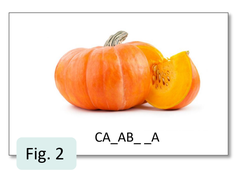

Fig. 2

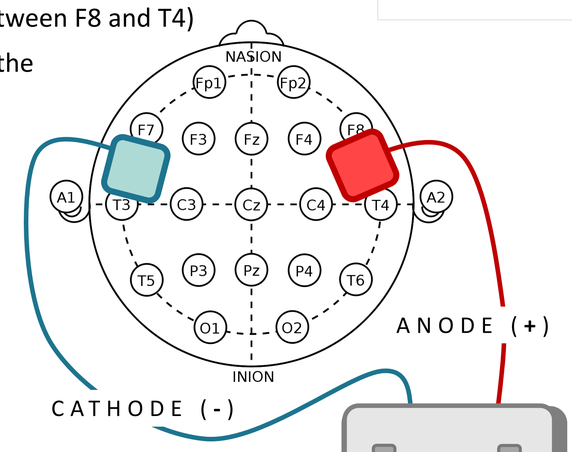

Fig. 1

STIMULI & MATERIALS

The patient selected words related to cooking; specifically, food. The total of 67 stimuli where divided into two categories:

- Category 1: vegetables (29 words)
- Category 2: fruits (34 words)

Photographs of the stimuli where shown to the participant via a PowerPoint presentation during the stimulation sessions (see **Fig. 2**) and through sheets during assessment (see **Fig. 3**).


Fig. 3

ASSESSMENT

- Naming of stimuli by confrontation with the selected stimuli (**Fig. 2**), as follows:

Free naming → Phonetic Clue

- Naming within descriptions of:
  - The preparation of a meal (list the ingredients and steps required to prepare it).
  - The picture of a grocery store (*What do you see?*)

RESULTS

Scores:

- **2 points** for an immediate hit (word is named directly upon confrontation)
- **1.5 points** for a hit after SFA
- **1 point** for a hit after a phonetic cue

As can be observed in **Fig. 4** and **Fig. 5**, the amount of hits per session increased throughout the intervention (with a steeper improvement in category 2).

A notable improvement in naming was observed gradually along the assessment sessions (again, in this case, steeper for category 2). The improvement measured after the intervention did not only maintain over time, it improved even further. See **Fig. 6** and **Fig. 7**.

With a more qualitative approach, naming was also measured through descriptions of recipes an image that involved the words. Descriptively, it appears that further context aided in accessing the word, and this facilitatory effect increased along with the positive results of the intervention.

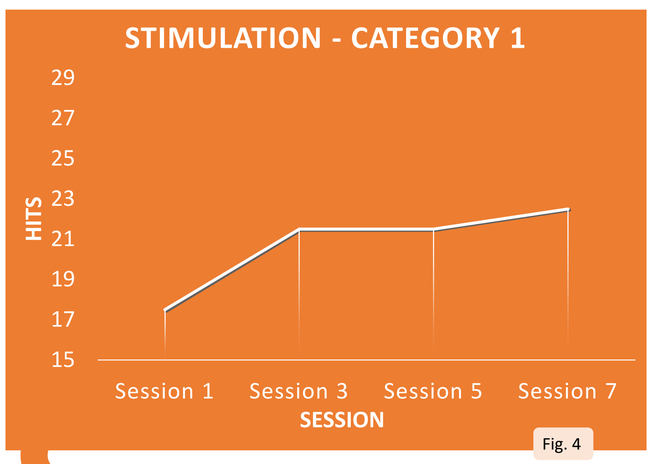

Fig. 4

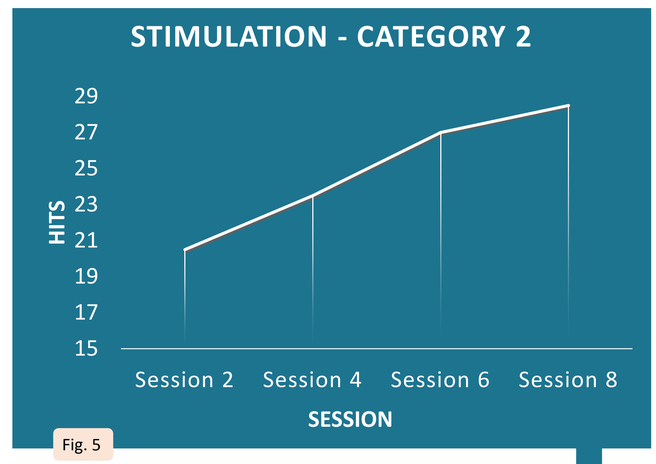

Fig. 5

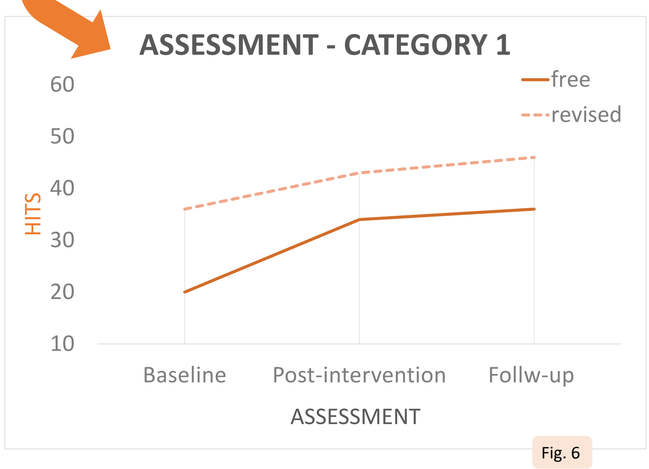

Fig. 6

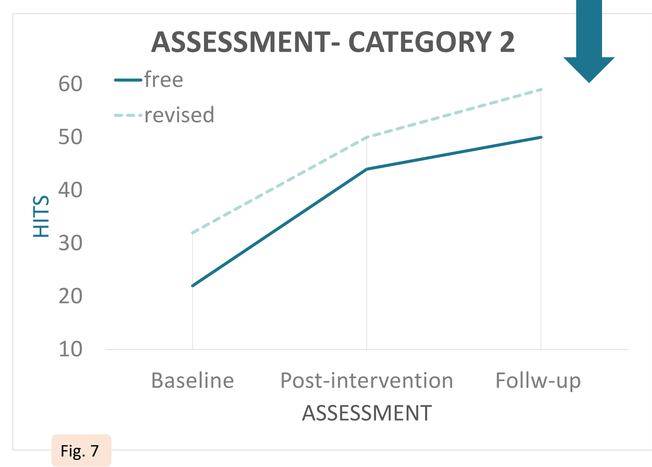

Fig. 7

DISCUSSION

In the present study, an improved naming ability was observed through an intervention that combined a training for naming stimuli (repetition and SFA) and tDCS.

HIGLIGHTS

- **Novel electrode placement**. Surprisingly, inhibitory (cathodal) stimulation over the affected left frontotemporal area, lead to improved naming. Based on the study by Monti et al. (2008), where a monopolar tDCS was applied over the left frontotemporal area, we tested the efficacy of a bipolar montage setting the cathode on the left hemisphere.
- **Long term maintenance** of effects.
- **Specific training** for words frequently used in the patients **Activities of Daily Living**.
- A **cogntive procotol** designed to facilitate alternative access paths to the target words, accompanied with multiple cues and strategies to aid errorless learning.

FUTURE DIRECTIONS

- Comparing magnitude of changes in stimulation vs SHAM group.
- A more detailed base line (multiples measures on several days).
- Using a different set of stimuli for the assessment.

CONCLUSION

Transcranial direct current stimulation is a rather novel approach, that – considering its low cost and risk, in sum to positive results found in studies like these – seems to be a **promising tool to use in combination with classical neuropsychological rehabilitation strategies**. What is most striking, and promising about the present study is, how the improvement in naming was not only maintained up to 8 months after the intervention, but gradually increased. This single case study may not serve to draw general conclusions about the effect of tDCS, but it sheds light on an interesting approach that ought to be studied further.

ACKNOWLEDGMENT

BIBLIOGRAPHY

1. Schoenberg, M. R., & Scott, J. G. (2011). The little black book of neuropsychology: a syndrome-based approach (pp. 1-37). New York:: Springer.
2. Fregni, F., Nitsche, M. A., Loo, C. K., Brunoni, A. R., Marangolo, P., Leite, J., … Bikson, M. (2015). Regulatory considerations for the clinical and research use of transcranial direct current stimulation (tDCS): Review and recommendations from an expert panel. Clinical Research and Regulatory Affairs, 32(1), 22–35. https://doi.org/10.1016/j.saa.2017.02.025
3. Holland, R., Crinion, J., Holland, R., & Crinion, J. (2017). Can tDCS enhance treatment of aphasia after stroke ? Can tDCS enhance treatment of aphasia after stroke ?, 7038(April), 1169–1191. https://doi.org/10.1080/02687038.2011.616925
4. Grossman, M., Hamilton, R. H., Hung, J., Reilly, J., Coslett, H. B., & Bauer, A. (2017). Semantic Feature Training in Combination with Transcranial Direct Current Stimulation (tDCS) for Progressive Anomia. *Frontiers in Human Neuroscience*, *11*(May), 1–12. https://doi.org/10.3389/fnhum.2017.00253
5. Monti, A., Cogiamanian, F., Marceglia, S., Ferrucci, R., Mameli, F., Mrakic-Sposta, S., … Priori, A. (2008). Improved naming after transcranial direct current stimulation in aphasia. *Journal of Neurology, Neurosurgery and Psychiatry*, *79*(4), 451–453. https://doi.org/10.1136/jnnp.2007.135277