Regularity encoding and deviance detection in the human auditory brainstem

ABSTRACT:

We aimed at demonstrating that increasing the regularity in the acoustic background helps to back-propagate the encoding of its regularities upstream the auditory pathway. Specifically, we wanted to show that 1) the human auditory system was able to track stimulus repetition effects at brainstem level, only when precise timing information is available, and 2) that the beneficial effects of temporal regularity in back-propagating the encoding of the acoustic environment relies on the entrainment of neural oscillations to the rhythm of stimulation. The EEG of healthy subjects was recorded during passive listening of sounds presented at a constant or random pace. Results of experiment 1 showed that the auditory brainstem response showed repetition effects, (e.g., adapted to irrelevant information) that were stronger when stimuli occurred in regular compared to random timing. Results of experiment 2 confirmed that temporal predictability is critical to enhance regularity encoding. In fact, the span of adaptation of the N1 auditory evoked potential was larger for isochronous that for random timing. Moreover, the results disclosed a new component of the evoked potentials that is "emitted" when a stimulus is expected (as induced by its constant timing presentation) but nevertheless never occurs. Critically, we showed that this "emitted" response was related to larger Beta oscillations as a function of the Delta rhythm phase. We conclude that *only* when the content of stimulation is predictable, the auditory system is able to pre-activate memory traces to compare with future stimulation, and that this predictive activity is organized in time by entrained oscillations to the rhythms of the acoustic scene.

Keywords
Predictive coding, Mismatch negativity, Frequency following response (FFR), Brain oscillations

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