

“Oh No, Too Slow” the CRN as an Index of Performance

Monitoring in Individuals with Alcohol Problems

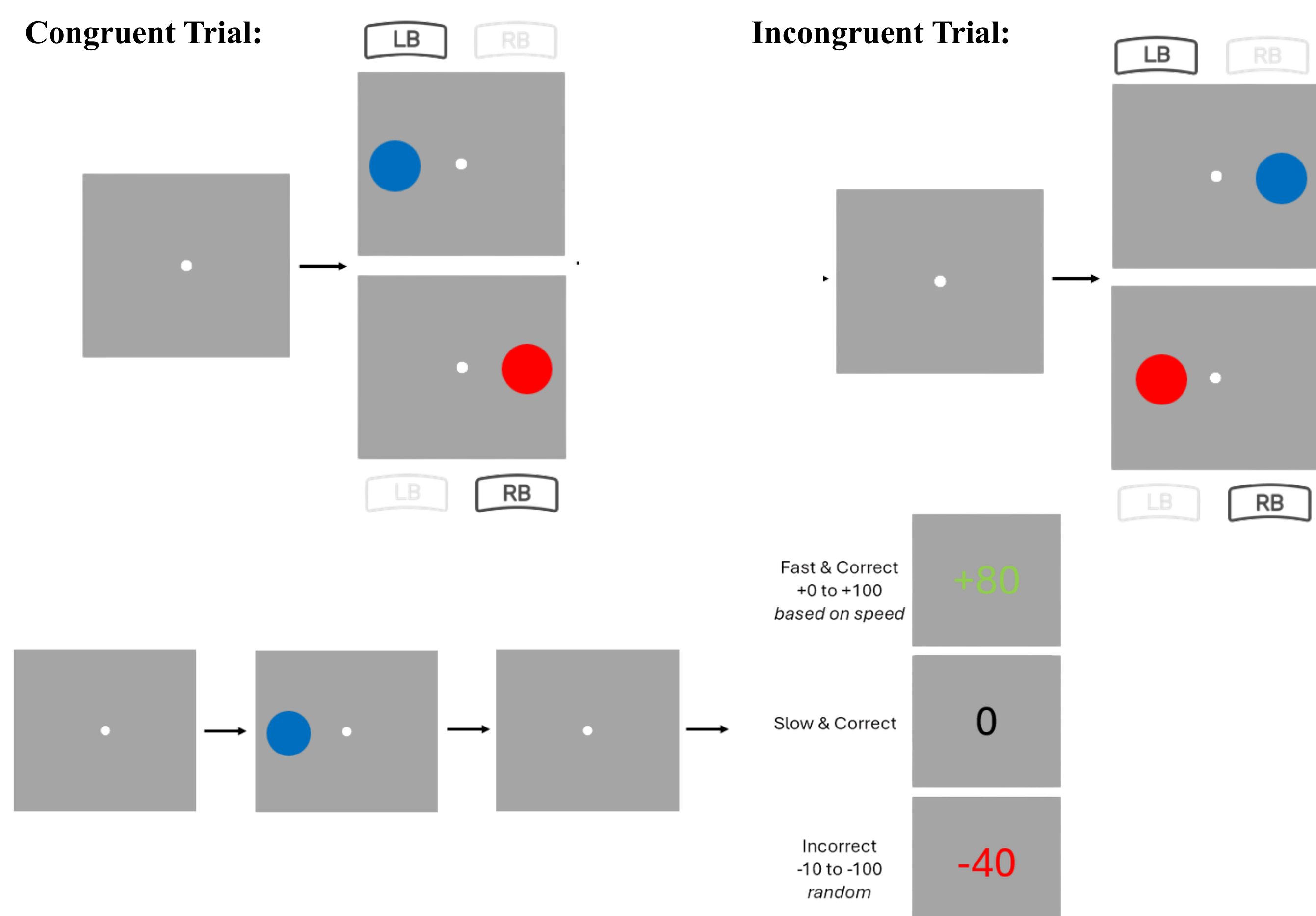
Alivia V. Corral, Aashi P. Patel, Colin B. Bowyer, Chris B. Martin & Danielle N. Jones

INTRODUCTION

- The error-related negativity (ERN) is an event-related potential (ERP) that is thought to reflect the performance monitoring processes (Olvet & Hajcak, 2009) that occur when an individual makes a mistake (Gehring et al., 1993).
- While most research focuses on the ERN's relationship with anxiety, there is substantial evidence that a blunted ERN predicts alcohol use disorder (Gorka et al., 2019)
- Alcohol use disorder is also associated with a weakened ability to learn from loss feedback in reward learning tasks (Li et al., 2025).
- The correct response negativity (CRN) is the counterpart to the ERN that happens on trials where a participant does **not** make a mistake (Files et al., 2021). Prior research has shown that the CRN predicts response speed in speed-incentivised tasks (Files et al., 2021). In these tasks contexts, the magnitude of the relationship between the CRN and response speed is another way to measure the a person's *performance monitoring capacity*.
- The current study tests if people with alcohol problems have a diminished performance monitoring capacity, as measured by the strength of the relationship between CRN and response speed, when they receive different types of feedback.

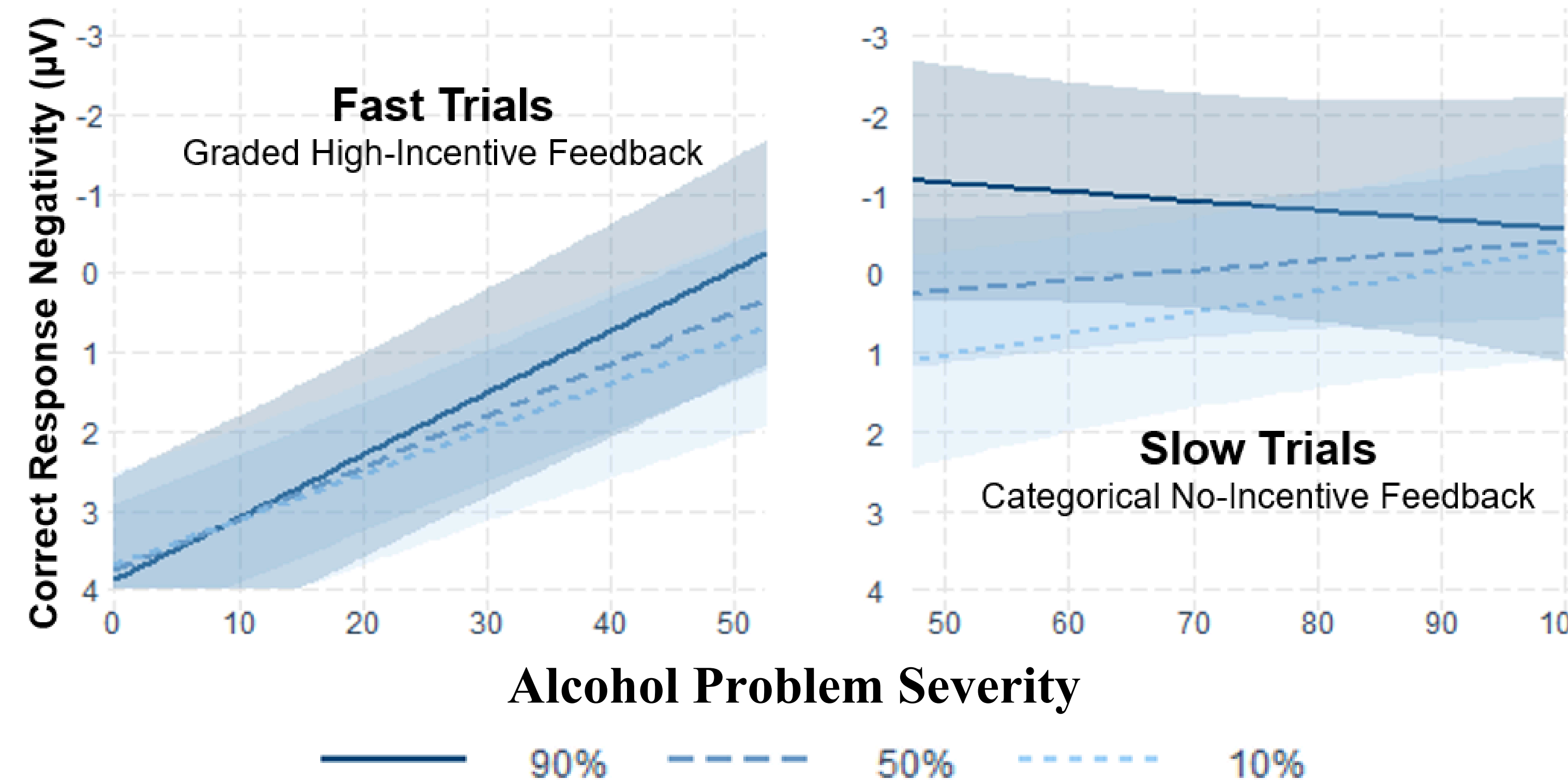
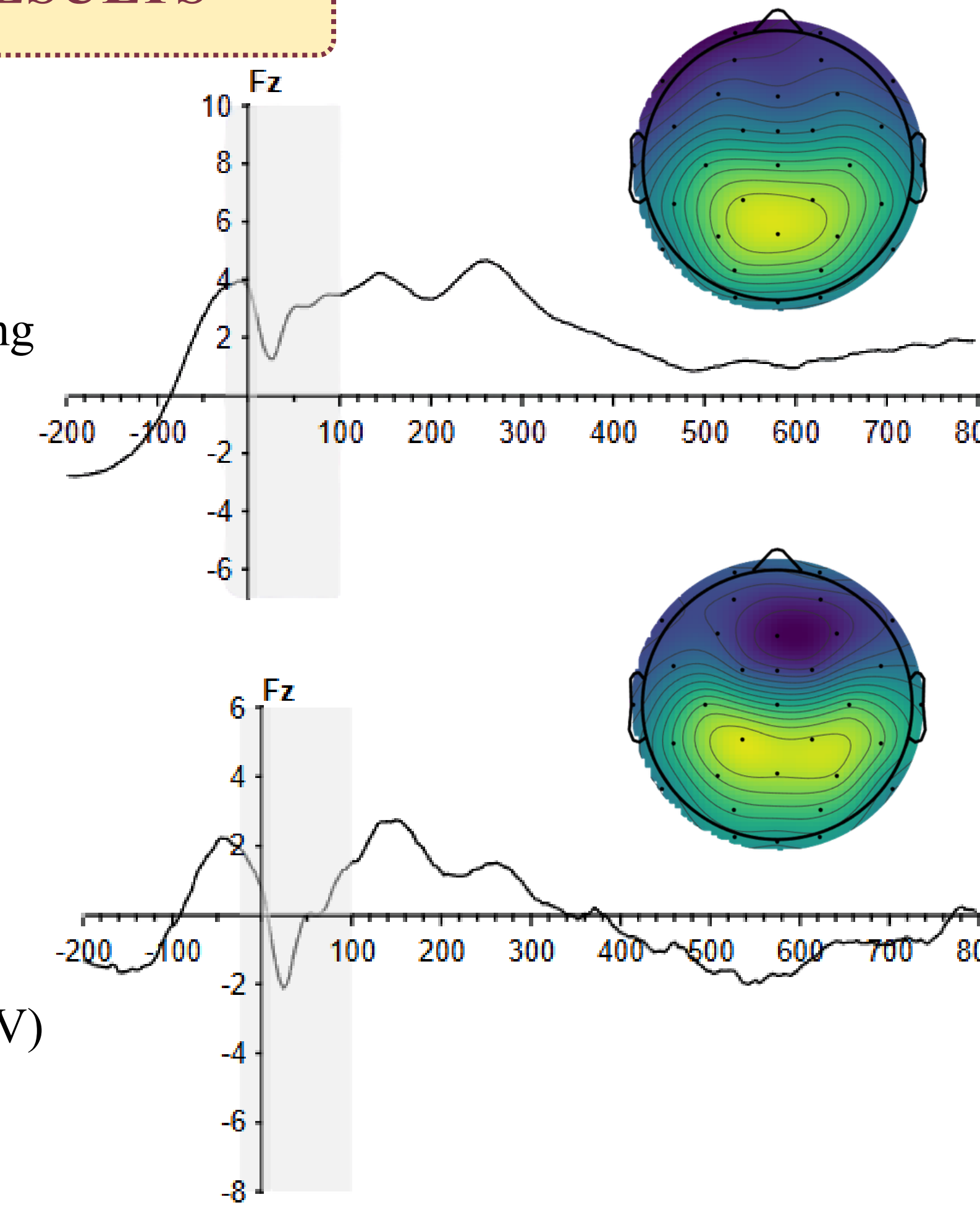
METHODS

- Participants:
 - 101 college and community adults
 - Age: $M = 23$ years old; $SD = 5.4$ years
 - Gender: 57 Women; 40 Men; 3 Non-Binary
- Questionnaire Measures:
 - Alcohol Use Disorders Identification Test (AUDIT; Babor et. al., 2001)
 - Provides a score that quantifies the number of alcohol-related problems a person has experienced during the past year.
- Simon Task:
 - EEG data was recorded for the duration of task.
 - An **inhibitory control task** in which participants respond to the color of a circle with a right or left button press. Circles will appear on either side of the screen - participants are instructed to ignore spatial location, and just respond based on the color.
 - Congruent trials:** correct button press = same side of screen that circle appears on
 - Incongruent trials:** correct button press = different side of screen that circle appears on
- Two Block Design
 - Regular block : participants received no reward; were told to be fast and accurate
 - Reward block: incentivized speed and accuracy; participant performance translated to monetary reward. Points were based on response speed, relative to their average speed in the regular block. Participants received feedback about point changes every trial.
 - Correct Above Threshold Responses (wins):** gained 1 to 100 points based on speed (faster responses = more points)
 - Correct Below Threshold Responses (no change):** 0 points
 - Incorrect Responses (loss):** lost 10 to 100 points at random



RESULTS

- EEG Data**
 - Collected using 32-channel Biosemi EEG system
 - EEG data were processed offline using MATLAB Version 2022b
- EEG Data Processing**
 - Time Window: -25 to 100ms post-response**
 - Rereferenced:** Mastoid
 - Baseline corrected**
 - Bandpass filter:** 0.1Hz to 30Hz
 - Blink correction:** Gratton and Coles Method (SOURCE)
 - Artifact rejection:** max threshold ($|75| \mu V$); flatline detection; sample-to-sample differences ($|50| \mu V$)
 - Electrode:** Fz



Slow Trials Simple Slopes:

	β	S.E.	p
High Alcohol Problems	0.01	0.02	0.47
Medium Alcohol Problems	-0.01	0.01	0.13
Low Alcohol Problems	-0.03	0.01	0.03

Fast Trials Simple Slopes:

	β	S.E.	p
High Alcohol Problems	-0.08	0.01	< .001
Medium Alcohol Problems	-0.07	0	< .001
Low Alcohol Problems	-0.08	0.01	< .001

DISCUSSION

- For individuals with more severe alcohol problems, the CRN does not track with response time in trials where response is too slow and no feedback has been received - these trials provide no feedback information and have no monetary incentive value.
 - For individuals with no alcohol problems the CRN **does** track response times in these no information no incentive trials.
- For **all participants**, the CRN does track response in the fast and correct trials - these trials provide participants with high information feedback and high monetary incentive value.
- Interpretations:**
 - People show little to no difference in correct response monitoring when they receive high incentive, high information feedback post-trial completion regardless of the severity of alcohol problems.
 - Individuals with alcohol problems show a deficit in their ability to internally monitor when the feedback they receive has low information and low incentive value.
 - The severity of the alcohol problems an individual has predicts the severity of this deficit.
- Limitations:**
 - Only analyzed this process under the context of the Simon Task.
- Future Directions :**
 - Determine if this relationship exists in other inhibitory control tasks and those similar to it such as a modified flanker task.
 - Determine if this trend is found in individuals with other substance use problems.
 - Modify current Simon Task to see how a modified incentive is given to participants - potentially eliminate money as a reward to see how much monetary rewards alter CRN if at all.

REFERENCES AND ACKNOWLEDGMENTS



First, I want to thank my research mentor Danielle Jones for encouraging my curiosity and fueling my ambitions within the field of research. I also want to thank the team of research assistants I have collaborated with who foster a healthy, welcoming community. Finally, I want to thank our participants for their efforts and dedication to this project, without them this research would not be possible.