

How predictions and update signals shape our auditory experience

Yamil Vidal^{*1}, Jorie van Haren², Federico De Martino² and Floris P. de Lange^{1,3}

¹Donders Centre for Cognitive Neuroimaging, Radboud University, Nijmegen, the Netherlands

²Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands

³Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands

*Corresponding author: yamil.vidal@donders.ru.nl

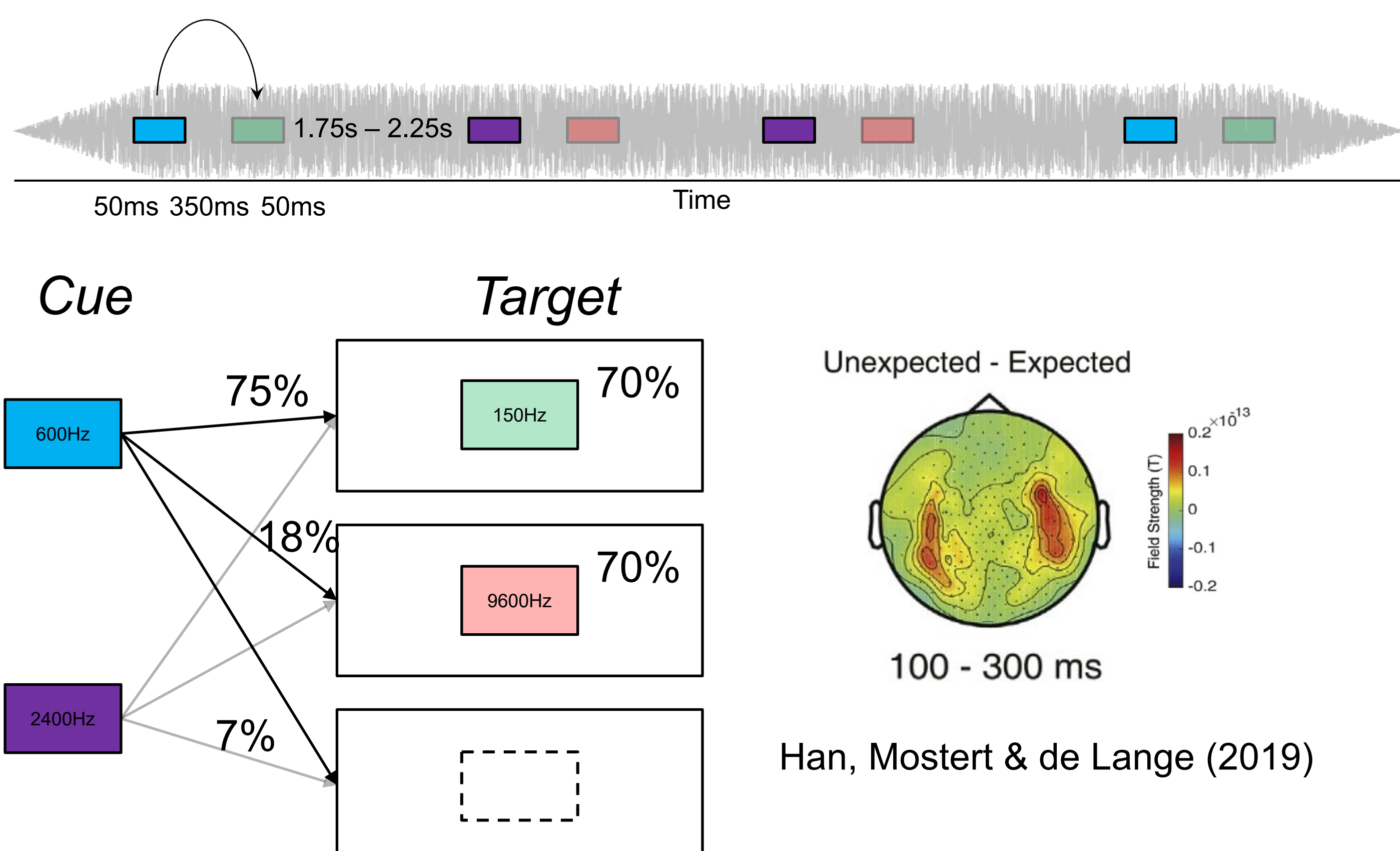
Introduction

- Perception can be understood as an inferential process in which the brain combines its noisy sensory input with predictions generated by internal models.
- The content of our perceptual experience might be determined by the hypothesis about the state of the world with the highest posterior probability (e.g. Rorot 2021; Hohwy et al., 2008).
- The question of how the content of our sensory experience results from the interaction between priors (predictions) and update signals has not been tested directly.
- We have implemented a challenging auditory task in which tones are presented against a noisy background, and where tone predictability is manipulated.
- Presenting stimuli in noise brings to the foreground the inferential nature of perception.

Experimental design

MEG, behavior and pupillometry

Localizer (each pitch), Staircase x 2 (targets), Main task x 11



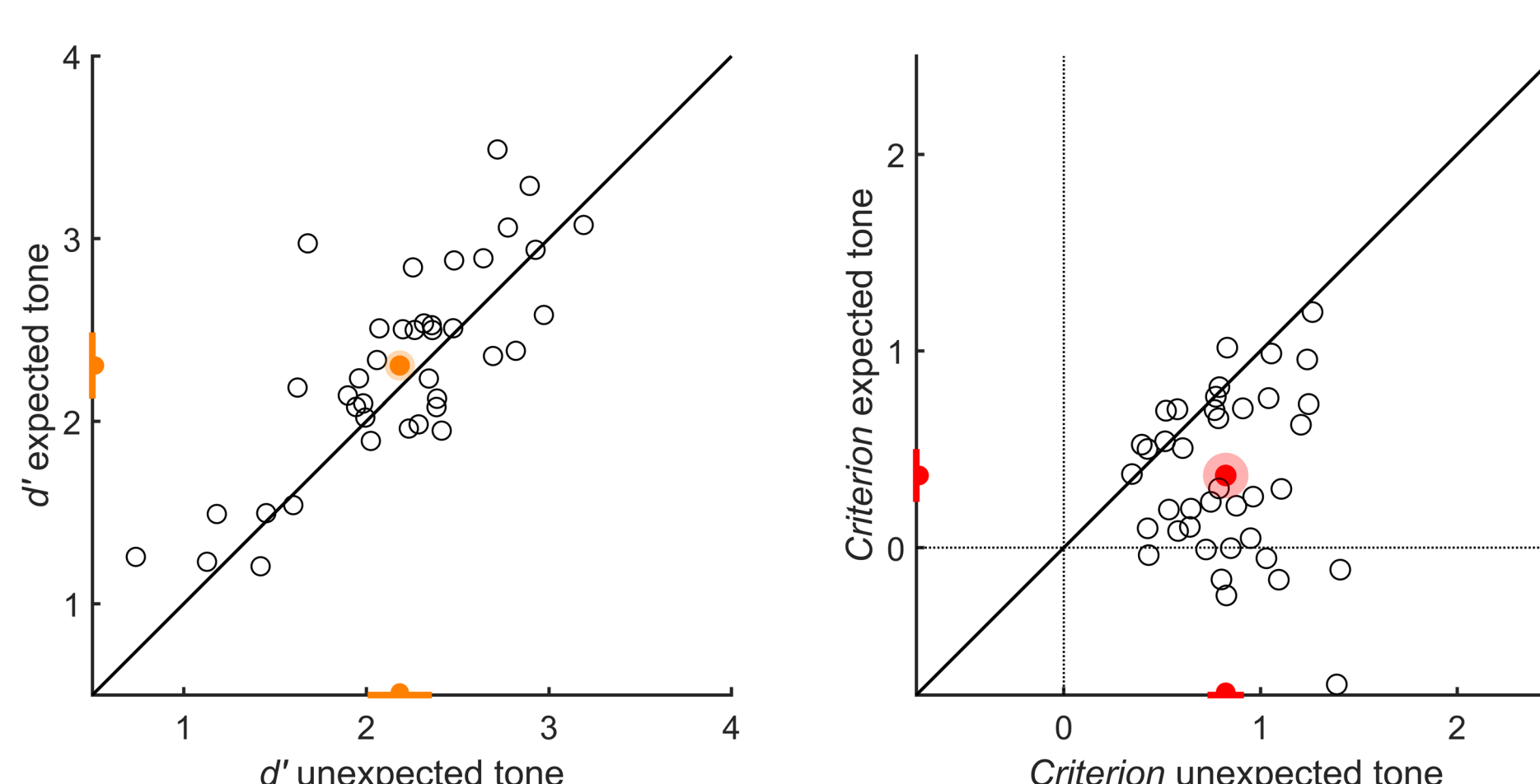
Predictions

- We will only hear unexpected tones if the update signal is strong enough to update our internal model.

The difference between expected and unexpected tones will be higher when tones are detected compared to when they are missed.

Similarly, higher amplitude update signals might be associated with faster tone detection, but only in the case of unexpected tones.

Behavioral results (n = 39)



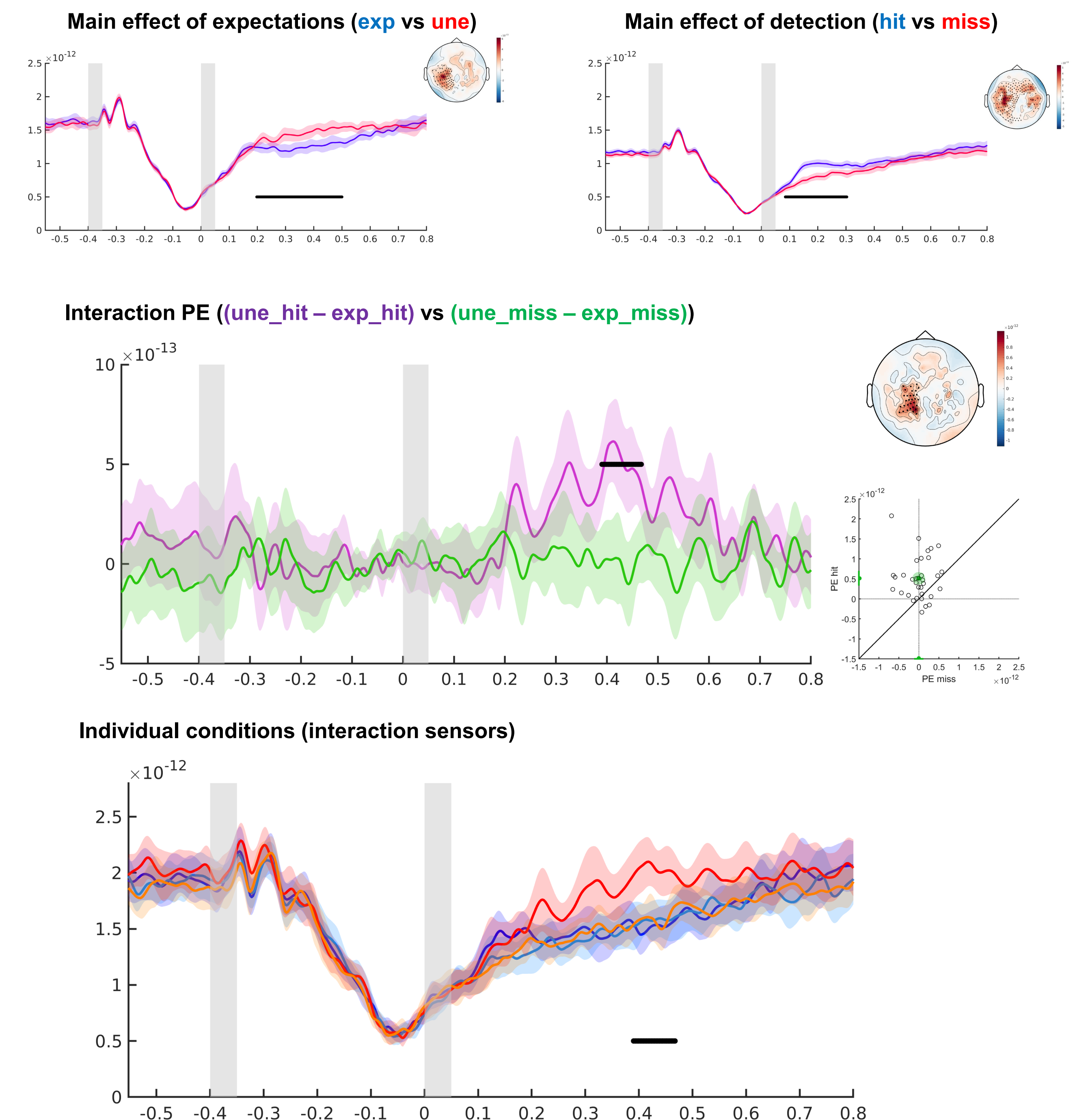
dPrime exp: 2.30 [2.12, 2.49]
dPrime une: 2.18 [2.01, 2.36]
Difference: 0.12 [0.00, 0.24]

t(38) = 2.09, p = 0.022
g = 0.22 [0.01, 0.43]

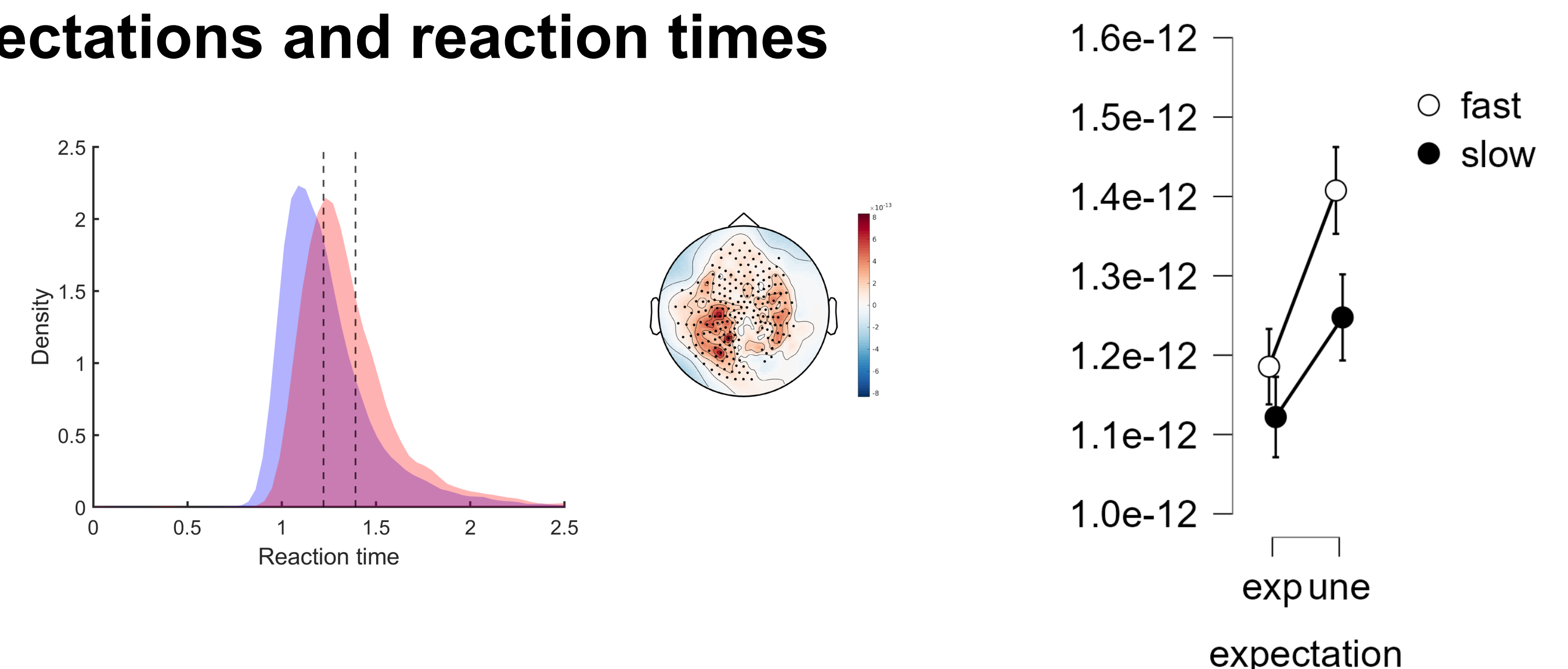
criterion exp: 0.37 [0.23, 0.50]
criterion une: 0.82 [0.73, 0.92]
Difference: -0.46 [-0.62, -0.29]

t(38) = -5.65, p = 8.7e-07
g = -1.26 [-1.78, -0.78]

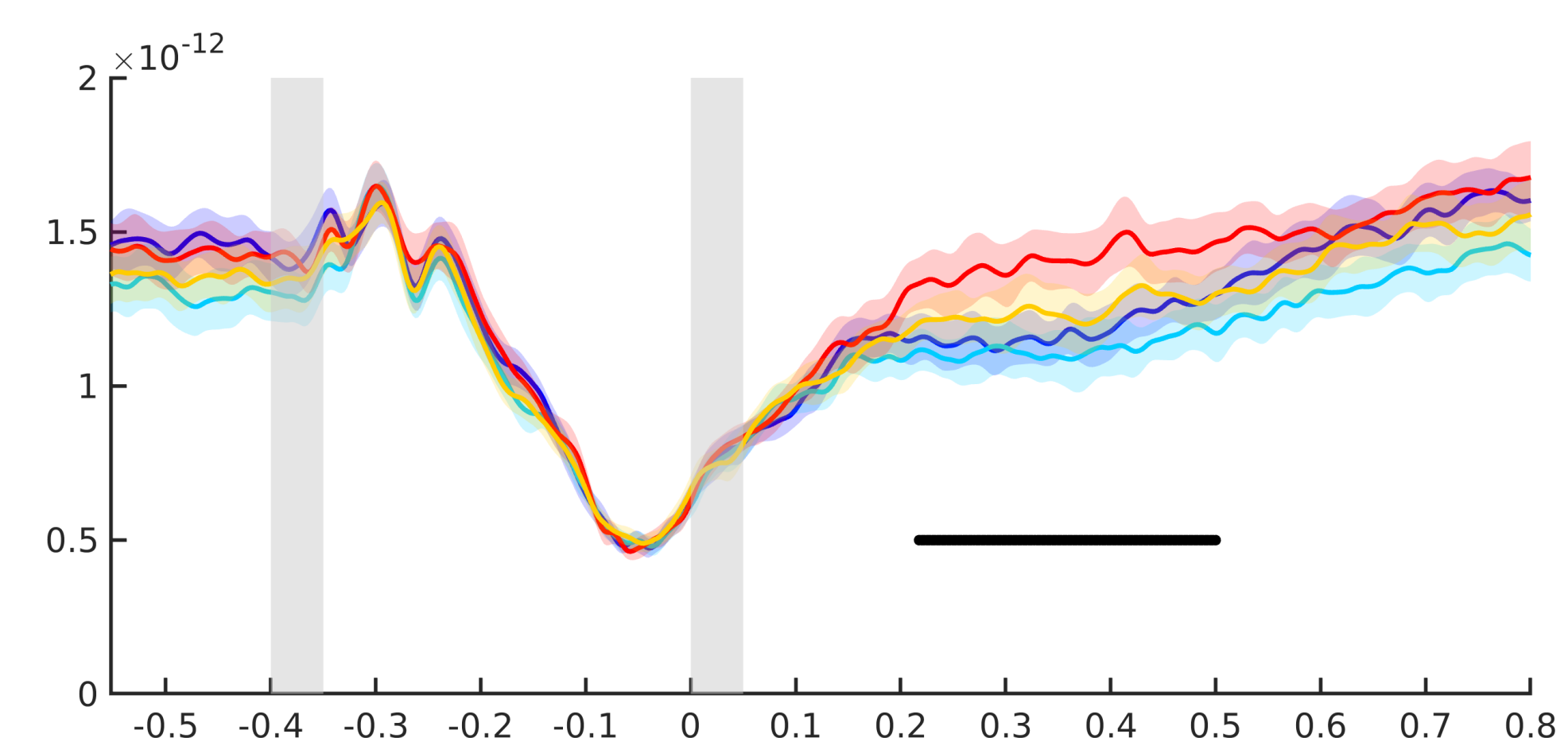
Expectations and detection of tones



Expectations and reaction times



All hits (cluster sensors: exp fast, exp slow, une fast, une slow)



Discussion

While the amplitude of a putative update signal is higher when tones are detected compared to when they are missed, the timing of the main effects suggests that, rather than model updates causing detection, the detection of tones happens first, and internal models are updated a posteriori.

