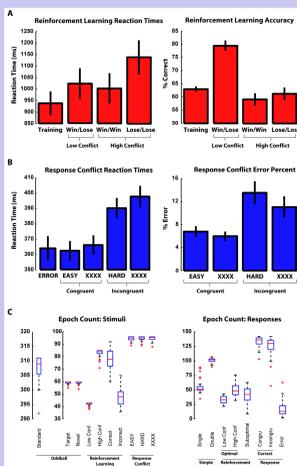
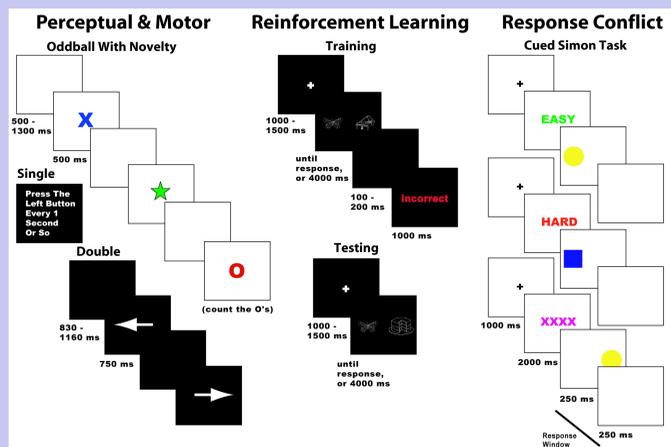


James F. Cavanagh^{1,2} Laura Zambrano-Vazquez² John J.B. Allen²

¹Brown University ²University of Arizona

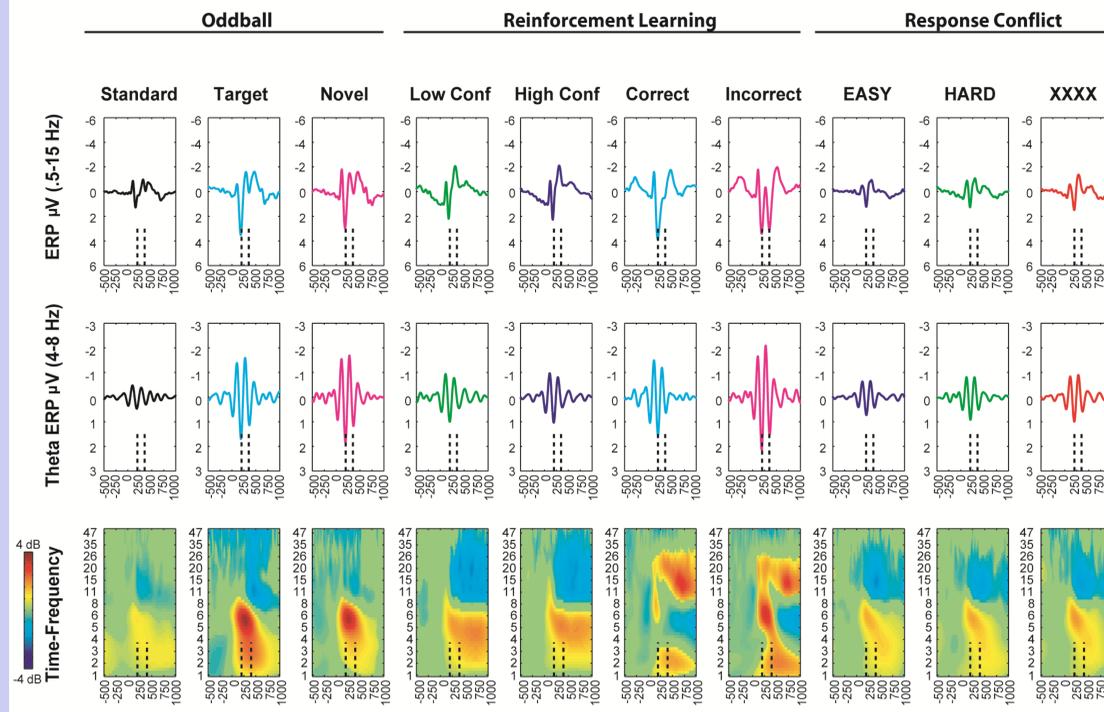
Abstract

- Theta band activities over the medial frontal cortex (mPFC) have been proposed to reflect a common substrate of the FRN/N2 and ERN/CRN ERP components during action monitoring tasks.
- For example, previous investigations have suggested that oscillatory perturbations in mPFC theta reflect the degree of error, punishment and conflict during stimulus and response processing.
- Here, 40 participants completed three different tasks with varying degrees of stimulus and response conflict.
- Theta-band filtered ERPs demonstrate remarkable phase consistency following all types of stimuli and responses.
- Permutation tests revealed that all stimuli and responses in the FRN/N2 and ERN/CRN time ranges were associated with mPFC theta power increases.
- The common denominator of mPFC theta suggests a generic processing mechanism for coordinating endogenous and exogenous performance-relevant information.
- This process is enhanced in situations typically associated with mPFC functioning: reactive responses to novelty, error, punishment and conflict.

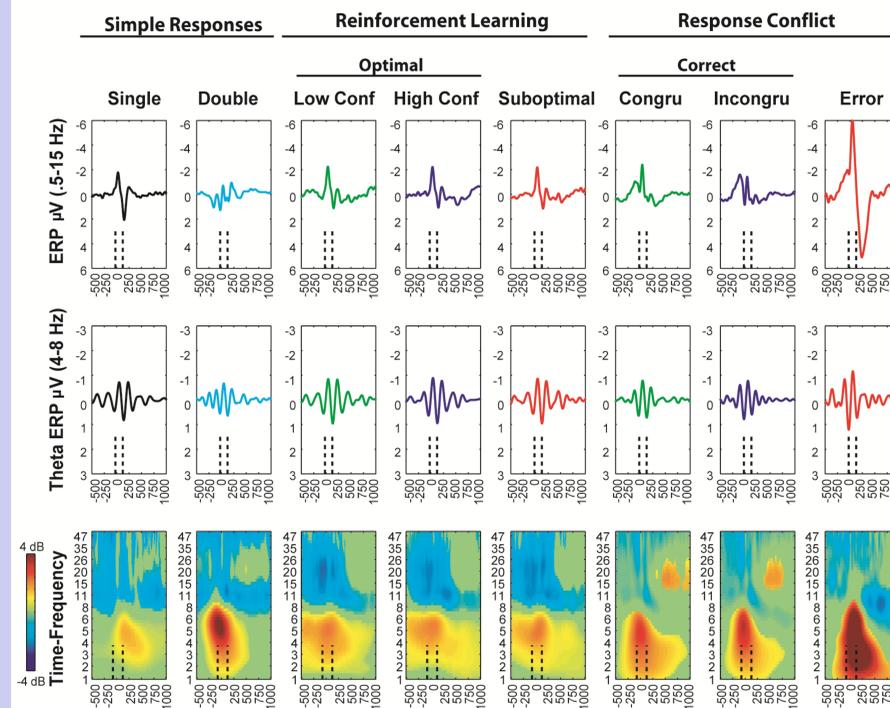


- EEG data are from the FCz electrode with an average reference (60 electrodes).
- The time range for data quantification (ERPs and time-frequency) are displayed on stimulus-locked (*N2 range: 200-350ms*) and response-locked (*ERN range: -25:175 ms*) plots.
- ERPs were quantified as the deflection from the trough in the expected time range and the preceding peak.
- Theta power was quantified as the magnitude of the wavelet-convolved signal, converted to dB change from pre-cue activity.
- Time-frequency plots were permutation tested 500X with cluster-wise thresholding for multiple comparisons

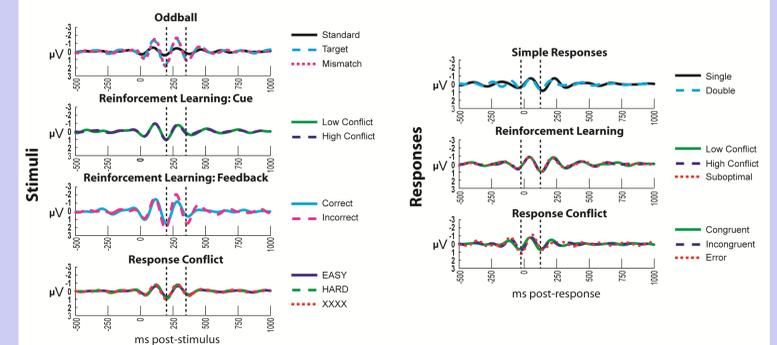
Stimuli



Responses



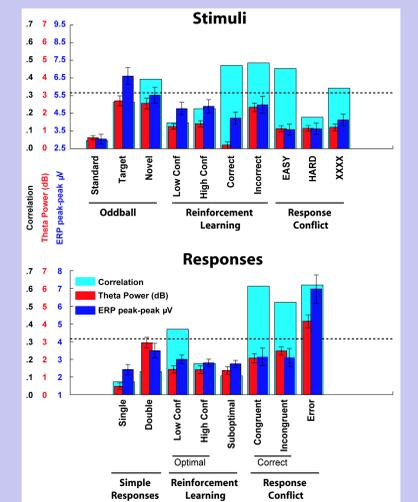
Theta Band (4-8 Hz) Filtered ERPs



- Theta band (4-8 Hz) filtered ERPs, overlapped within each task and condition.
- These comparisons demonstrate a remarkable degree of phase consistency during both stimulus processing and manual responding.

- Theta power (dB) and ERP amplitude (.5-15 Hz, µV) for each condition in the FRN/N2 or ERN/CRN time range.

- The correlation between theta power and raw ERP component amplitude is shown in cyan behind each pairing. The horizontal dotted line displays the threshold for statistical significance.
- While the values are similarly scaled, they do not strongly correlate during non-demanding processes.



Conclusions

- A wide variety of stimulus-locked ERP components in the N2 time range and response-locked ERP components in the ERN time range are associated with medial frontal theta power phase consistency and power increases.
- While other frequency bands contribute to these EEG signatures in varying circumstances, the underlying theta-band characteristic suggests a common spatio-temporal mechanism for information processing.
- The tendency to define ERP components based on task circumstances may obfuscate the generative neural mechanisms.
- Spectral transformations are highly desirable when attempting to parse commonalities and differences in EEG signatures.