Feedback Processing in Declarative Learning – an ERP Study

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INTRODUCTION

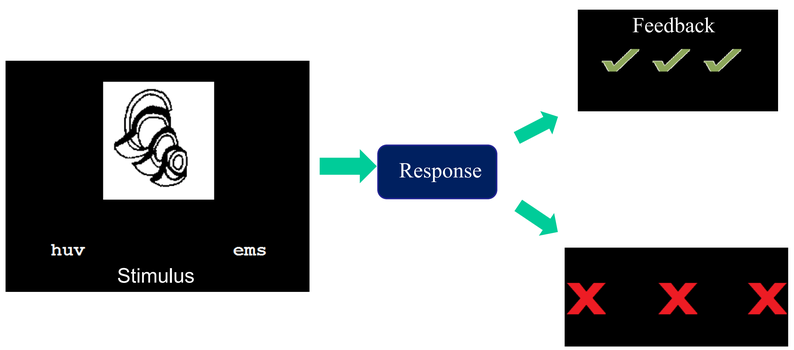
- Learning is often achieved through trial and error guided by feedback. The ability to process performance feedback is, therefore, an important part of the learning process. The purpose of the present study was to evaluate at the electrophysiological level the changes in the processing of positive and negative feedback during the learning process. Three event related potentials, the feedback related negativity (FRN), a fronto-central positivity (FCP) and the P300, were examined.

RESEARCH AIMS:

The study's goal was to evaluate ERPs associated with the processing of performance feedback (FRN, FCP, P300) as they changed over time during the learning process in a declarative learning task.

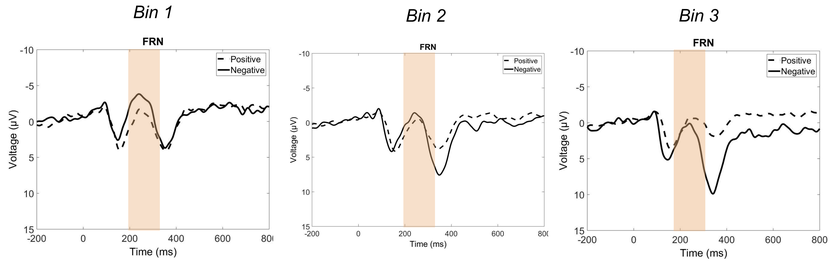
METHODS

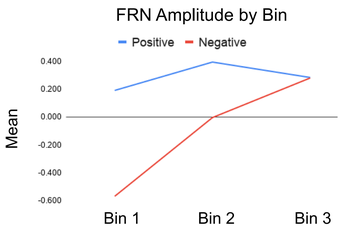
- Participants included twenty healthy young adults, ages 19 to 35, 3 men and 17 women (M = 25.9, SD = 3.87).
- Each participant completed a declarative paired-associate learning task while their electrophysiological (EEG) data were recorded.
- Participants were tasked with learning the correct association between nonsense words and novel objects by choosing the correct word out of two possible options. Each response was followed by performance feedback to indicate the correctness of the choice. EEG was time-locked to the presentation of the feedback.
- The stimulus was presented for 5 blocks of trials. Blocks of trials were divided into three bins to evaluate change over time.
- ERP processing parameters used were impedance below 50 kΩ, low pass filter of 30 Hz and high pass filter of 0.1 Hz, baseline correction, and artifact correction using ICA.
- Temporal PCA was conducted on electrodes FCz and Pz to measure the amplitude of the components.



RESULTS

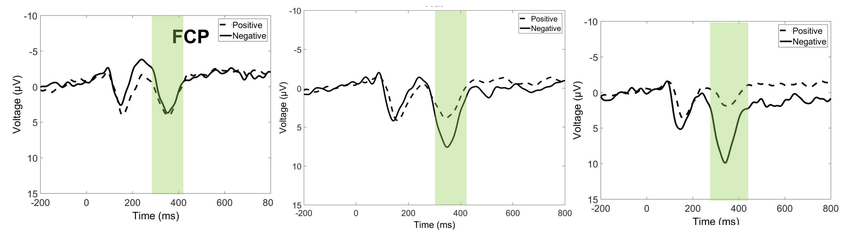
Changes in FRN during the learning process

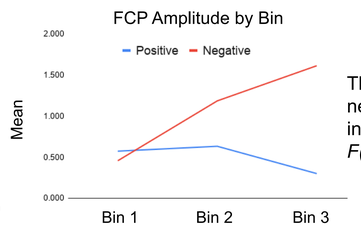




The FRN elicited by negative feedback decreased with learning *F(1,20)=4.338,p=0.029.*

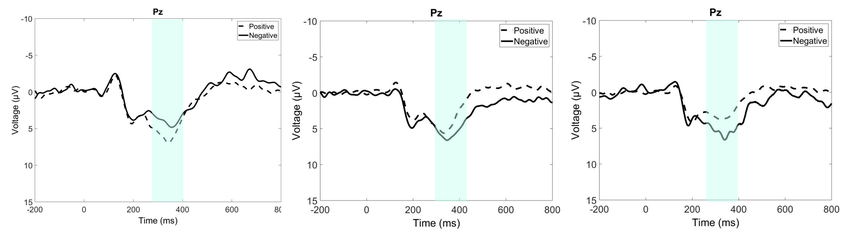
Changes in FCP during the learning process

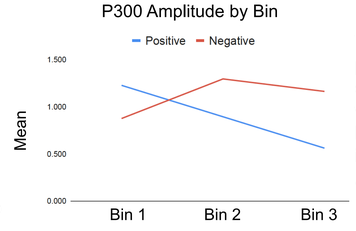




The FCP elicited by negative feedback increased with learning *F(1,20)=14.79, p=0.01.*

Changes in P300 during the learning process





The P300 elicited by positive feedback decreased with learning, while the P300 elicited by negative feedback increased with learning *F(1,20)=7.37, p=0.004.*

CONCLUSION

The results indicated that the FRN to negative feedback decreased with learning. This is in line with previous findings of a decrease difference in FRN amplitude between positive and negative feedback during learning (Arbel et al., 2014). However, in a previous report the decreased difference was driven by changes in FRN to positive feedback, whereas in the present report, it was driven by changes to negative feedback. The FCP to negative feedback increased with learning suggesting increased attention to negative feedback as learning progresses. The P300 associated with positive feedback decreased with learning, while the P300 to negative feedback increased with learning. The P300 findings can be interpreted within the framework of violation of expectancy, with positive feedback violating learners' expectancy at the beginning of the learning process, and negative feedback violating expectations when learning is established.

- Arbel, Y., Goforth, K., & Donchin, E. (2013). The good, the bad, or the useful? The examination of the relationship between the feedback related negativity (FRN) and long-term learning outcomes. Journal of Cognitive Neuroscience, 25,1249–1260.
- Arbel, Y., Murphy, A., & Donchin, E. (2014). On the Utility of Positive and Negative Feedback in a Paired-associate Learning Task. Journal of Cognitive Neuroscience,26(7), 1445-1453. doi:10.1162/jocn_a_00617

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