

## **The Effect of Transcranial Alternating Current Stimulation on Novel Word Acquisition: Paradigm Development**

Novel word acquisition is a crucial part of both first language acquisition and foreign language learning. On the neural level, novel word acquisition involves frontal and temporal activations (Bakker-Marshall et al. 2018). However, less is known of how these regions interact on the neurophysiological level and how different types of neural oscillations support the functional linkage between brain regions involved in novel word acquisition.

The neural bases of novel word acquisition have primarily been investigated via neuroimaging methods (Bakker-Marshall et al. 2018), which can reveal correlational but not causal links between neural and behavioral processes. On the other hand, neurostimulation methods allow to directly modulate neural activity. Among them, transcranial altering current stimulation (tACS) allows to enhance neural oscillations at a target frequency. Only few reports have investigated the effect of tACS on novel word acquisition (Ambrus et al. 2015; Antonenko et al. 2016). This paper aims to do so and specifically to investigate the role of theta-band neural oscillations in the left frontotemporal network in novel word acquisition. This will be one of the pioneer studies on the modulatory effect of tACS applied to novel word acquisition.

We have designed an experiment with application of tACS in human participants and developed an explicit word learning paradigm. We have prepared stimuli lists of 80 pseudowords (PW) based on one of our previous studies. We have also selected 80 semantically unrelated Russian nouns as translations of PW from a database containing normative data for different psycholinguistic parameters (Akinina et al. 2014). Firstly, we have developed an acquisition phase, during which participants learn novel words. The acquisition phase includes a passive acquisition task, a three-alternative-forced choice task and a recall task. Secondly, we have developed a testing phase to check how successfully participants acquired novel words. The testing phase includes recognition, recall and semantic decision tasks. During tACS experiment, there will be two acquisition phases, separated by a 4-day interval. During each of them, tACS in the theta-range frequency or sham (placebo) stimulation will be applied. To test the effect of tACS, there will be an immediate testing phase after each acquisition phase, as well as a delayed testing phase four days after each acquisition phase.

Due to COVID-19, we have not yet collected tACS data but we have validated the word learning paradigm (both acquisition and testing phases) online. In the testing phase, participants performed well in recognition (accuracy:  $M=71\%$ ,  $SD=15.27\%$ ) and semantic decision (accuracy:  $M=74.5\%$ ,  $SD=10.2\%$ ), but not in the recall task (accuracy:  $M=16.75\%$ ,  $SD=12.86\%$ ). Thus, the paradigm provides a variety of task difficulty levels, with no floor or ceiling effects, and should be sensitive to tACS-related improvement of performance. The only change we made to the paradigm based on online validation was to extend the response time in the recall task to 10 seconds. The paradigm has proven suitable for the planned tACS experiment and also can be adapted for other studies on novel word acquisition.

### **References**

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