Weighting of neural prediction error by rhythmic complexity:

A predictive coding account using mismatch negativity

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Intro

- According to predictive coding (PC), our brain constantly tries to predict the timing of upcoming events during language and music listening.
- For incorrect predictions, precision-weighted 'error signals' are generated that induce an update of the internal model, in order to attain more precise temporal predictions of the incoming sensory stimulus.
- In electrophysiology, the error signal is thought to be reflected in the mismatch negativity (MMN) evoked potential.
- Here, we manipulate the complexity of rhythmic patterns to examine how different degrees of temporal uncertainty modulate the size of the MMN prediction error signal.

Methods

Design

- We recorded 64-channel EEG data (SR =1000 Hz) from 17 participants in a rhythmic oddball paradigm.
- Five-tone rhythms were presented in three blocks of different complexity: zero, medium, and high entropy. Each block contained standard (80%), small (10%) and large timing deviant sequences (10%).
- The Shannon entropy of rhythms was calculated based on the number of distinct inter-onset intervals (IOIs) in the standard sequences.

Pre-processing EEG data

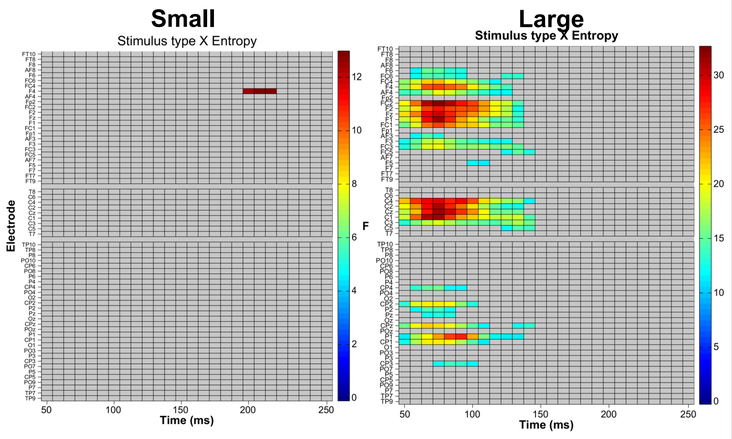
- Downsampling to 125 Hz; offline reference to average mastoids; bandpass filtering 0.1-30 Hz; epoching -100 to 600 ms from 4th tone onset; artifact rejection; baseline correction (-100. to 0ms).

Mass univariate analyses

- Separate for small and large deviants.
- Two-way ANOVAs at all electrodes and time points of interest (50-250 ms). Factors: Stimulus (standard vs deviant); Entropy (zero, medium, large). Dep variable: MMN amplitude.
- Permutation-based correction (10000 permutations; αFWE=0.05)

Results

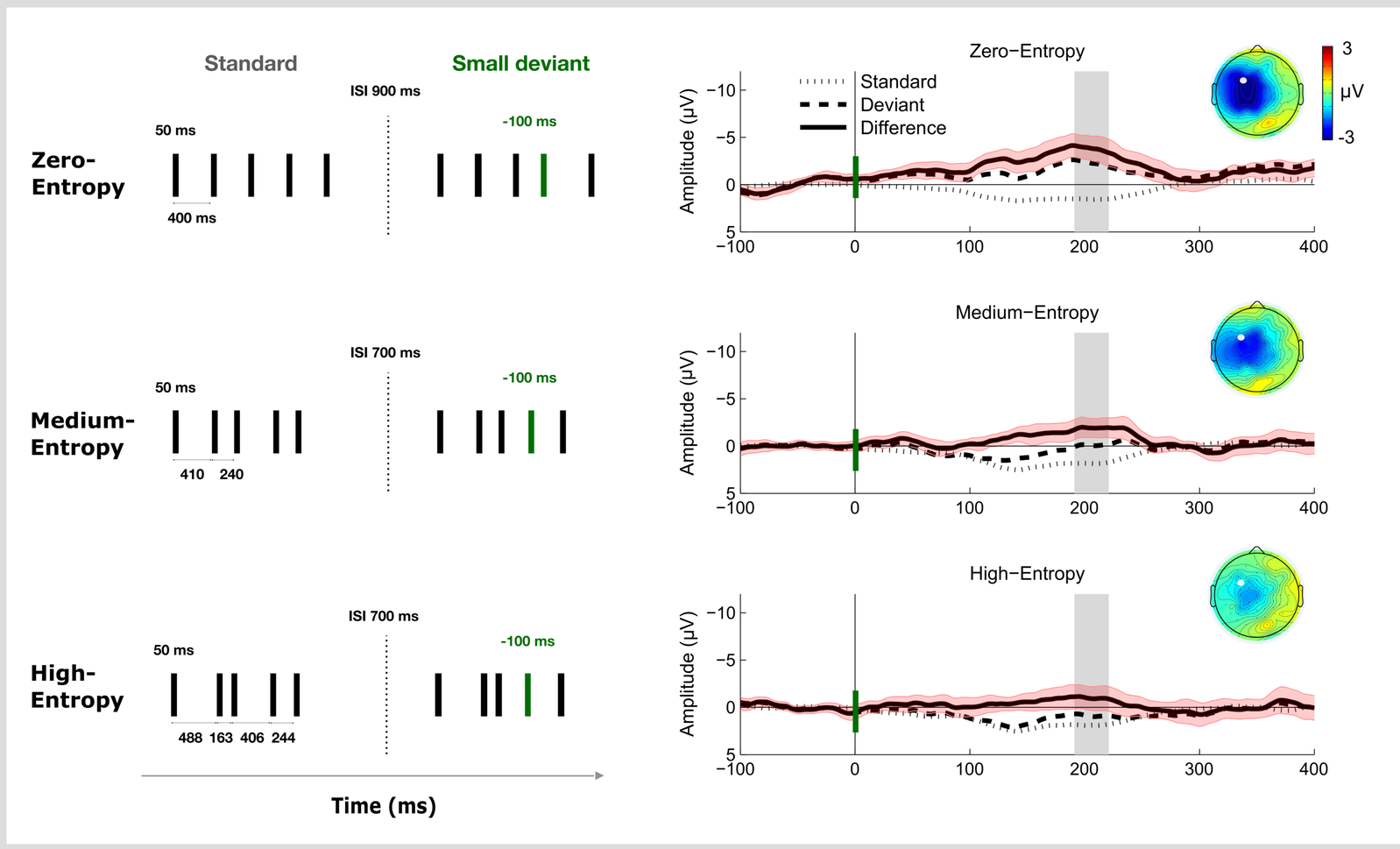
- *Small deviants:* With increasing entropy, MMN decreases significantly.
- *Large deviants:* With increasing entropy, the N1 shows a significant increase.

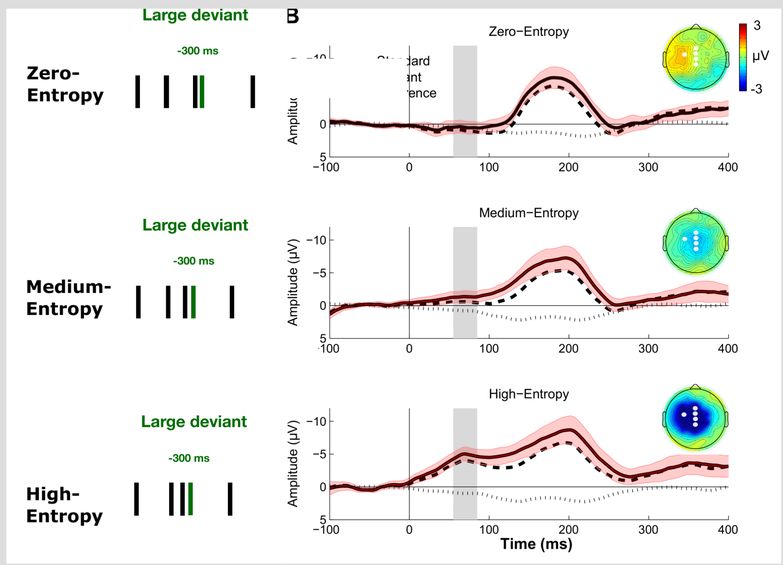


Discussion

- We support the hypothesis of a precision-weighted modulation of neural prediction error by rhythmic complexity.
- The N1 responses display an interaction of effects of rhythmic complexity and orienting of attention.
- In future works, MMN can be used as a neurophysiological marker of rhythmic complexity

Neural prediction error elicited by timing deviations in tone patterns decreases as a function of rhythmic complexity





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