

Getting the aging brain to train: A working memory and neurostimulation approach

ABSTRACT:

Background

Transcranial direct current stimulation (tDCS) has been suggested to boost working memory training (WMT) effects. Nevertheless, few studies have explored the effects of WMT coupled with tDCS in older adults.

Aims

To assess the effects of 5-days WMT coupled with tDCS on near- (Digit Span and Corsi Block Taping) and far- (Raven Advanced Progressive Matrices - RAPM) transfer tasks, as well as, in event-related potentials (ERPs) and salivary IGF-1. An additional aim was to assess if ERPs are related with fluid intelligence (Gf), a commonly assessed constructed to infer generalization of WMT effects.

Method

54 healthy old adults ($M_{age} = 68.6$, $SD_{age} = 6.0$; 32 females) were randomly assigned to one of three groups: 1) WMT (dual n-back task) + atDCS (anodal, 2 mA; 20min; placed over left dorsolateral prefrontal cortex); 2) WMT + sham tDCS; 3) double-placebo. Assessments were carried out at baseline; post-training; 15 days follow-up. An EEG study was performed using baseline data to explore whether ERP components (i.e., P2, P3b and the LPC - late positive complex) were associated with Gf in the elderly.

Results

The analyses showed that only atDCS+WMT group displayed a significant improvement in Gf and short-term memory (forward digit span). Those results are in line with studies performed in the context of this project. First, our meta-analysis showed small significant and long-lasting near transfer effects of WMT, which was not the case for far transfer effects measured in Gf tasks. We also suggested that tDCS may modulate WM in older adults boosting cognitive processes involved in WM, by conducting a systematic review. Finally, our last study showed that high performance participants presented significant higher LPC amplitudes and shorter P3b latencies elicited by attention tasks when compared to the LP group.

Conclusions

WMT yielded transfer effects restricted to WM ability, while tDCS boosted its effects producing far transfer to Gf. Our results also suggested that the ERPs are associated with the Gf performance in older adults.

Keywords

tDCS, Working memory training, Neuroplasticity aging

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Published Work:

Teixeira-Santos, A. C., Moreira, C. S., Magalhães, R., Magalhães, C., Pereira, D. R., Leite, J., Carvalho, S., & Sampaio, A. (2019). Reviewing working memory training gains in healthy older adults: A meta-analytic review of transfer for cognitive outcomes. *Neuroscience & Biobehavioral Reviews*, *103*, 163-177. doi: 10.1016/j.neubiorev.2019.05.009

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