

TMS-evoked Potentials during finger movements and at rest

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Introduction

TMS-EEG coregistration allows to record the spread of neural activation from the stimulated area to connected regions [1]. In a previous work, we have shown that TMS on motor cortex generates an early latency positive component that reflects transcallosal signal inhibition [2]. Here, we investigate the evolution of signal propagation, focusing on the following component, i.e. P50, a positive component occurring around 40-60 ms in the hemisphere ipsilateral to stimulation. P50 has been associated with sensory feedback from the activated muscle [3,4] Alternatively, P50 could represent a feedback signal from the contralateral hemisphere to the stimulated hemisphere.

We have tested these two alternative hypotheses by looking at the effect of task execution on the amplitude of P50 and on the relation between P50 and DTI measures of microstructural integrity of the Corpus Callosum.

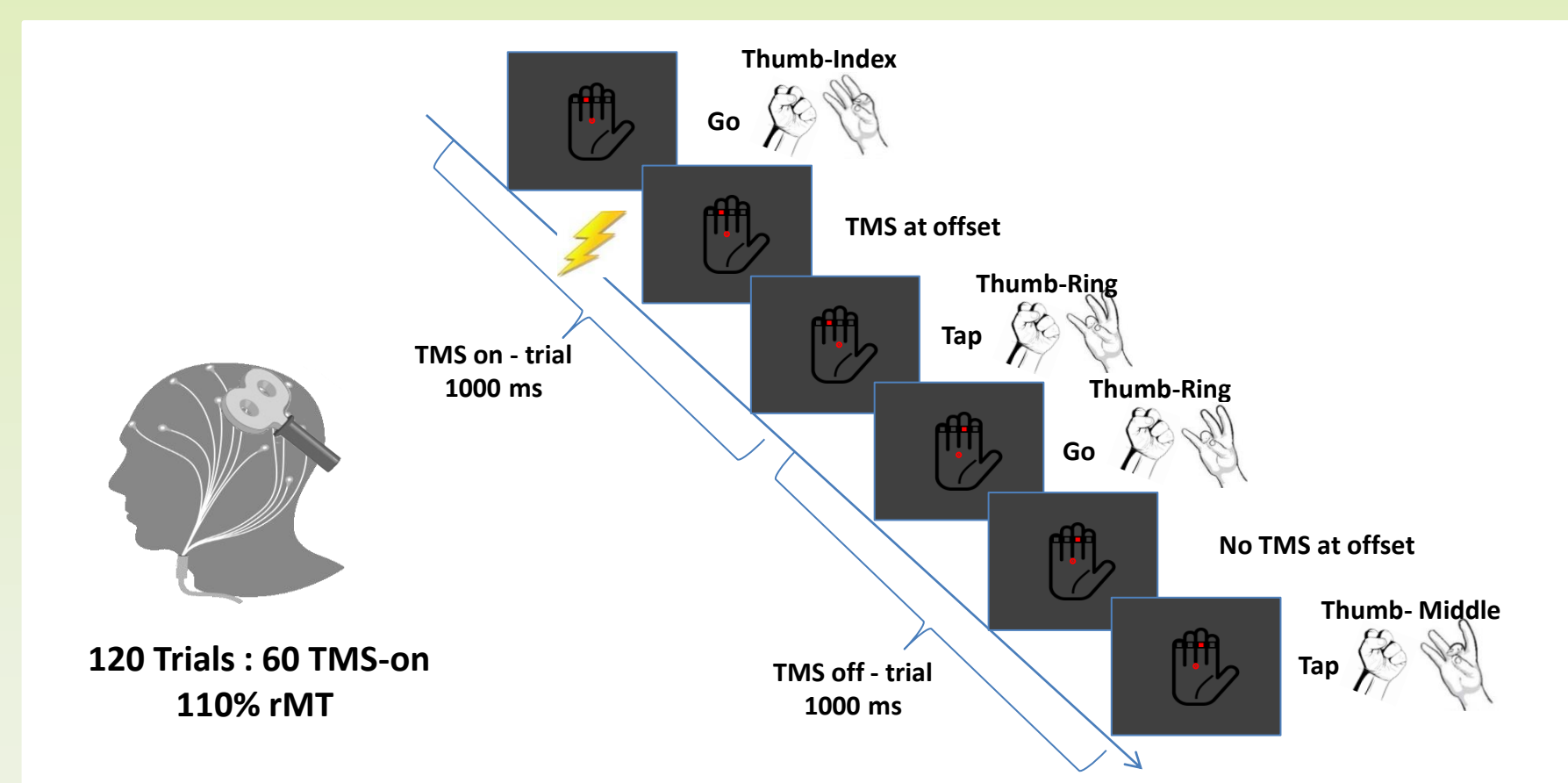
Methods

Subjects: 20 right-handed healthy volunteers

TMS-evoked potentials (TEPs) recorded while ipsilateral hand was contracted and contralateral hand was either at rest (NoTask) or performed a reaction time task (Task)

Two target sites in each hemisphere:

- Primary motor cortex (M1)
- Dorsal premotor cortex (PMC).



DTI of the CC body:
Mean Diffusivity - MD



Statistics: A cluster-based permutation approach was employed to compare M1 vs PMC conditions, and Task vs NoTask conditions [5]. Correlations were run between MD and P50 amplitude.

Results

1) **M1 vs PMC:** Around 40-60 ms, there is a TEP component, P50, that is higher for M1 than for PMC stimulation.

Positive cluster (39 – 82 ms),
 $p = 0.03$

Negative cluster (36 – 95 ms),
 $p = 0.014$

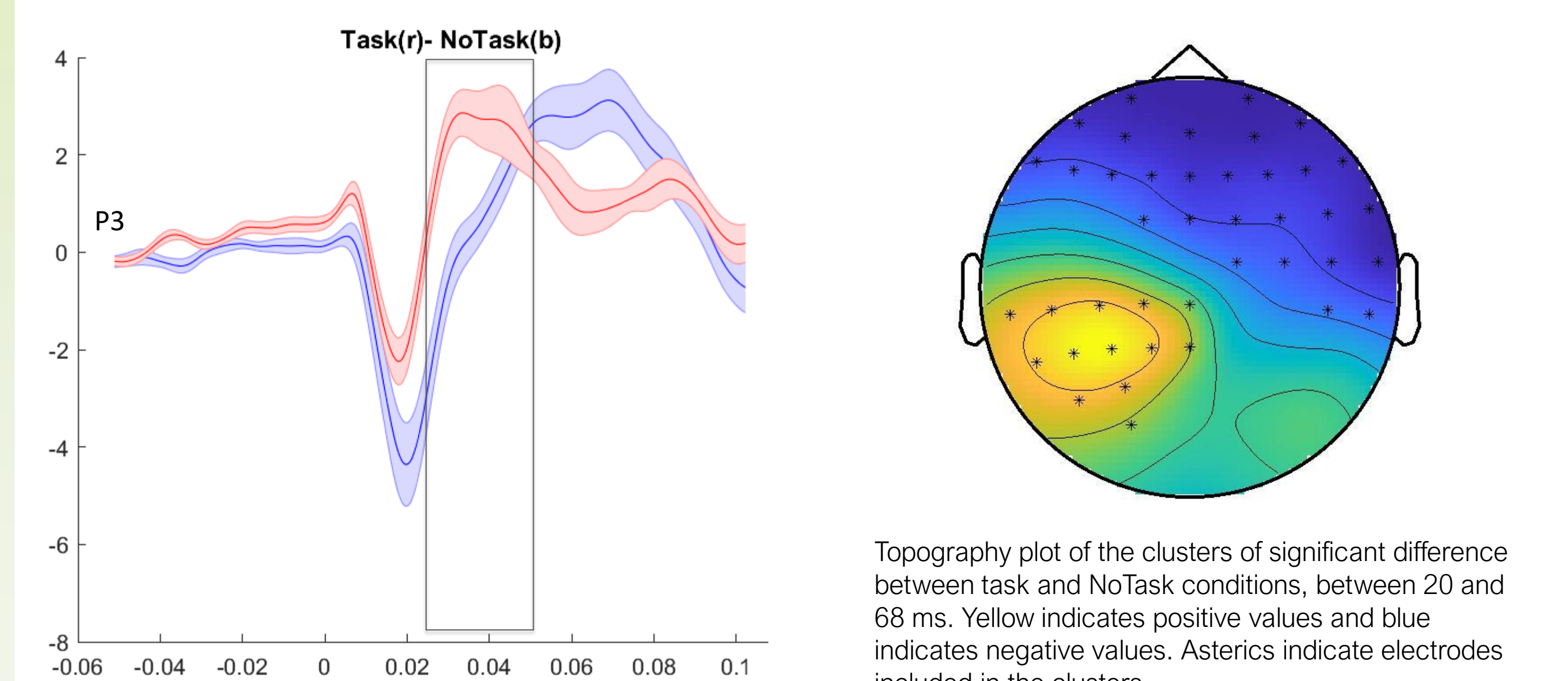
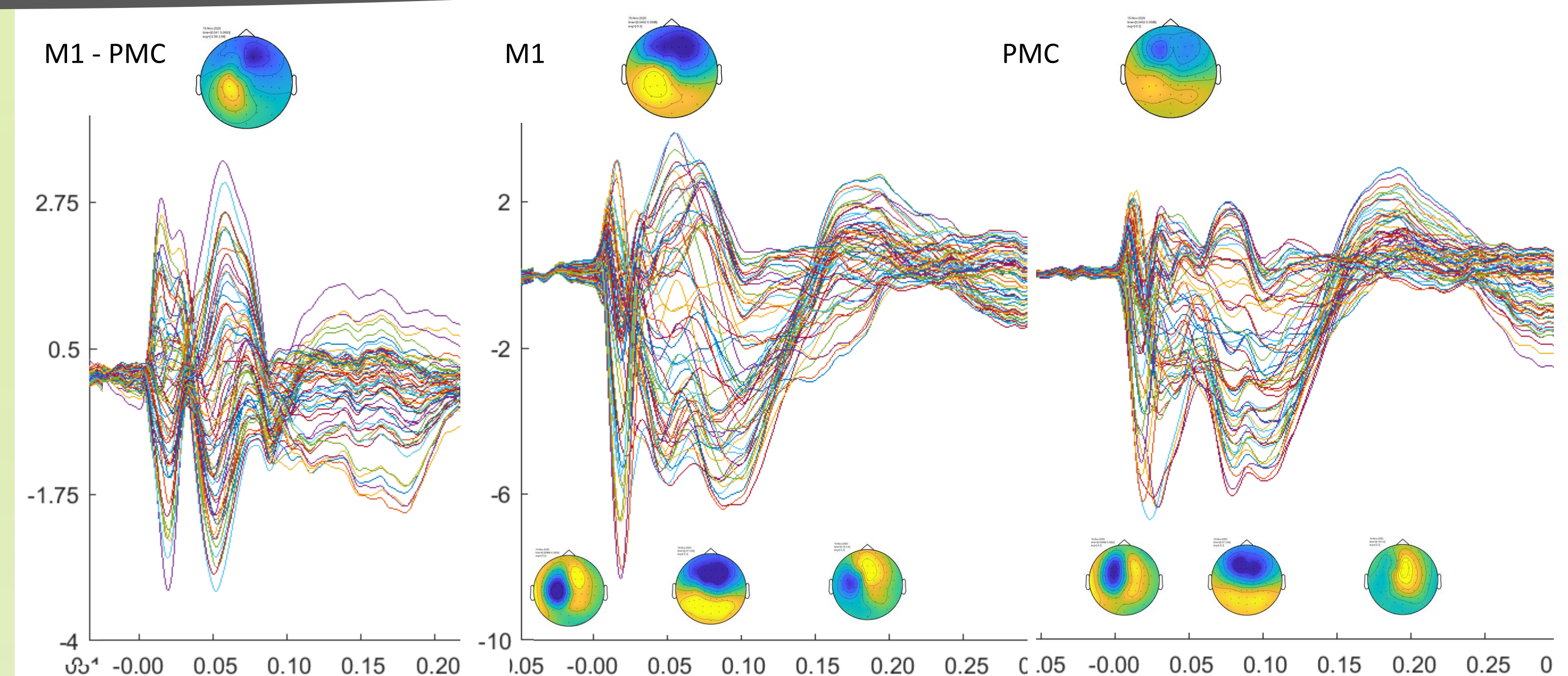
2) **Task vs Notask:** P50 is higher when subjects are performing the task than when they are at rest.

Positive cluster (23 – 68 ms),
 $p = 0.02$

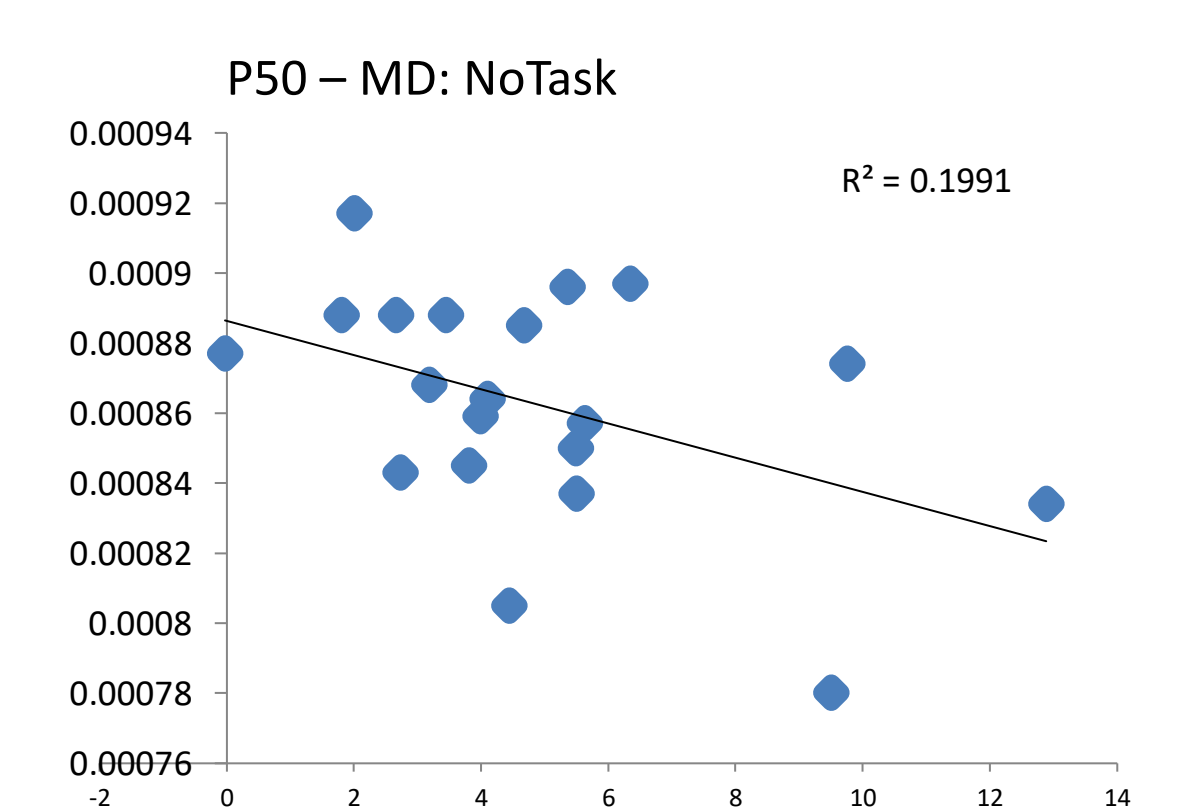
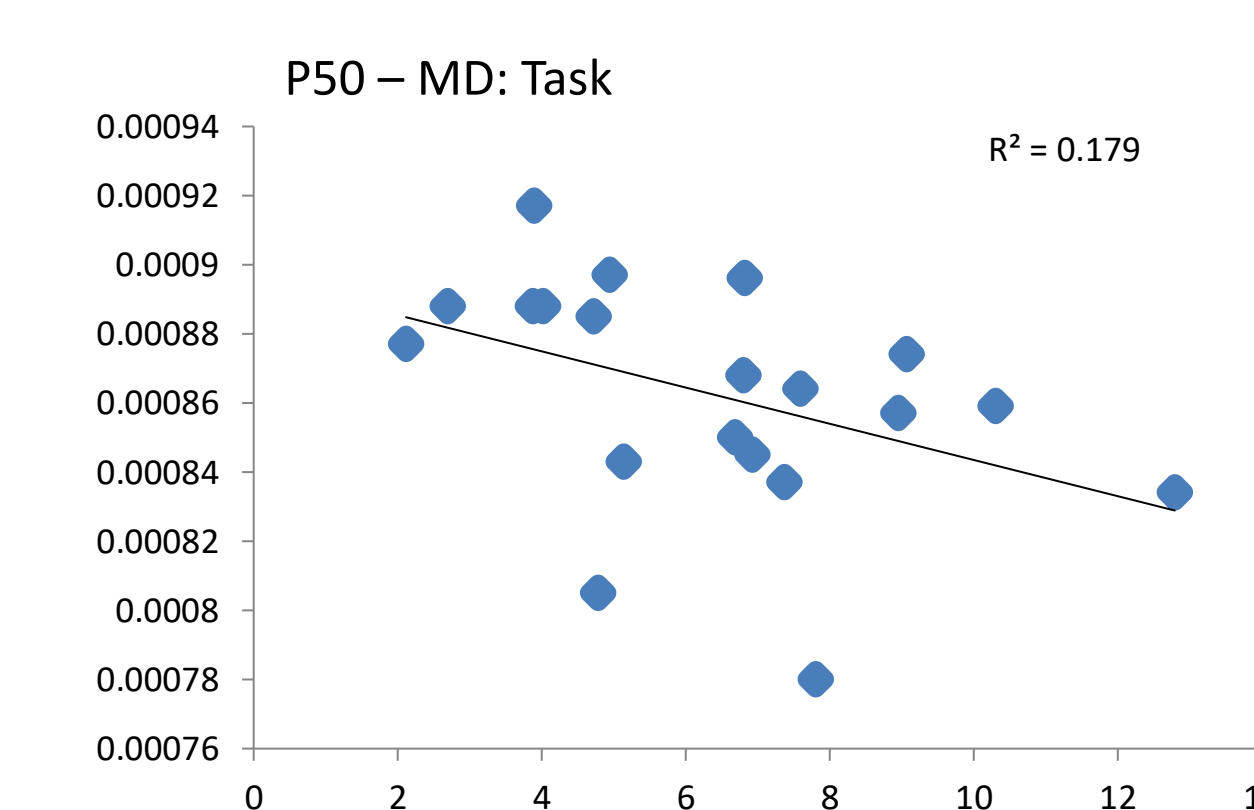
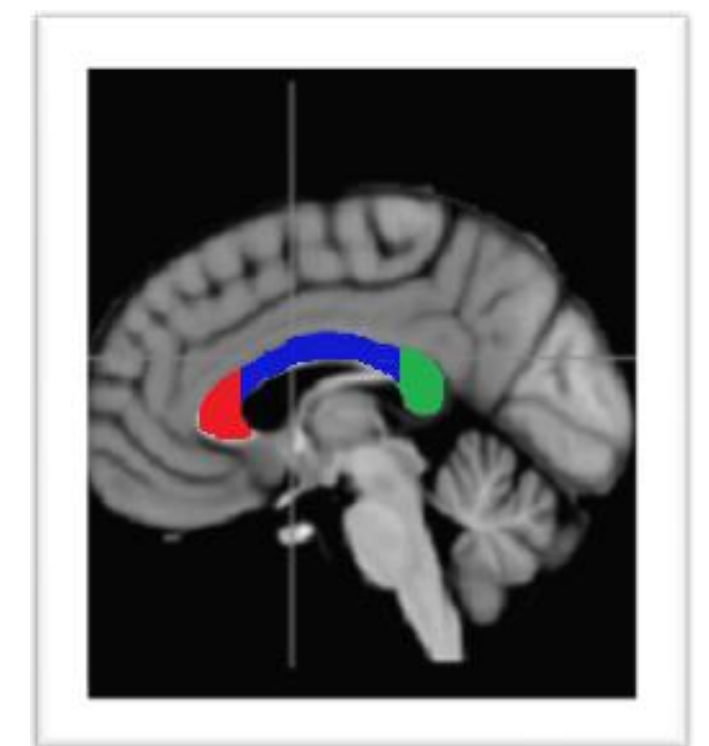
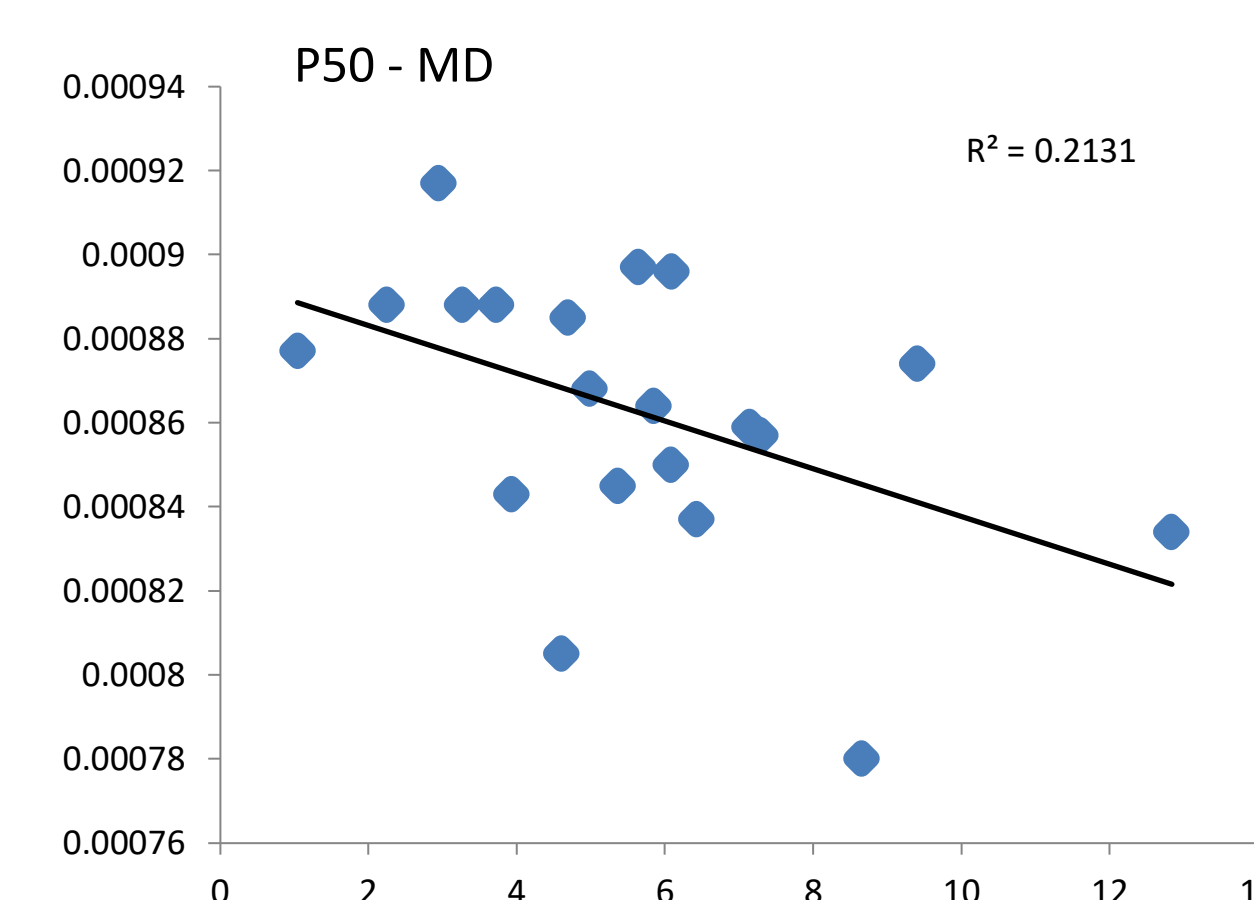
Negative cluster (19 – 49 ms),
 $p = 0.03$

3) **P50 and DTI:**

P50 amplitude correlates with MD of the CC body ($p = 0.04$), with similar trends both in Task ($p = 0.06$) and in Notask ($p = 0.049$) conditions.



Topography plot of the clusters of significant difference between task and NoTask conditions, between 20 and 68 ms. Yellow indicates positive values and blue indicates negative values. Asterisks indicate electrodes included in the clusters



Conclusions

Our results show that P50 is a component specific for stimulation of M1, which is not generated after the stimulation of a different target in the motor system. Task performance increases the amplitude of P50. This may be a consequence of an increase in the sensory feedback from the muscle, given that MEPs are increased, or a stronger signal from the contralateral hemisphere. The last results showing an association between microstructural integrity of the corpus callosum and P50 amplitude support the latter hypothesis, i.e. that P50 is at least in part a feedback signal to the stimulated hemisphere from the contralateral hemisphere.

References

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- [2] Bortoletto et al (Under review): Asymmetric transcallosal conduction delay leads to finer bimanual coordination. <https://doi.org/10.1101/2020.01.24.918102>
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- [5] Maris and Oostenveld (2007). Nonparametric statistical testing of EEG- and MEG-data. *J Neurosci Methods* 164(1):177-90