

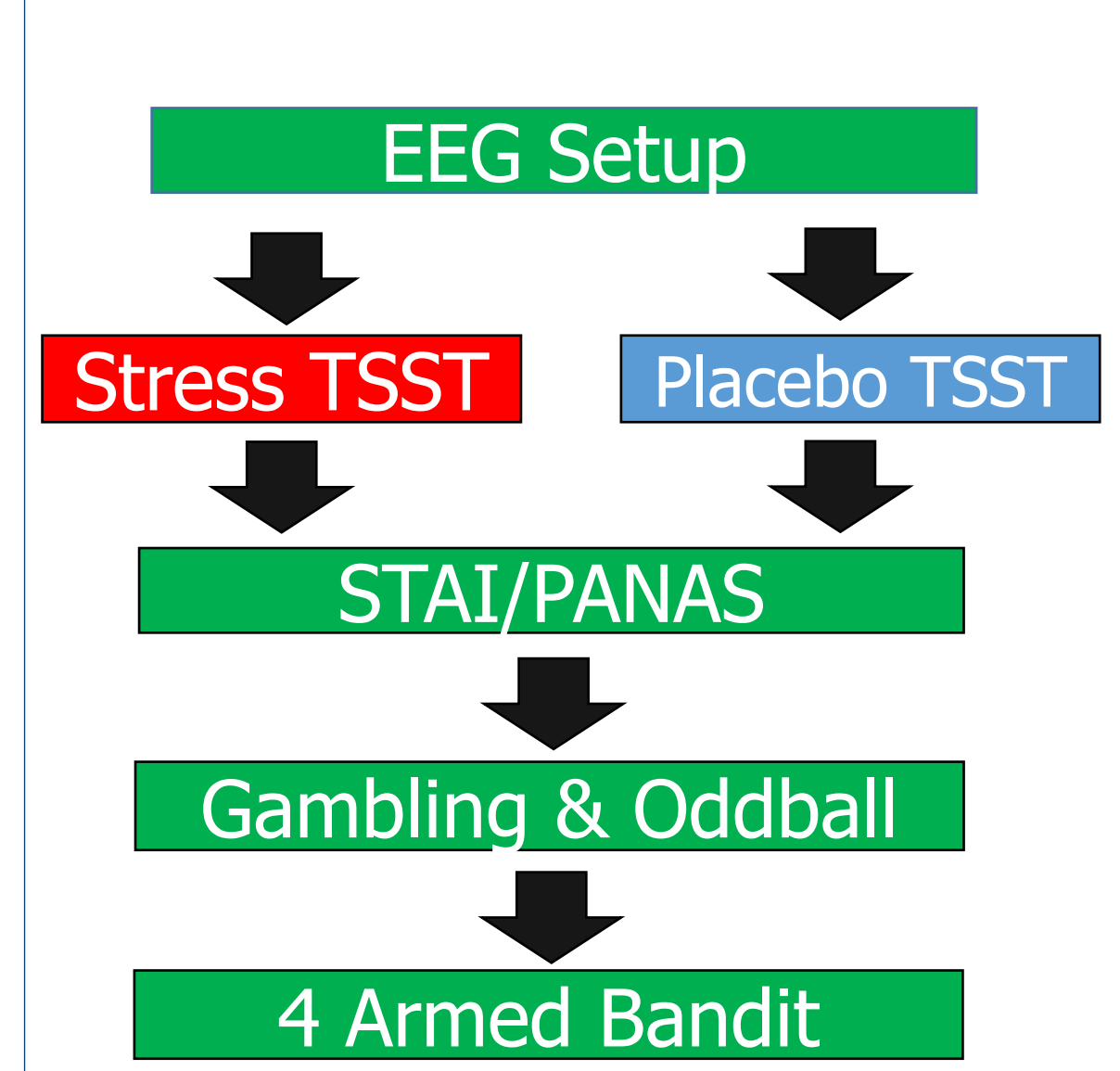
# Using EEG to investigate the neuro-modulatory systems underlying stress and decision making

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## INTRODUCTION

- Acute Stress impacts both norepinephrine and dopamine
- These same neuromodulators play a role in decision-making systems that underlie context updating (norepinephrine), reward learning (dopamine), and the explore-exploit dilemma (norepinephrine & dopamine)
- Goal:** To investigate how stress impacts these two systems using a combination of behaviour, neurophysiology (EEG), & computational modeling
  - Induced Stress using the Trier Social Stress Task (TSST)
  - Heart-rate, scores on the State-Trait anxiety Inventory (STAI), and Scores on the Positive and Negative Affect Schedule (PANAS) were measured as manipulation checks for the stressor

## PROCEDURE



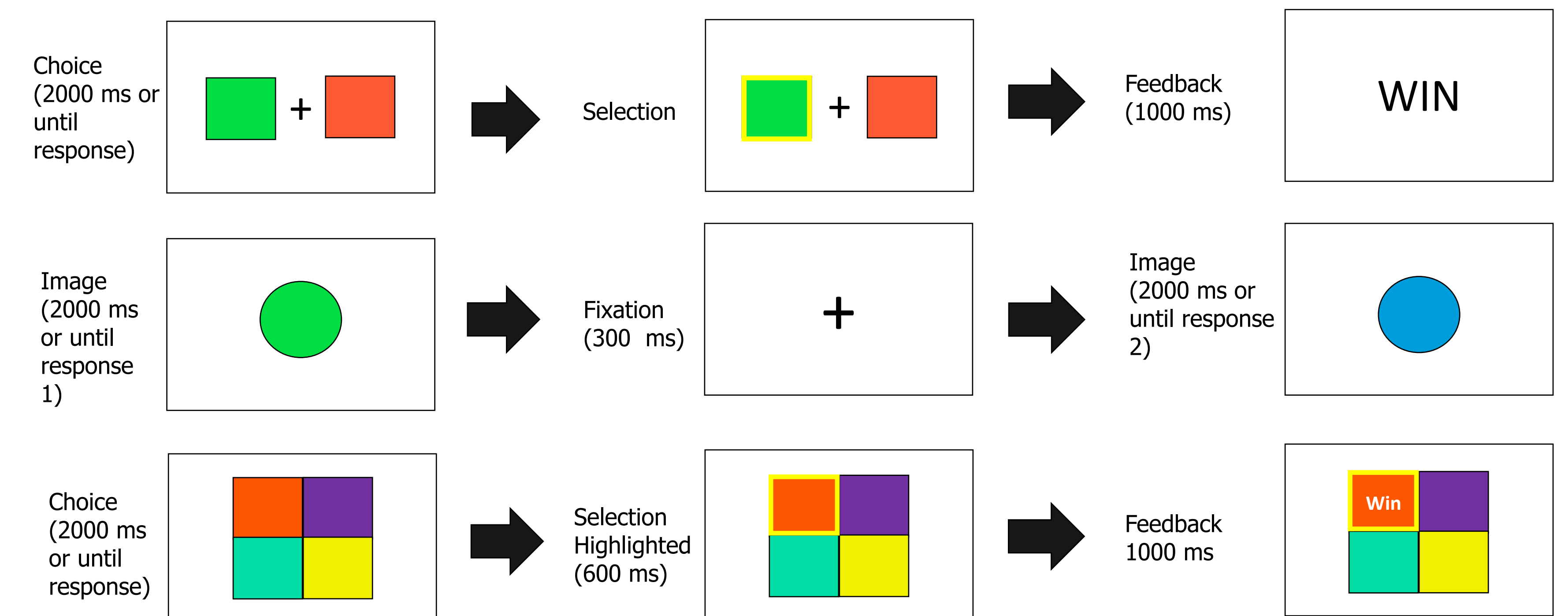
## TASKS

**Gambling**  
Reward learning

**Oddball**  
Context Updating

**4-armed Bandit**  
Explore-Exploit

## METHODS



## MANIPULATION CHECKS

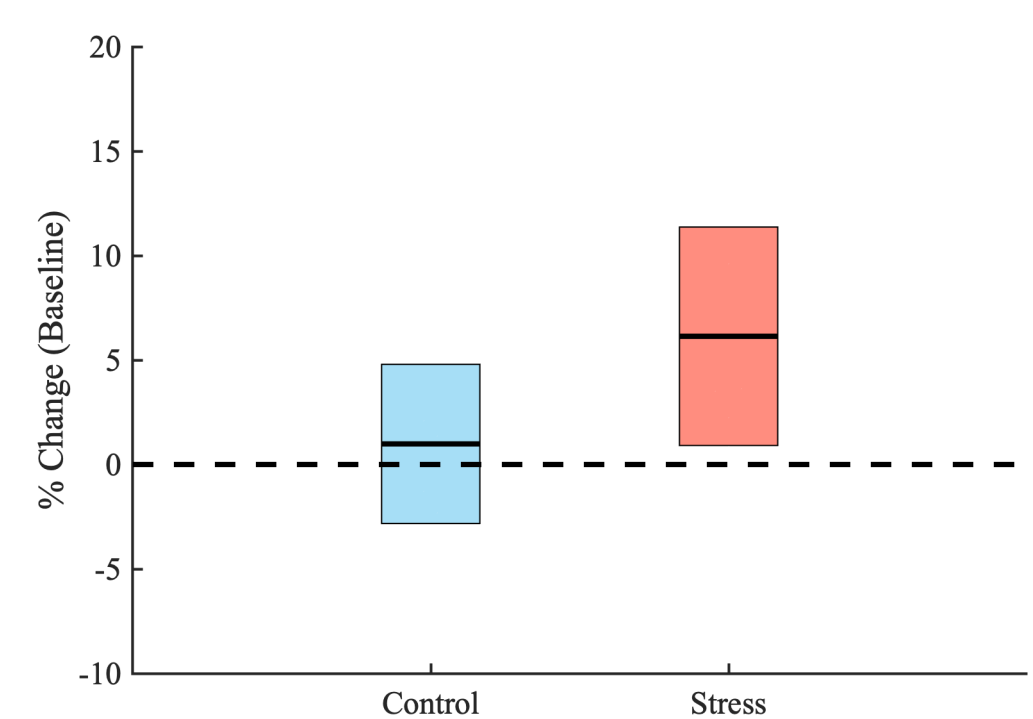


Fig 1. Heart Rate – Change from Baseline

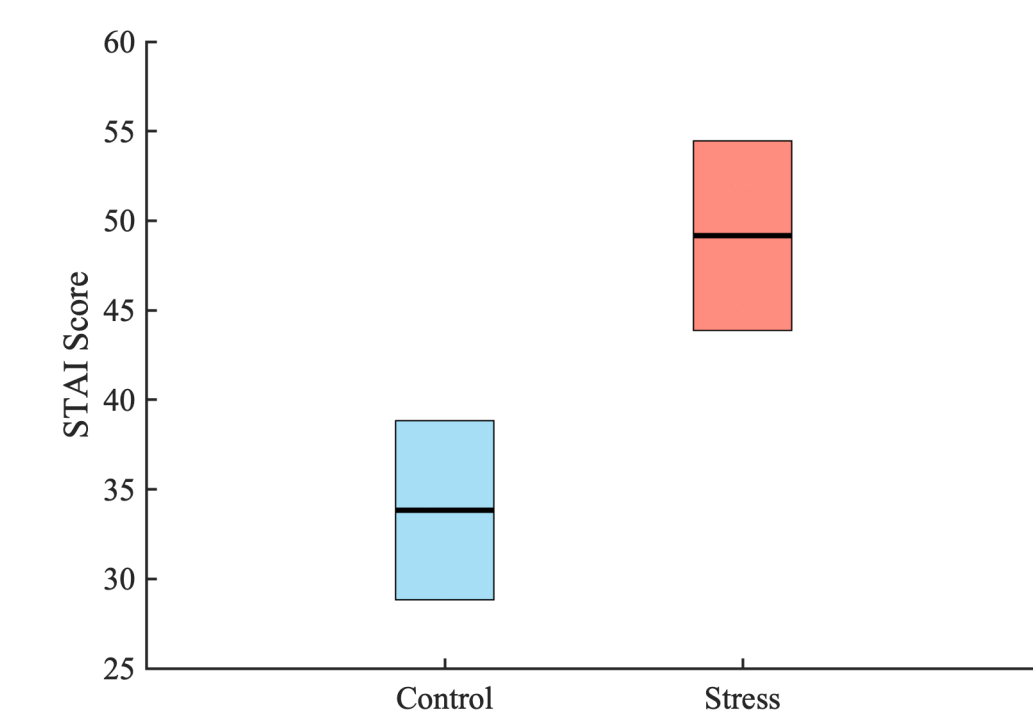


Fig 2. State-Trait Anxiety Inventory (STAI) Score

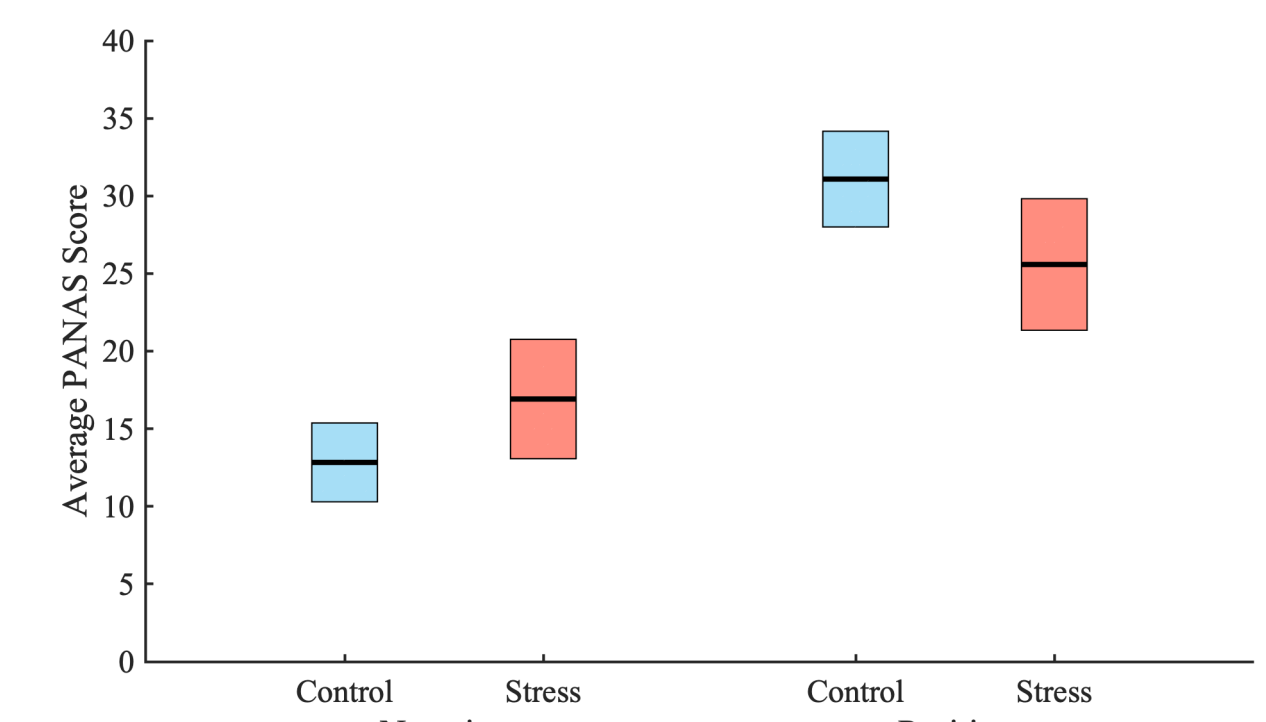


Fig 3. Positive and Negative Affect Schedule (PANAS) Score

## Gambling Task

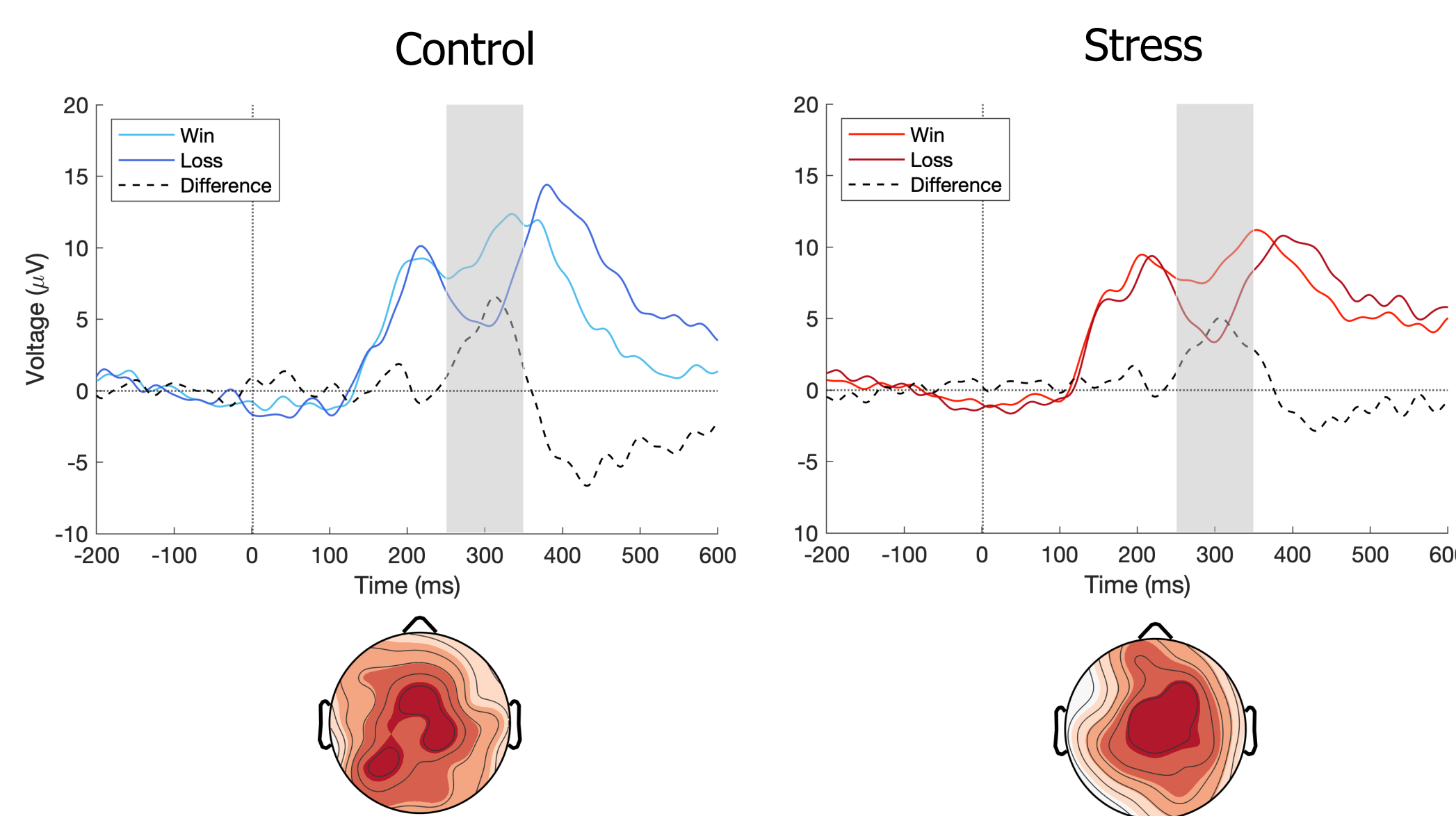


Fig 4. Reward Positivity for control (left) and stress participants (right)

## Oddball Task

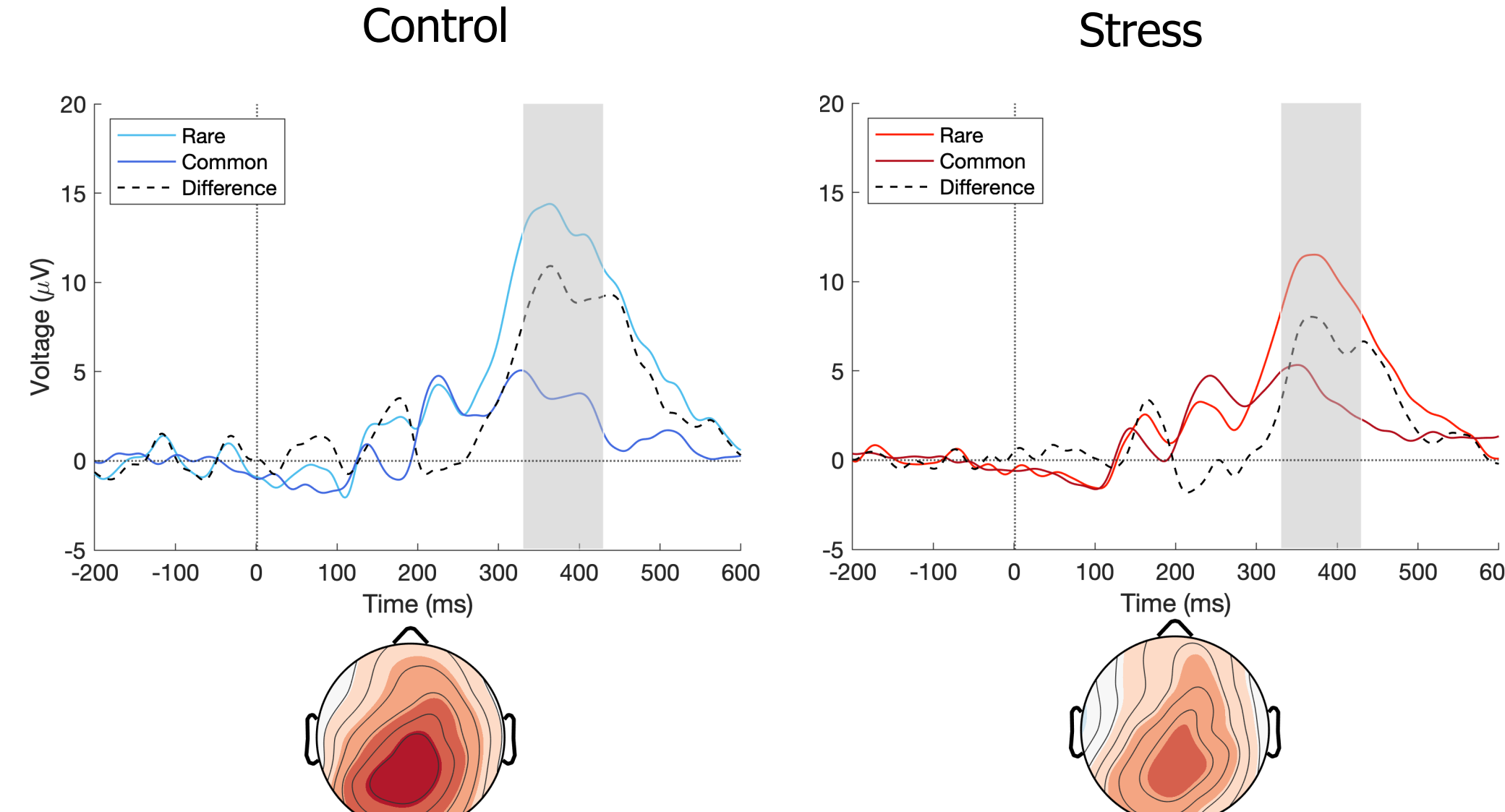


Fig 5. P300 for control (left) and stress participants (right)

## RESULTS

### 4-armed Bandit

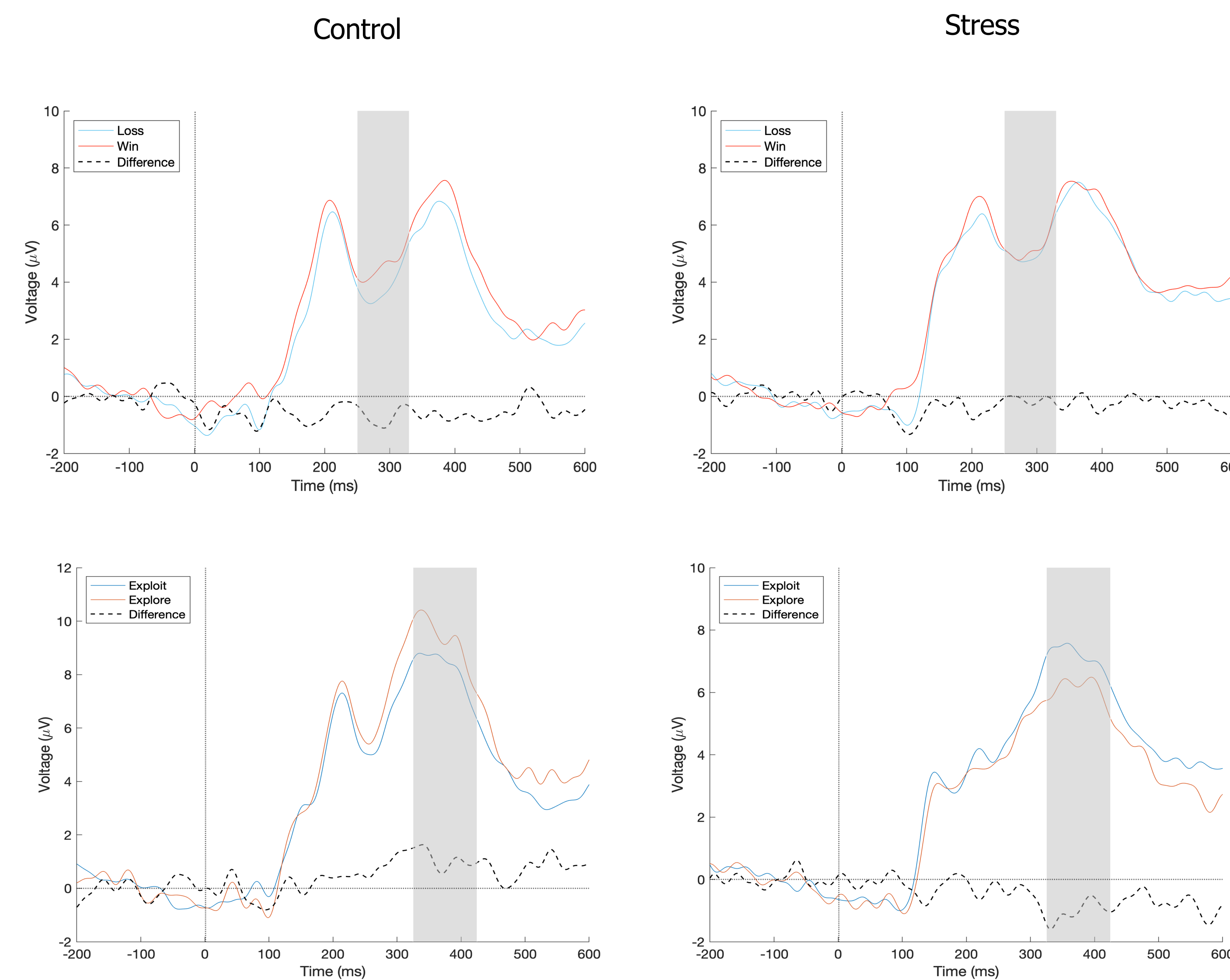


Fig 6. Reward Positivity (top) and P300 (bottom) for the 4 armed Bandit. Control (left) and stress (right). Explore trials were classified using a Win-Stay Lose-Shift Model

### Model Performance

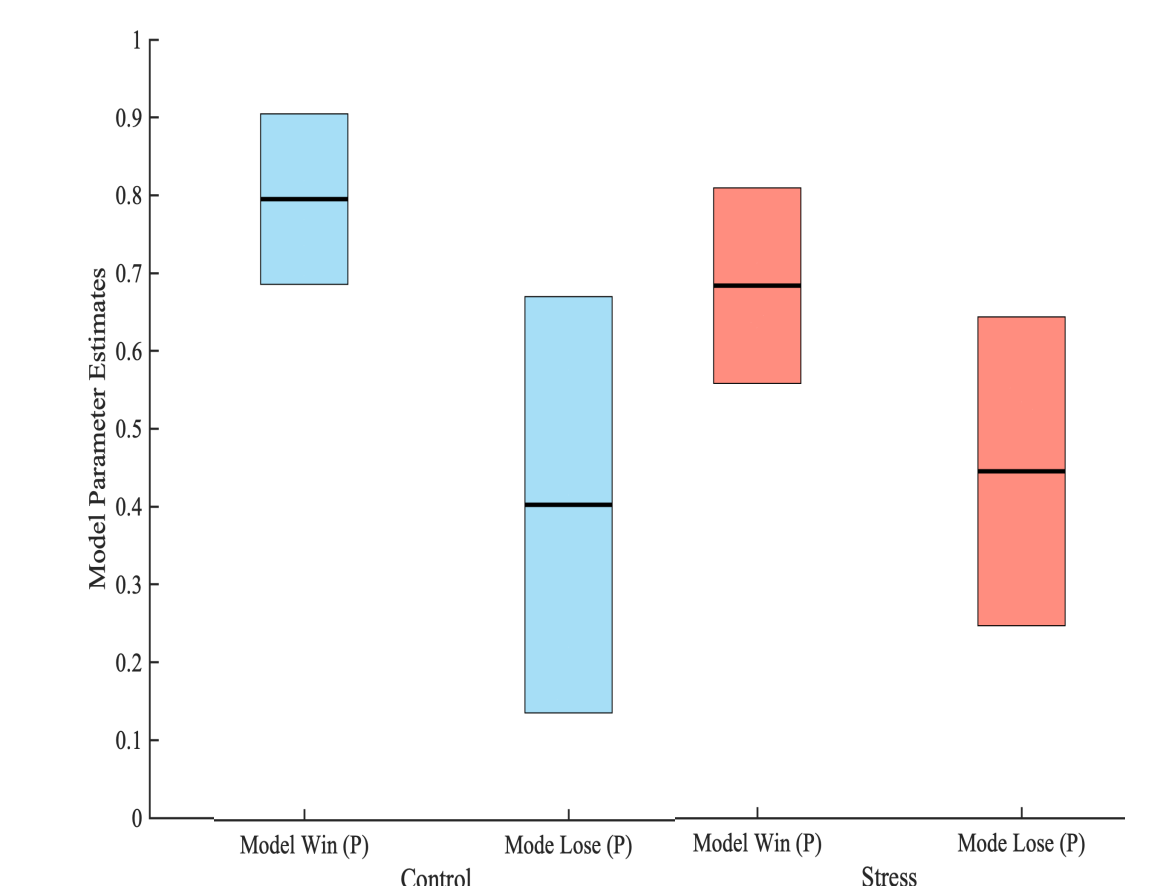


Fig 7. Win-Stay, Lose-Shift model parameter differences. Parameters are the probability of winning: **Win(P)** and the probability of losing: **Lose(P)**

### Stress minus Control

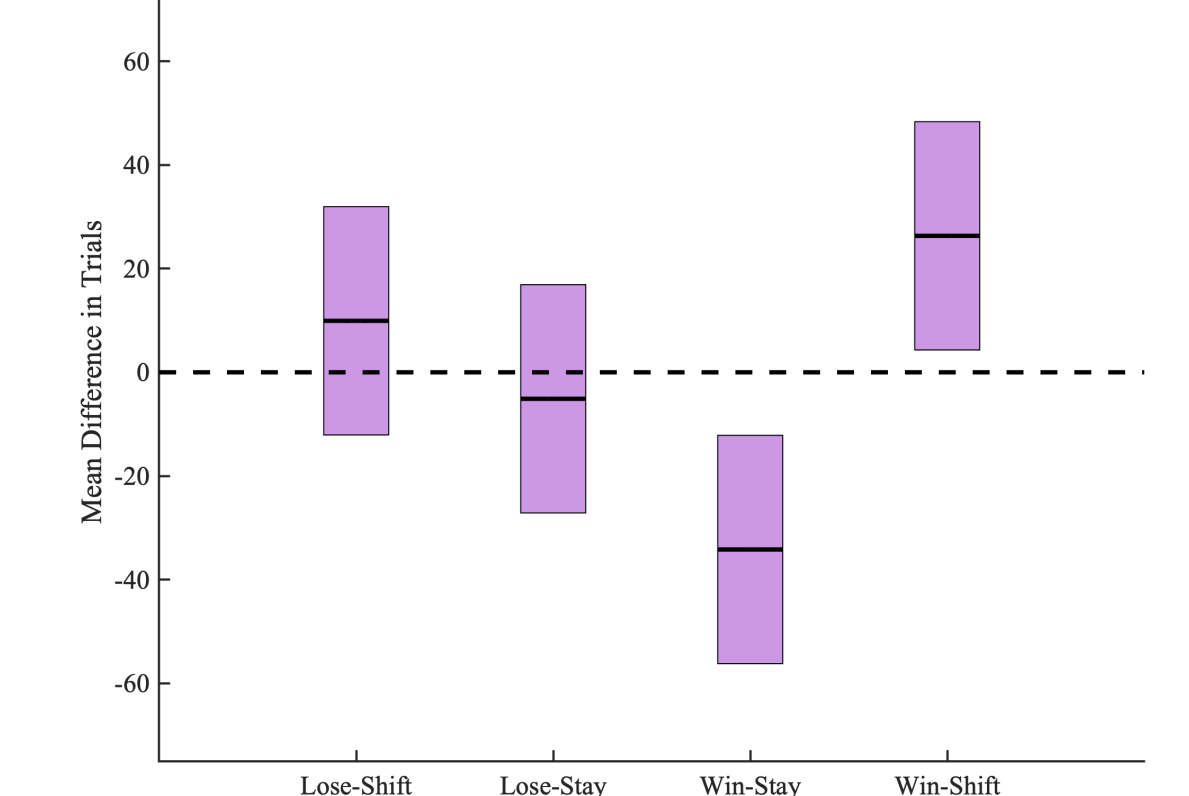


Fig 8. Differences in Win-Stay, Lose-Shift trial classifications. Difference is Stress minus Control

## CONCLUSIONS

- Stress caused higher heart-rate, greater anxiety, less positive affect, and more negative affect.
- Stress reduced the P300 in the Oddball task but did not seem to impact the Reward Positivity in the Gambling Task
- Stress reduced the Reward Positivity in the 4-armed bandit while causing the P300 to flip on explore-exploit trials and stress reduced the win percent of the model and less optimal behaviour (more win-shift and less win-stay)
- EEG & Modeling provide insight into the time-course of the effects of acute stress on dopamine and norepinephrine

