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Clustering and switching on semantic fluency after transcranial direct current stimulation (tDCS)

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Introduction

Semantic fluency can be enhanced by a single session of anodal transcranial direct current stimulation (tDCS) over the left hemisphere. However, such effect has been found to depend on small differences in stimulation protocols, and can sometimes be detected only after a short interval from the stimulation offset (Penolazzi, Pastore & Mondini, 2013). The investigation of tDCS effects on verbal fluency mainly concerned total word production, whereas other relevant components of this task, like “clustering” and “switching”, have been usually neglected. To the best of our knowledge, the only study addressing these fluency components (Vannorsdall et al., 2012) reported an increase in the number of clustered words during anodal stimulation (decrease during cathodal) over the left dorsolateral prefrontal cortex. The present study, by comparing different tDCS protocols, was aimed to test whether small differences in either the active electrode positioning, or the positioning/size of reference electrode can alter clustering and switching phenomena during semantic fluency.

Methods

90 healthy, right-handed volunteers were randomly assigned to receive one of the following five protocols: 1) anode over the left frontal cortex/cathode over the right supraorbital area (rSOa), 2) anode over the left fronto-temporal cortex (IFTe) /cathode over the rSOa, 3) anode over the IFTe/cathode over the right FTe, 4) anode over the IFTe/big-size cathode over the rSOa, 5) Sham. In the active stimulations, a current of 2 mA was delivered for 20 minutes. The semantic fluency task was assessed before stimulation, immediately after it, and 15 minutes after post-stimulation test. In addition to the total number of generated word, investigated elsewhere (Penolazzi et al., 2013), the number of switches and clusters, mean cluster size and percent words in clusters were analyzed (Vannorsdal et al., 2012).

Results and Discussion

Although the montage with anode over the left frontal cortex/cathode over the rSOa enhanced total word production (Penolazzi et al., 2013), analyses of the variables related to clustering and switching phenomena did not reveal any significant difference between the various montages (ps>.05). This suggests that stimulation was ineffective in changing the clustering and switching phenomena for all the protocols tested here. The comparison of our results with those reported on this topic
(Vannorsdall et al., 2012) suggests that more prefrontal stimulations seem to be more effective than frontal or fronto-temporal stimulations in altering such verbal fluency components. This highlights the importance of considering electrode positioning differences in producing tDCS linguistic effects.

References
