SAPIENZA UNIVERSITÀ DI ROMA

THE ROLE OF CEREBELLUM IN SUB-SECOND TIMING PROCESSING: A CONTINGENT NEGATIVE VARIATION STUDY

XXVIII Congresso della Società Italiana di Psicofisiologia e Neuroscienze Cognitive
REAL BRAINS IN THE VIRTUAL SIPF ANNUAL MEETING

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Background: Time management is an important aspect of human behaviour and cognition. In recent years, functional imaging studies have tried to identify the neural correlates of several timing functions, ranging from simple motor tapping to higher cognitive time estimation functions. Several brain regions, such as dorsolateral prefrontal cortex, anterior cingulate gyrus, the supplementary motor area and the inferior parietal lobes, are thought to be involved in tasks of motor timing and time estimation. However, also subcortical regions such as the basal ganglia and the cerebellum seem to play a role in timing control.

Aim: to explore the role of the cerebellum in the timing control, we transitorily inhibited cerebellar activity by means of cathodal tDCS and studied the effects on ERP components elicited during a S1-S2 motor task in healthy subjects.

Methods:

Subjects: Sixteen healthy subjects (7 male, 9 female; mean age 25±0.8 yrs; range 24-27 years)

Procedure: S1-S2 task prior and after cathodal/sham cerebellar tDCS in separate sessions.

Cathodal session: intensity of stimulation: 2 mA delivered for 20 min.

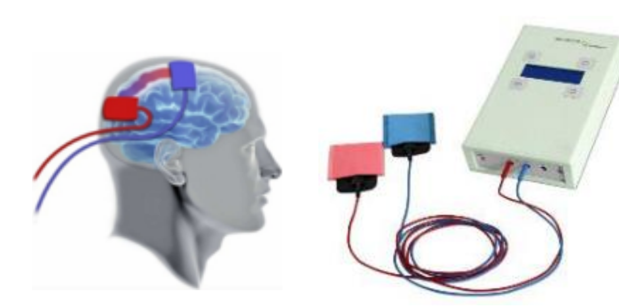
Sham session: pseudo stimulation:110uA over 15 ms every 550 ms.

S1-S2 motor task: duration discrimination task with a matching-to-sample procedure: subjects were asked to judge whether the duration of a probe interval trial was shorter (Short ISI trial: 800ms), longer (Long ISI trial: 1600ms), or equal to the Target interval of 1200ms represented into the base trial.

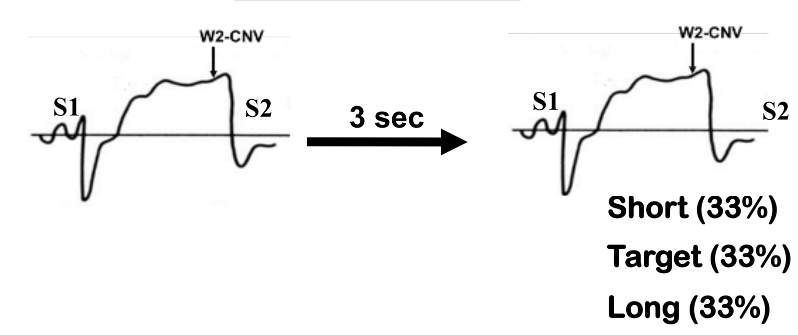
ERPs outcome: total-CNV and W2-CNV areas.

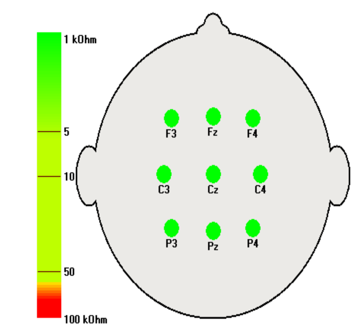
Performance measures: mean reaction times (RTs) of correct responses; absolute number of errors.

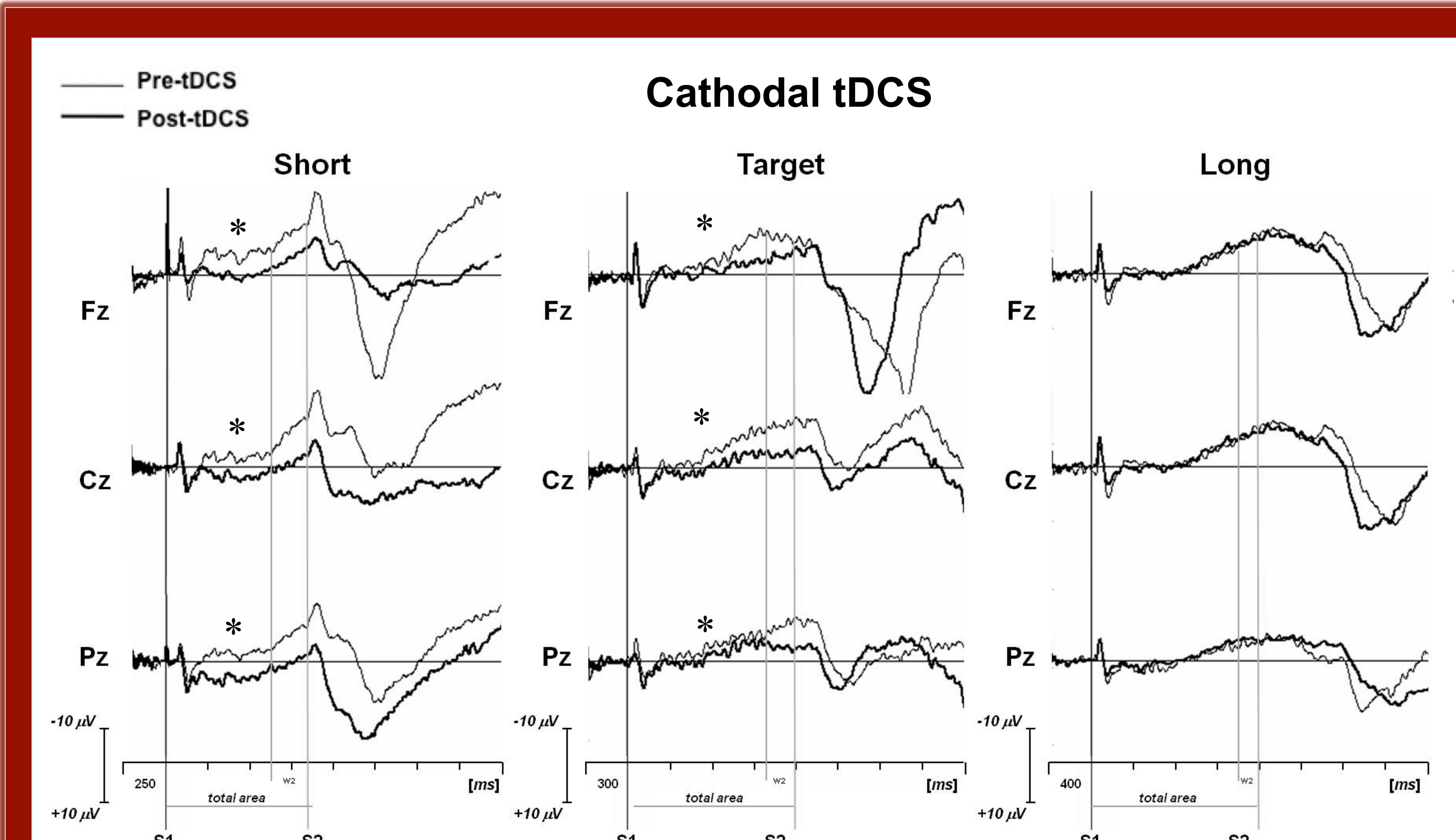
Analyses: CNV parameters for each interval (short, target, long) were analyzed separately by rmANOVA with the experimental “condition” (cathodal, sham), the “electrode” (Fz, Cz, Pz), and the “timing” (pre-tDCS and post-tDCS) as the within-subject factors. Performance measures were analyzed separately by means of rmANOVA, with the experimental “condition” (cathodal, sham) and the “timing” (pre-tDCS and post-tDCS) as the within-subject factors.



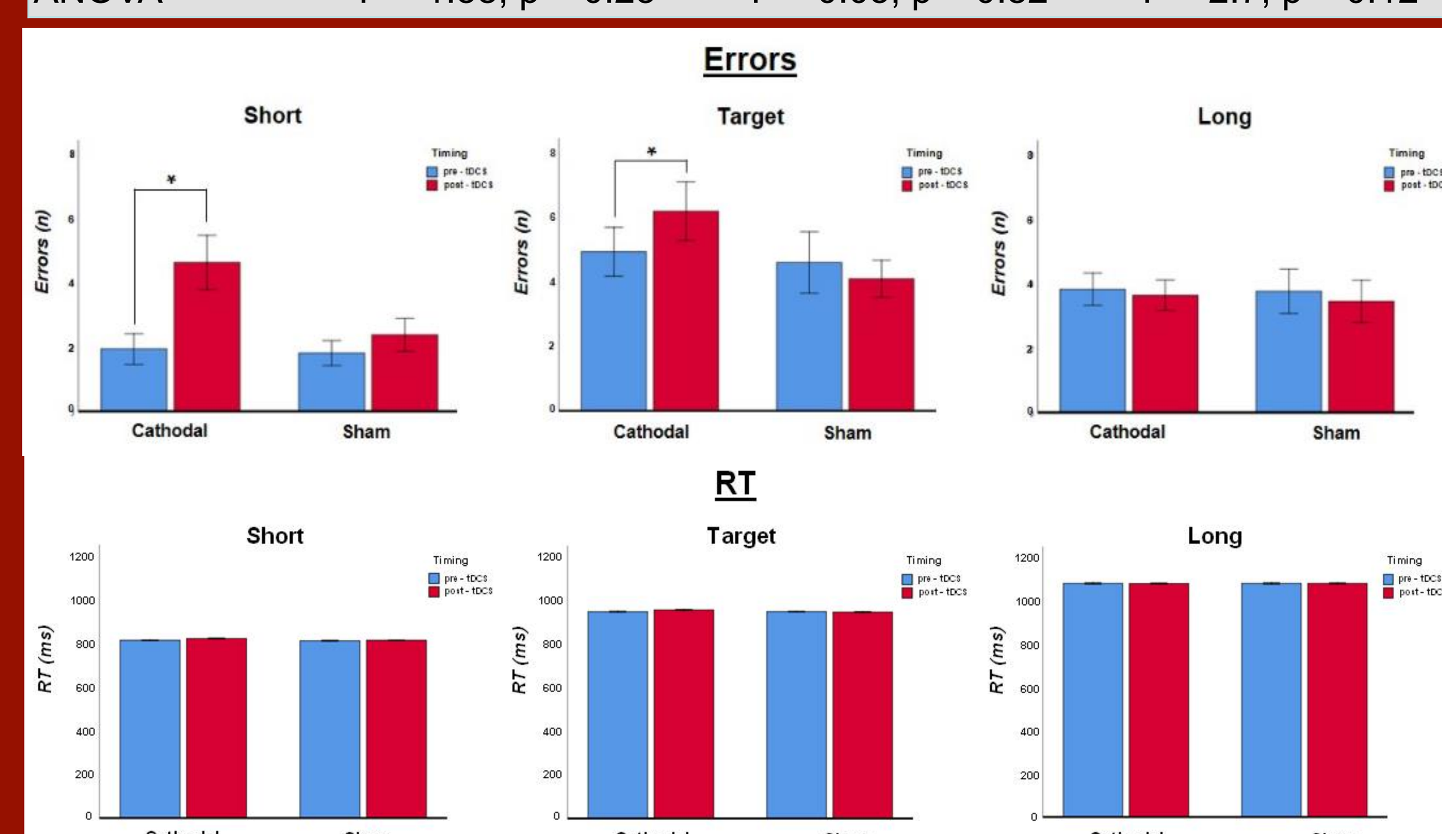
“S1-S2” Task

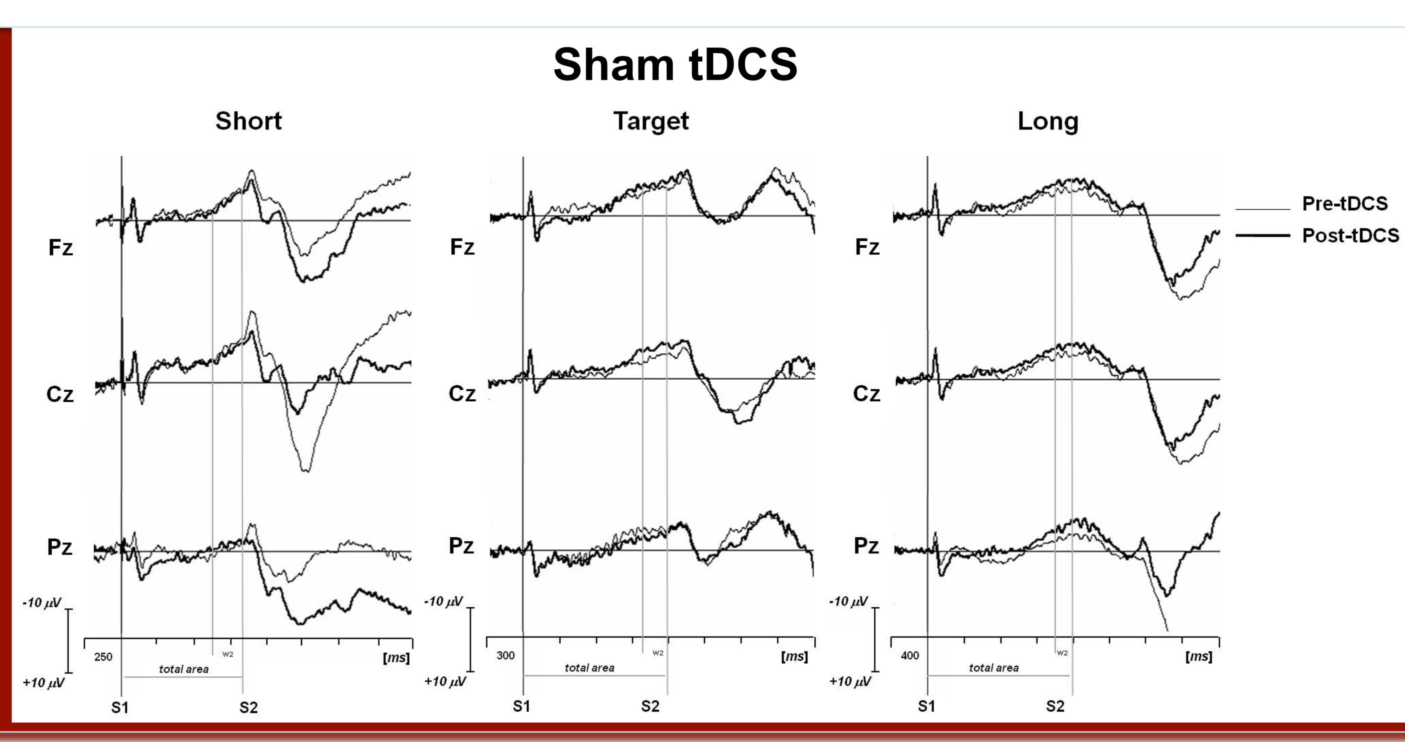






	Attention		Fatigue		Pain	
	Pre-tDCS	Post-tDCS	Pre-tDCS	Post-tDCS	Pre-tDCS	Post-tDCS
Cathodal	9.2±0.9	9.0±1.0	8.9±1.1	8.8±1.0	9.3±1.0	9.2±1.0
Sham	9.1±1.1	9.0±1.0	8.8±1.0	8.7±1.2	9.6±0.9	9.5±0.9
ANOVA	F = 1.58; p = 0.23		F = 0.05; p = 0.82		F = 2.7; p = 0.12	



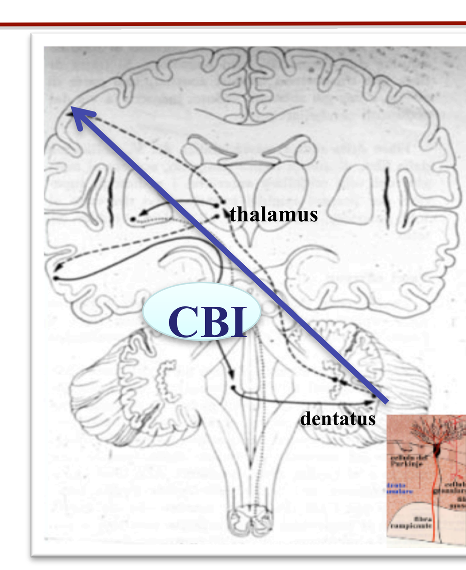


Cathodal tDCS for short and target interval

⬇ **Total-CNV Amp**
W2-CNV Amp

⬆ **Errors**

Discussion: These data indicate that cerebellar inhibition following cathodal stimulation selectively reduced the available attentional resources to make adequate time estimations for second or sub-second interval timing, while the supra-second timing control was not altered. We argue that the cerebellum is specifically involved in the management of short time intervals mostly related to automatic or involuntary cognitive processes, while the timing control of longer intervals mainly requires the activation of associative cortical brain areas.



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