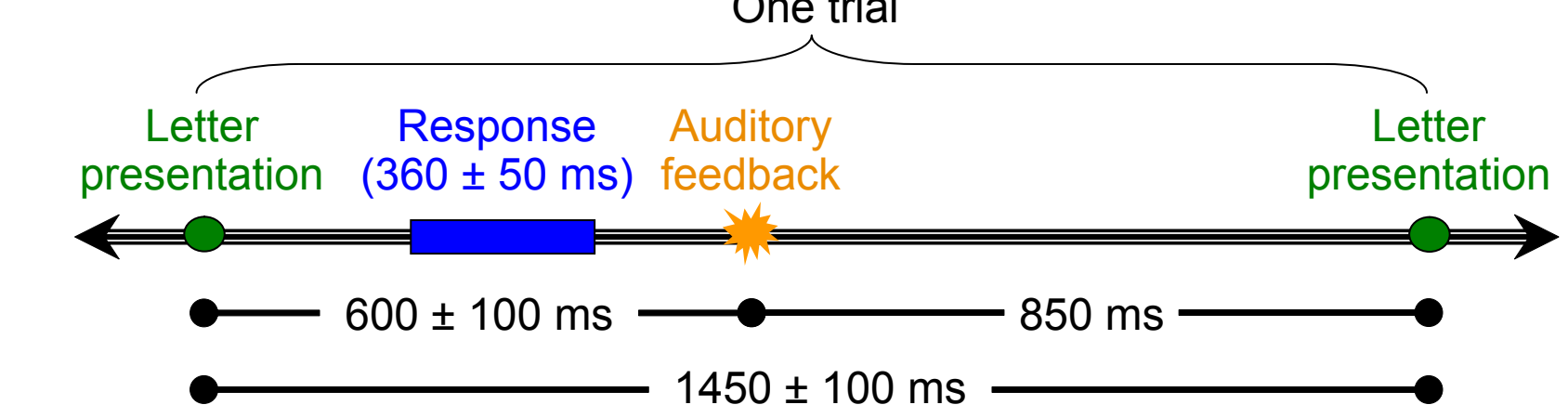
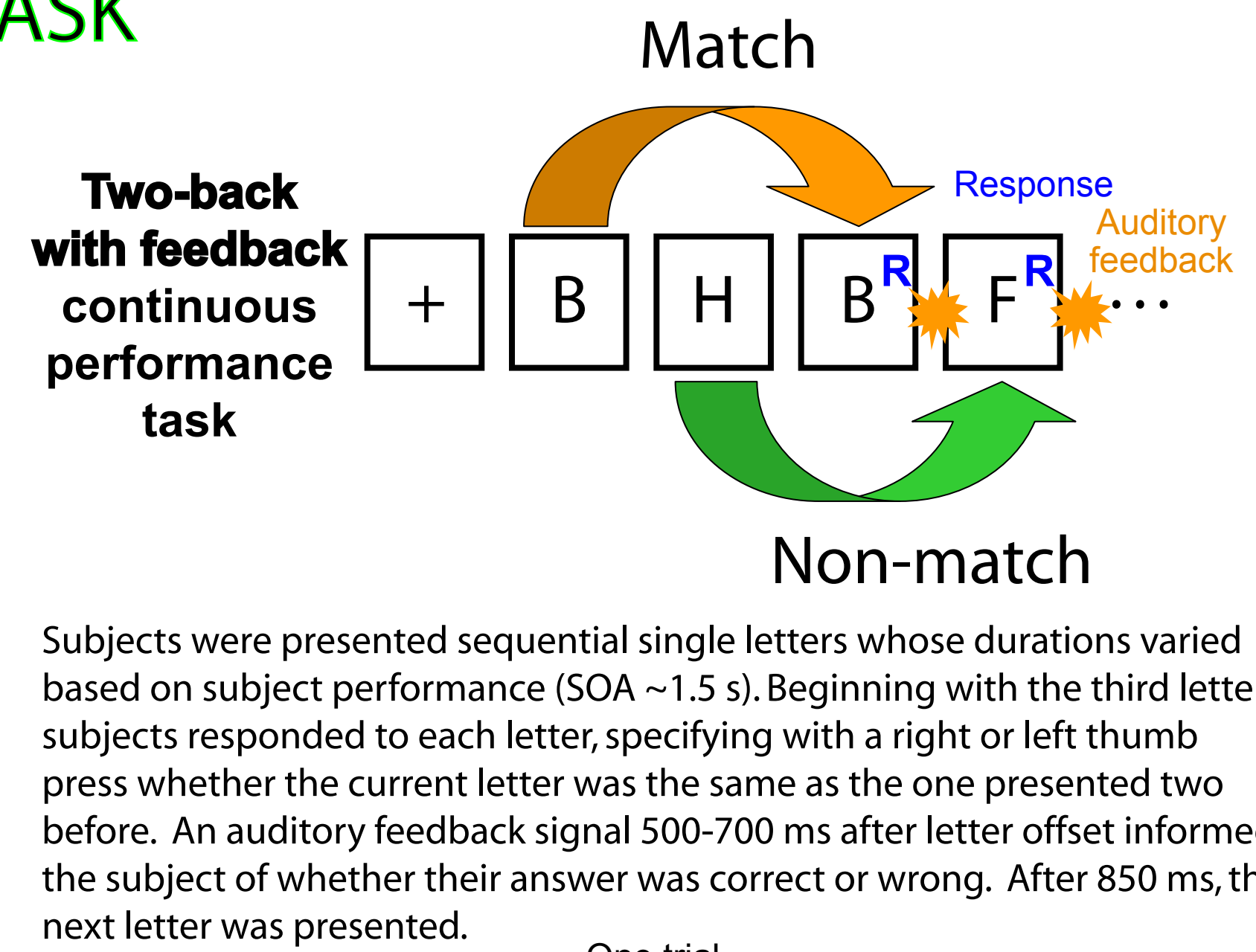


OBJECTIVES

1. Discover context-dependent changes in EEG activities by blind decomposition of single-trial log spectrograms plus trial-identifying context vectors
2. Validate and explore the associations identified by the context decomposition method

TASK



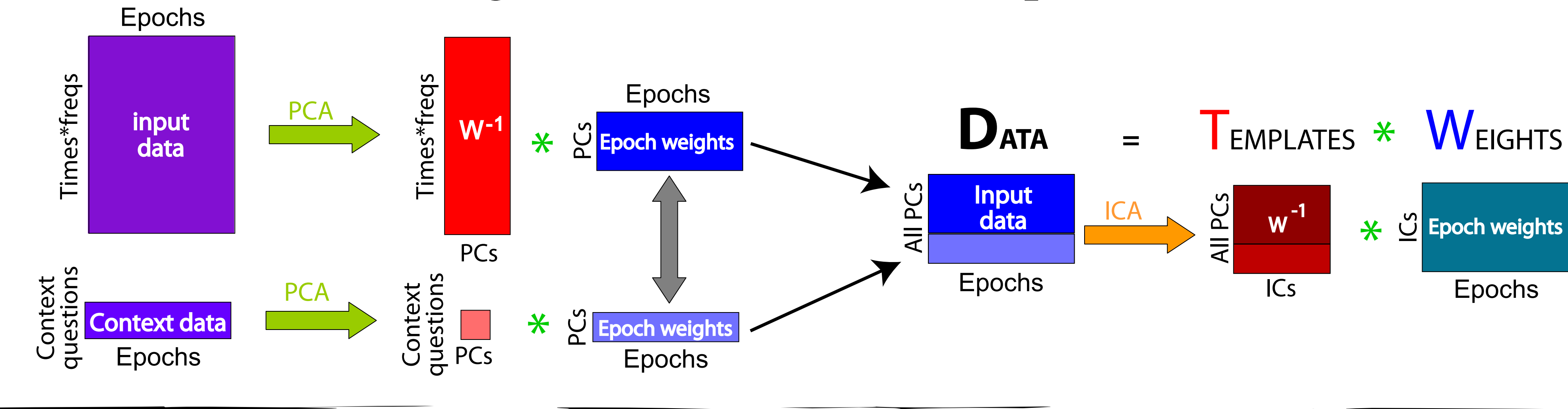
Event-related EEG spectral dynamics associated with situational context

A single-subject, single-source study

Julie A. Onton^{1,2} Scott Makeig²

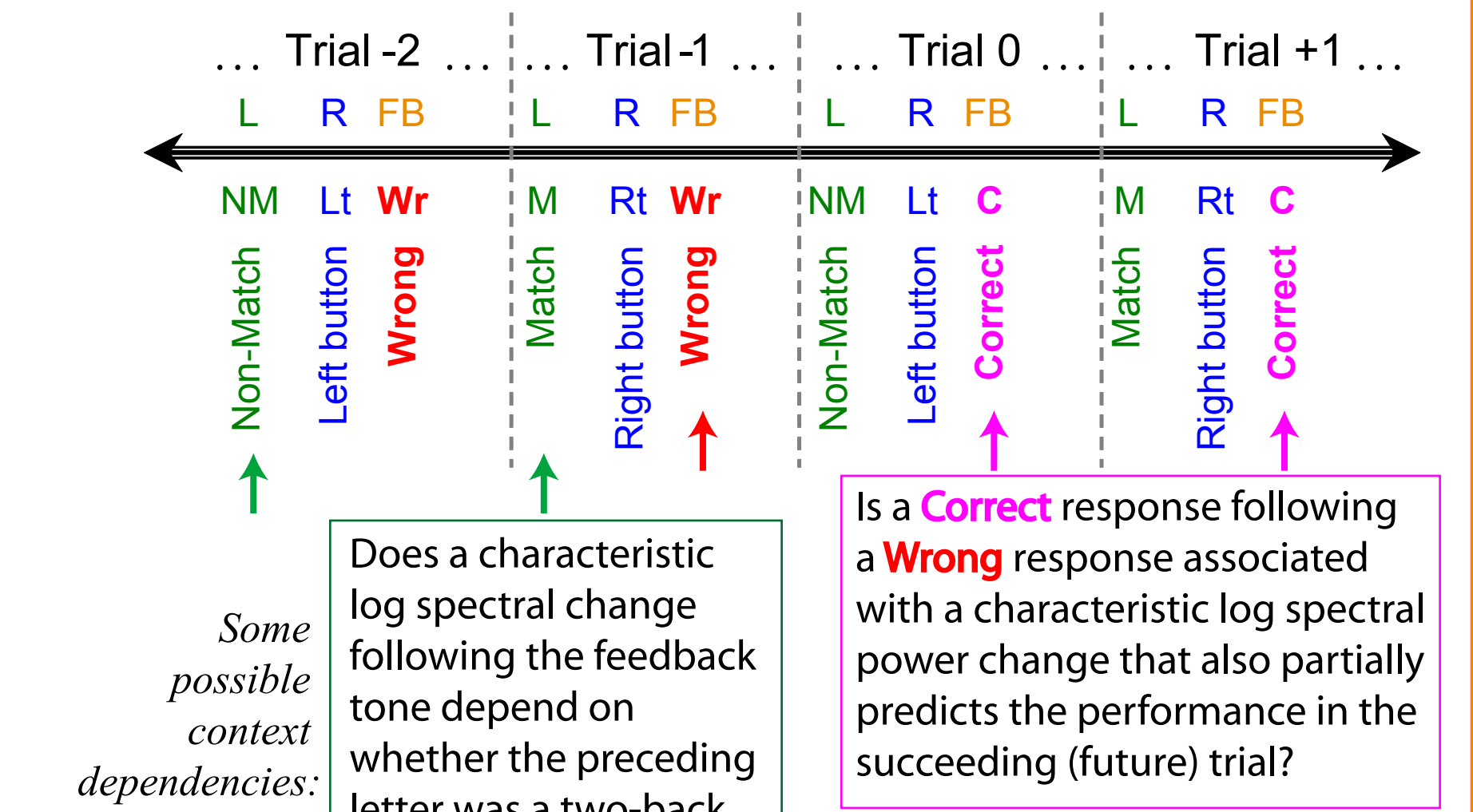
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Context ICA: find maximally independent task-related log spectral changes in single trials associated with specific behavioral contexts



CONTEXT ICA CONCEPT

Sample trial sequence:

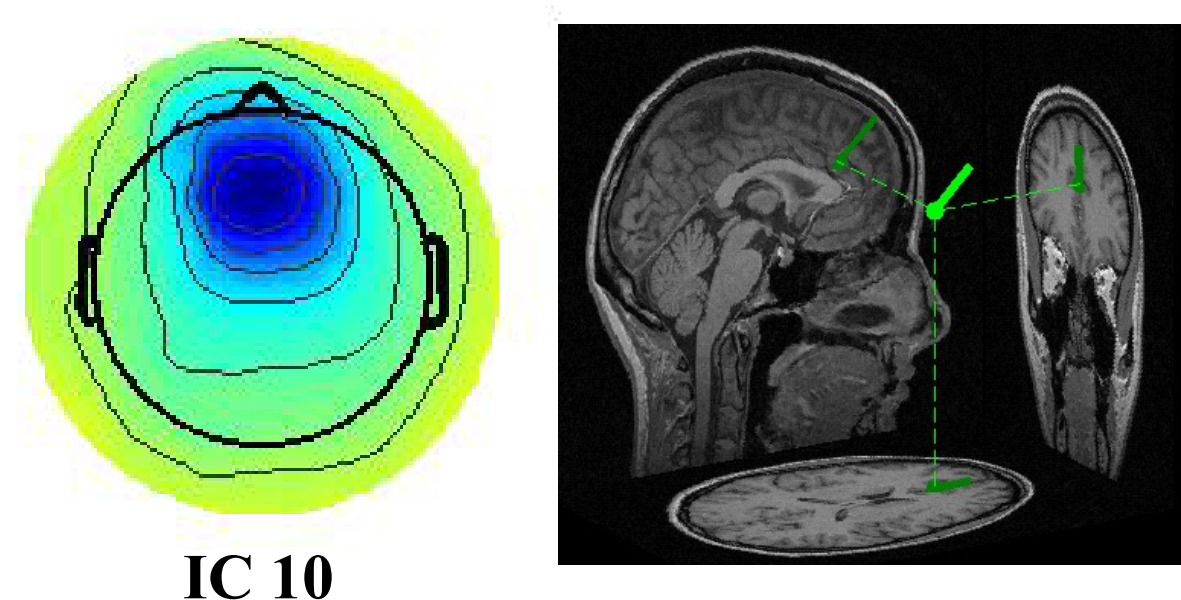


8 CONTEXT QUESTIONS

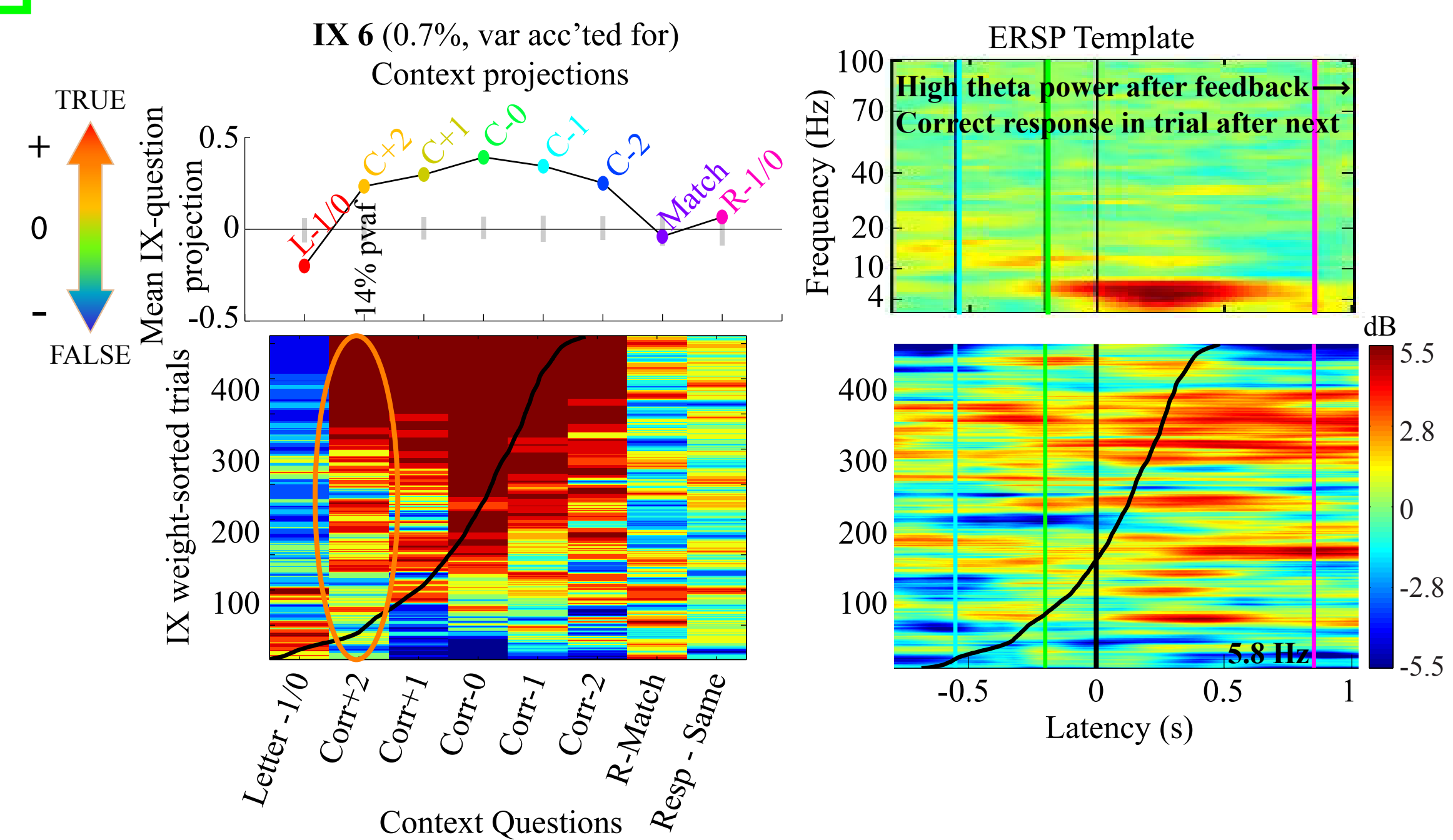
- Current letter same as 1-back?
- Trial +2 will be correct?
- Trial +1 will be correct?
- Current trial correct?
- Trial -1 was correct?
- Trial -2 was correct?
- Current trial is a match?
- Current response button same as 1-back?

Trial-to-trial variations in event-related log power spectral perturbations following auditory feedback tones in this task may depend not only on the task significance of the current stimulus or the immediately preceding letter but on the combination of past performance, manual response history and the letter sequence, among other known and unknown variables. Context ICA (xICA) separates trial-to-trial spectral variability into a (log) linear mixture of active context dependencies with associated time-frequency activity.

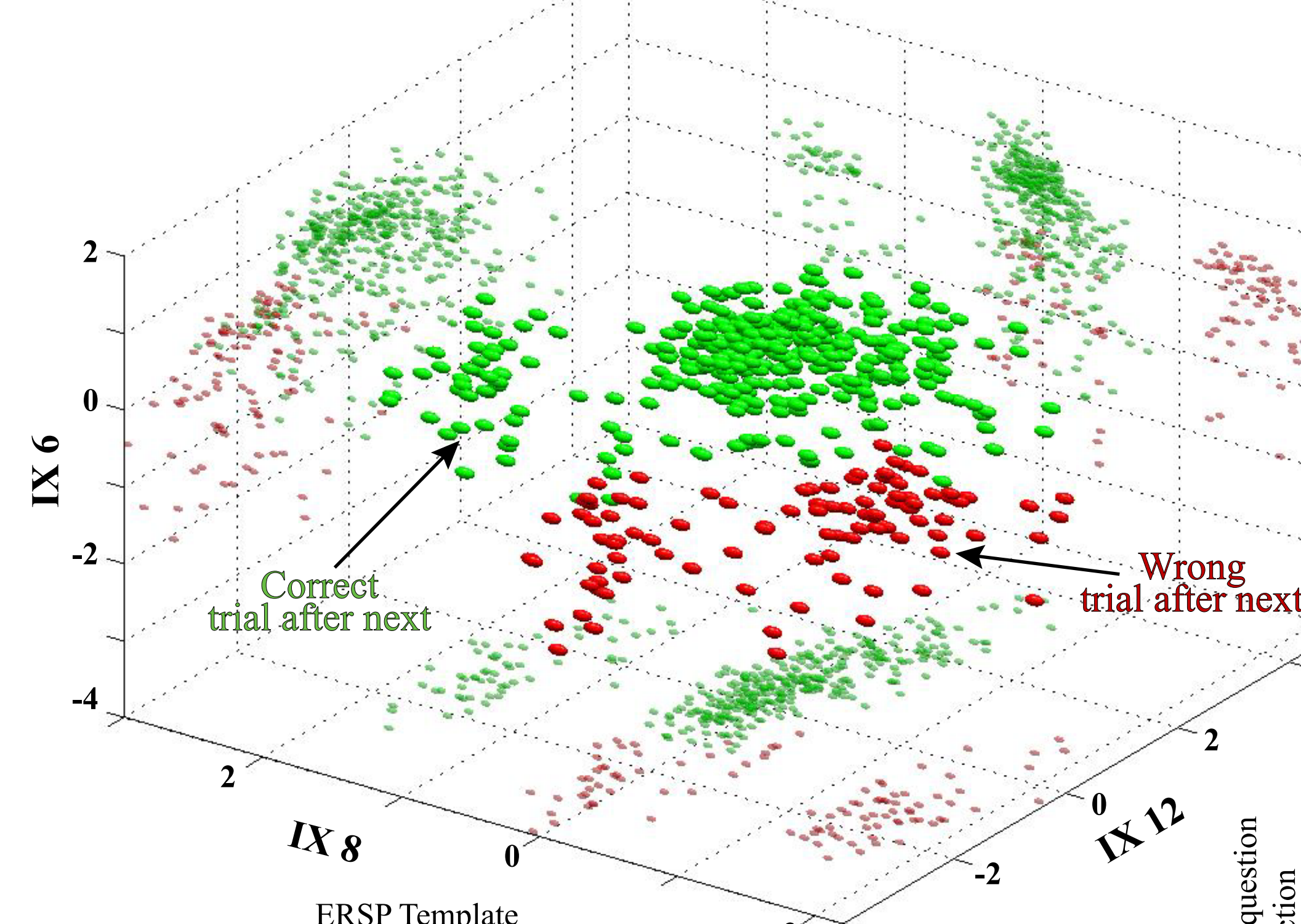
Frontal midline theta IC (dorsal anterior cingulate)



All context results shown are from decomposition of IC10 (frontal midline theta; dACC) activity from one subject



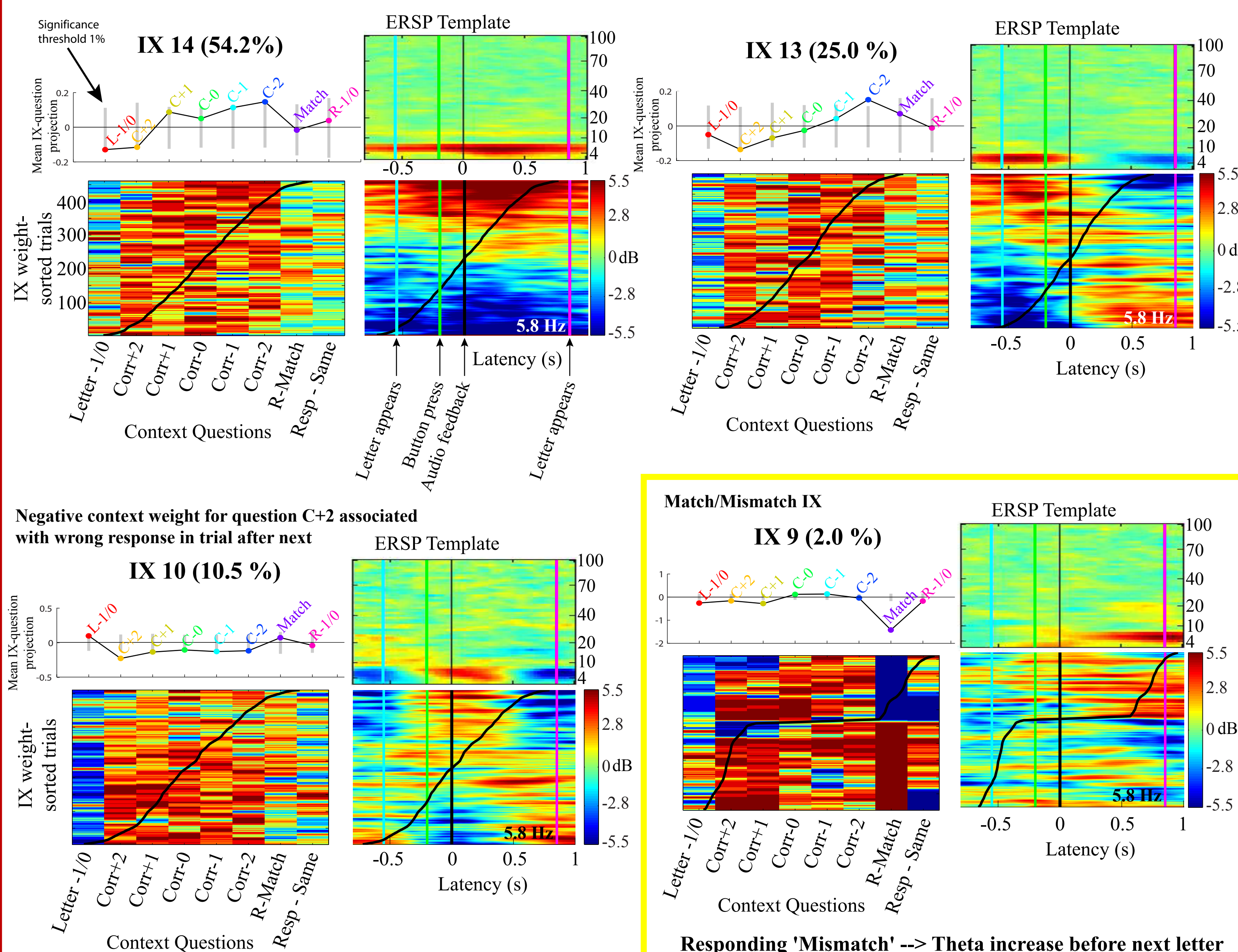
Independent context (IX) trial weights



While these three theta power patterns *do* relate to working memory success, the *largest* portion of theta power variations were *not* linked to *these* context questions

Highest theta variance accounted for IXs:

Three IXs accounting for most trial-to-trial theta variance had little effect on subsequent responses



SUMMARY

Inter-trial variability may sometimes be explained by known factors involved in task performance. Context ICA (xICA) decomposition can find linear dependencies between continuous EEG (log spectral) data and discrete binary (yes/no) variables.

In this subject, total frontal-midline theta power during letter-presentation trials of a 'two-back' working memory task was only very weakly associated with correct match judgments (two trials later) to the letter presented during the trial. However, three specific theta power patterns were associated with correct match judgments in the trial-after-next:

- IX6.** *Theta increase following auditory feedback* (associated with good performance in general)
 - IX8.** *Theta increase following button press* (predictor of poor performance in the next trial, but good performance in trial after next)
 - IX12.** *Theta increase before letter onset* (predictor of future good performance when past performance has been poor)
- For this subject, frontal midline theta power also tended to increase following 'Mismatch' responses according to IX9 (yellow box)