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"A meeting of minds"

ACADEMIC ORGANISERS: VINCE WALSH, CHARLOTTE STAGG & SVEN BESTMANN

Figures

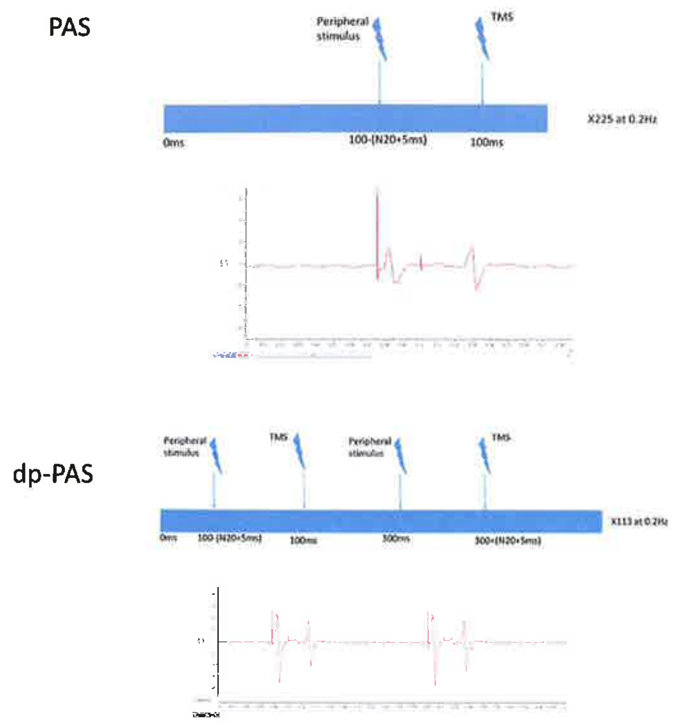

Figure 1. A comparison of PAS25 and dp-PAS25. In both protocols, the peripheral stimulus can be seen to precede the TMS pulse. Both pulses evoke a response, which can be seen from the traces above. The sharp vertical deflections are the corresponding artefacts of the electrical and magnetic stimulators. The first waveform is the muscle response to the electrical stimulation, and the second is the response to the TMS: the MEP. Note that there is a 200ms delay between the end of the first paired stimuli and the second paired stimuli in dp-PAS. Also, each frame in PAS is repeated 225 times, but only 113 times in dp-PAS to keep the number of delivered stimuli the same. Furthermore, the frequency of stimulation between frames is kept at 0.2Hz. (one set every 4.5-5 seconds)

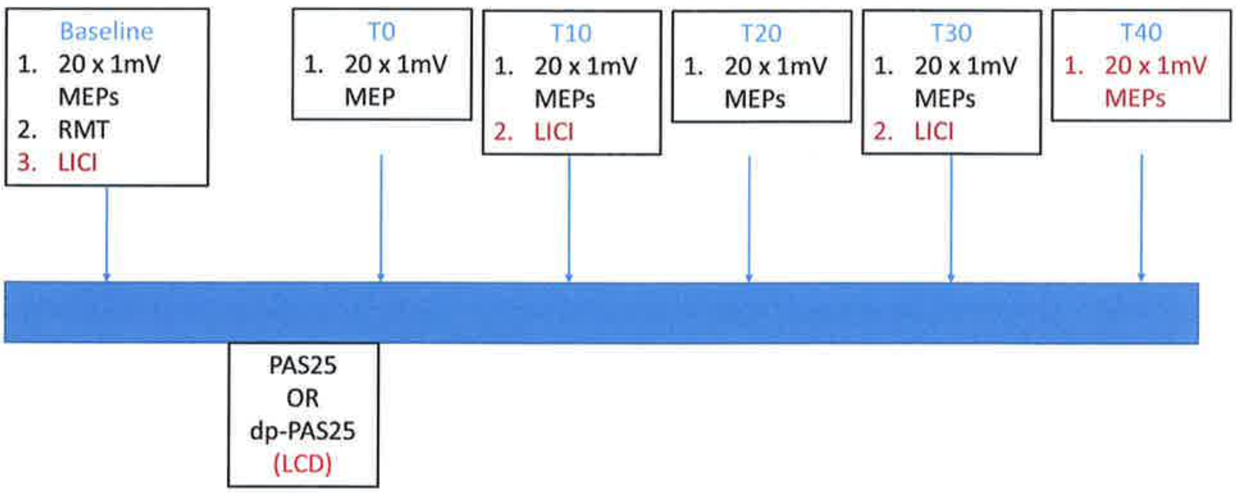

Figure 2. A summary of the dp-PAS25 and PAS25 protocols. All experimental parameters in black were calculated in both PAS protocols. Those in red were measured only for dp-Pas25.

13. Frank Zhu[1,2], Andrew Yung[1,3], Jamie Poolton[1], Gordon Cheng[3], Tatia Lee[3] & Rich Masters[1]

Suppressing verbal working memory with cathodal tDCS over left dorsolateral prefrontal cortex to promote implicit motor learning.

1. Institute of Human Performance, The University of Hong Kong, Hong Kong SAR, China
2. Department of Surgery, The University of Hong Kong, Hong Kong SAR, China
3. Department of Psychology, The University of Hong Kong, Hong Kong SAR, China

Introduction

Compared to explicit motor learning, implicit motor learning have been shown to produce performance that is more stable in conditions of psychological stress, multitasking and even physiological fatigue. Therefore, researchers have deliberately attempted to devise implicit motor learning paradigms to suppress contributions from verbal-analytical explicit processes in the learning and performance of motor tasks.

Transcranial direct current stimulation (tDCS) is widely used as a noninvasive brain stimulation technique to modulate the cortical excitability. Previous research has shown that tDCS over left dorsolateral prefrontal cortex (DLPFC) can be used to modulate working memory. We hypothesized that simultaneous cathodal (inhibitory) tDCS over left DLPFC during motor learning would suppress verbal working memory, therefore, to promote motor learning in an implicit direction.

Methods

In this single blinded tDCS study, novices practiced a golf putting task with either Real (N=14) or Sham (N=13) cathodal tDCS over left DLPFC during the training phase on Day 1. At least 24 hours later, all participants returned for the test phase on Day 2, including two retention conditions with a dual-task condition in between, under which participants were required to concurrently count number of both high and low pitch tones randomly generated by a computer. Verbal working memory capacity was measured by the counting recall task from the Automated Working Memory Assessment (AWMA) immediately before and after the training phase with tDCS on Day 1, and before the test phase without tDCS on Day 2.

Results

Participants displayed higher verbal working memory score before the test phase on Day 2 than that before the training phase on Day 1, see Fig.1. Further analysis revealed that participants in the Sham stimulation group displayed higher verbal working memory score immediately after the training phase on Day 1, but no more increase was found before the test phase on Day 2. In contrast, participants in the Real stimulation group displayed higher verbal working memory score before the test phase on Day 2, but not immediately after the training phase on Day 1.

The number of successful putts increased across the training blocks, and participants in the Real stimulation group performed better than the Sham stimulation group during both training and test phases, see Fig.2. Furthermore, participants in the Real stimulation group had more successful putts than the Sham stimulation group under dual-task condition, but not under retention conditions.

Conclusions

Cathodal tDCS over the left dorsolateral prefrontal cortex (DLPFC) suppressed verbal working memory and facilitated motor performance during both training and test phases, particularly under dual-task condition. The characteristics suggest that cathodal tDCS over left DLPFC online during training may be an effective method for learning motor skills implicitly.

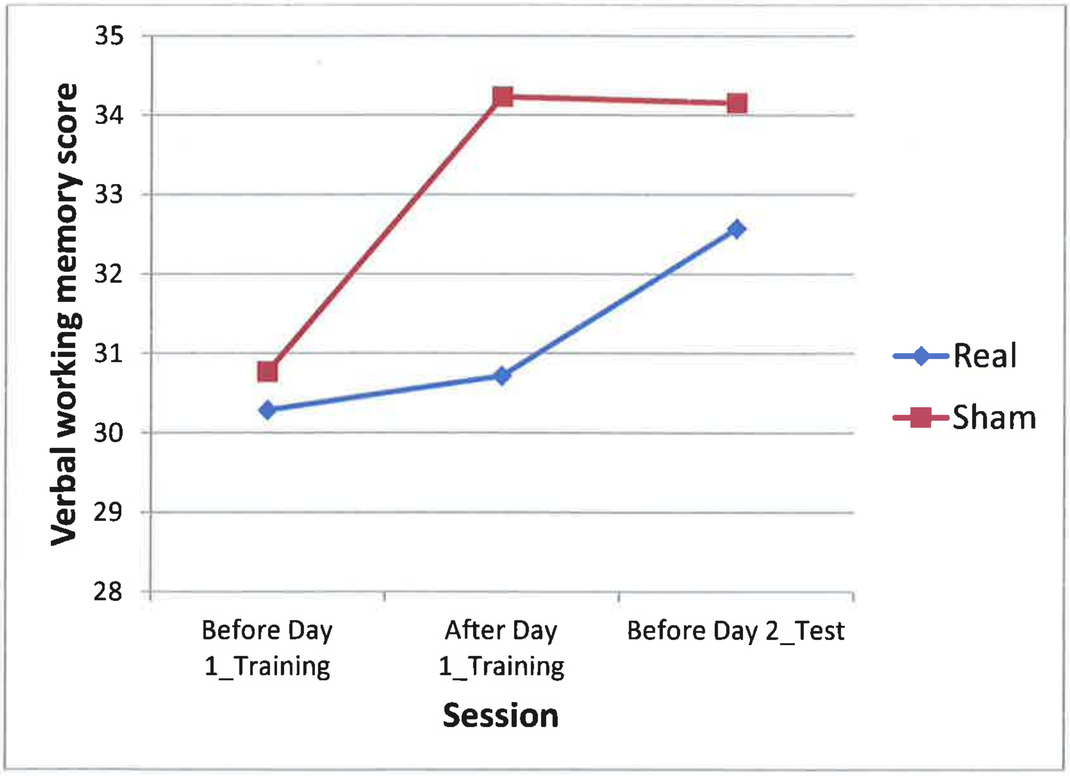

Fig.1 Verbal working memory score immediately before and after training phase with tDCS on Day 1, and before test phase without tDCS on Day 2.

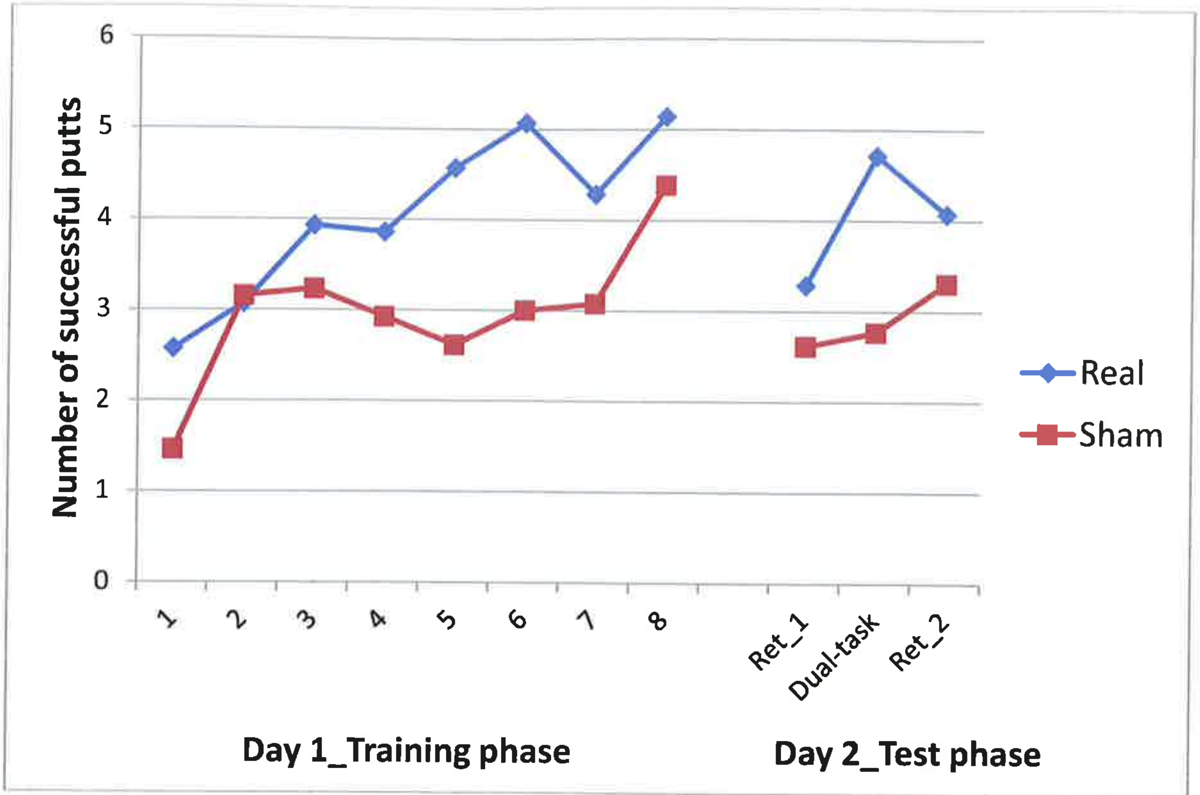

Fig.2 Mean number of successful putts made during training and test phases.

14. Muthalib M[a], Dutta A[b], Besson P[a], Rothwell J[c], Ward T[d], Perrey S[a]

Comparison of online *vs* offline effects of HD-tDCS induced modulation of cortical sensorimotor networks using a combined fNIRS-EEG setup

[a]Movement To Health (M2H) Laboratory, EUROMOV, Montpellier-1 University, Montpellier, France
[b]DEMAR team, Institut National de recherche en Informatique etAutomatique, Montpellier, France
[c]Sobell Department of Motor Neuroscience and Movement Disorders, University College London, London, United Kingdom
[d]Department of Electronic Engineering, National University of Ireland, Maynooth
Ireland

Introduction

Transcranial direct current stimulation (tDCS) is a non-invasive electrical brain stimulation technique that is shown to modulate cortical excitability and behavioural responses (1). Although high-definition (HD)-tDCS targeting the primary sensorimotor cortex (SMC) can produce comparable “offline” excitability changes to conventional tDCS in a polarity specific manner (2), it is not clear how HD-tDCS modulation modifies “online” activity within the modulated cortical sensorimotor network at rest and during a motor task. Therefore, we used a HD-tDCS-neuroimaging (electrophysiological-EEG) and hemodynamic-fNIRS) platform for measuring the bilateral cortical sensorimotor network activation of a healthy subject at rest and during a simple finger sequence task in order to compare the “online” and “offline” effects of anodal HD-tDCS targeting the SMC.

Methods

Design: 10 min before (pre), at 10 min during (online), and 3min after (offline) anodal HD-tDCS of the SMC, the subject performed a self initiated simple finger sequence task with their right and left hand in an alternating blocked design (30-s task and 30-s rest, repeated 5 times).