Using transcranial direct current stimulation (tDCS) to treat pure alexia: a case study

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Introduction

Transcranial direct current stimulation (tDCS) has shown promise in enhancing recovery of naming in aphasia, but it is unclear whether it can similarly improve reading in alexia. We hypothesized that tDCS could accelerate practice-related increases in reading speed compared to sham tDCS in a person with pure alexia (NHL). We further hypothesized that tDCS would produce a generalized facilitation of word access, resulting in faster reading of unpracticed paragraphs and a reduced length effect in single word reading.

Method

NHL is a 70-year-old right-handed retired engineer with mild pure alexia resulting from a traumatic brain injury to the left occipital lobe and right frontal lobe in 2005. His reading is accurate but slow, with a word length effect. We measured oral text reading speed before and after five consecutive days of treatment with tDCS followed ten days later by five days of sham treatment. NHL read aloud 4 passages with feedback, during tDCS and 4 matched passages during sham treatment. Oral reading times of these paragraphs were tested at the beginning of each treatment day. tDCS was administered at 2mA for 20 minutes, with the anode over left posterior temporal lobe and the cathode over the right, based on a prior study demonstrating reduced reading times in healthy subjects using a similar configuration (Turkeltaub et al., 2012). Generalization was assessed before and after the course of tDCS on untrained single words (length 3-9 letters), and on untrained passages matched to training passages. Effects of tDCS on untrained paragraphs were compared both to sham, and to prior reading times from 2007 and 2009.

Results

Reading times decreased on practiced paragraphs during both real and sham tDCS (F(4,24)=18.125, P<.001). Reading times on training paragraphs (as a percentage of pre-tDCS reading times) were shorter during the week of tDCS treatment compared to sham (F(1,6)=.017). Examining the time course of improvement during treatment, reading times improved earlier in the 5-day course of treatment with tDCS, but overall improvement was similar for both conditions by the end of treatment (Figure 1a). Assessing generalization effects, available data for three of the untrained passages showed stable reading times for six years before tDCS, with a large decrease in reading time for all three, 10 days after tDCS (Figure 1b). However, effects on untrained paragraphs

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in comparison to sham were not clear. The length effect decreased after tDCS (Length x Time F(2,172)=4.942, P=.008; Pre-tDCS: 208 ms/letter, 1 day post-tDCS: 147 ms/letter, 10 days post-tDCS: 136 ms/letter).

Conclusion

This case study suggests that tDCS may accelerate training effects in alexia therapy, such that more material could be trained in a given number of sessions. Effects of tDCS may generalize beyond trained items, but further research is needed to confirm these effects and extend them to various specific reading deficits.