Tracking the Time Course of Attentional Sharpening Using EEG

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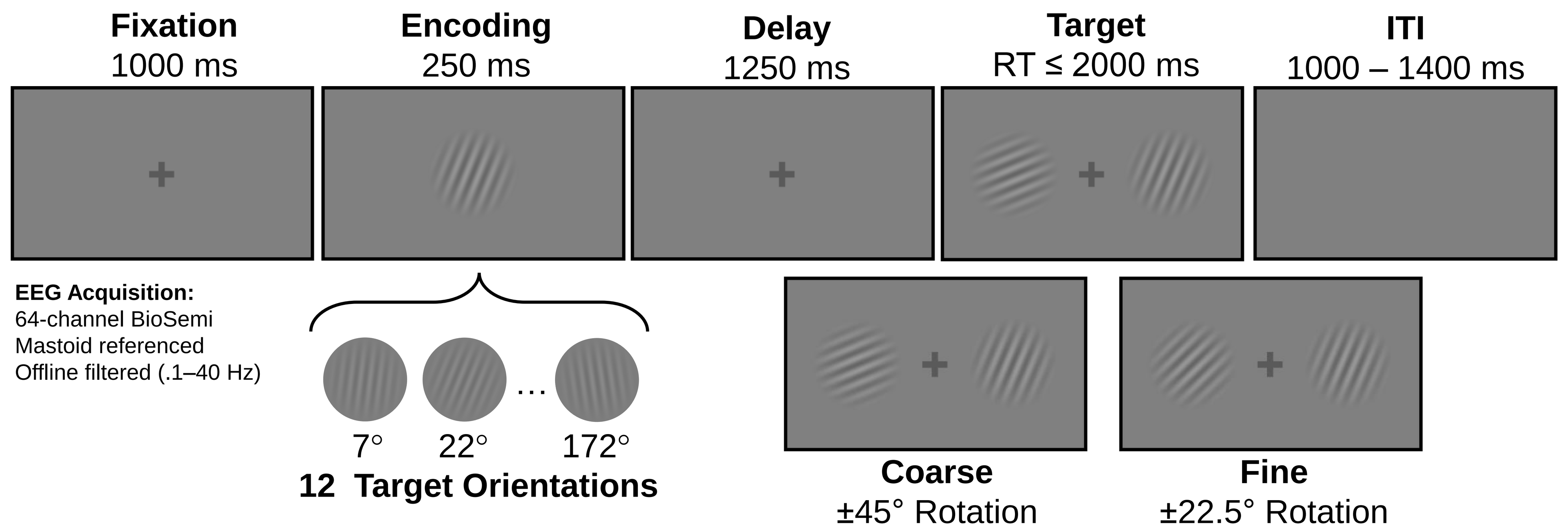
Attentional sharpening **refers to the apparent narrowing of attentional templates to optimally distinguish between targets and distractors that are expected to resemble one another. The mechanisms that allow for such narrowing, however, have largely remained understudied. Here, we use EEG to track the attentional, mnemonic, and decisional processes that underscore attentional sharpening.**

Method

N **= 30**

Task: Localize target grating using left and right arrow keys.



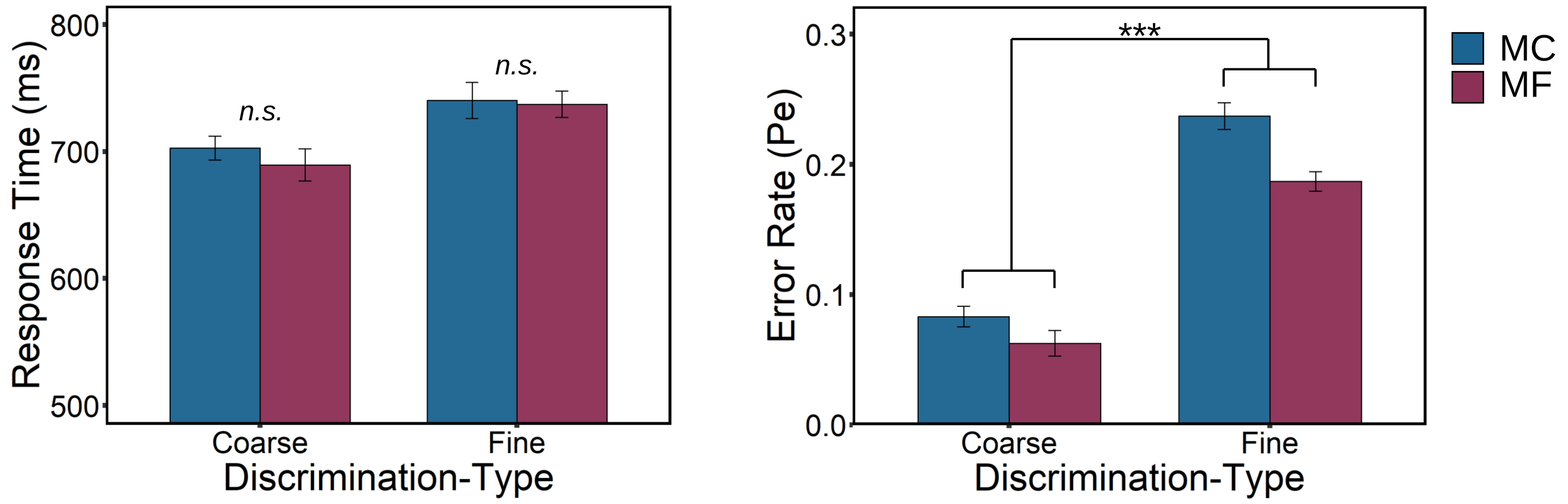
EEG Acquisition:
64-channel BioSemi
Mastoid referenced
Offline filtered (.1–40 Hz)

Mostly Coarse (MC)
Session 1

Mostly Fine (MF)
Session 2

960 Trials/Session

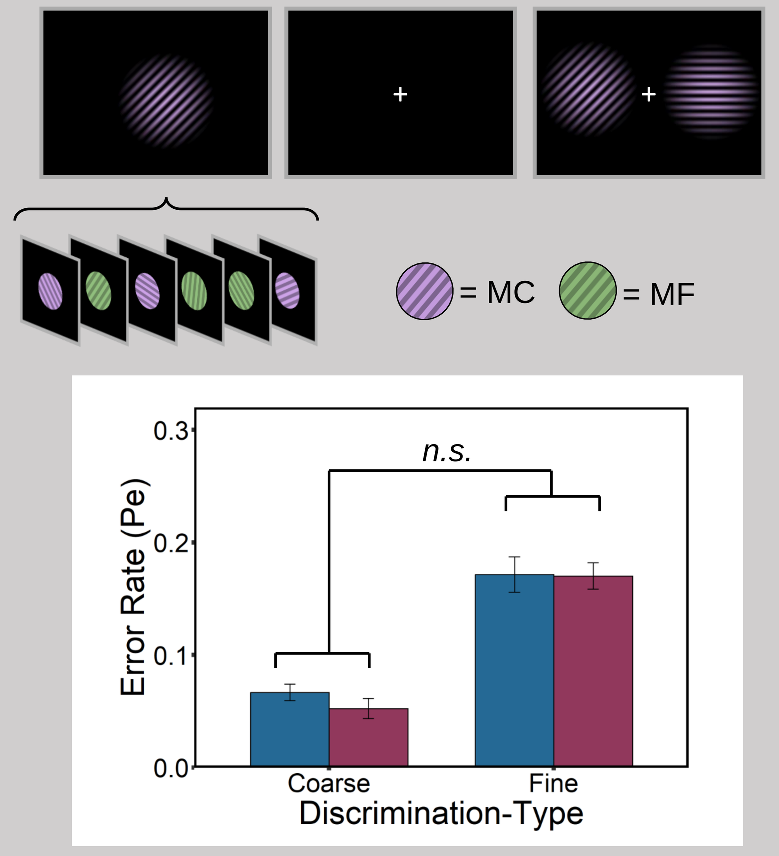
Behavioral Results



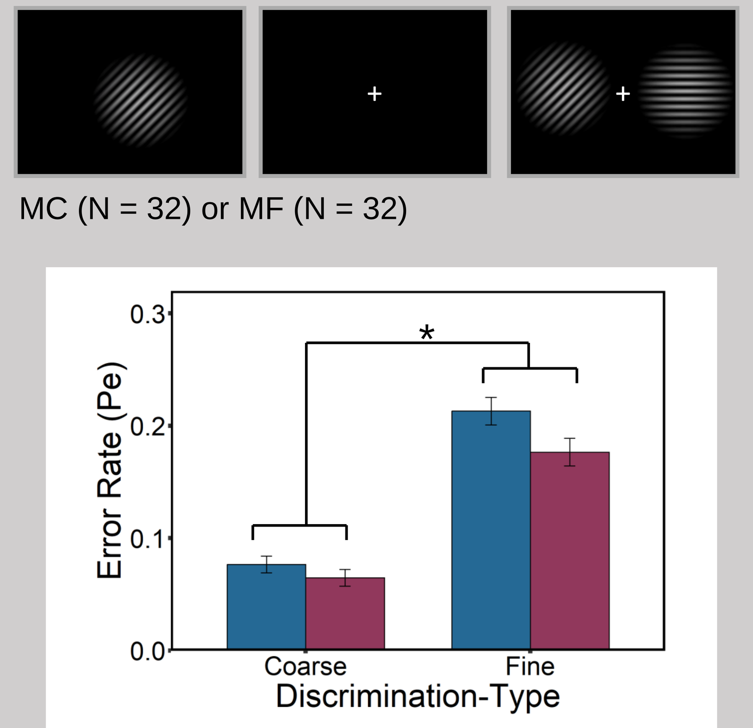
Fine discriminations were slower and less accurate than coarse discrimination. During the MF session, participants were relatively more accurate without sacrificing speed, especially during fine discriminations.

Online Experiments

Within-Subject Manipulation (*N* = 32)



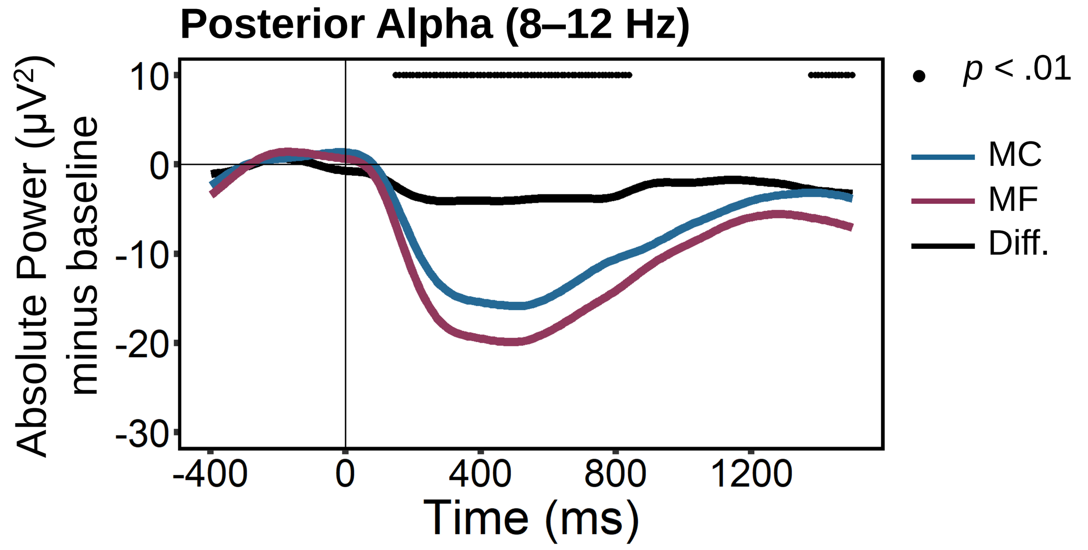
Between-Subject Manipulation (*N* = 64)



Cue-Locked Time-Frequency Results

Cue-locked alpha power (8–12 Hz) measured at posterior ROI (i.e., parietal, parieto-occipital and occipital sites) over encoding and delay period.

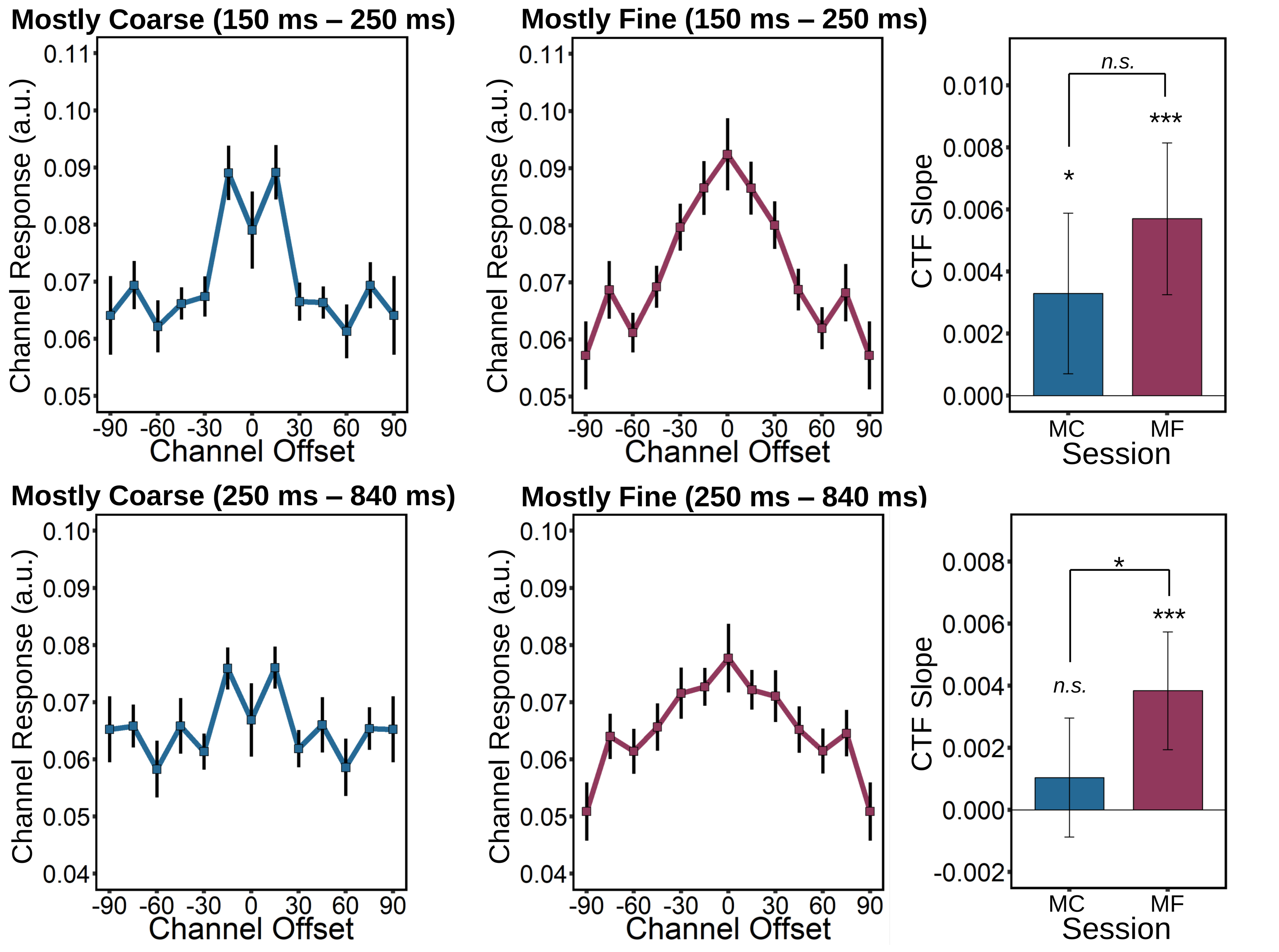
Greater decrease in alpha power observed from 150 ms – 840 ms during MF session following cue-onset, suggesting greater attentional allocation.



Forward Encoding Model Results (Cue-Locked)

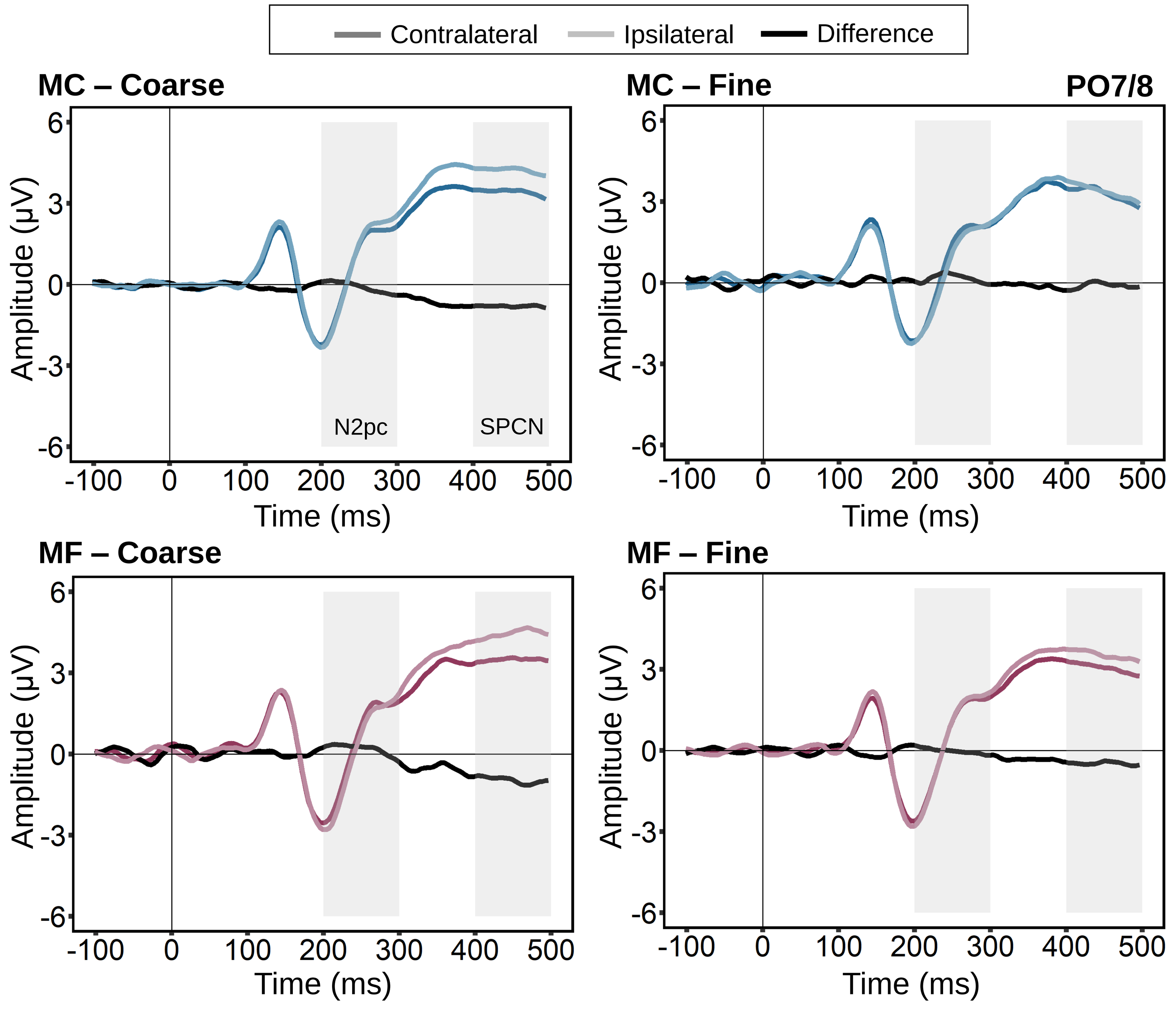
Over the period where session-based differences in alpha activity were observed, we used a forward encoding model to construct channel tuning functions (CTFs) from the raw EEG signal at occipital sites (O1,Oz,O2).

➢ *Forward encoding model: Delta basis set; 10-fold cross-validation; stratified partitions; 10 repetitions.*



Orientation of target successfully recovered from occipital sites during encoding for both MC and MF sessions (i.e., CTF slope > 0). During maintenance, orientation was recovered during MF session, but not MC session.

Target-Locked ERP Results



The N2pc was absent following target presentation, perhaps due to the low-contrast nature of the stimuli and/or because orientation is a relatively poor guiding feature.

The amplitude of the SPCN was larger for coarse versus fine discriminations, and for the MF session compared to the MC session possibly marking more efficient target-match decisions.

Summary

- Using EEG, we investigated the mechanisms underlying the sharpening of target representations over periods of encoding, maintenance and target selection.
- We show that the expectation of a target-similar lure produces a greater decrease in posterior alpha-band activity at encoding that extends into maintenance.
- This global adjustment in attention may support stimulus-specific representations at posterior sites, as target orientation is recoverable from occipital electrodes over this period only when a fine-discrimination is expected.
- These stimulus-specific representations seem to be of greatest benefit at a target-matching stage where individuals can more accurately determine whether an item is or is not the target.