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WITHDRAWAL SYMPTOMS OF ELECTRICAL BRAIN STIMULATION IN A PROBABILISTIC DECISION MAKING TASK

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Introduction

It has been shown that transcranial direct current stimulation (tDCS) can improve many aspects of cognition, including decision making and learning[1]. However, it has not been studied whether the brain is capable of adapting itself to perform at least equally well without tDCS, after initially learning the task under the influence of tDCS. A probabilistic learning task was used to investigate this question.

Methods

Participants took part in three groups of Active-Active (n = 17), Active-Sham (n = 16) and Sham-Sham (n = 15) transcranial direct current stimulation (tDCS) (**Figure 1**). Each participant attended two experimental sessions. In both sessions participants were asked to perform a probabilistic decision making task. In this task participants adapted to changes in reward contingencies. Participants were presented with two options with one of them being designated as the better choice, leading to higher probability of rewarding than punishing feedback (**Figure 2**). Participants were asked to maximise their gain by choosing the better option. The contingencies changed over the course of the trials. Consequently, participants had to adjust to the changes in the environment. Participants received 15 minutes or 16 seconds of anodal tDCS over the left dorsolateral prefrontal cortex for Active and Sham stimulation conditions, respectively.

Results

Independent sample t-tests showed no significant differences between performance in the 1st session of different groups[2]. More importantly, comparison of performance in the sessions of different groups showed a significant difference for the Active-Sham condition, showing an impairment in Session 2 (**Figure 3**). Further analysis showed that participants in the 2nd session of Active-Sham group changed their decision more often[3] (**Figure 4**).

Conclusions

- This result shows that learning under the influence of TES leads to adaptation, which induces changes that might not be efficient without tDCS in a later session.
- In more general terms, this result indicates that learning a task under the influence of tDCS leads to creation of a model which may no longer be valid without tDCS.

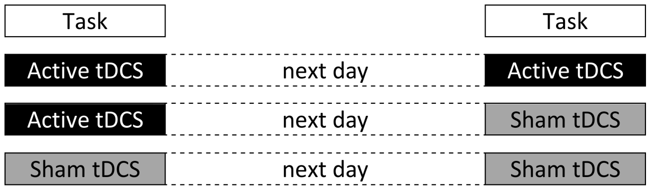

Figure 1. Procedure of the study.

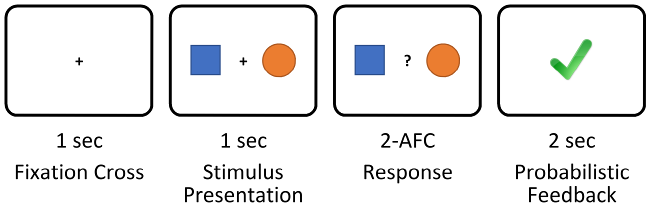

Figure 2. Procedure of the task. Probabilistic feedback was given with 70% and 40% chance of positive feedback after correct and wrong responses, respectively. AFC: alternative forced choice.

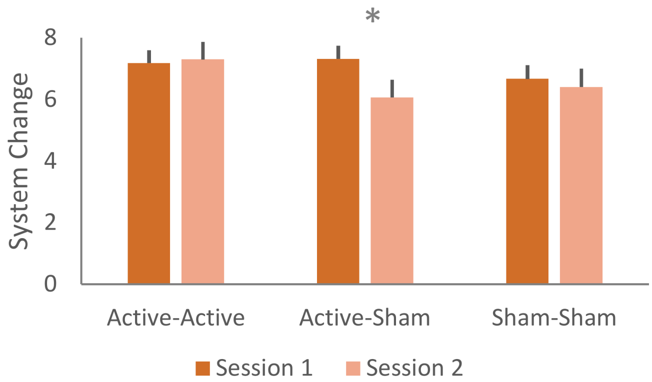

Figure 3. Comparison of the performance between groups. * $p = 0.028$

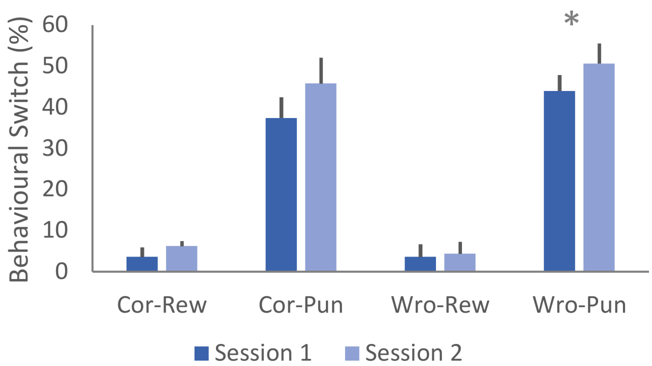

Figure 4. Percentage of behavioural switch for the Active-Sham group for combination of choice (correct/wrong) and feedback (rewarded/punished). * bootstrap paired t-test $p = 0.019$

Acknowledgement

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References

1 Hecht D, et al. (2010) *Journal of Neuroscience.*
2 Smittenaar P, et al. (2014) *PloS one.*
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