KATHOLIEKE UNIVERSITEIT LEUVEN

Faculty of Kinesiology and Rehabilitation Sciences

BIOMEDICAL KINESIOLOGY

Does non-invasive brain stimulation over the primary motor cortex improve consolidation of motor memories?

L. Pauwels, E. Bekkers, O. Rroji and N. Wenderoth

INTRODUCTION

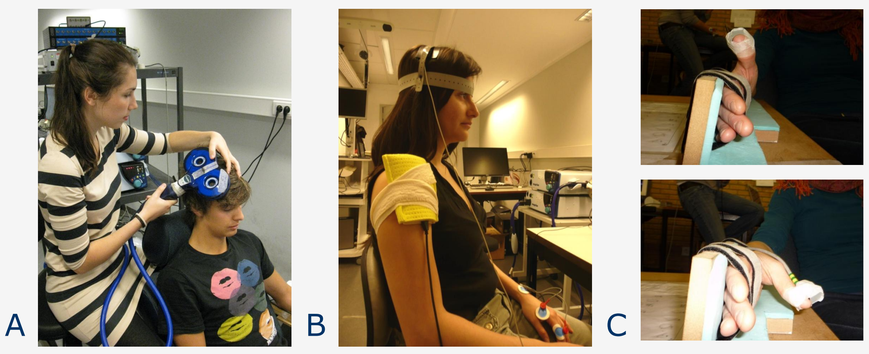
Anodal transcranial Direct Current Stimulation (tDCS) is a non-invasive, painless cortical stimulation technique that is well tolerated by healthy subjects and patients. Recent studies have demonstrated that non-invasive brain stimulation enhances memory formation and cortical plasticity for learning a variety of new motor skills.

Here we tested whether tDCS affects use-dependent plasticity, reflecting increases in motor efficiency due to practice rather than acquiring a new skill. Therefore, either anodal or sham tDCS was applied during a single training session of practicing ballistic thumb movements. Retention was quantified 30 min after training, at the next day and one week later.

HYPOTHESIS

- tDCS over the primary motor cortex improves consolidation of motor memories formed due to intensive practice.

MATERIALS & METHODS



n=12 (age 18-30, 5 female, 4 left-handed)

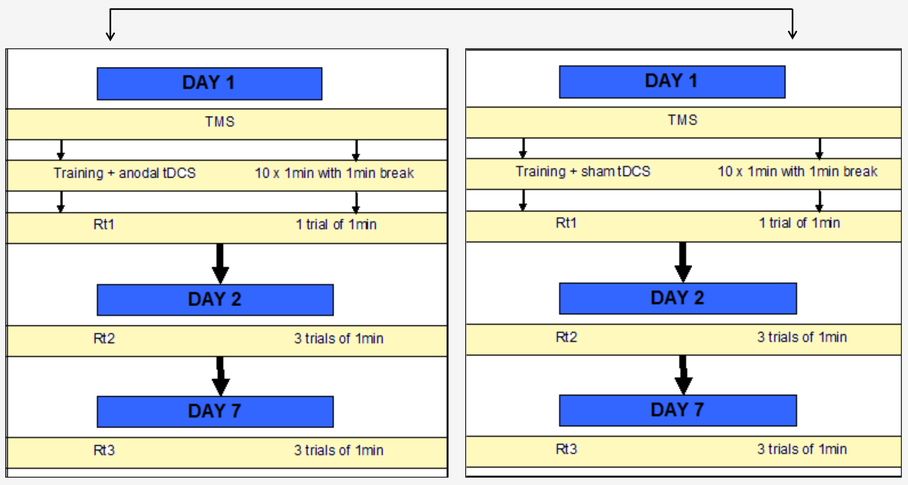
A – Transcranial Magnetic Stimulation (TMS) was used to determine the hotspot and to measure cortical excitability.

B – tDCS was applied for 20 min with an intensity of 1mA during a single training session.

C – 3D kinematic Fastrak sensor was used to measure ballistic thumb movement. One trial consisted of 20 movements.

D – Subjects were able to see their own performance and improvements.

CROSS-OVER DESIGN



RESULTS

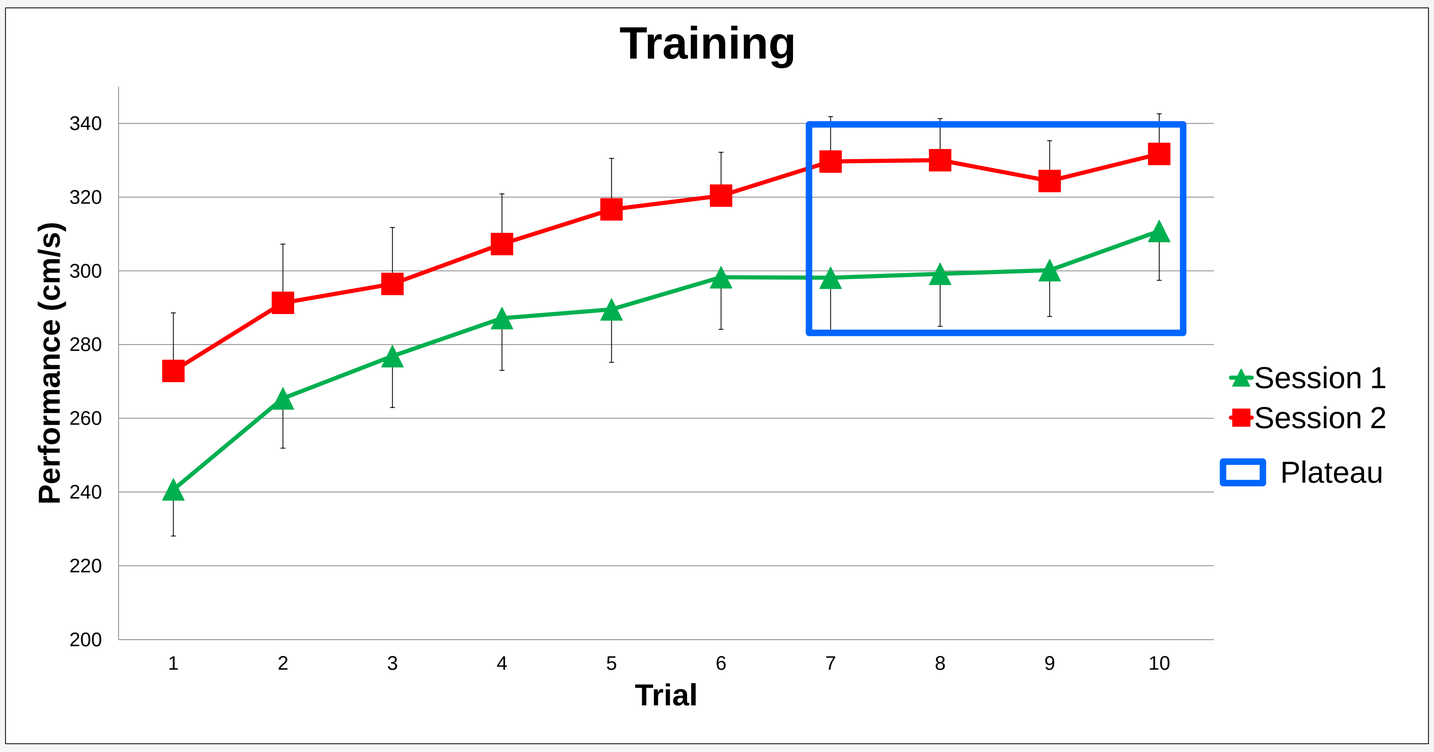


Fig. 1 Training
This figure shows mean performance (velocity in cm/s) of all subjects during the first training session compared with the means of the second session. Performance reached a plateau starting from trial 7.
Statistical analysis were performed using ANOVA. We found a trend towards significance for "session effect" (p=0.054) and a highly significant "trial effect" (p<0.001). No sessionxtrial effect was found (F(9,99)=0.5234; p=0.854).

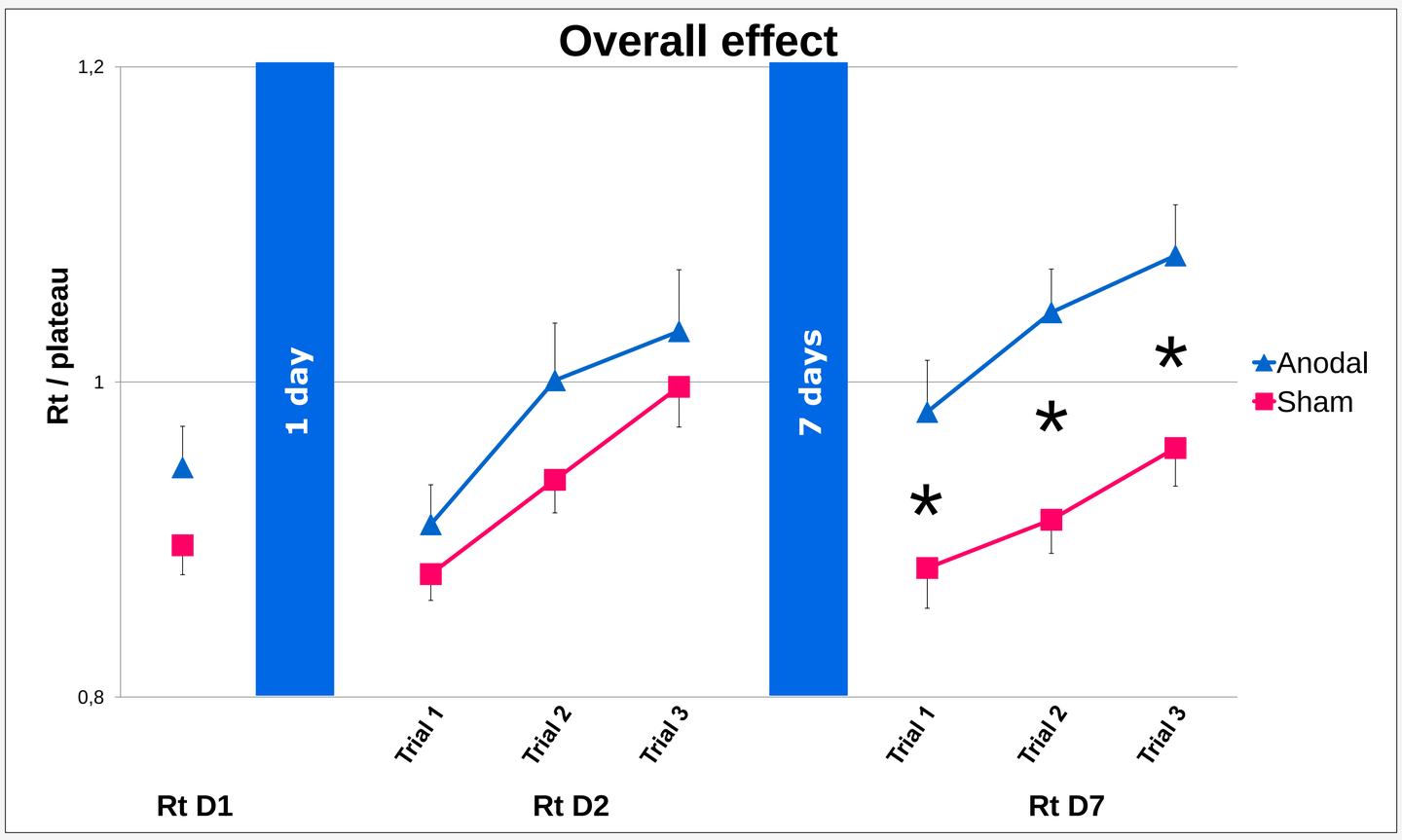


Fig. 2
The normalized data shown are calculated by deviding the performance during the retention tests by the averaged plateau performance (=last 4 training trials of the corresponding session). Statistical analysis were performed using ANOVA. A significant "stimulation x time effect " was found by using a Tukey post-hoc test (F(6,60)=3.34; p= 0.007).

*p<0.05

CONCLUSIONS

- **Our data show for the first time that tDCS has a positive effect on use-dependent plasticity.**
- **tDCS did not affect training performance per se but rather memory consolidation. Its beneficial effect seems to be enhanced when the motor memory is repeatedly reactivated even if reactivation occurs one day after the tDCS intervention.**
- **Our results might have important implications for increasing the efficiency of motor practice in healthy subjects and rehabilitation settings.**