

on the left dorsolateral prefrontal cortex (L-DPFC) and left inferior frontal gyrus (L-IFG), for the improvement of verbal fluency performance and creativity skills in a group of multilingual healthy adults.

Participants and Methods: Fifty healthy adults, aged 18-47 years, participated in the study. All of them were native Spanish speakers of which three were bilingual (Spanish and English) and 47 were multilingual (Spanish, Basque and English). The study had a randomized, counterbalanced, double-blind, sham-controlled design. The participants were randomly allocated to either a tRNS active group or a placebo-control group. All participants were tested individually in one session divided into three parts: (1) baseline, (2) online, and (3) offline assessment. In the active condition, a 1.5mA current (100–500 Hz) was delivered for 20 minutes (online phase). Participants' verbal fluency was assessed through semantic and phonemic verbal fluency tasks in three different languages (Spanish, Basque and English), while creativity was assessed in their native language with the Remote Associations Test (RAT, pre and post forms) for convergent thinking, and with the Unusual Uses subtest (UU, pre and post forms) for divergent thinking. In addition, the linguistic profile of the participants was evaluated with the Language Experience and Proficiency Questionnaire (LEAP-Q), and their processing speed and cognitive flexibility were assessed with the Stroop Color and Word Test (SCWT).

Results: The results showed significant differences in phonemic fluency between the groups during the online assessment in Spanish ($F=5.31$, $p=0.026$), and in the offline assessments in Spanish ($F=6.44$, $p=0.015$) and English ($F=10.80$, $p=0.002$), with participants in the active condition performing better. While no differences were observed in the performance of the groups in verbal fluency in Basque, neither in the online ($F=1.06$, $p=0.31$), nor in the offline assessment ($F=2.62$, $p=0.11$). Furthermore, no significant differences were observed between groups in semantic verbal fluency tasks in any of the languages, neither during stimulation nor offline. However, there were no differences between conditions in the online (Spanish, $F=0.86$, $p=0.35$; English, $F=2.95$, $p=0.09$; and Basque, $F=0.01$, $p=0.94$) and offline (Spanish, $F=2.53$, $p=0.11$; English, $F=0.74$, $p=0.39$; and Basque, $F=1.39$, $p=0.24$) semantic tasks. In creativity, significant differences were observed between groups on the RAT ($F=9.58$, $p=0.003$),

while no differences were observed in the performance of any of the three dimensions of the UU (Originality, $F=0.44$, $p=0.51$; Flexibility, $F=0.42$, $p=0.51$; Fluency, $F=0.69$, $p=0.41$). In the SCWT, statistically significant differences were only observed in the colour-word part ($F=7.60$, $p=0.008$) during the online assessment, showing a better performance of the participants under the tRNS condition compare to the sham condition.

Conclusions: The results obtained in this study suggest that the excitatory effects of tRNS over the L-DLPFC L-IFG could contribute to the improvement of phonemic verbal fluency and verbal convergent thinking, in healthy individuals.

Categories: Neurostimulation/Neuromodulation

Keyword 1: neurostimulation

Keyword 2: learning

Keyword 3: language: second/foreign

71 Treatment with TMS Improves Aspects of Attention in Depression: A Pilot Study

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Objective: Repetitive transcranial magnetic stimulation (TMS) is an evidenced based treatment for adults with treatment resistant depression (TRD). The standard clinical protocol for TMS is to stimulate the left dorsolateral prefrontal cortex (DLPFC). Although the DLPFC is a defining region in the cognitive control network of the brain and implicated in executive functions such as attention and working memory, we lack knowledge about whether TMS improves cognitive function independent of depression symptoms. This exploratory analysis sought to address this gap in knowledge by assessing changes in attention before and after completion of a standard treatment with TMS in Veterans with TRD.

Participants and Methods: Participants consisted of 7 Veterans (14.3% female; age $M = 46.14$, $SD = 7.15$; years education $M = 16.86$, $SD = 3.02$) who completed a full 30-session course of TMS treatment and had significant depressive symptoms at baseline (Patient Health Questionnaire-9; PHQ-9 score >5). Participants were given neurocognitive assessments measuring aspects of attention [Wechsler Adult Intelligence Scale 4th Edition (WAIS-IV) subtests: Digits Forward, Digits Backward, and Number Sequencing] at baseline and again after completion of TMS treatment. The relationship between pre and post scores were examined using paired-samples t-test for continuous variables and a linear regression to covary for depression and posttraumatic stress disorder (PTSD), which is often comorbid with depression in Veteran populations.

Results: There was a significant improvement in Digit Span Forward ($p=.01$, $d=-.53$), but not Digit Span Backward ($p=.06$) and Number Sequencing ($p=.54$) post-TMS treatment. Depression severity was not a significant predictor of performance on Digit Span Forward ($f(1,5)=.29$, $p=.61$) after TMS treatment. PTSD severity was also not a significant predictor of performance on Digit Span Forward ($f(1,5)=1.31$, $p=.32$).

Conclusions: Findings suggested that a standard course of TMS improves less demanding measures of working memory after a full course of TMS, but possibly not the more demanding aspects of working memory. This improvement in cognitive function was independent of improvements in depression and PTSD symptoms. Further investigation in a larger sample and with direct neuroimaging measures of cognitive function is warranted.

Categories: Neurostimulation/Neuromodulation

Keyword 1: attention

Keyword 2: depression

Keyword 3: neurostimulation

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72 Cognitive Training Paired with Bifrontal tDCS Decreases Depressive Symptoms in a Non-Clinical Sample of Older Adults: Preliminary Evidence

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Objective: Subthreshold depressive symptoms are both prevalent and associated with negative outcomes in older adults, including conversion to major depressive disorder and other medical conditions. Antidepressants are not recommended as first-line or sole intervention for subthreshold depression; thus, finding other efficacious interventions is important. In depressed adults, transcranial direct current stimulation (tDCS) applied to the frontal lobe has antidepressant properties and pairing tDCS with cognitive training results in additional benefit due to enhancement of frontal cortical activity. However, these studies have primarily targeted depressed adults under age 65 years and less is known about whether this intervention combination is beneficial or affects subthreshold depressive symptoms in older adults.

Participants and Methods: We are reporting secondary data analyses from Nissim et al. (2019), who recruited 30 non-demented healthy older adults and randomized them to receive active or sham tDCS in combination with cognitive training for 2 weeks. Active tDCS was delivered bifrontally over F3 (cathode) and F4 (anode) for 20-min at 2 mA intensity through two 5x7 cm² saline saturated sponge electrodes using the Soterix Medical 1x1 tDCS clinical trials device. Sham tDCS had identical set-up with 2 mA stimulation for 30-sec with 30-sec ramp up and down. Cognitive training was administered