Effects of tDCS on Processing Speed and Working Memory in Aphasia: A Preliminary Single-Case Report

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INTRODUCTION

- Processing speed deficits are common among stroke survivors and particularly notable in individuals with aphasia but research has largely overlooked direct treatments targeting these deficits.
- No studies have explored the use of transcranial Direct Current Stimulation (tDCS) to enhance processing speed specifically in individuals with aphasia.
- Though working memory interventions have shown promise in other populations, (traumatic brain injury and age-related cognitive decline) their effectiveness in individuals with aphasia remains underexplored
- This study investigates 1) **the potential effects of active tDCS on processing speed** and explores 2) **working memory in an individual with aphasia**

METHOD

- Study Design:
  - Data presented are preliminary and derived from the first recruited participant (female, age 70, 30 months post-onset, 17 years of education), who received active tDCS.
  - The participant underwent five sessions of active anodal tDCS applied to the left dorsolateral prefrontal cortex.
- Pre- and post-treatment assessments
  - Western Aphasia Battery-Revised (WAB-R)
  - Montreal Cognitive Assessment (MOCA)
  - Processing Speed Tasks (PST-kit: Visual Pattern Comparison, Letter Comparison, Lexical Decision, Sentence Completion)
  - Working Memory Tasks (Numerical subtract-2 span
  - Verbal alphabet span
  - Spatial NIH Toolbox WM)
  - Story Retelling Procedure (SRP; McNeil et al., 2001).

Table 1. Participant Information

Age	70
Gender	Female
Years of Education	17
Post-Onset Time (POT)	30 months

RESULTS

- The participant demonstrated modest cognitive improvements following the tDCS intervention.
- WAB-R scores slightly improved from 91.5 to 93.2 (1.86%)
- MOCA scores increased from 19 to 22 (15.79%)
- Improvements were evident in working memory tasks:
  - Verbal WM span increased from 2.5 to 4 (60%)
  - Numerical WM total score improved from 14 to 17 (21.43%)
  - Spatial WM percentile improved from the 50th to the 75th percentile.
  - Processing speed showed notable improvements, especially in lexical decision (45.83%), letter comparison (16.37%), and sentence completion tasks (14.33%).
  - No changes were observed in SRP results.

Table 2. Descriptive Test Results after tDCS Sessions

Linguistic and Cognitive Tasks	Pre	Post	% Changes
WAB-R AQ	91.5	93.2	1.86%
MOCA	19	22	15.79%
SRP	24.33	24.33	0%

Table 3. Working Memory after tDCS Sessions

Working Memory	Pre	Post	% Changes
WM1: Numerical-Subtract-2 Span	Span 4 Total 14	Span 4.5 Total 17	12.50% 21.43%
WM2: Verbal-Alphabet Span	Span 2.5 Total 10	Span 4 Total 14	60% 40%
WM3: Spatial-NIH ToolBox WM	Raw Score 12 T-Score 50 50%tile	Raw Score 14 T-Score 57 75%tile	16.67% 14% 25%tile

RESULTS

Table 4. Processing Speed after tDCS Sessions

Processing Speed Tasks	Pre-RTs	Post-RTs	% Changes
Pattern Comparison	1614.59	1488.86	7.79%
Letter Comparison	819.89	685.73	16.37%
Lexical Decision	1557.44	843.69	45.83%
Sentence Completion	12583.85	11000.74	14.33%

CONCLUSION

- Preliminary data suggests active tDCS targeting the DLPFC may positively influence cognitive functions, notably working memory and processing speed, in individuals with aphasia
- Even brief intervention periods yielded measurable improvements in cognitive functioning.
- Results must be interpreted with caution as the current data are derived from a single participant without a sham control condition for comparison.

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