Visuomotor adaptation and the effects of cerebellar TBS

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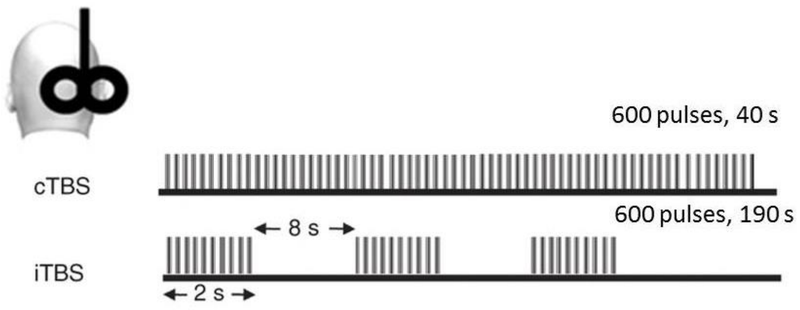
Introduction

Accurate and smooth motor performance requires the development, maintenance, and flexible adjustment of an appropriate internal model, a process called motor adaptation. This process is a form of motor learning that restores accuracy when systematic motor errors are encountered. Previous studies point to a critical role for the cerebellum in motor adaptation[1]. Non-invasive brain stimulations techniques (TES, TMS) have been successfully used for modulating the motor performance[1,2,3]. So, we decided to investigate the effects of cerebellar theta burst stimulation (TBS) on visuomotor adaptation performance.

Methods

In total, we report the results of 36 healthy right-handed subjects (19 females, mean age: 26.2±2.7 years old; 17 males, mean age: 25.1±2.3 years old). Participants were assigned randomly to one of the three stimulation conditions: cTBS, iTBS or sham. Subjects were tested with a visuo-motor adaptation task, VAT[2,3].

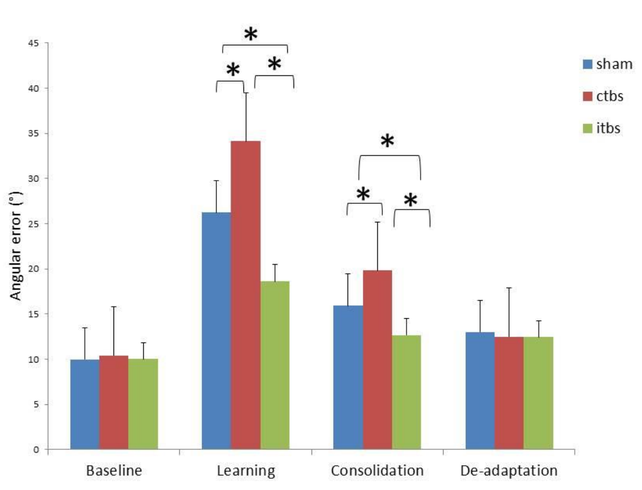


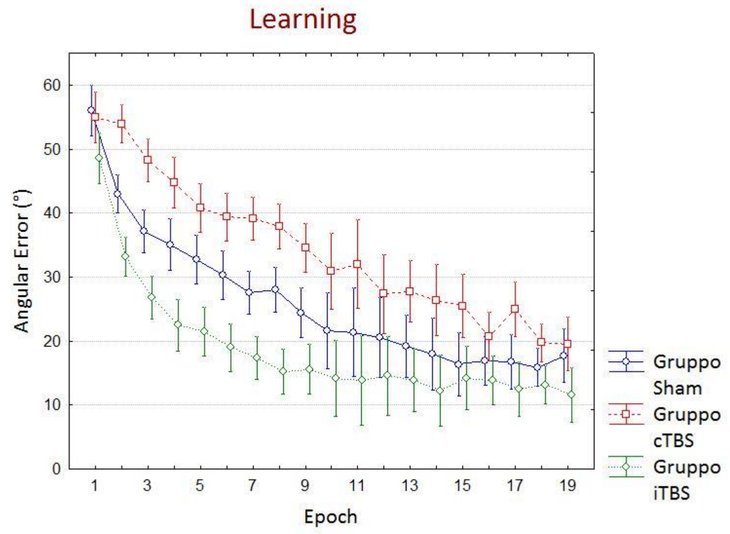
Experimental design

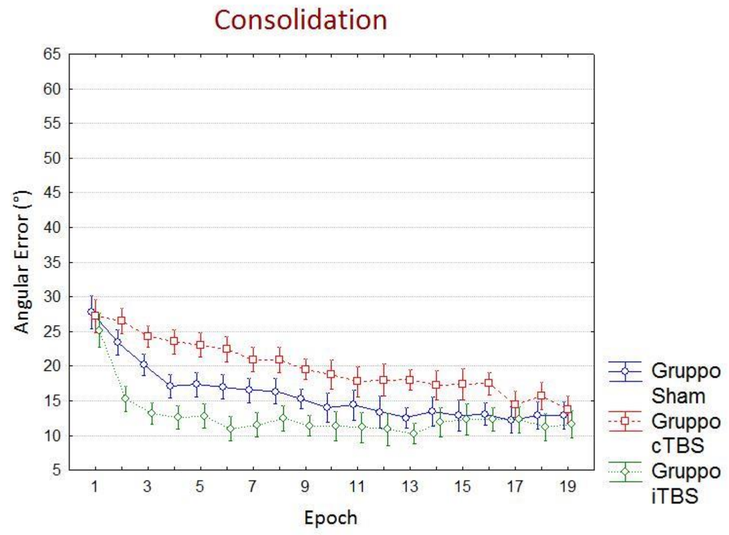
Visuomotor Adaptation Task VAT					
Baseline		Learning		Consolidation	De-adaptation
48 trials 0° deviation	cTBS/iTBS/ Sham	152 trials -60° deviation	Break 45'	152 trials -60° deviation	152 trials -60° deviation

Results

No differences were found in the baseline condition between the three stimulation groups ($p>0.05$). The performance at the learning session was significantly different among the three stimulation condition (Stimulation Group effect: $F(2,33)= 31.02$, $p<.00001$; Epoch effect: $F(18,594)= 98.73$ $p<.0001$; Interaction effect: $F(36,594)=3.03$ $p<.00001$). In particular iTBS reduced, while cTBS increased the mean angular error. These modulations persisted during the consolidation phase (Stimulation group effect: $F(2,33)=39.12$ $p<.00001$; Epoch effect : $F(18,594)=61.74$ $p<.0001$: Interaction effect: $F(36,594)=5.08$ $p<.0001$). No significant changes were detected for the de-adaptation phase.







Conclusion

These findings provide more evidence supporting the opposite modulations of TBS on motor adaptation:

- intermittent TBS increased the ability to adapt to the angular perturbation
- continuous TBS inhibited the ability to adapt to the angular perturbation

This study provides novel evidence suggesting that the cerebellum is involved in visuomotor learning and that cerebellar stimulation could have potential benefit in treating patients with stroke or dementia.

References

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