

The Effect of Positive and Negative Associative Value on the Mismatch Negativity and P3 Responses

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Introduction

The mismatch negativity (MMN) and P3 are components of electrophysiological brain activity that are implicated in processes of distraction and attentional capture (Horváth, Winkler & Bendixen, 2008). While the MMN occurs pre-attentively, the P3 is believed to occur at the level of conscious awareness of a stimulus.

While stimuli conditioned with a value (e.g. reward) have the ability to capture attention involuntarily (Kim & Anderson, 2019), the effects of value and valence on pre-attentive neural responses are less well characterized.

It was predicted that value-conditioned, but task-irrelevant, auditory distractor stimuli would elicit larger MMN responses than neutral stimuli, and that responses to punish-conditioned tones would be greater than reward-conditioned tones. No effect of value or valence was expected for the P3.

Methodology

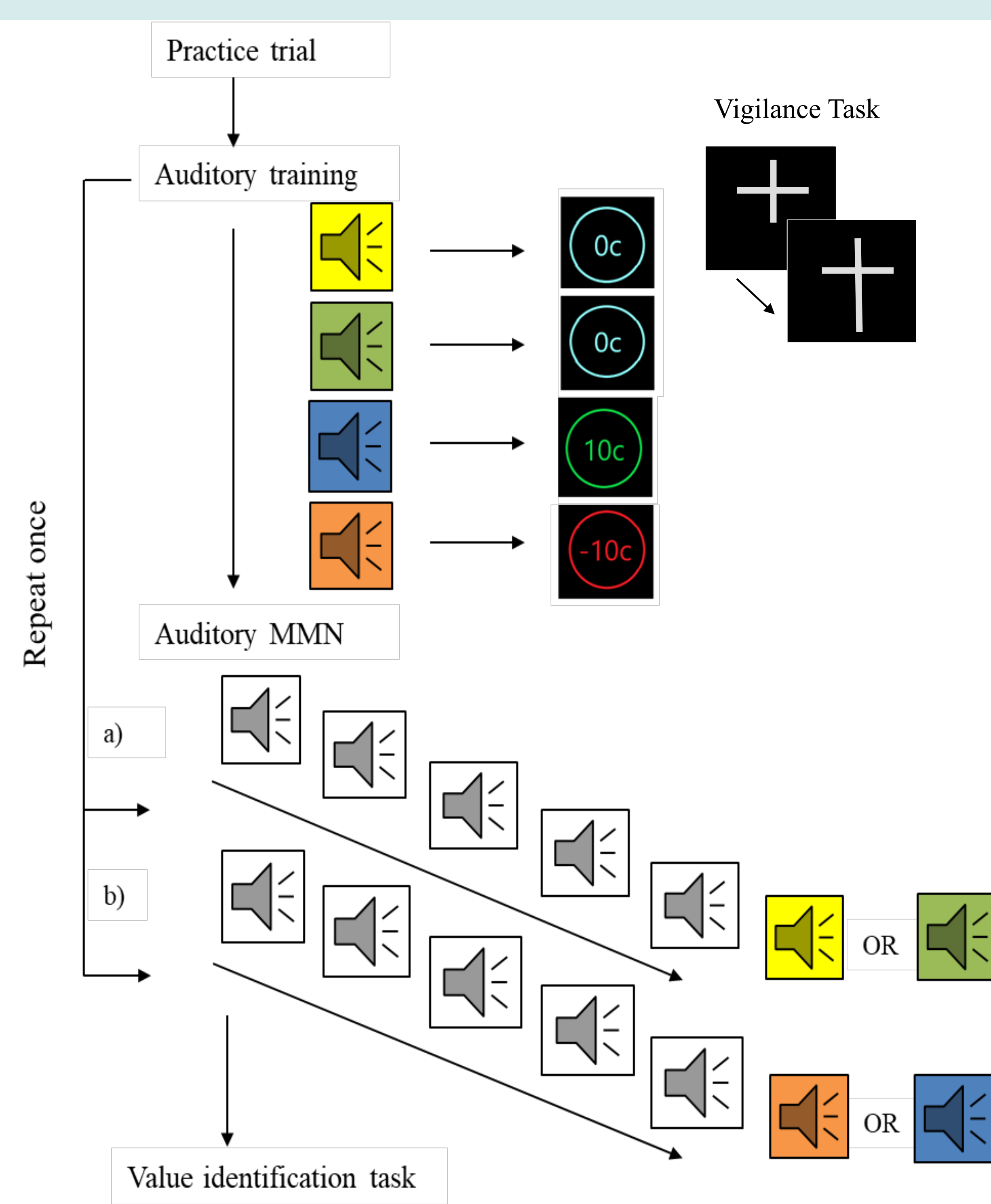


Figure 2. Experimental procedure (n = 50)

50 participants took part in an auditory oddball task while completing a primary visual task. This task was a demanding vigilance task, to control for the effect of attention on event-related potentials.

Four deviant tones were conditioned to signal positive, negative and neutral monetary values (10c, -10c, and two 0c). Tones varied in frequency (450Hz-1550Hz).

These tones were then presented intermittently among repeated standard tones while participants completed the primary visual task over 4 blocks.

Results

EEG pre-processing isolated the MMN and P3 response potentials. Results revealed a typical MMN in response to deviant tones, however, no effect of value or valence on the MMN was found (see Figure 3).

The P3 responses revealed an effect of value, but not valence (see Figure 4).

Conclusion

It appears that value - but not valence - may influence response amplitudes implicated in the orienting of attention.

These findings suggest that associative value may not influence attentional-capture pre-attentively, but instead impact only at the level of conscious awareness or response selection.

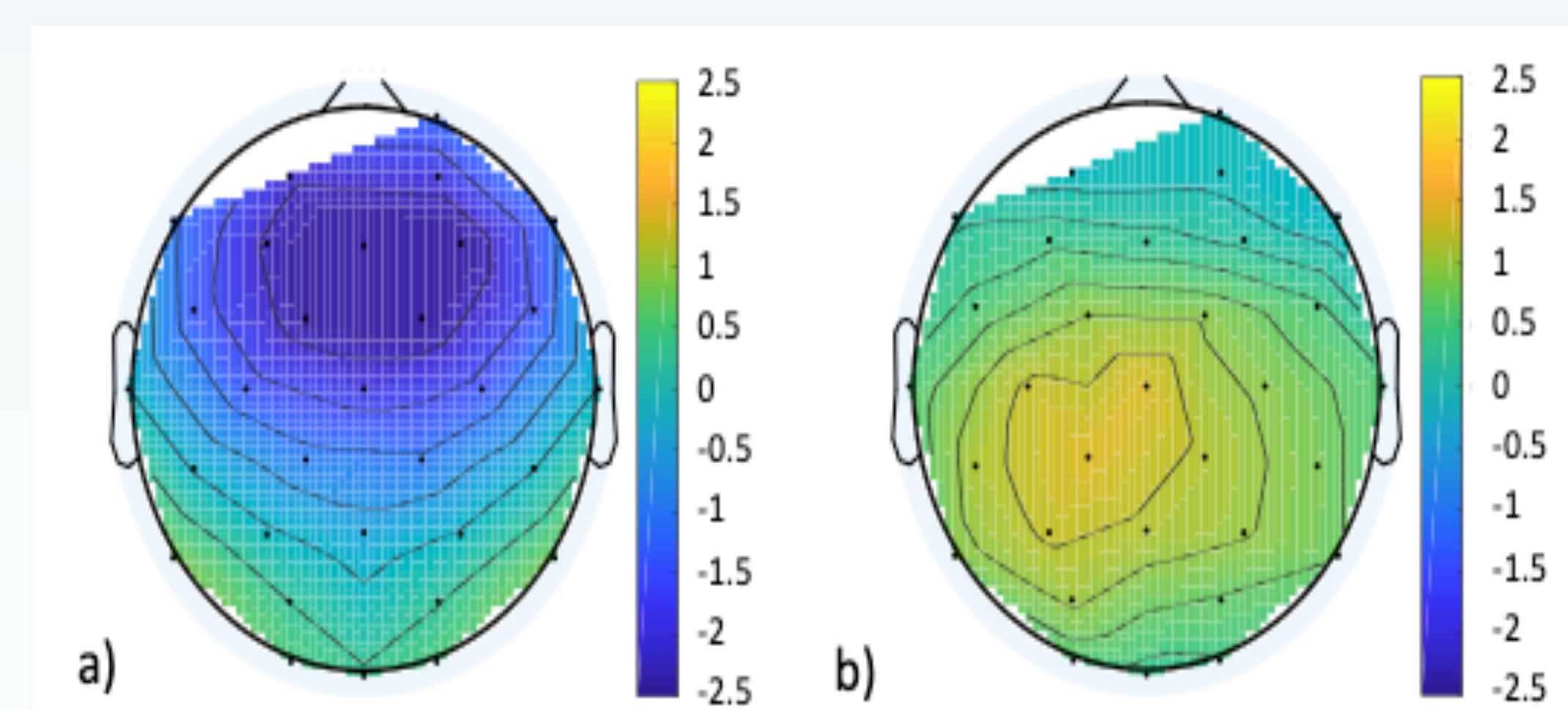


Figure 5. Scalp map showing MMN activity in frontocentral region (depicted on the left); and P3 activity in the centroparietal region (depicted on the right).

References

Horváth, J., Winkler, I., & Bendixen, A. (2008). Do N1/MMN, P3a, and RON form a strongly coupled chain reflecting the three stages of auditory distraction? *Biological Psychology*, 79, 139-147.

Volosin, M. (2018). Electrophysiological correlates of the attention-distraction balance. PhD thesis, Eötvös Loránd University - Budapest.

Watson, P., Pearson, D., Wiers, R.W., & Le Pelley, M.E. (2019). Prioritising pleasure and pain: attentional capture by reward-related and punishment-related stimuli. *Current Opinion in Behavioural Sciences*, 26, 107-113.

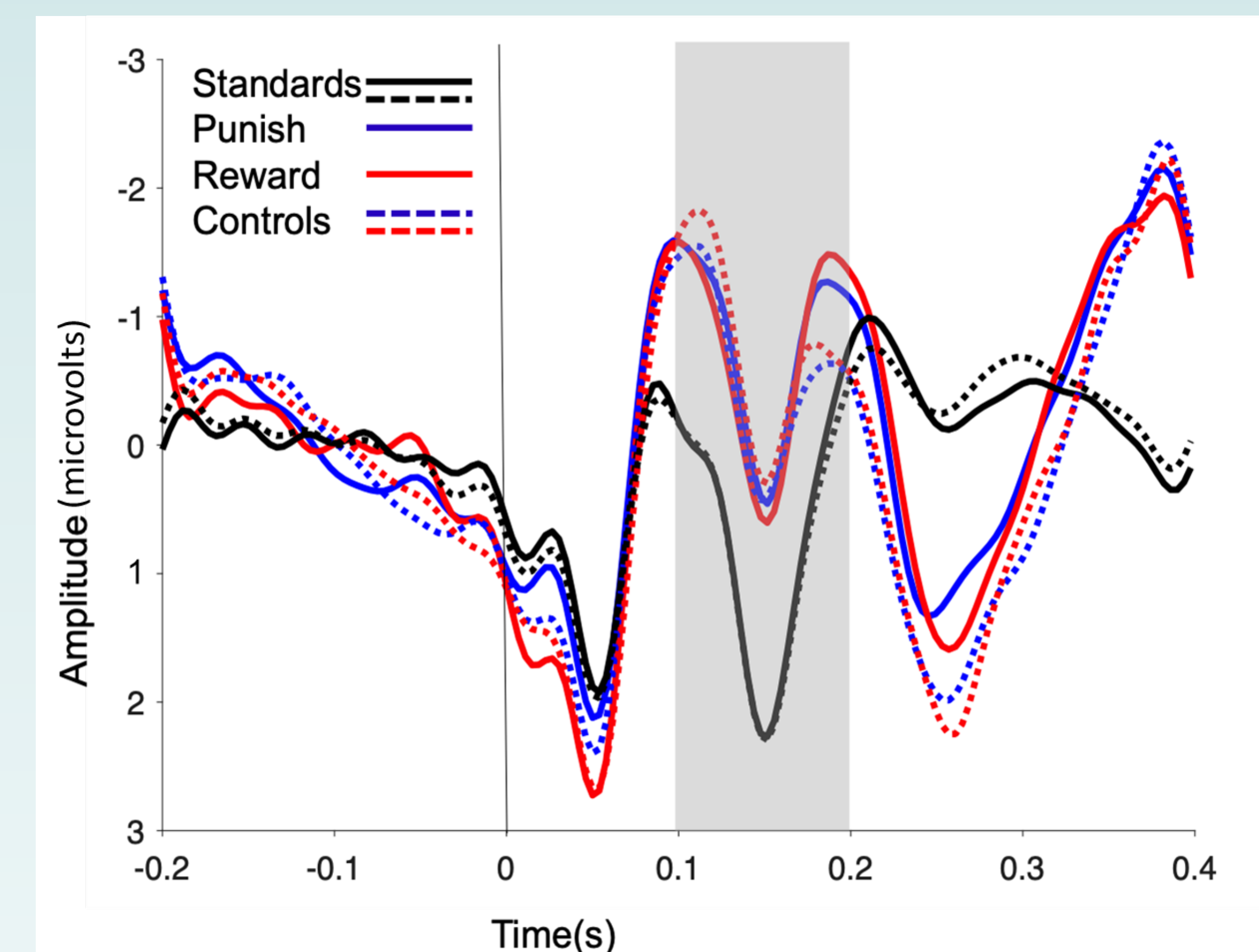


Figure 3. Average mean amplitude responses to all standard and deviant stimuli. The grey area indicates the MMN time window. The broken lines indicate responses to neutral deviant tones and their paired standard tone; the continuous lines are the value-conditioned deviant and paired standard responses.

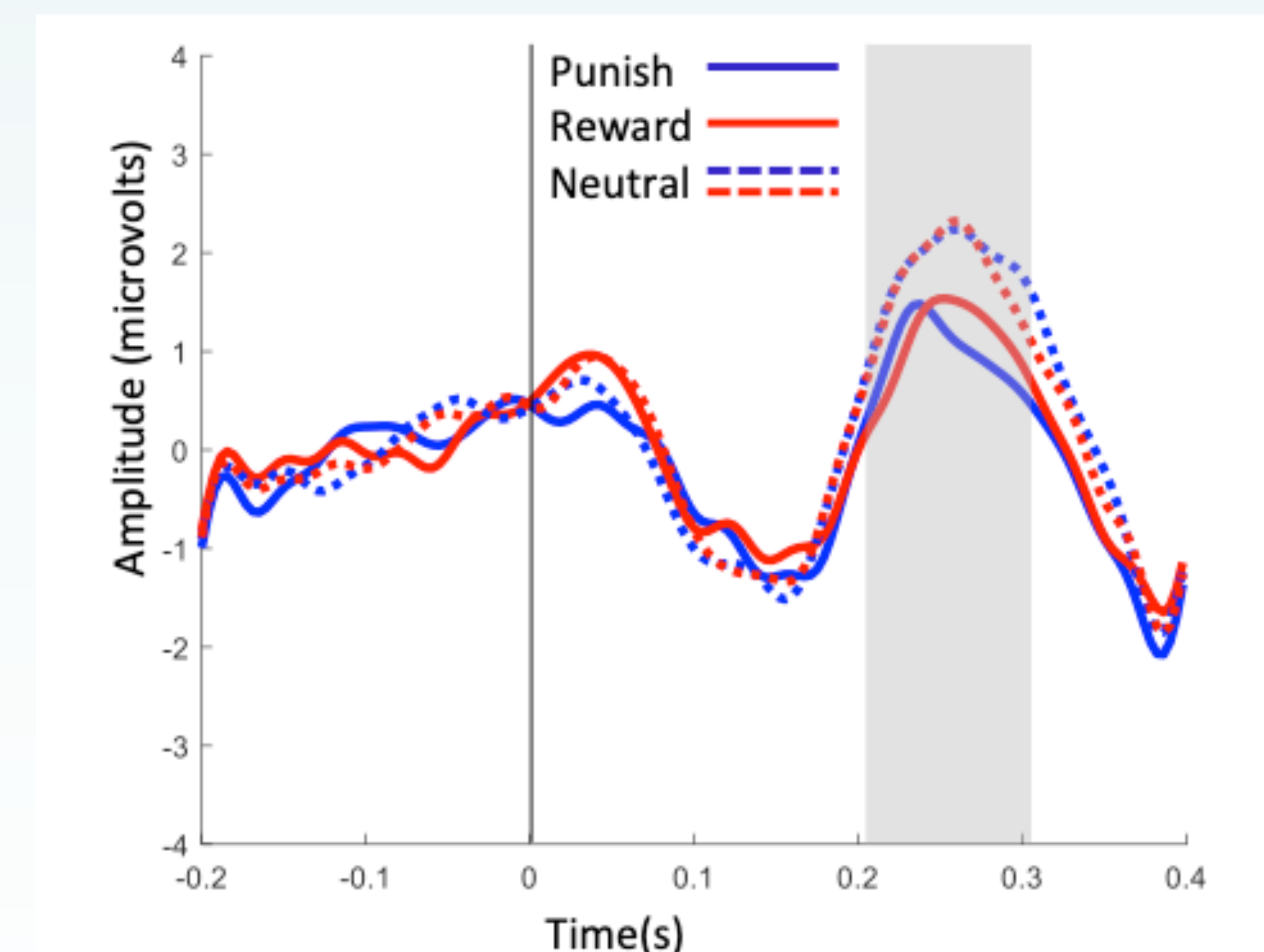


Figure 4. Average mean evoked responses to each deviant stimulus over time (sec). The grey area highlights the difference in mean P3 response between valued (unbroken lines) and neutral (dotted lines) stimuli.

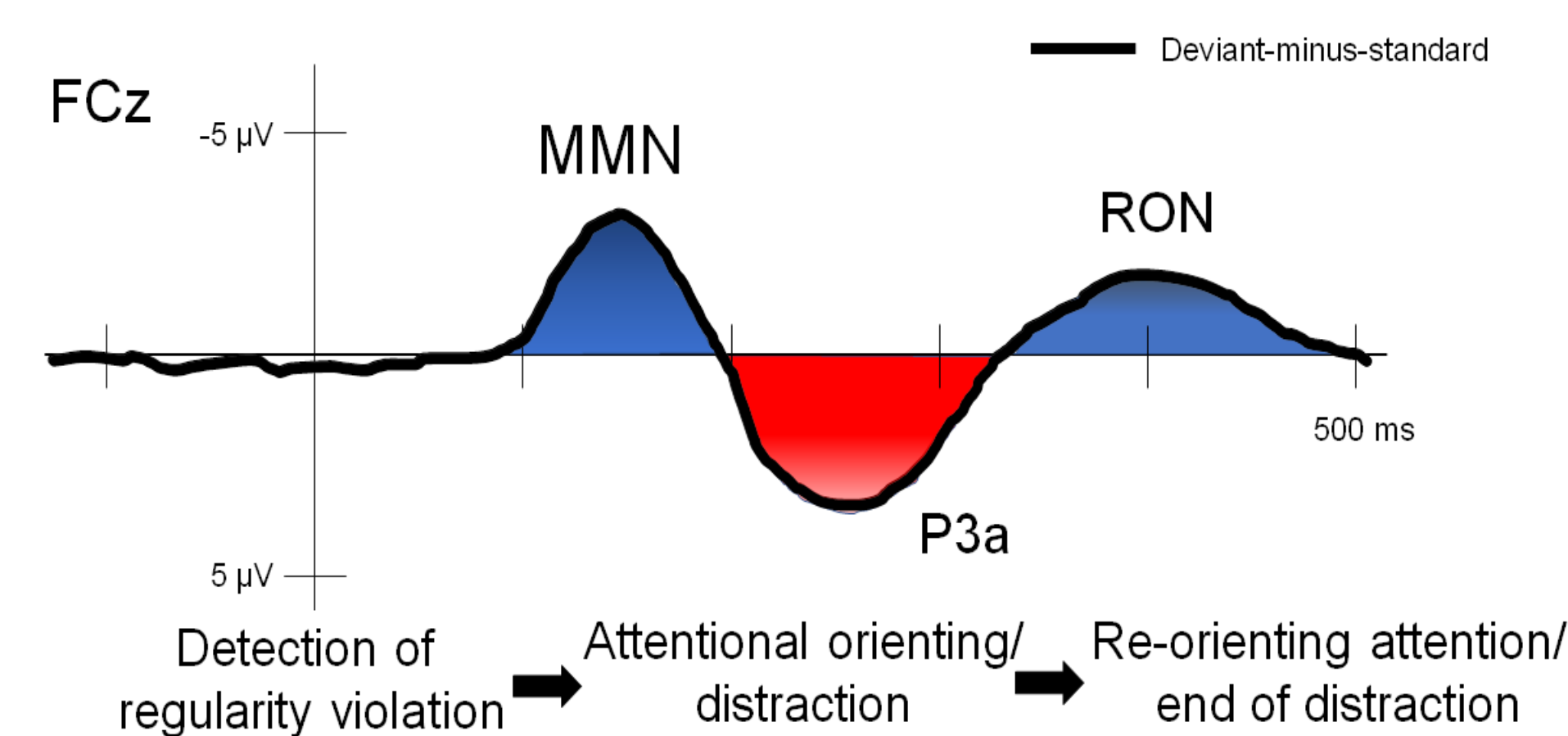


Figure 1. Event-related potentials indexing each stage of distraction (taken from Volosin, 2018).