Individual differences in learning rate are reflected in feedback related brain processes

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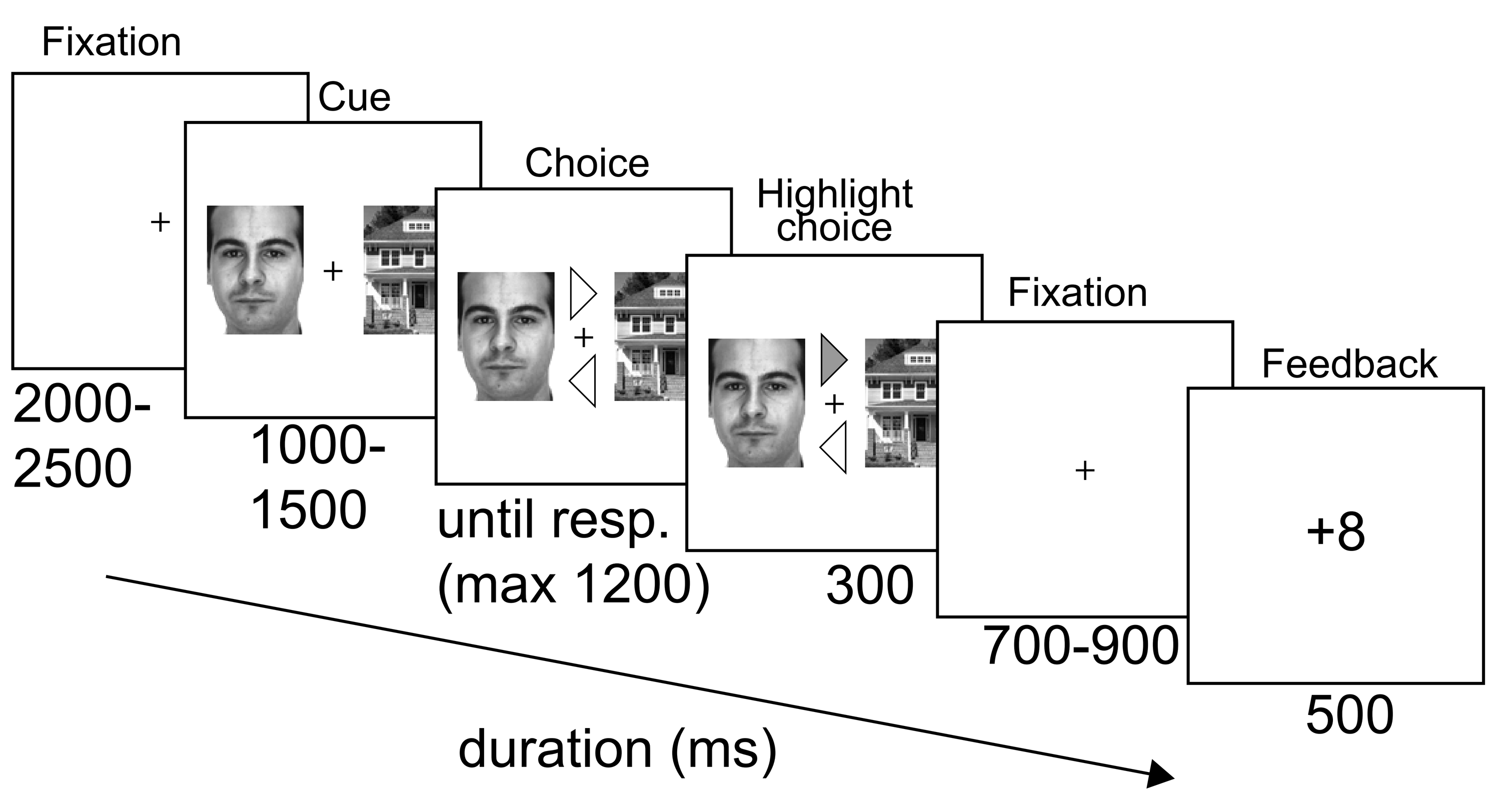
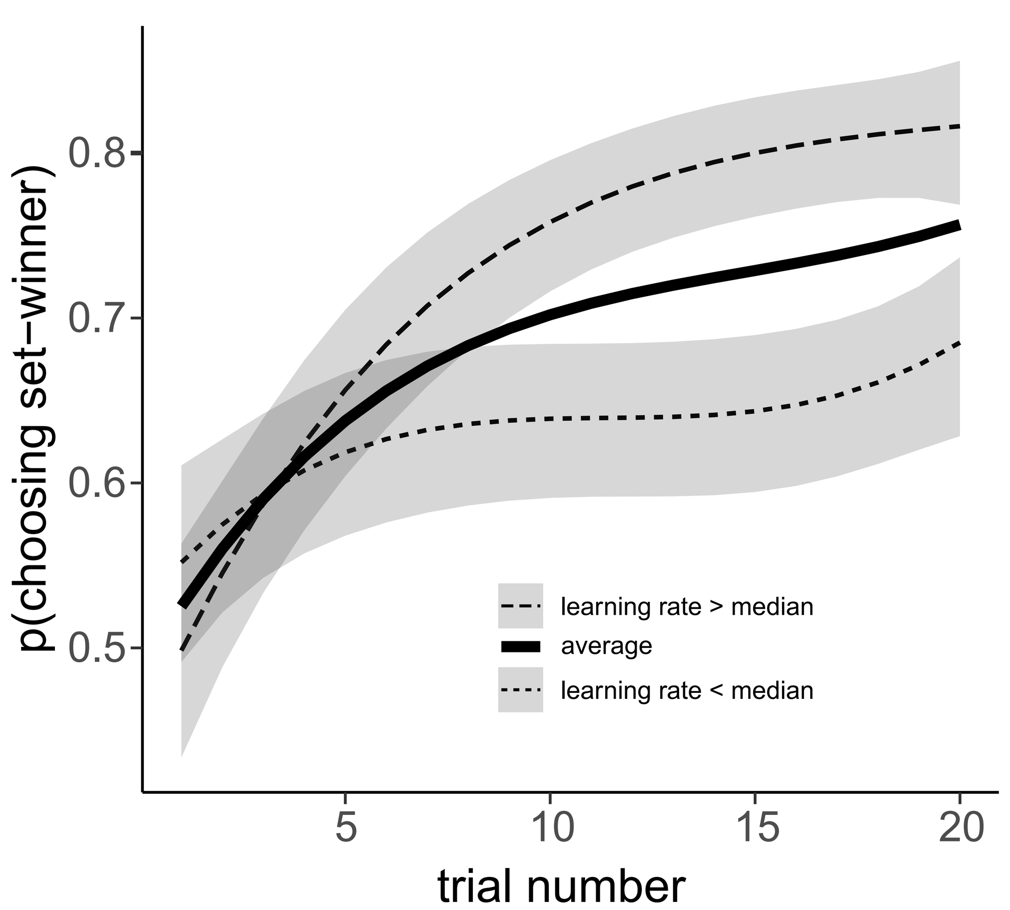
How do we use feedback?

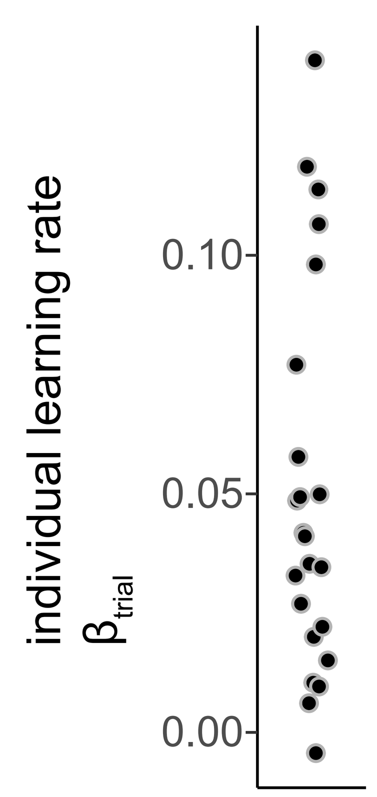
The ability to use and integrate feedback information over time is key to our ability to learn and make decisions. Although it is fairly well established how the brain processes outcomes on a single trial, it is less well studied how these processes depend on encountered information on previous trials.



*Here, participants chose on each trial either a face or a house, which was followed by receiving either a zero (**0**) gain (**+**) or a loss (**-**) of **different magnitudes (0:8)***

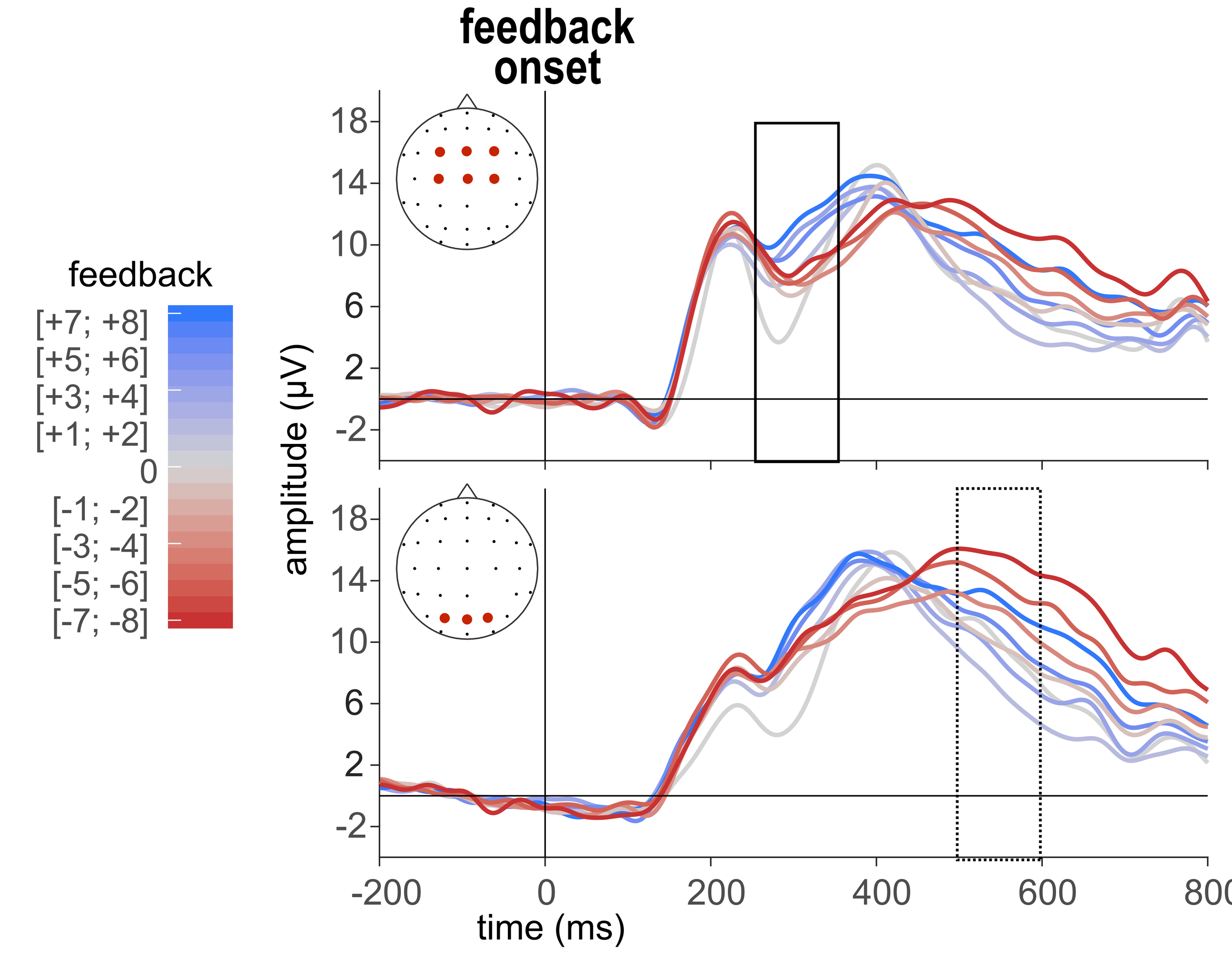
On each set of 20 trials either the face or house was the set-winner and was more likely to yield net gains.



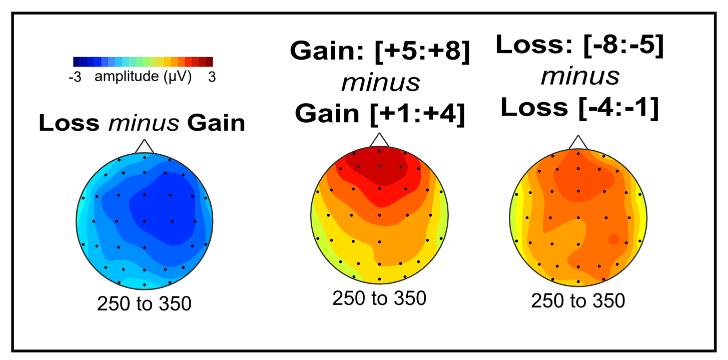


Participants learned over the course of 20 trials to choose the stimulus that yielded higher net-gains. There was substantial variability in how well participants were able to do so.

Processing of current feedback

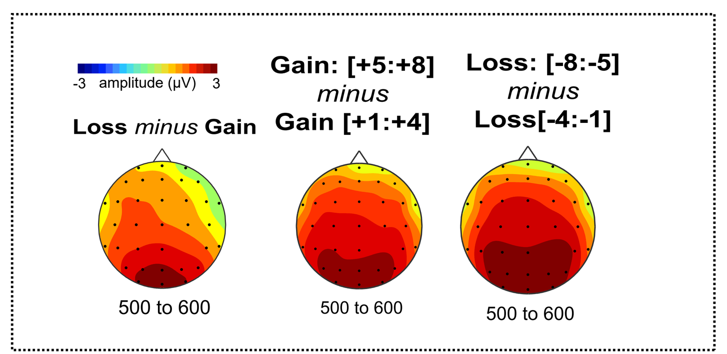


Early processing (250-350ms)



Feedback processing was marked by amplitude modulations induced by both magnitude and valence in the early latency range with distinct topographical effects. Specifically, valence showed a classical negative polarity feedback related negativity (FRN). In terms of feedback magnitude, we found a larger positive deflection for larger outcomes.

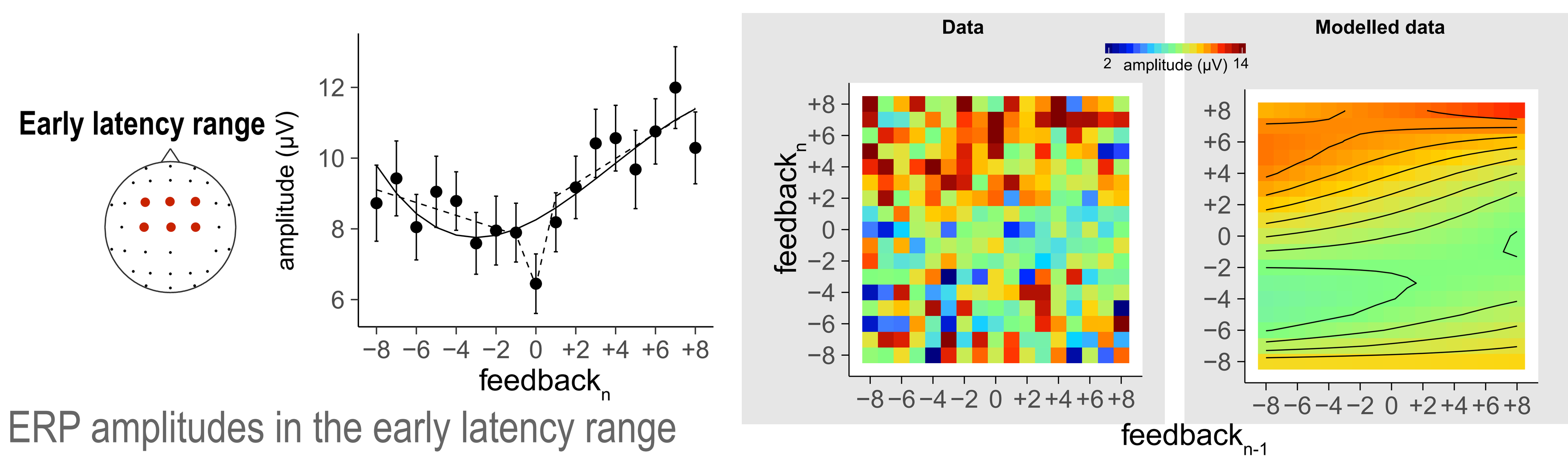
Late processing (500-600ms)



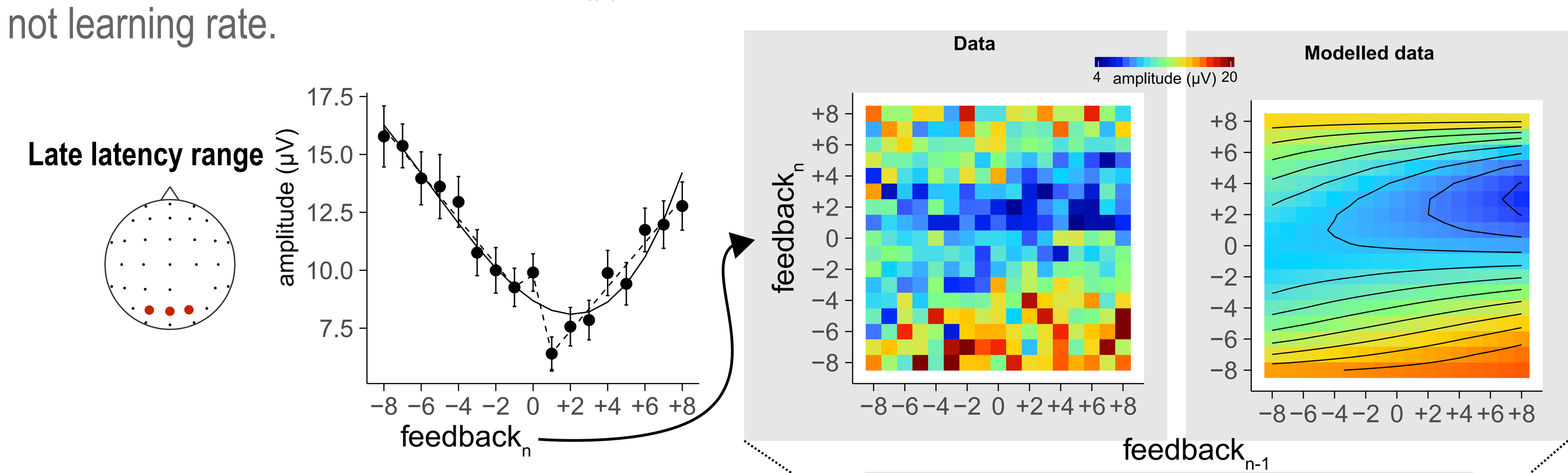
Both magnitude and valence modulated amplitudes in the later latency range. These modulations had similiar scalp topographies (suggestive of a modulation of the Late Positive Complex [LPC]), suggesting a similiar neuro-cognitive process by both factors is involved in this later time period.

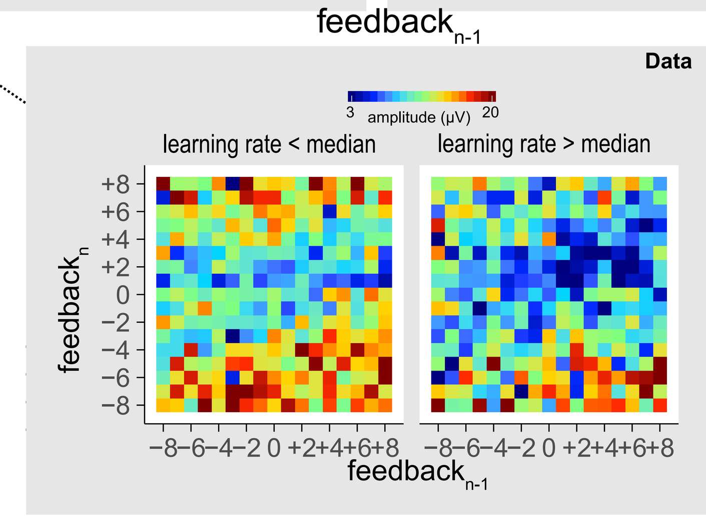
Integration of Feedback

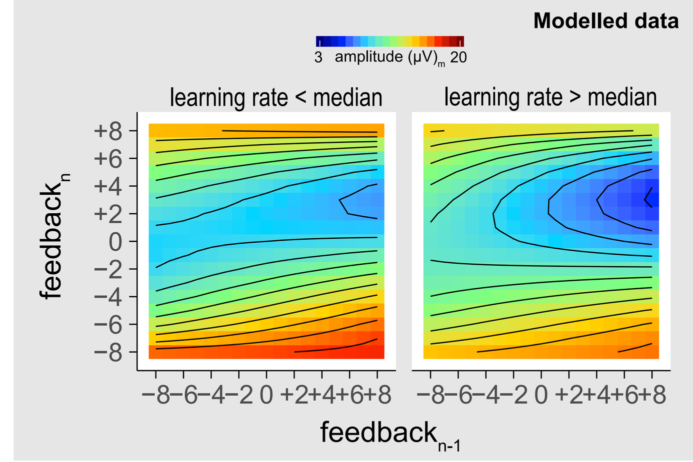
across trials



ERP amplitudes in the early latency range were slightly modulated by feedback_{n-1} but not learning rate.







ERP amplitudes in the late latency range were modulated by feedback_{n-1}. High learning rates were characterized by an LPC that was stronger modulated by previous feedback information as opposed to low learning rates.

Summary

Early

Feedback processing was characterized by amplitudes in the early latency range (250-350ms) being modulated by the magnitude and valence on the current trial. In this early time range we found minimal influence of the feedback of the previous trial, suggesting a feedback registration mechanism, that is not modulated by prior information (i.e. expectation).

Late

Processes in the late latency range (500-600ms) were modulated by both current feedback contents, and also by the feedback on the previous trial, indicating an integrative role. Strikingly, this integration was even further modulated by the individual participants' learning rate. As such, the processes that are marked by the LPC subserve a dynamic updating role that is highly susceptible to prior information.

In sum, this study provides a novel and important set of findings providing more insight into how the brain dynamically integrates feedback information over multiple trials to guide decision making in an uncertain world.

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