Comparing Electrophysiological Correlates of Feedback Processing Across Reward Tasks: RewP and P300 in Two Paradigms

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BACKGROUND

- Two event-related potentials (ERPs), namely the **Reward Positivity (RewP)** and the **P300**, have been identified as electrophysiological correlates of feedback processing in reward tasks.[1,2]

- It is still unclear **how learning and expectancy modulate RewP and P300** elicited by monetary feedback **intraindividually**.

RESESARCH AIM

- We expected RewP enhancement following rewards [2] and associations between ERPs across reward tasks.

- We further investigated potential **modulatory effects of learning processes** on P300 and RewP.
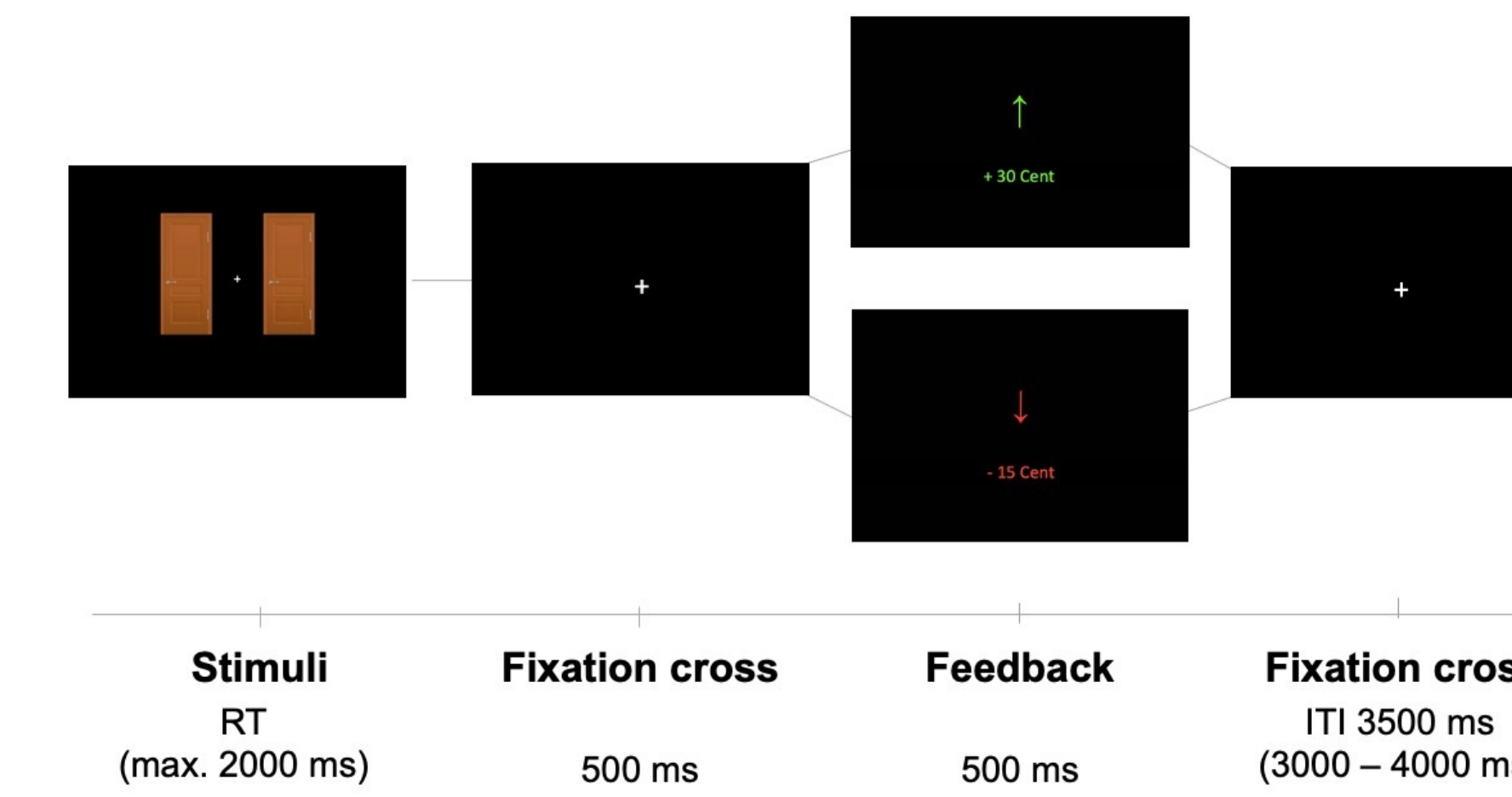
METHODS

SAMPLE

- **37 healthy participants** (females $n = 24$) aged 18 – 57 years ($M = 31.4$, $SD = 12.7$)
- **Executive functions: TMT A**: $M = 24.10$, $SD = 7.20$, **TMT B**: $M = 54.67$, $SD = 25.74$
- **Clinical characteristics: SHAPS**: $M = 0.86$, $SD = 1.72$, **BDI II**: $M = 2.31$, $SD = 3.04$

DATA ANALYSIS

- **2 x 2 repeated measures analysis of variance (ANOVA)** for ERPs with feedback (positive/negative) and task (guessing/learning)
- **2 x 2 repeated measures ANOVA** for ERPs with feedback valence (positive/negative) and validity (valid/invalid) in learning task
- **Pearson correlations** between ERPs across tasks, ERPs and clinical variables (SHAPS, BDI II), or number of wins in the learning task
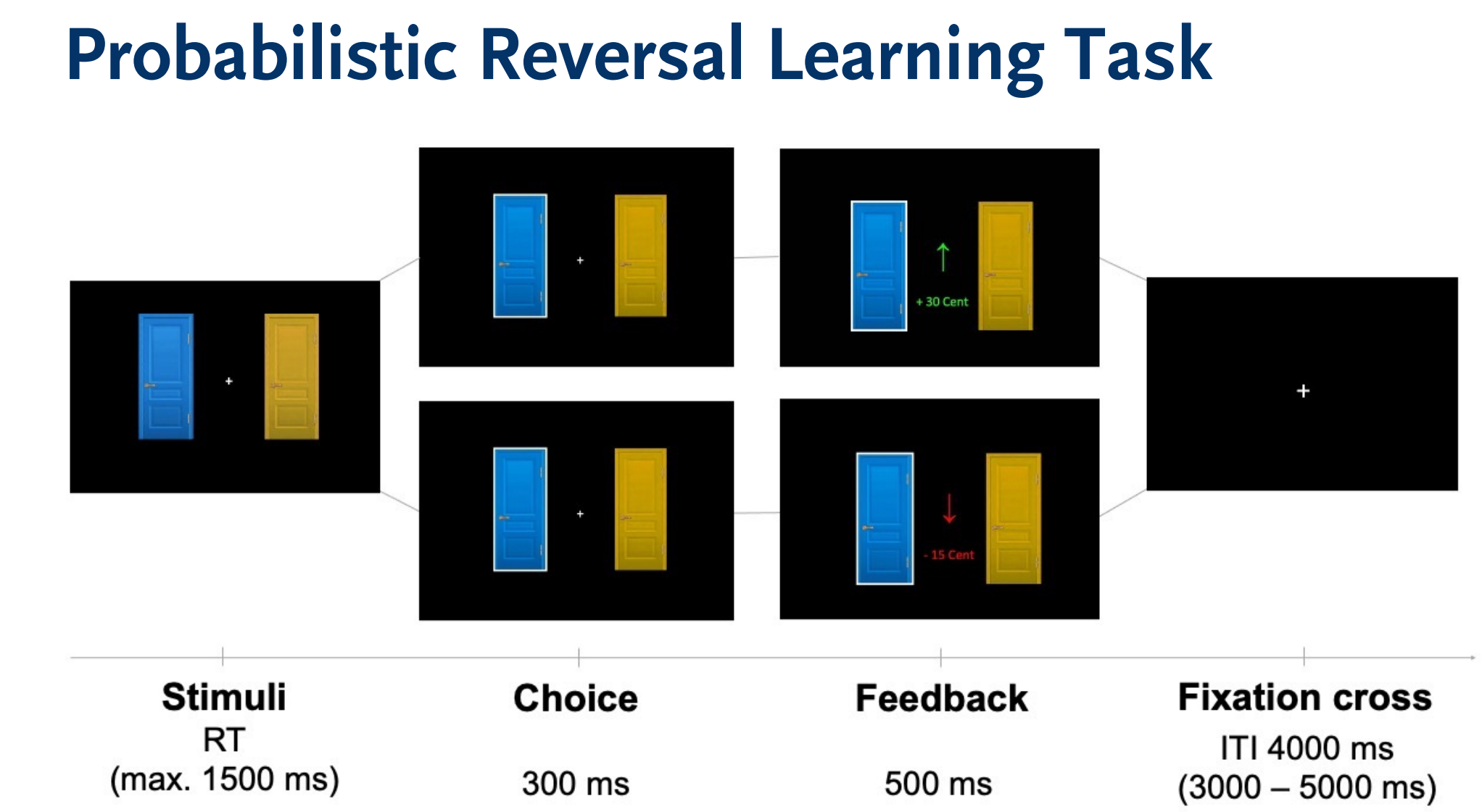
GUESSING TASK:
Doors Task

Stimuli RT (max. 2000 ms) — Fixation cross 500 ms — Feedback 500 ms — Fixation cross ITI 3500 ms (3000 – 4000 ms)
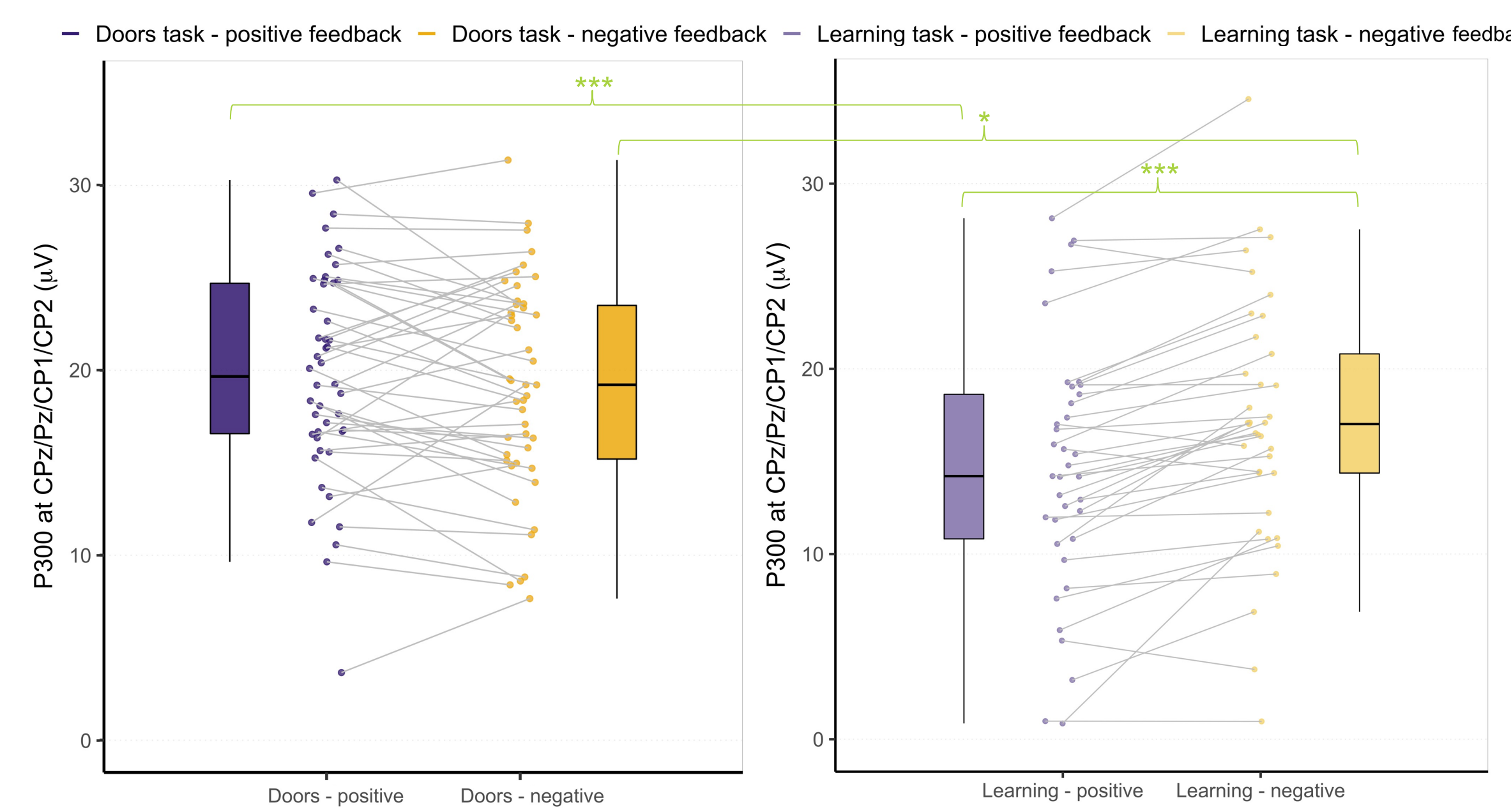
- 60 trials with random, monetary feedback (30 win / 30 loss)

LEARNING TASK:
Probabilistic Reversal Learning Task

Stimuli RT (max. 1500 ms) — Choice 300 ms — Feedback 500 ms — Fixation cross ITI 4000 ms (3000 – 5000 ms)
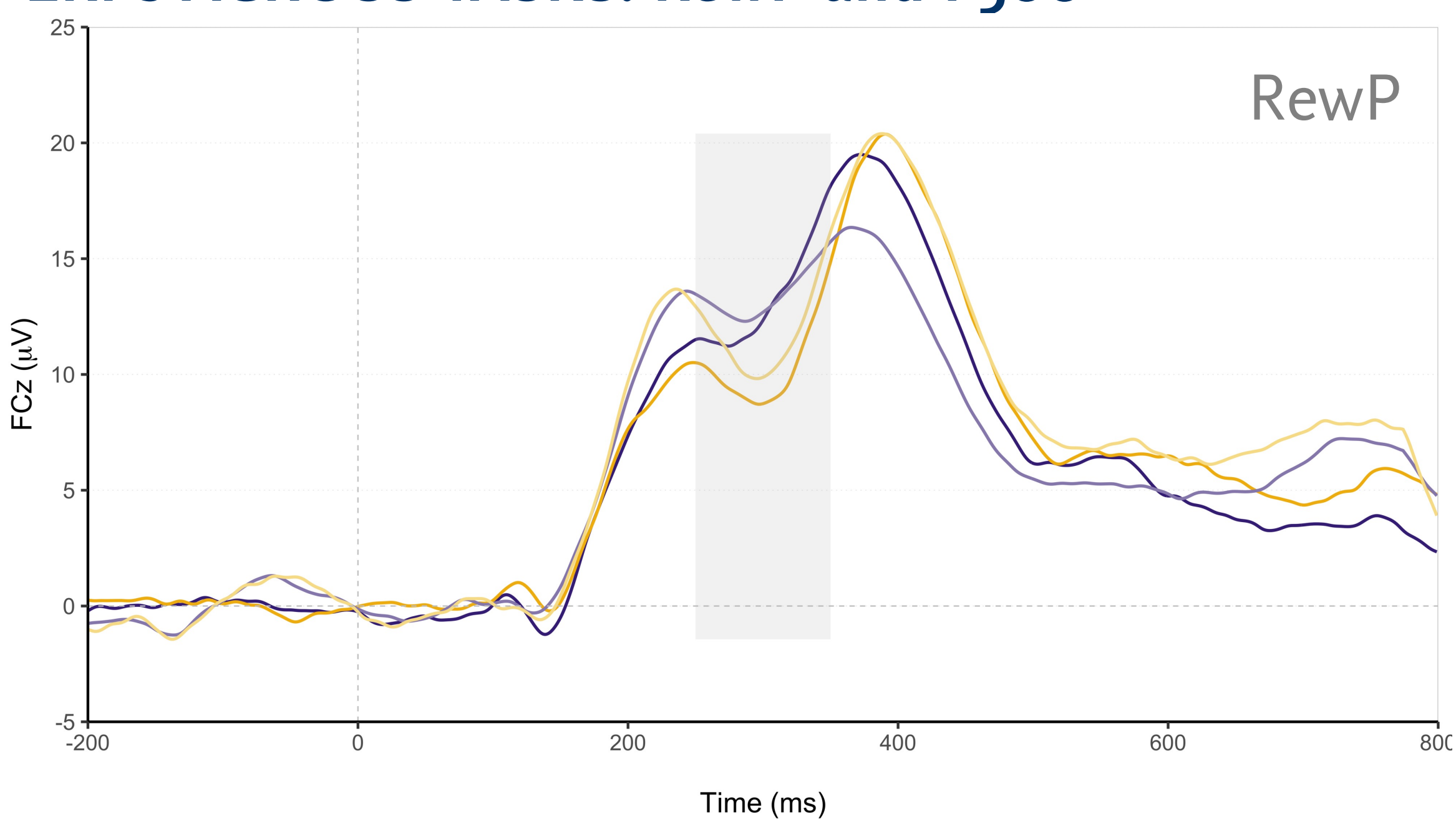
- 140 - 160 trials with probabilistic (70:30) monetary feedback
- Contingency change with learning criterion (6-10 correct choices)

RESULTS

ERPs ACROSS TASKS: RewP and P300

Doors task - positive feedback | Doors task - negative feedback | Learning task - positive feedback | Learning task - negative feedback
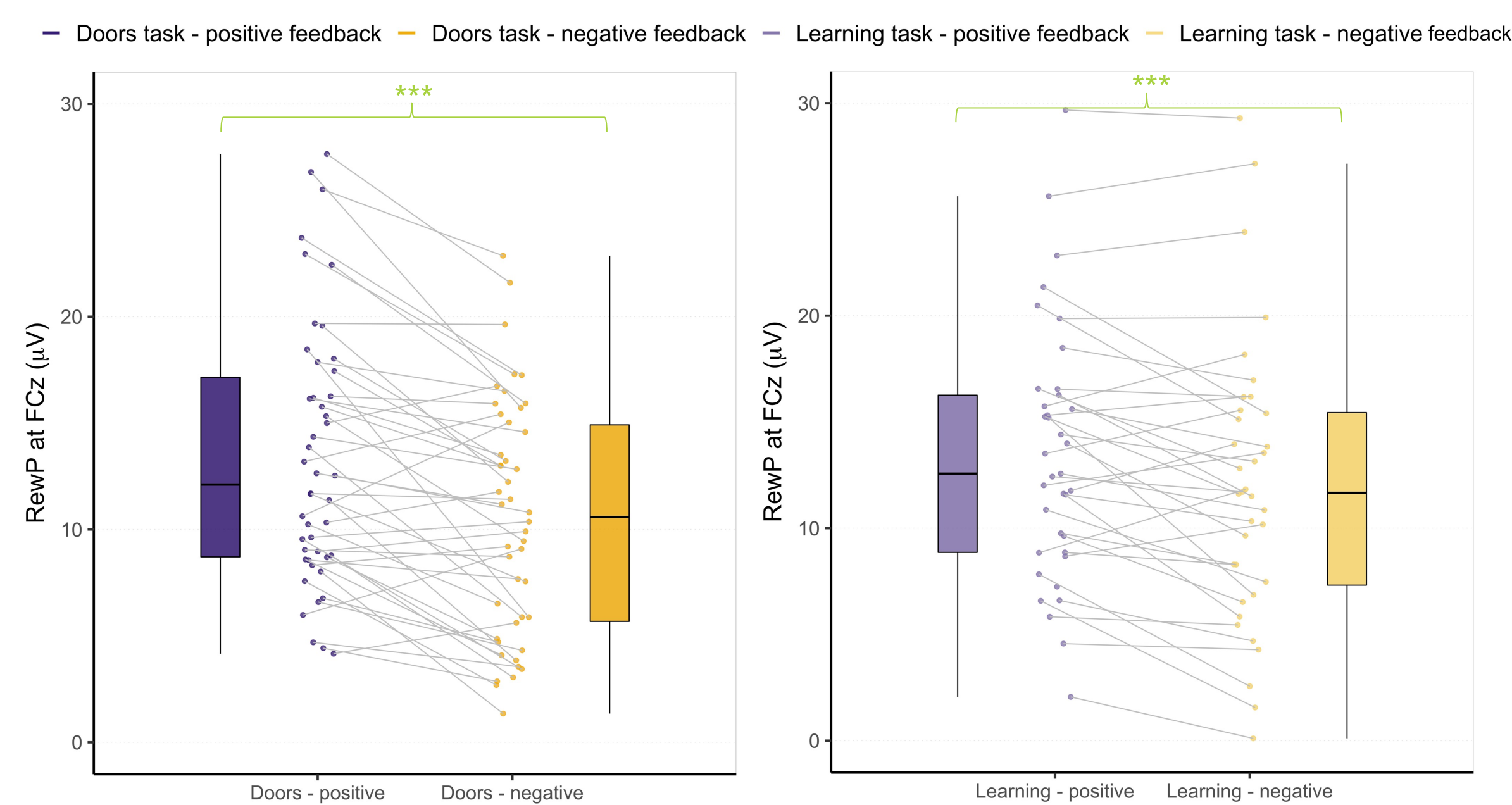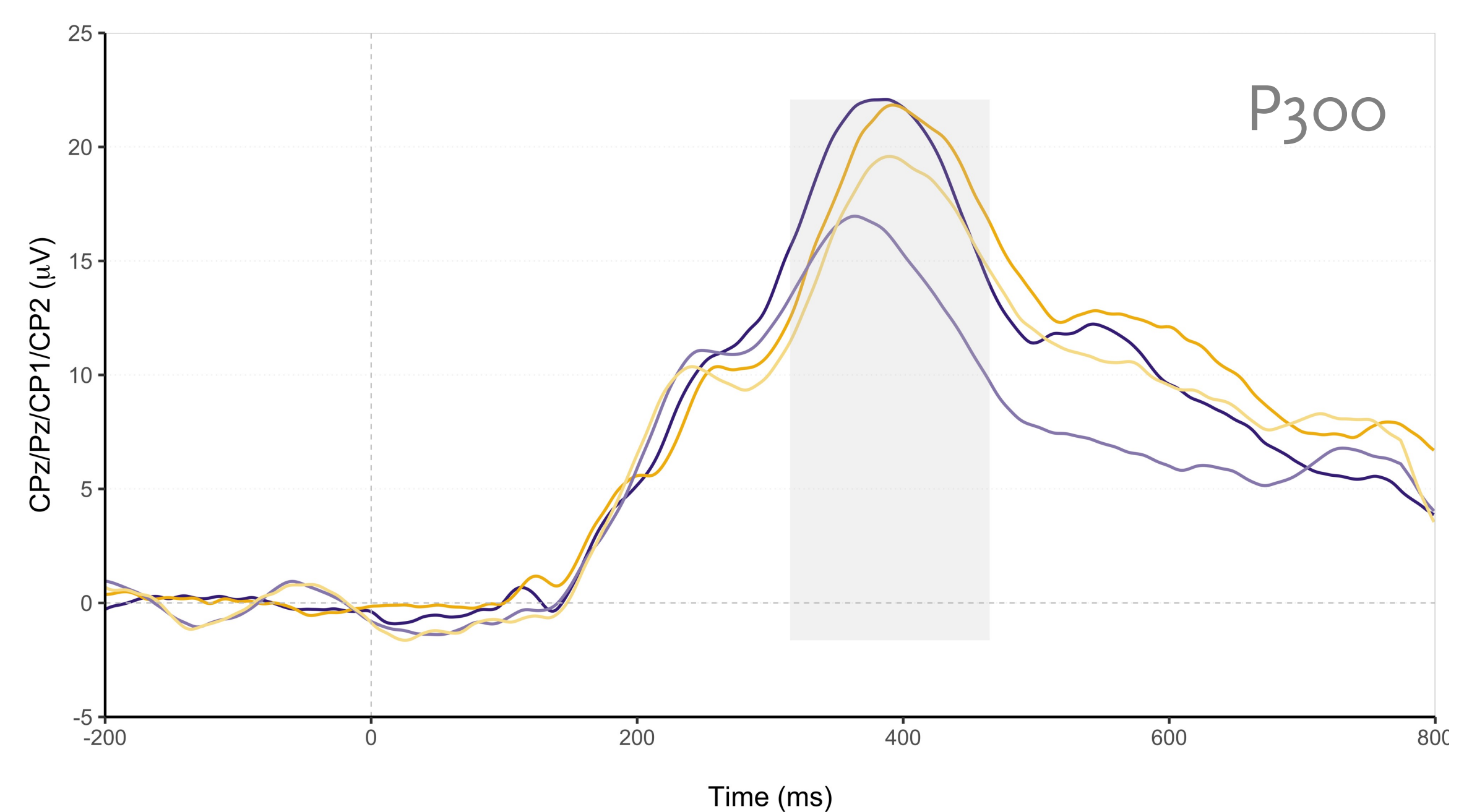
Feedback effect on RewP amplitudes within tasks. $F_{(1, 36)} = 23.70$, $p = .035$

- Positive feedback in Doors task > Negative feedback in Doors task
- Positive feedback in Learning task > Negative feedback in Learning task

Task and feedback interaction on P300 amplitudes. $F_{(1, 36)} = 24.43$, $p < .001$

- P300 amplitudes vary depending on feedback in Learning task; Learning task negative feedback > Learning task positive feedback
- No feedback effect in Doors task

FEEDBACK VALIDITY IN THE LEARNING TASK: RewP and P300

RewP

- Main effect of **feedback**: RewP after positive feedback > RewP after negative feedback $F_{(1, 36)} = 7.85$, $p = .008$
- **No effect of feedback validity or interaction** between feedback valence and validity
  Validity: $F_{(1, 36)} = 1.51$, $p = .227$; Valence x Validity: $F_{(1, 36)} = 0.53$, $p = .471$

P300

- Main effect of **feedback**: P300 after negative feedback > P300 after positive feedback $F_{(1, 36)} = 18.75$, $p < .001$
- Main effect of **validity**: P300 after invalid feedback > P300 after valid feedback $F_{(1, 36)} = 5.33$, $p = .027$
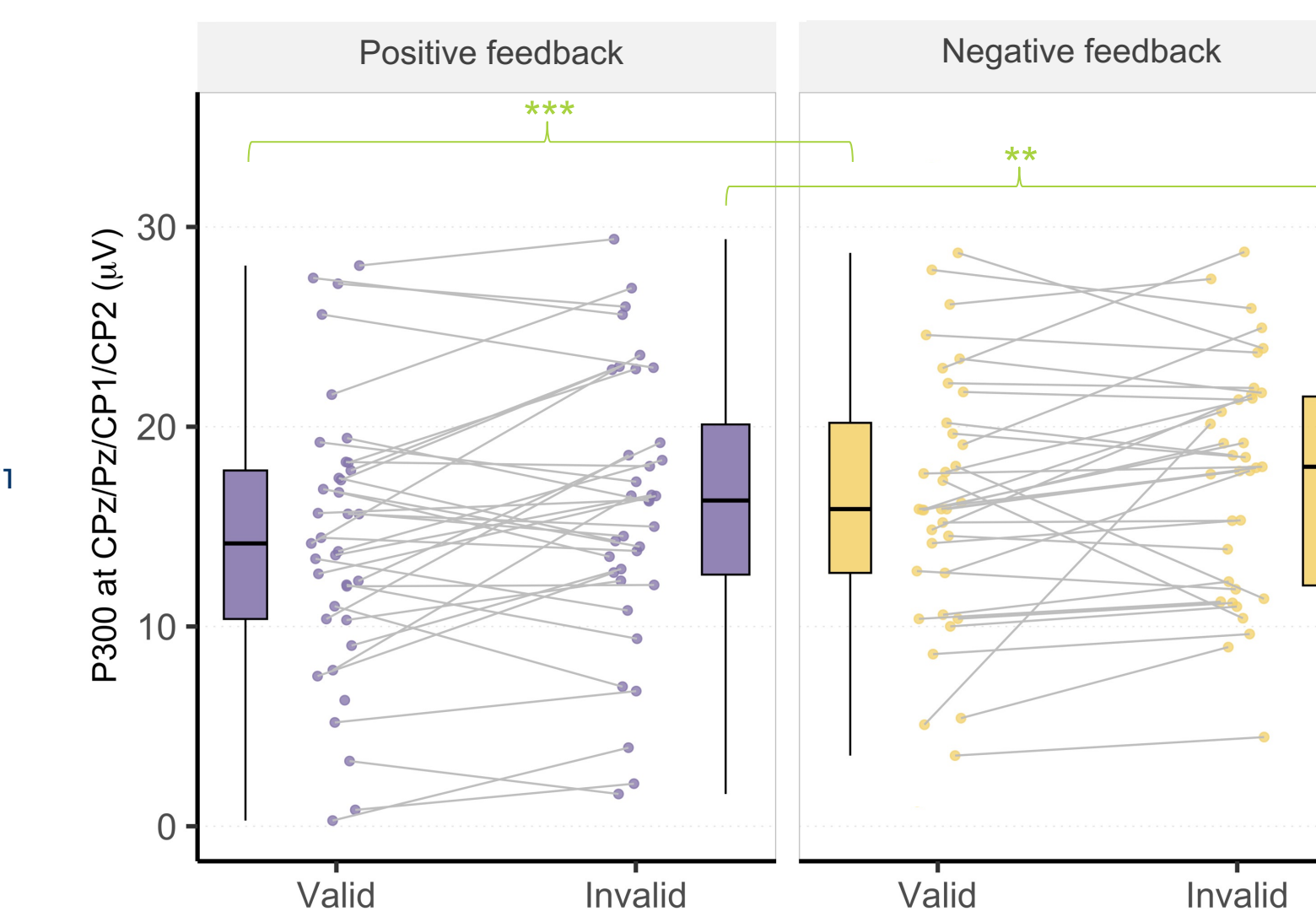
ASSOCIATIONS BETWEEN ERPs, TRAITS, ABILITIES AND LEARNING

Positive correlations between RewP amplitudes as well as P300 amplitudes across tasks.

RewP

- After positive feedback in Doors task x after positive feedback in Learning task $r_{(35)} = 0.60$, $p < .001$
- After negative feedback in Doors task x after negative feedback in Learning task $r_{(35)} = 0.59$, $p < .001$

P300

- After positive feedback in Doors task x after positive feedback in Learning task $r_{(35)} = 0.65$, $p < .001$
- After negative feedback in Doors task x after negative feedback in Learning task $r_{(35)} = 0.65$, $p < .001$

No association between ERPs and traits, executive functions, or number of wins. All $ps > .05$

DISCUSSION & CONCLUSION

SUMMARY

- First results suggest that RewP amplitudes do not differ across paradigms. Thus, our findings highlight a robustly enhanced RewP to rewards compared to losses across reward paradigms.

- In contrast, P300 amplitudes seem to vary with both the task and feedback valence.

- Furthermore, expectancy of feedback seems to modulate the P300 component. The P300 appears to be sensitive to unexpected feedback. In learned situations, this effect is more pronounced for unexpected negative feedback.

TO COME

- Analysis on behavioral outcomes with computational modeling

- Large-scale data collection aiming for a sample of 400 patients with internalizing disorders

[1] Bellebaum, C., & Daum, I. (2008). Learning-related changes in reward expectancy are reflected in the feedback-related negativity. *European Journal of Neuroscience, 27*(7), 1823– 1835. doi: 10.1111/j.1460-9568.2008.06138.x

[2] Proudfit, G.H. (2015). The reward positivity: from basic research on reward to a biomarker for depression. *Psychophysiology, 52*,449–59.