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Variations in working memory capacity: Suppression of distractors or enhancement of targets?

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Dissociable mechanisms underlying individual differences in Working Memory Capacity

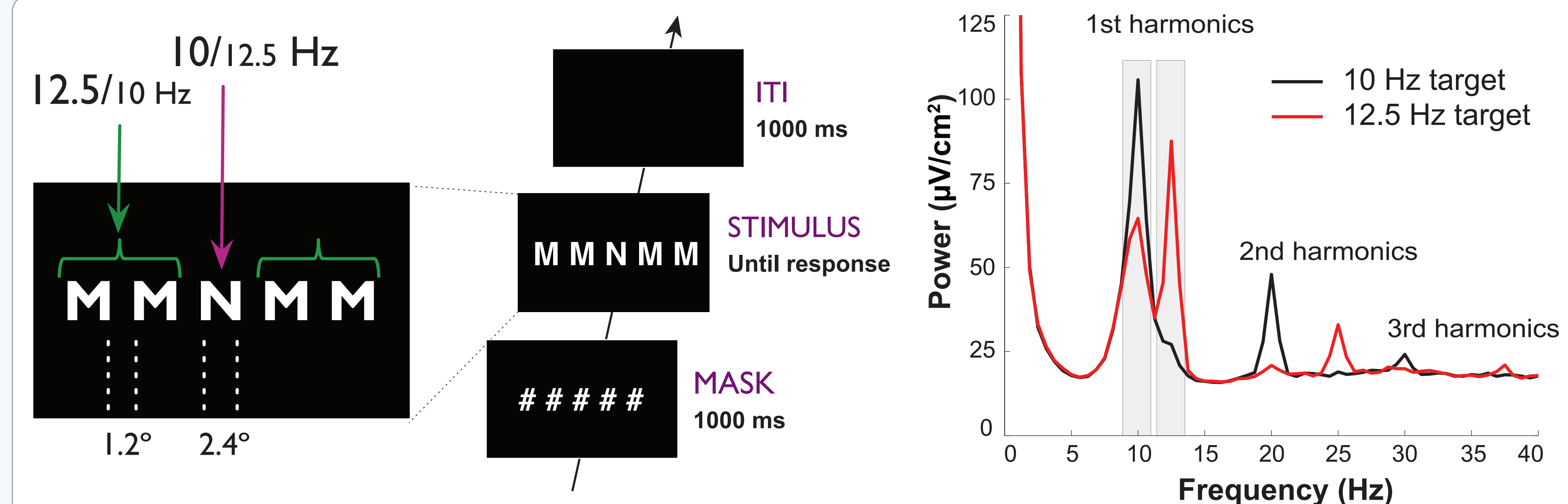
Rasa Gulbinaite, Addie Johnson, Ritske de Jong, Candice C. Morey, Hedderik van Rijn
 Experimental Psychology Department, University of Groningen

QUESTION

The ability to control attention to minimize distraction is the primary factor determining working memory capacity (WMC)^{1,2}, a characteristic that strongly correlates with cognitive abilities, including intelligence³. We tested whether superior attention control abilities exhibited by high-WMC individuals are mediated by

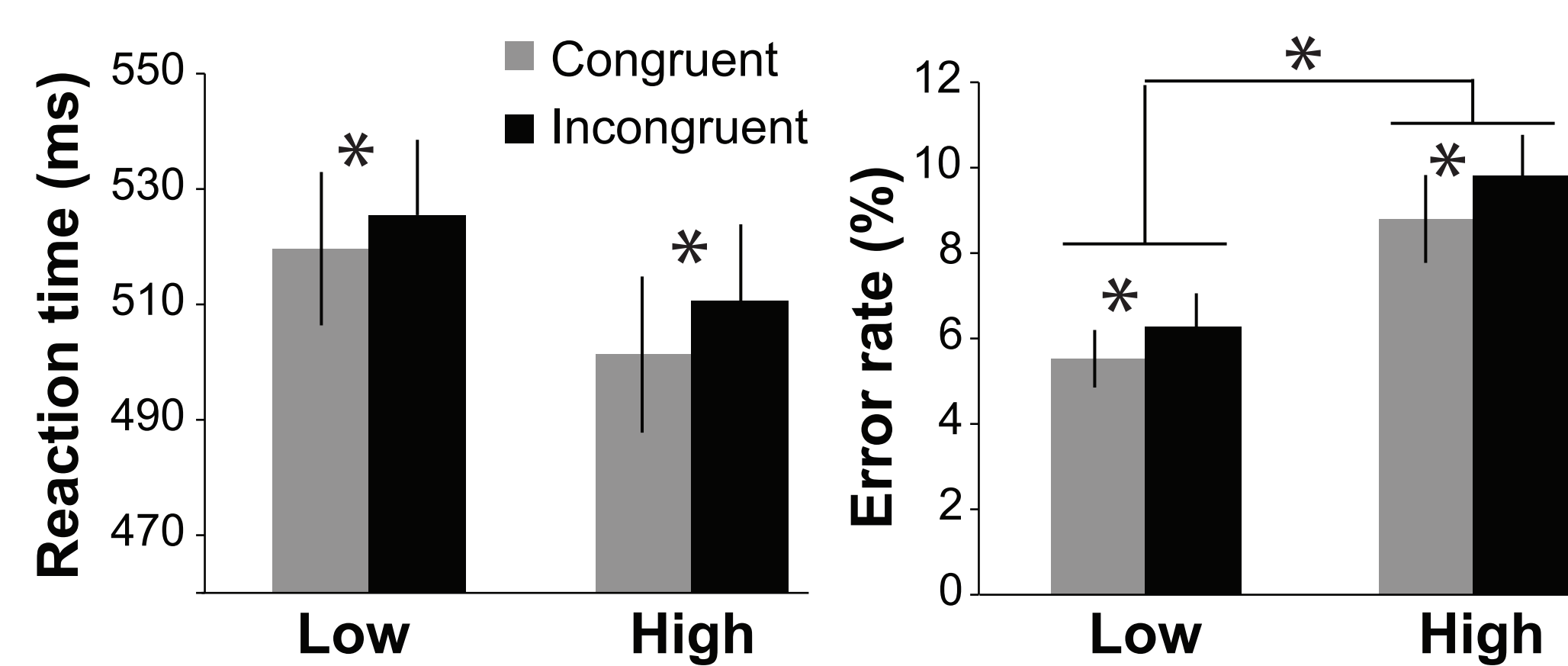
- stronger suppression of irrelevant information,
- enhancement of relevant information,
- or both?

TASK

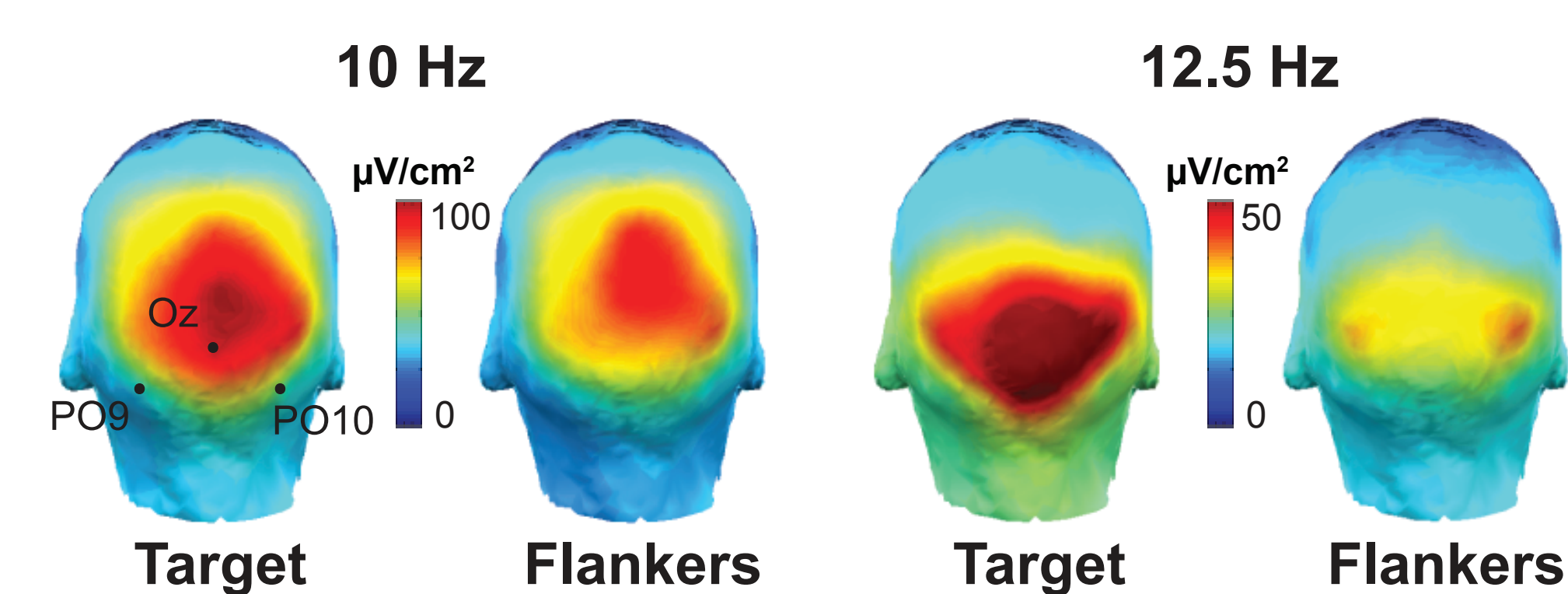


RESULTS

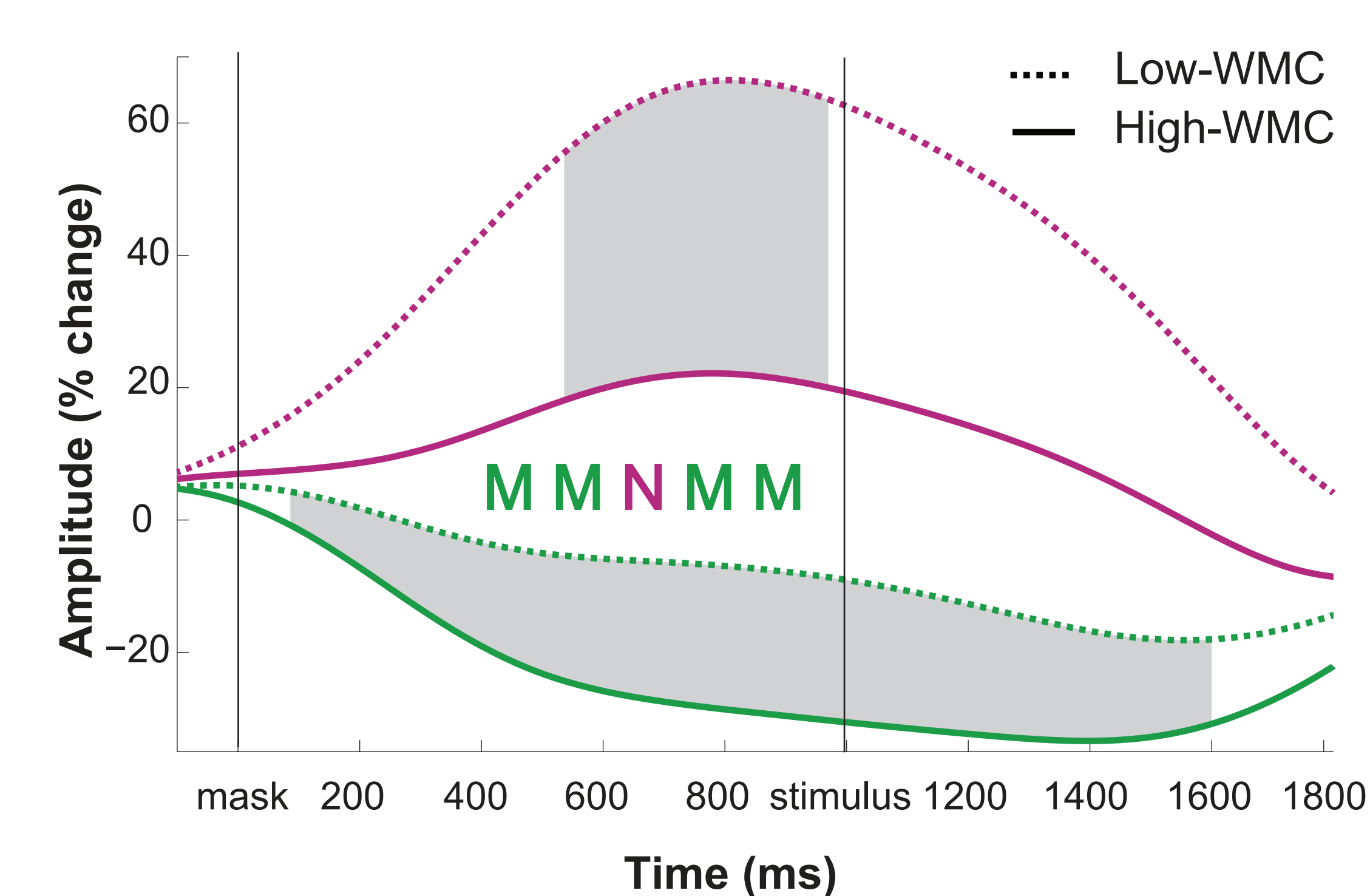
Behavioral performance



Attentional modulation of SSVEPs

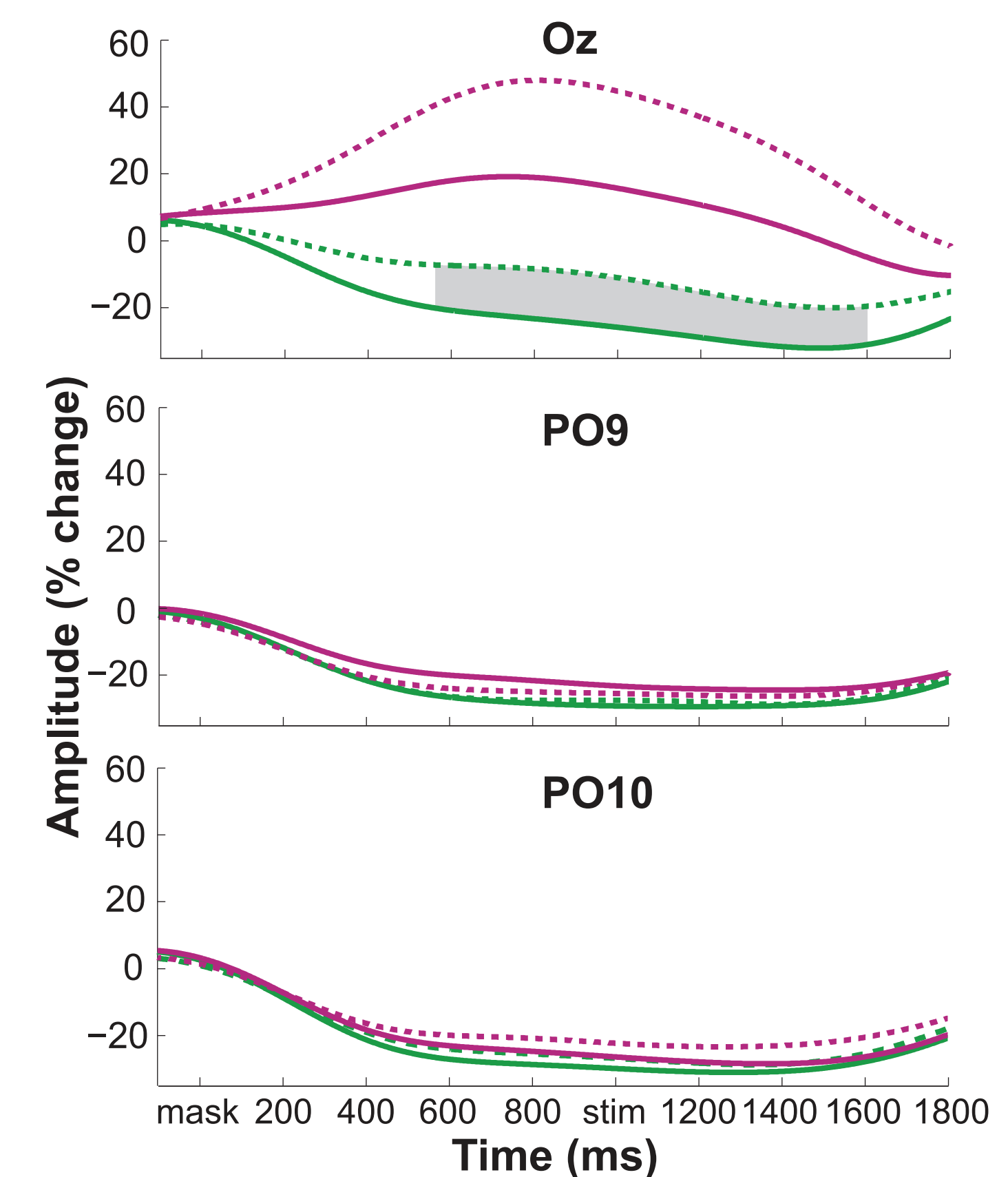


Strategic WMC-related differences in both target and distractor processing



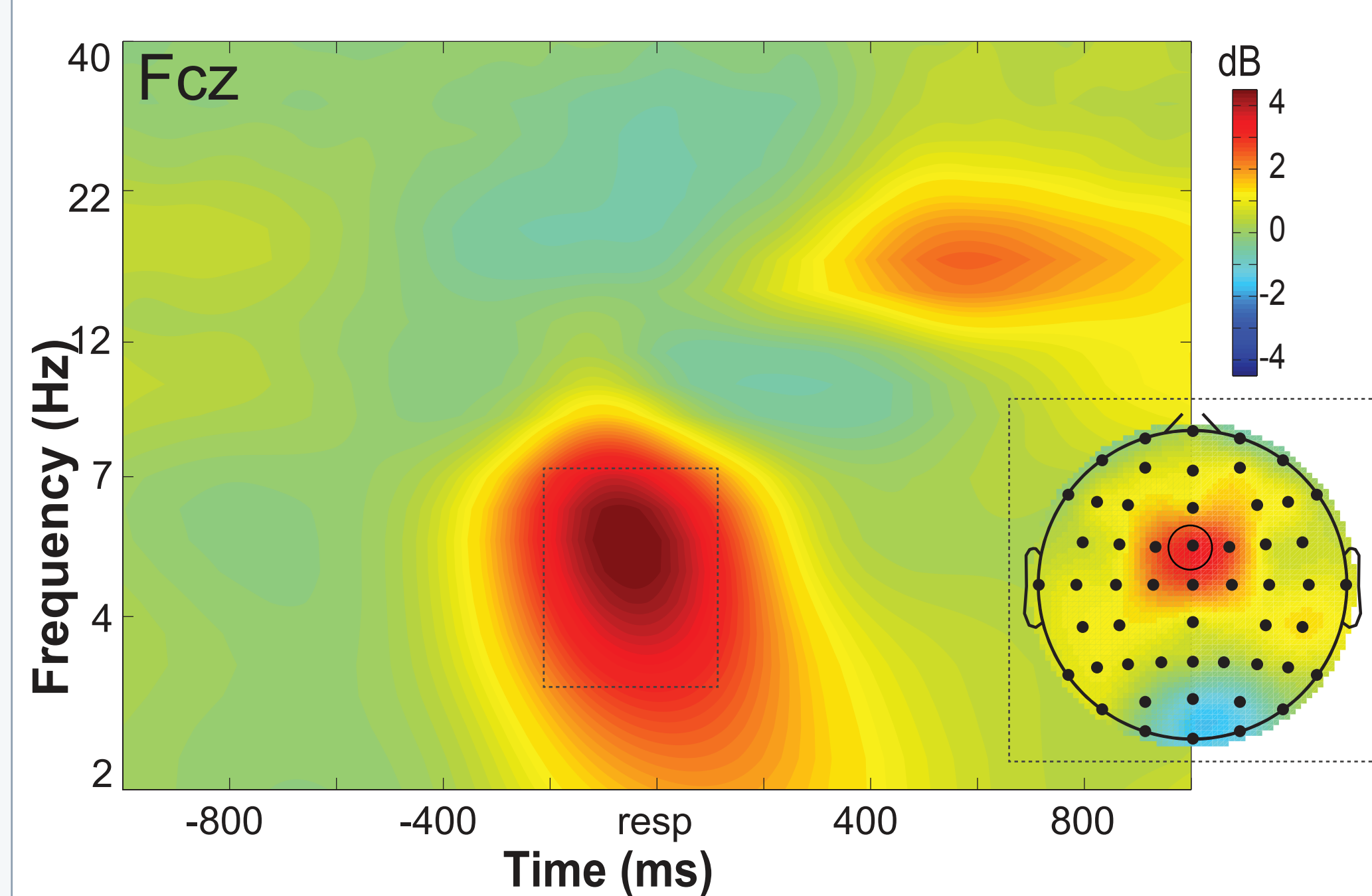
- Both WMC groups: increased attention to the target compared to the flankers;
- Different strategies to obtain the same signal-to-noise ratio: The low-WMC increased attention to the target, whereas high-WMC suppressed attention to the flankers.

Control analysis

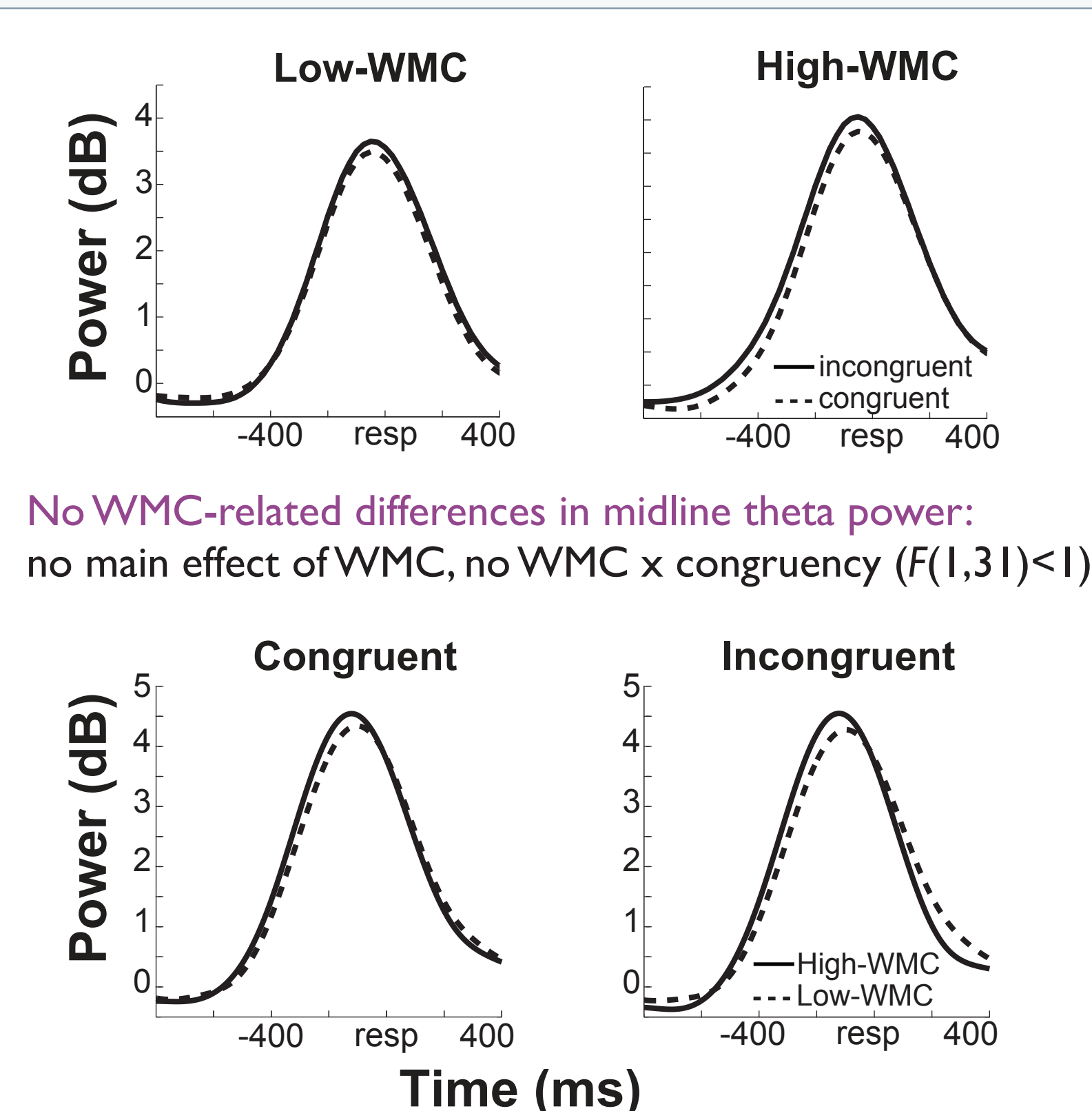


Statistically significant group differences in SSVEP amplitudes were observed only in occipital electrodes that showed strong SSVEPs.

Conflict-related theta-band (3-7 Hz) power



- Increase in theta-band (3-7 Hz) power in peri-response time interval (-200 - 100 ms) in frontocentral electrodes
- Main effect of congruency ($F(1,31) = 8.96, p = .005$)

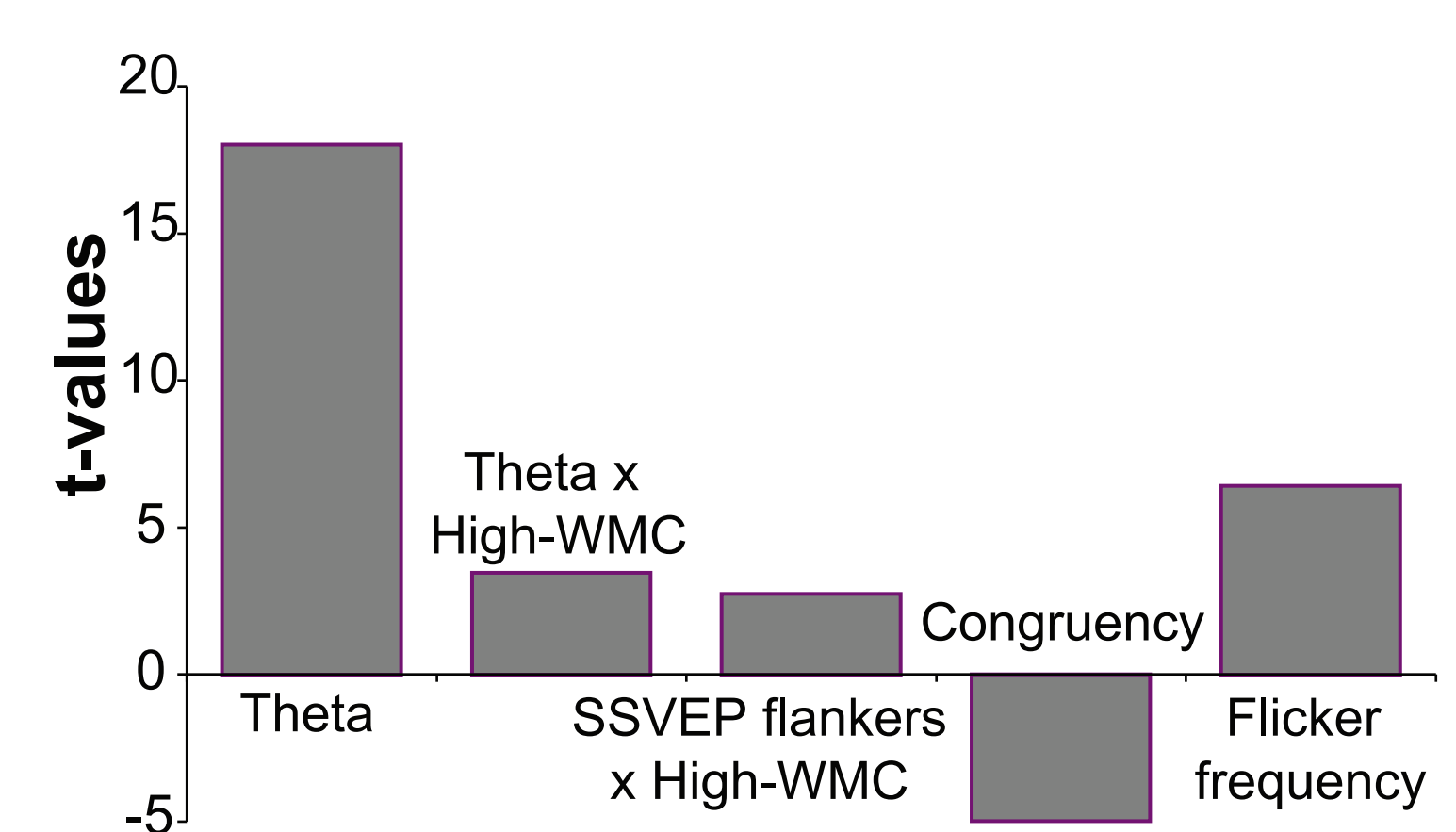


No WMC-related differences in midline theta power: no main effect of WMC, no WMC x congruency ($F(1,31) < 1$)
 Significantly earlier recruitment of cognitive control networks in high-WMC group on incongruent trials: Group x Congruency interaction ($F(1,31) = 3.94, p = .056$)
 Incongruent trials ($t(31) = 2.13, p = .041$)

Single-trial analyses

Linear mixed effects model with:

- Dependent variable: reaction time;
- Fixed effects: congruency, WMC group, flicker frequency, theta-band (3-7 Hz) power in peri-response time window (-200 - 100 ms), target and flanker SSVEP amplitude in stimulus-response window;
- Random intercept per subject.



DISCUSSION

- WMC is related to the control of attention to both relevant and irrelevant information. High-WMC individuals inhibit distractors more strongly, whereas low-WMC individuals enhance targets. Two different strategies can result in similar behavioral performance, yet suppression might be more neurally efficient⁴.
- In a frequency-tagged version of the Eriksen flanker task, as in a standard version^{5,6}, conflict-related theta power was increased. However, frontal midline theta did not show WMC-related differences.
- General implications for the use of SSVEPs to study cognitive processes. SSVEPs can be successfully applied to cognitive tasks with small stimuli and relatively short stimulus presentation times.

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CONTACT

rasa.gulbinaite@gmail.com