PRIMARY SOMATOSENSORY CORTEX AND SHORT-TERM RETENTION OF BODY- AND NON BODY-RELATED INFORMATION:

preliminary results from a repetitive TMS study

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1 – BACKGROUND

The **primary somatosensory cortex (S1)**, once thought to be only modality-specific, is involved in higher level functions like emotion recognition[4] and motor learning by observation[3]. Some theories speculate that sensorimotor areas may be **involved not only in the perception of intrinsic features of the stimuli but also in the short-term retention of that information.**

In a recent EEG study, it has been suggested that the neural responses of somatosensory cortices to visually perceived body-related information probably reflect their involvement in short-term memory (STM)[2] especially when the STM task is engaging for the participant.

2 – AIM

The present study looks for causal evidence that S1 is implicated in the retention of visual information that are salient for this cortical area[1]. To this purpose we interfered with S1 activity by means of repetitive Transcranial Magnetic Stimulation (rTMS) during a classic STM task where body- and non body-related information had to be retained.

Experiment 1 ⟹ **role of S1 in the STM retention of body-related material** ⟹ Delay match-to-sample task depicting **hands stimuli**

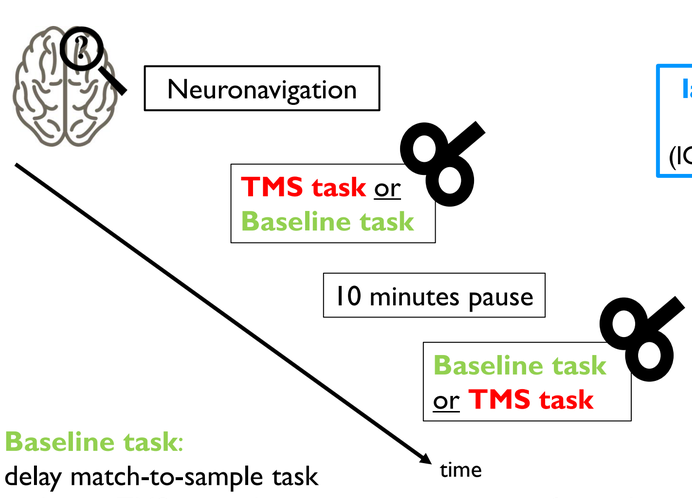
Experiment 2 (ongoing) ⟹ **role of S1 in the STM retention of non body-related material** ⟹ Delay match-to-sample task depicting **shapes (i.e., polygons)**

3 – METHODS and MATERIALS

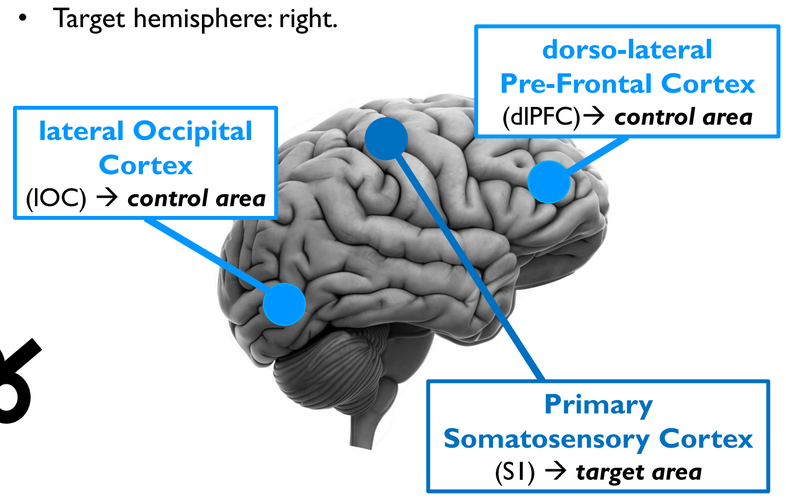
Experiment 1:
- 18 healthy participants;
- 3 within-subjects sessions for each cortical area (dlPFC, S1, lOC) randomized and counterbalanced;
- Target hemisphere: right.

Experiment 2 (ongoing):
- 10 healthy participants;
- 3 within-subjects sessions for each cortical area (dlPFC, S1, lOC) randomized and counterbalanced;
- Target hemisphere: right.

EXPERIMENTAL PROCEDURE



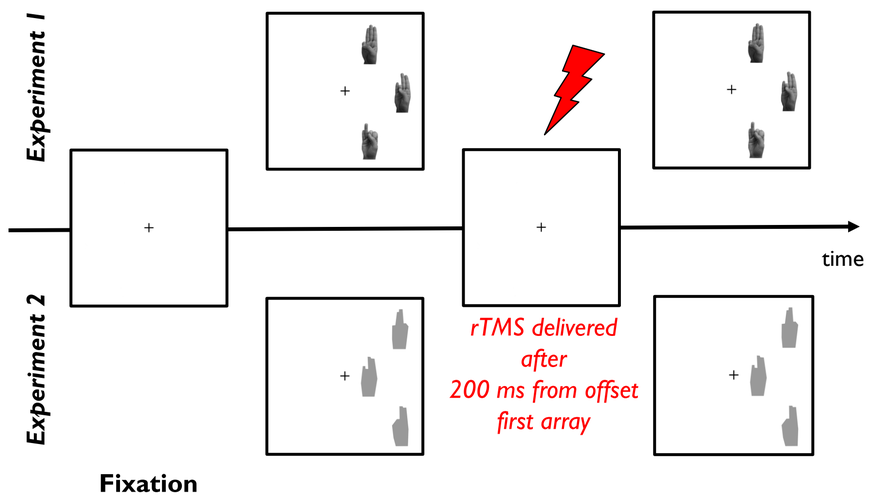
Baseline task: delay match-to-sample task without rTMS. In each session, participant performed it before or after the TMS protocol (order kept fixed within subjects but counter-balanced between subjects)



rTMS: 3 pulses at 10 Hz always delivered at 60% of maximum stimulator intensity during the retention phase of the experimental task

EXPERIMENTAL TASKS

Delay match-to-sample task: 64 coupled arrays, 32 =, 32 ≠, randomly presented in the right or left visual hemifield (32 stimuli for hemifield).



Fixation Duration (d) jittered between 6000 and 8000 ms

First array d = 200 ms

Retention phase d = 1000 ms

Second array and response ***(same or different)*** d = 2000 ms

4 - RESULTS

* p < 0.05 ** p < 0.01 *** p < 0.001 + p = 0.059 *(planned comparisons)*

In ***Experiment 1***, we analyzed the sensitivity detection index (d') in the delay match-to-sample tasks through a 2 x 3 repetitive-measures ANOVA (rmANOVA) with factors "Condition" (Baseline task vs. TMS task) and "Stimulation" (S1, dlPFC, lOC). Results showed a statistically significant interaction between the two factors ($F_{2,34}$=4.35, p=0.036). Planned comparisons revealed an improvement of subjects' performance in the STM task only when rTMS is delivered over S1.

In ***Experiment 2***, we performed the same statistic analysis: the 2 x 3 rmANOVA and planned comparisons didn't show any significant effect. ($F_{2,18}$=1.69, p=0.229). However, these results have to be considered preliminary due to the small sample size.

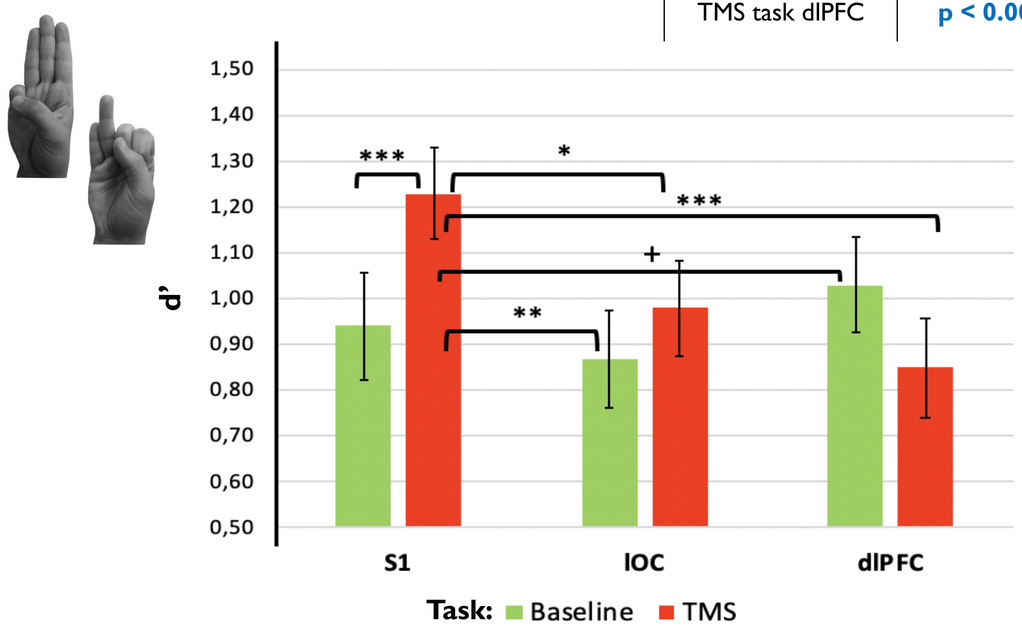
Experiment 1

rm ANOVA

	F	p	ηp²
Stimulation * Condition	4.35	**0.036**	0.204

Planned Comparisons

TMS task S1 *vs.*	Baseline task S1	**p < 0.001**
	Baseline task lOC	**p = 0.002**
	TMS task lOC	**p = 0.03**
	Baseline task dlPFC	**p = 0.059**
	TMS task dlPFC	**p < 0.001**



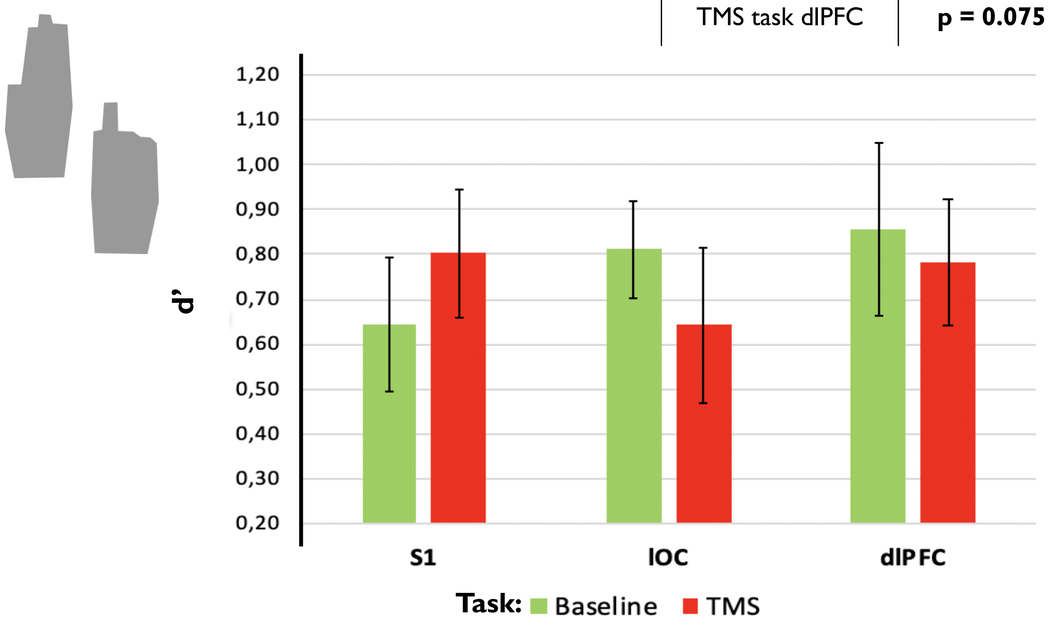
Experiment 2 (preliminary results)

rm ANOVA

	F	p	ηp²
Stimulation * Condition	1.69	**0.229**	0.195

Planned Comparisons

TMS task S1 *vs.*	Baseline task S1	**p = 0.20**
	Baseline task lOC	**p = 0.36**
	TMS task lOC	**p = 0.191**
	Baseline task dlPFC	**p = 0.226**
	TMS task dlPFC	**p = 0.075**



5 - CONCLUSIONS

Our results demonstrate that rTMS over **S1 applied during a visual STM task improves performance, suggesting that S1 may be involved in visual STM when body-related stimuli had to be retained. This involvement seems to be driven by the intrinsic features of the visual stimuli**: despite the small sample size of *Experiment 2*, and the fact that the experiment is still ongoing, an improvement of the performance is seen only when stimuli represented hands but not when depicting shapes/polygons. These results shed light on the cross-modal involvement of primary sensory cortices in the retention of information in short-term memory[2], showing that their recruitment is driven by the intrinsic features of the percept rather than by the sensory modality in which stimuli are presented. Further experiments will investigate the role of attention and whether the recruitment of S1 persists when the task is less difficult[2].

6 – REFERENCES

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