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Neural basis of functional fixedness during creative idea generation: an EEG study

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INTRODUCTION

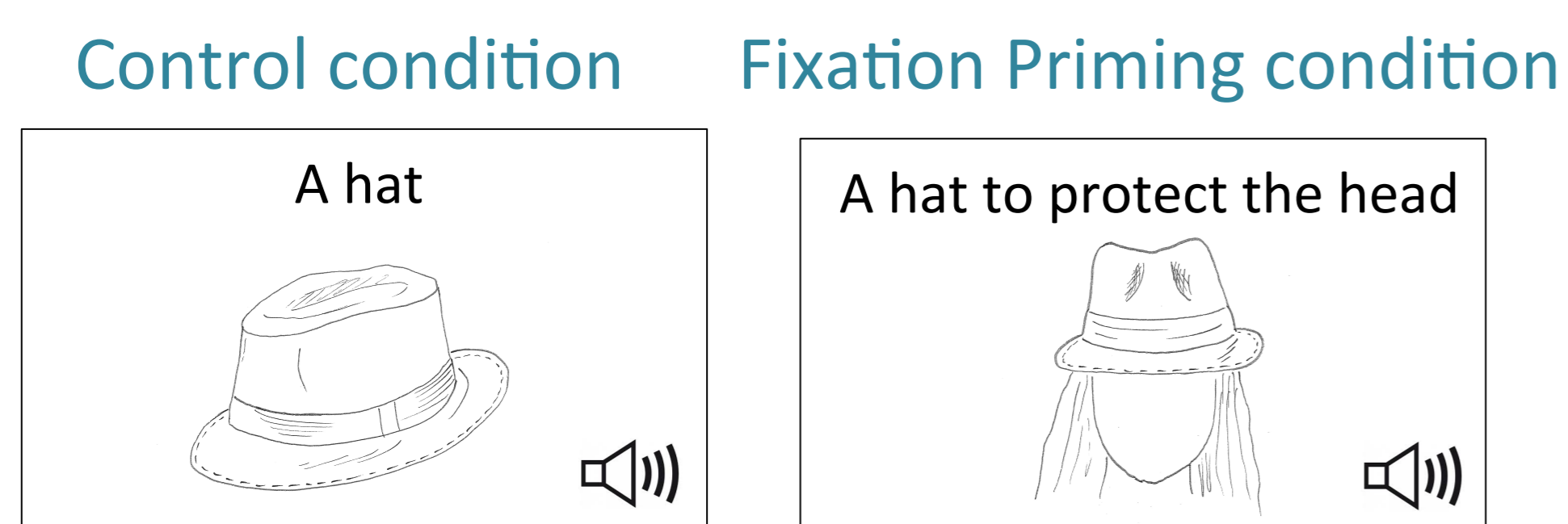
A lot of studies showed that creativity, defined as a valuable ability to generate a new and useful idea, can be constrained by fixation effects. While the automaticity of knowledge usually leads to an adaptive mechanism allowing to answer quickly and correctly when confronted to known situations, sometimes the spontaneous activation of knowledge may be used in an inappropriate and counterproductive way and constrain the exploration of other solutions (Duncker, 1945; Smith et Ward, 1993 ; Cassotti et al., 2016). Therefore, if “to think outside the box, one must forget what is inside the box” (Storm and Angello, 2010), the question that needs to be investigated is: “how to think outside the box?”. Even if some theories and experiments defended that creativity is exclusively related to automatic mechanisms (Martindale, 1999), other recent behavioral and neurocognitive experiments such as the dual system theory of creativity (Cassotti et al., 2016) support the implication of cognitive inhibition (Benedek et al., 2014 ; Cassotti et al., 2016). Then, the present study aim for the first time to identify neural bases of these mechanisms.

PARTICIPANTS

21 young adults (11 females, 10 men, $m = 20,33$, $SD = 2,18$), right handed participated to the EEG experiment.

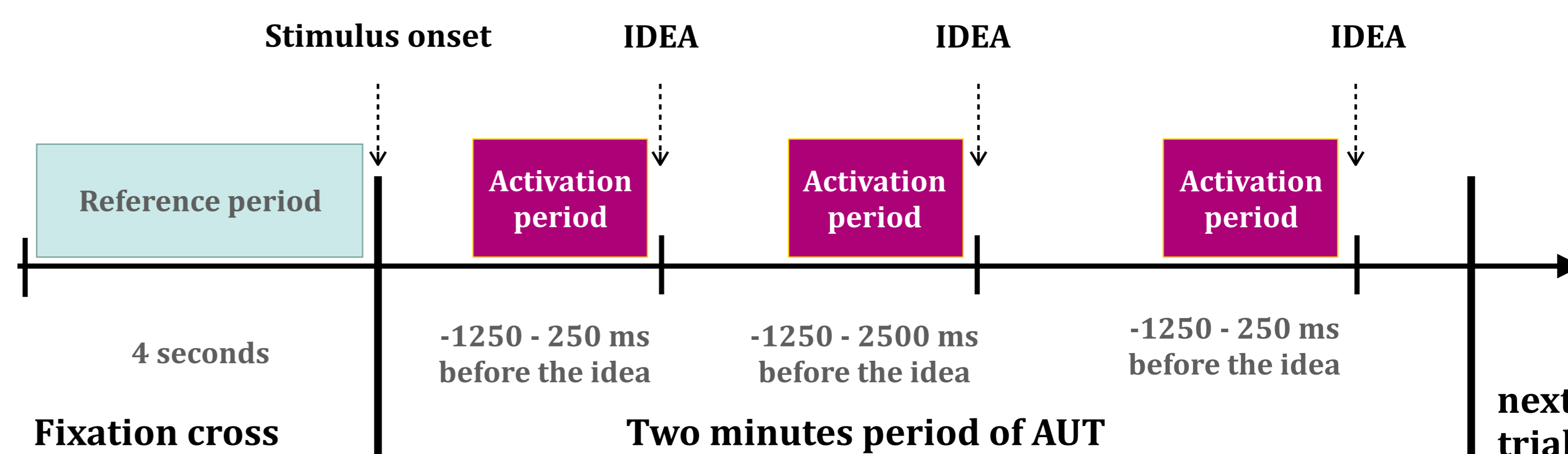
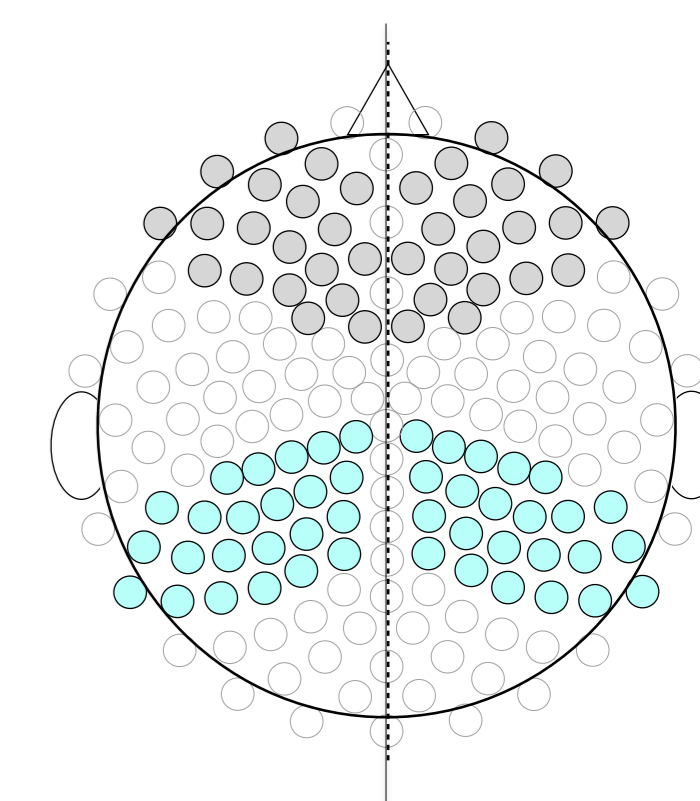
ALTERNATIVE USES TASK

14 objects were presented. For each of it, participants were given two minutes to generate as many creative use as they could, according to two conditions :



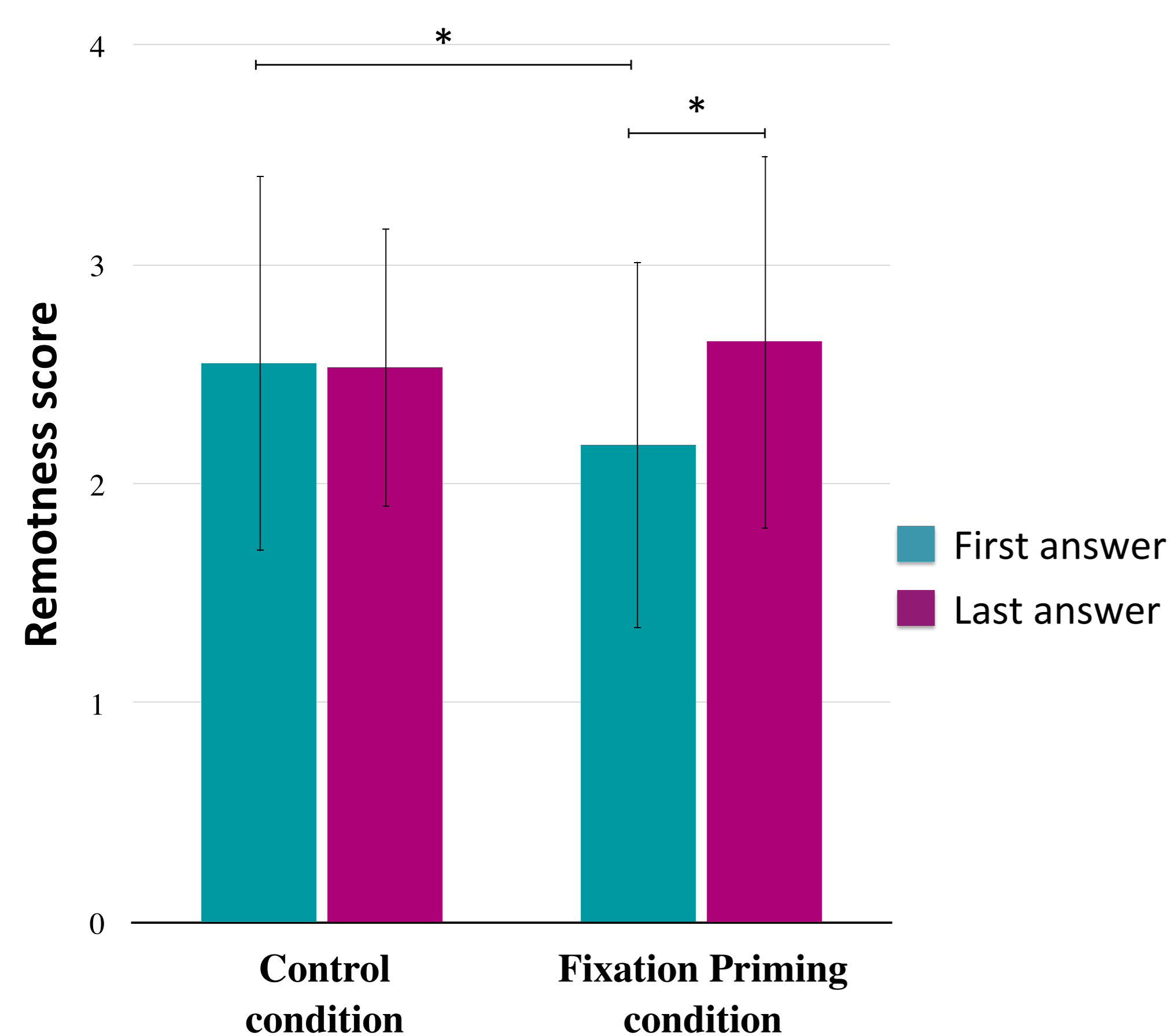
PHYSIOLOGY

As this study seeks to investigate the temporal dynamics of idea generation at both frontal and temporo-parietal sites, idea generation interval (Activation periode) was split in 9 time windows of 200ms each, overlapping on 100 ms. Moreover, the Task Related alpha Power data was aggregated from two frontal ROI, and two temporo-parietal ROI.

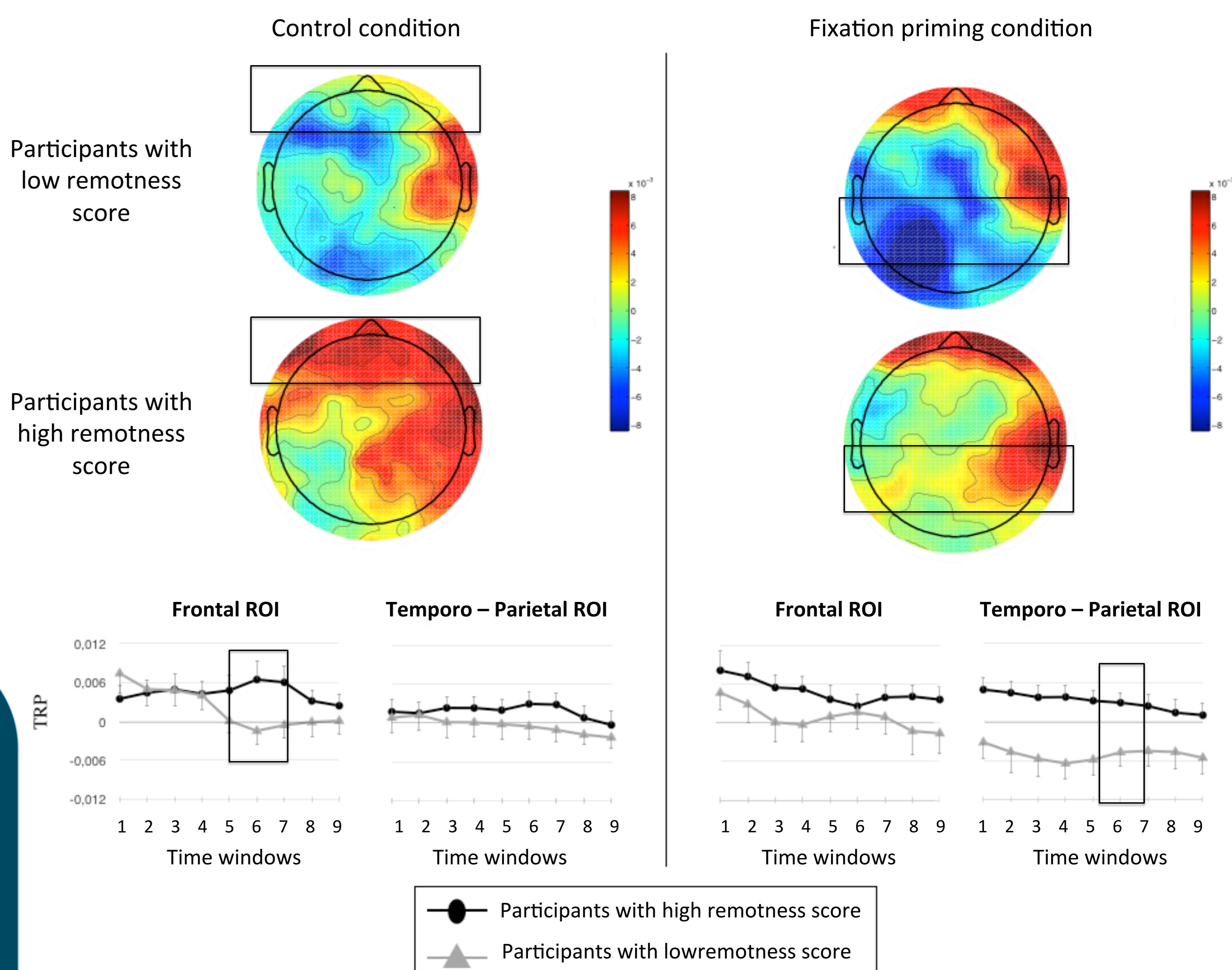


RESULTS

BEHAVIORAL RESULTS



PHYSIOLOGICAL RESULTS



DISCUSSION

As expected, priming the classical use of an object before the generation of creative alternative uses of the object impeded participants' performances in terms of remotness. In the control condition, while the frontal alpha synchronization was maintained across all successive time windows in participants with high remotness scores, it decreased in participants with low remotness scores. In the Fixation Priming condition, while all participants maintained frontal alpha synchronization throughout the period preceding their answer, only participants with high remotness scores maintained alpha synchronization in the temporo-parietal regions. Then, our findings provide additional evidence for the role of cognitive control in creative ideation, while suggesting that cognitive control alone is not enough to generate new ideas.