tDCS reduces phonological errors in patients with Primary Progressive Aphasia

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Introduction

- Patients with Primary Progressive Aphasia (PPA) vary in their speech symptoms depending on the underlying pathology and area of brain damage.
- Phonological errors resulting in mispronunciation of words are hallmark characteristics of patients with PPA. Here, phonology refers to the cognitive representation of speech sounds, articulatory commands and co-ordination.
- Phonological errors are usually targeted using language therapy but often have relatively modest outcomes. This study aims to determine whether tDCS reduces phonological errors in patients with nfvPPA more than a sham.
- Apraxia of Speech manifests acoustically by slower speech (Duffy et al., 2017) and longer segmental durations, as shown in stroke aphasia (Basilakos et al. 2017, Haley et al. 2012). In general, PPA variants differ in speech acoustics, as recent machine-learning models suggest (Themistocleous et al., 2020; Themistocleous et al., 2019). Marangolo et al., 2013 found that Transcranial direct current stimulation (tDCS) promotes AOS recover in patients with post-stroke aphasia.
- Themistocleous (2021) found that language therapy with tDCS resulted in improved speech productions (shorter consonants and vowels) in the tDCS condition over sham that lasted for two months.
- We hypothesize that tDCS, combined with speech and language therapy, will reduce phonological errors in individuals with PPA.

Goals

The work aims to determine whether tDCS over the left Inferior Frontal Gyrus (IFG) coupled with speech intervention reduces phonological errors in patients with PPA.

Methodology

- Six patients with nfvPPA/AOS participated in this pilot study.
- Four received anodal tDCS, and two received sham stimulation paired with speech therapy.
- All patients were treated with speech and language therapy with tDCS or sham condition for three weeks (15 sessions) in each phase.
- The speech therapy lasted 45 minutes, but the tDCS or sham stimulation occurred concurrently during the first twenty minutes of treatment.
- During tDCS and sham stimulation, patients participated in an oral word repetition task based on Dabul (2000). The test included 10-word triplets of increasing complexity in syllable numbers. In addition, we compared trained and untrained words to evaluate training effects.
- A composite score of the distance that estimates the phonological differences—phonemic deletions, insertions, substitutions, and transpositions---between the target word and the response (Themistocleous, 2021).
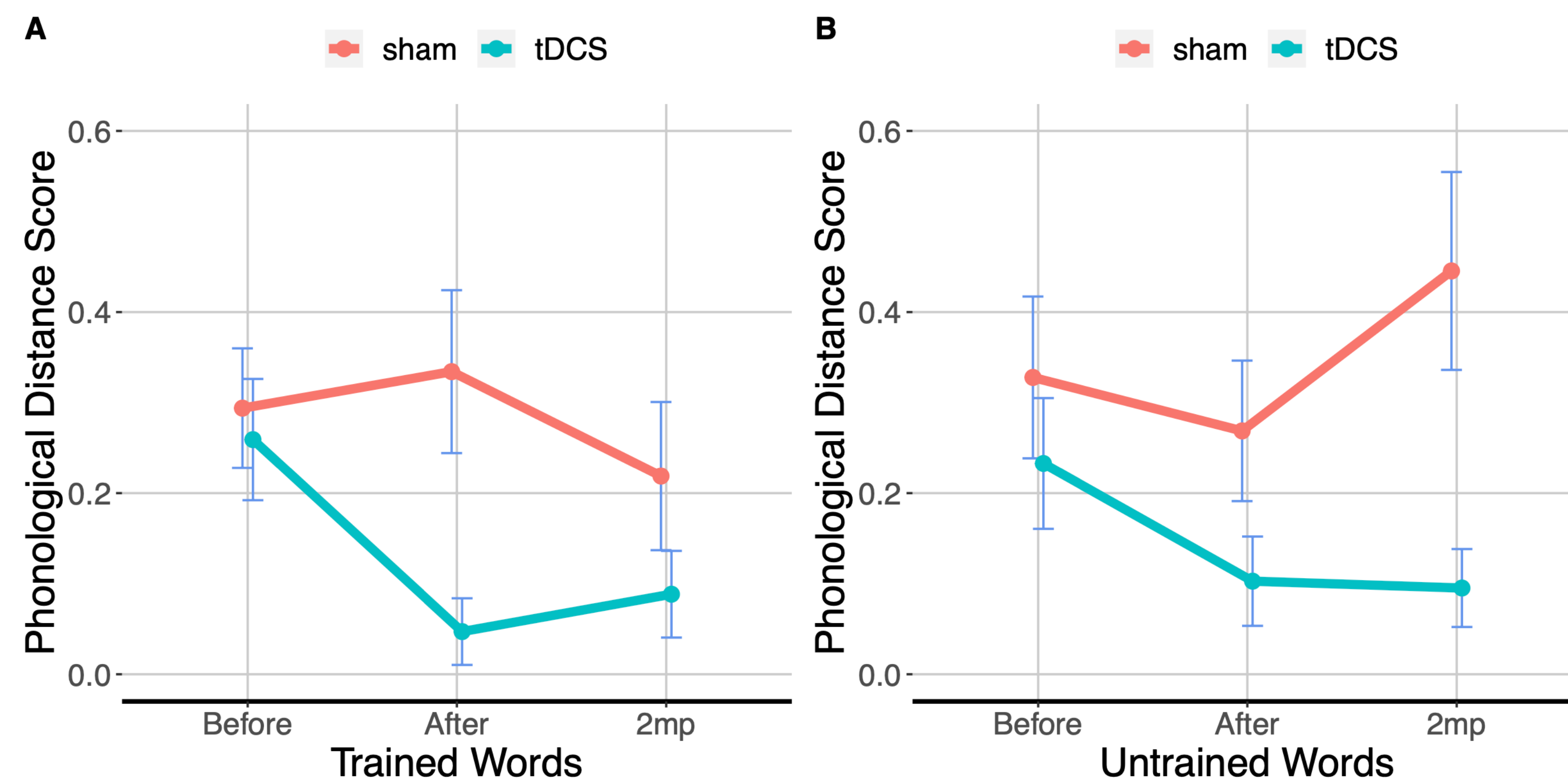
Results

Figure 1 The phonological distance score as an effect of timepoint Before, After, and two months post-treatment (2mp) shown for Trained Words (Panel A) and Untrained Words (Panel B) (the lower the better, a score = 0 means that the response does not differ from the target).

Discussion

- The study provided a method to quantify phonological errors in patients with nfvPPA/AOS.
- tDCS stimulation over the left IFG combined with language therapy reduces phonological errors (e.g., deletions, insertions, transpositions, and substitutions) in patients with nfvPPA/AOS.
- In two months post-therapy evaluation, the phonological distance in the untrained words with sham had deteriorated, whereas, in the tDCS condition, the distance did not change.
- The findings corroborate earlier findings, which showed that tDCS and language therapy results in faster speech production (shorter vowels and consonants) (Themistocleous et al. 2021).
- More data are required to establish a clear pattern. Yet, these preliminary findings demonstrate that language therapy with tDCS can improve phonology.

Bibliography

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