

## Introduction

- The Reward Positivity (RewP) is an event-related potential quantified as the difference between the amplitude of the feedback-related-negativity to gains (FRN-Gain) and losses (FRN-Loss) that peaks 250-350 ms after receiving external gain or loss feedback (Proudfit, 2015).
- The RewP is thought to measure reward sensitivity prominently featured in depressive disorders (Bowyer et al., 2019).
- Past work has found a diurnal variation in reward sensitivity in fMRI studies (Byrne et al., 2019). Tsypes et al. (2020) found a diurnal variation in RewP in older children in an EEG study, with two peaks around 12 PM and 5 PM.
- The current study** investigates the diurnal variation of the RewP in adults in an EEG study.
- It also aims to test if time of day predicts RewP amplitude and if the effect is moderated by age, as well as whether time of day interacts with RewP amplitude to predict psychopathology.

## Methods

### Participants

- College and community adults ( $N = 201$ ,  $M_{age} = 20.8$ ,  $SD = 4.3$ ) who completed the Doors task during EEG recording and filled out psychopathology and personality questionnaires between 10 AM and 6 PM.

### Depression

- Structured clinical interview for DSM-4R (SCID; First et al., 2001) was used to assess symptoms of the participant's worst major depressive episode (Worst MDE).

### Doors Task

- Participant gained 50 cents if they selected winning door and lost 25 cents if they selected losing door (i.e., balancing loss aversion; Tversky & Kahneman, 1979)

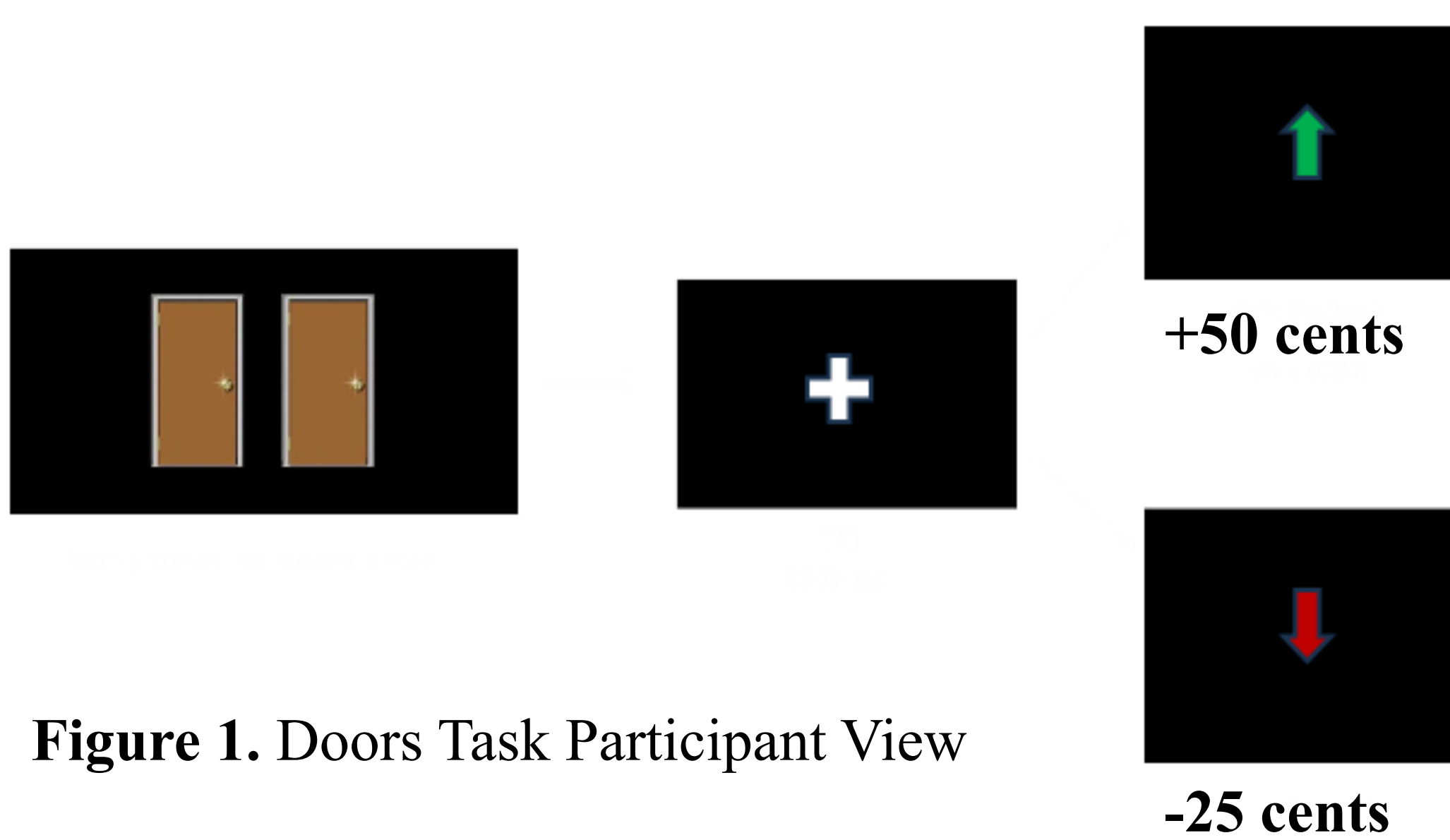
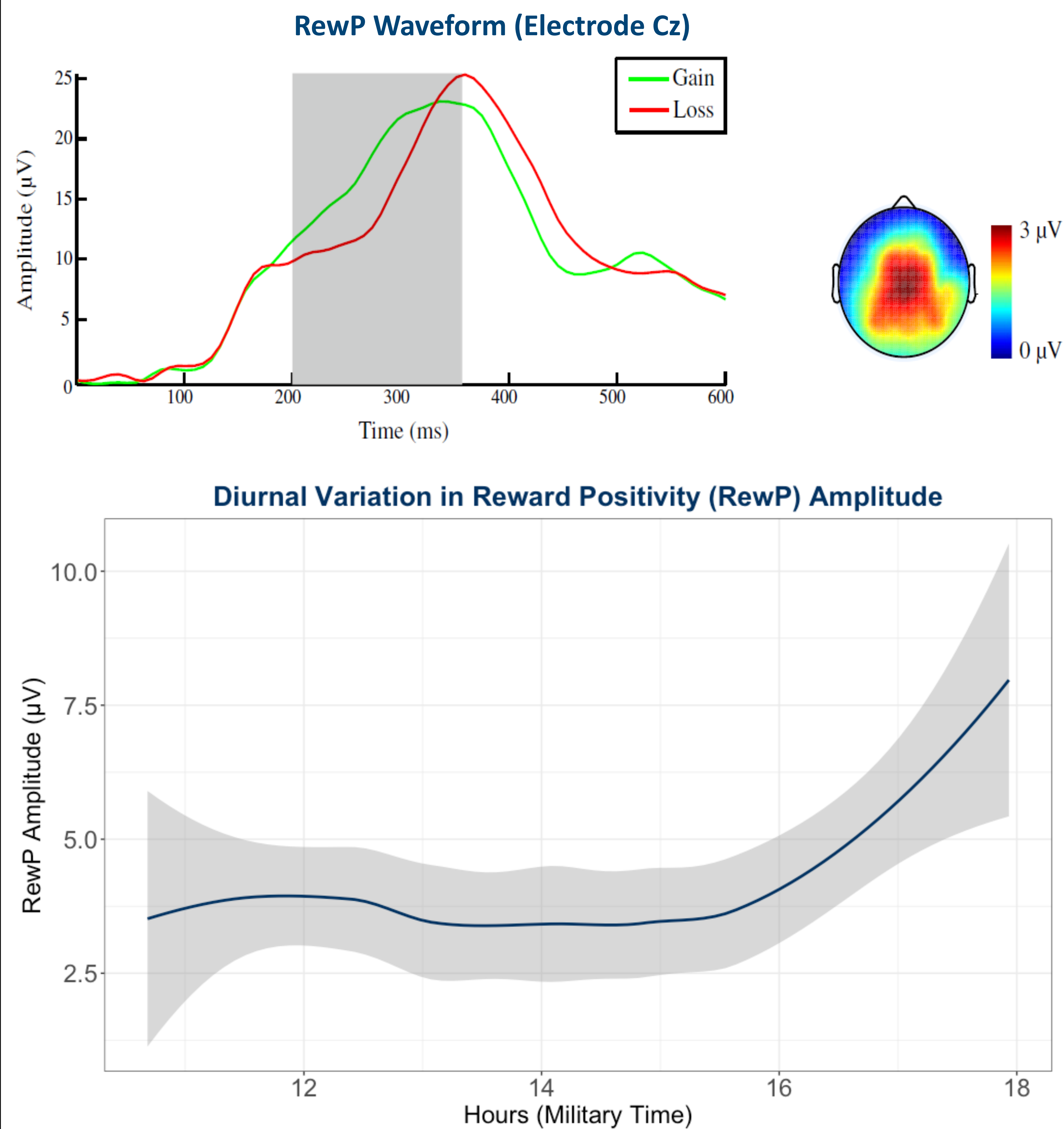


Figure 1. Doors Task Participant View

### Event-Related Potential (ERP)

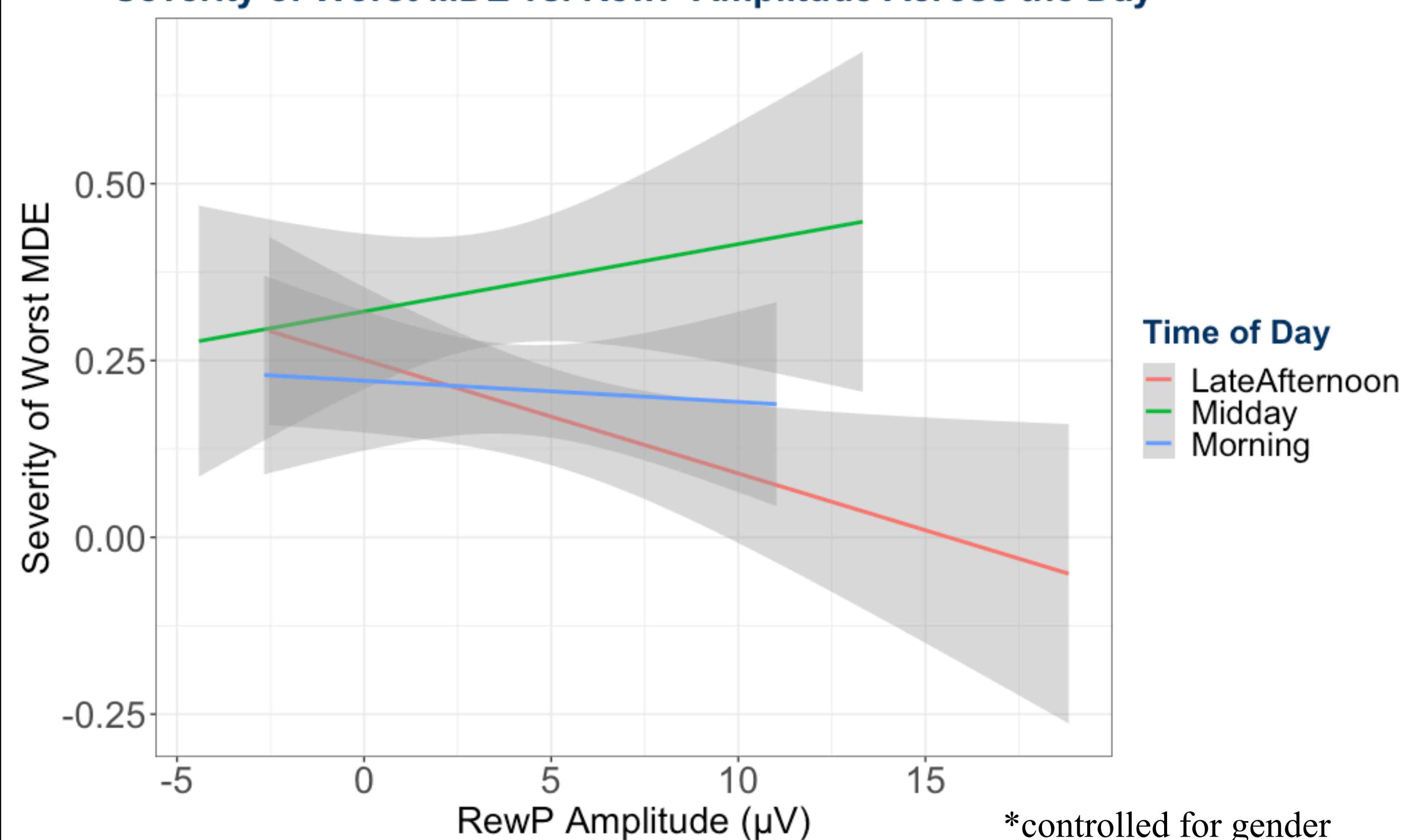
- RewP:** difference score of the mean ERP amplitude in a gambling task (Proudfit, 2015) for trials where money is won minus trials where money is lost at electrode Cz between 250-350ms following the reward or loss feedback

## Results



Time of Day Factor	RewP ~ Time of Day	RewP ~ Time of Day*Age
Linear	$\beta = .13, p = .06$	$\beta = -.24, p = .01^*$
Quadratic	$\beta = .17, p = .02^*$	$\beta = .12, p = .12$
Cubic	$\beta = .27, p = .11$	$\beta = -.16, p = .11$

### Severity of Worst MDE vs. RewP Amplitude Across the Day



The effect of RewP amplitude on severity of worst MDE was moderated by time of day ( $\beta = .25, p = .03$ ), such that this effect was maximal in the late afternoon/early-evening.

## Summary

- There was a quadratic effect of time on RewP amplitude, whereby RewP amplitude peaked most towards the evening (~4-6 PM)
- There was a linear effect of time by age interaction, such that younger participants' RewP's increased more across the day
- Time of day (morning vs. midday vs. late afternoon/evening) and RewP amplitude interacted to predict severity of depression, whereby blunted RewP amplitude late in the day was especially predictive of the severity of participants' worst MDE

## Discussion

- Early research suggested that humans are primed for daytime engagement when the chance of reward is high and threat is low (Clark et al., 1989).
- A contrasting theory proposes that unexpected rewards in the late-afternoon or early-evening elicit a strong phasic Dopamine signal known as reward prediction error (Schultz, 2016).
- While some studies have found support for peak reward activation in the early-afternoon between 11 – 2 PM (Byrne et al., 2017; Tsypes et al., 2020), others have found support for a peak in the late-afternoon between 4 – 7 PM (Hasler et al., 2014; Tsypes et al., 2020).
- The **current study's** results conform to the existing literature reporting a diurnal rhythm in reward processing, with a peak in the late-afternoon or early-evening.
- These results suggest that researchers need to consider time of day and participant-specific characteristics in methodology and analysis.
- Future research is needed to test between the two contrasting theories of daytime engagement and reward prediction error. One such study could compare within-person neural activation to rewards during the daytime and evening.

## References

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