

The ability to **monitor one's performance** is a crucial component of executive functions:

Performance monitoring relies heavily on external feedback;

Introduction

- Differences between actual and expected feedback offer learning; opportunities for updating future expectations and behaviors;
- Electrophysiological (EEG) data have provided insights of cognitive process associated with feedback monitoring.

### **Neural Correlates of Feedback Responsivity:**

- Feedback-Related Negativity (FRN): An event related potential observed in response to feedback.
- Thought to indicate performance monitoring and feedback responsivity, and is influenced by the valence, magnitude and probability of the feedback.
- Most studies use gambling paradigms with fixed reward probability.

Less is known about the difference between responsivity towards evaluative feedback, which signals effort and performance, and non-evaluative feedback, which in contrast reflects luck.

Individual differences in anxiety level and motivation might be other factors that impact people's neural activities towards evaluative vs. non-evaluative feedback.

**Research Questions** 

**RQ1**: Does the FRN vary as a function of the type of feedback (evaluative vs. non-evaluative) in a behavior inhibition task vs. a gambling task?

**RQ2**: How do individual difference factors – including grit, anxiety, and attentional control – relate to feedback responsivity?

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	Method														d				

**Sample:** 57 undergraduate students ( $M_{age} = 19.45$ ,  $N_{men} = 26$ ).

# **Procedure:**

- Participants completed four computerized tasks including 2 feedback tasks during EEG recording.
- Self-ratings of task performance were collected after each feedback task.
- Participants also completed several questionnaires, including a self-reported state/trait anxiety scale, a grit scale and an attentional control scale.
- EEG data were acquired using a ActiChamp system with 32 Ag/AgCl electrode cap (actiCAP).

# **Survey Measures:**

State-Trait Anxiety Inventory (STAI): Self-reported of one's general anxiety level, 20 items for State and Trait anxiety each, with 4-point Likert scale. E.g., "I feel nervous and restless".

Grit Scale: 12 items on a 5-point Likert scale to indicate one's grit level, from "Not like me at all" to "Very much like me". E.g., "I finish whatever I begin".

Attentional Control Scale (ACS): 20 items on a 4-point Likert scale. E.g., "It's very hard for me to concentrate on a difficult task when there are noises around".

# **ERP Measures:**

FRN: The mean amplitude calculated from a time- FRN window of 200-350ms following the positive/negative feedback.



# Effort or Luck? Comparing Neurophysiological Correlates of Evaluative And Non-Evaluative Feedback in College Students

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- No association identified between FRN and ACC or RT in the Go/NoGo task. However,  $\uparrow$  post-error slowing effect associated with  $\downarrow$  amplitude towards positive feedback, r(47) = 2.09, p <

# **Group Comparison in Go/NoGo**

- Participants in Group B rated their performance significantly worse than Group A for the Go/NoGo task, t(51) = -2.08, p < .05, though two groups had similar task accuracy, t(51) = .23, p > .5.



# **Doors Results**

- Doors, ps > .4.



- towards evaluative and non-evaluative feedback.
- towards positive feedback.

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Participants who received rigged positive feedback (Group A) had bigger diff\_FRN between two conditions (Figure 2), r(49) = -0.35, p < .05, specifically, showing larger amplitude in response to positive feedback, r(49) = 0.27, p = .07.

Figure.2 FRNs from Go/NoGo separated by Groups. Left: Group A; Right: Group B

Regardless of feedback manipulation, participants in the two groups did not differ in their self-ratings of Doors performance, t(53) = 1.38, p > .1, or in their FRNs from the

This is one of the few studies that has compared the difference of neural responsivity

Participants demonstrated a larger neural response to negative non-evaluative feedback, which is aligned with the FRN literature. However, when receiving evaluative feedback on their performance, participants showed larger FRN

The ACS score is only correlated with the FRN from the Go/NoGo task. This indicates that the attentional skills of response monitoring might be associated with people's interpretation of evaluative feedback but not non-evaluative feedback given in games perceived to involve luck rather than effort.

External feedback not only influences people's self-evaluation of performance, but also changes the neural responsivity to feedback. The larger FRN amplitude towards positive feedback in Group A vs. Group B might imply a larger neural response to "surprise" instead of negative valence.

Future research should explore how **responses to rigged positive feedback** influence motivation and performance adjustment within task, which could have implications for teaching applications of accurate and effective feedback.