

Reward Processing in Suicidal Adolescents: An Event-related Potential Study

Maretta R. Sonn, Annie Zhou, and Randy P. Auerbach

Columbia University Irving Medical Center – New York State Psychiatric Institute

Introduction

- Recent research has attempted to isolate reward-related differences between depressed adolescent suicide ideators versus attempters (Auerbach et al., 2015). Accordingly, the aim of this project was test whether specific neurophysiological markers related to suicidal thoughts and behaviors among adolescents.
- Prior depression research has closely examined the reward positivity (RewP), which is an event-related potential (ERP) that indexes neural sensitivity to receiving rewards (i.e., consummatory processes). Extant research has shown that the RewP associates with depression severity and predicts depression onset (Hajcak, 2015).
- Additionally, electrophysiology research also has probed oscillations related to reward and no-reward. Specifically, this work has focused on theta following loss as well as delta following reward. Whereas theta power following loss may stem from activity within the dorsal anterior cingulate cortex, delta power proceeding rewards is believed to result striatal activation.
- Thus, we tested whether RewP and power alterations may relate to suicidal thoughts.

Hypotheses and Objectives

- ERP amplitudes and delta power will be greater for Reward vs. No-Reward. Additionally, theta power will be enhanced for No-Reward vs. Reward.
- Depression symptom and suicidal ideation severity will correlate with: (a) a blunted RewP and delta power and (b) greater theta power.

Methods

Participants

- N = 33; 21.21% Male; Mean_{age} = 16.27 (SD = 1.62)
- All participants reported depression, anxiety, and/or substance use disorders
- n = 24 reported suicidal Ideation
- n = 12 reported a past year suicide attempt

Assessments

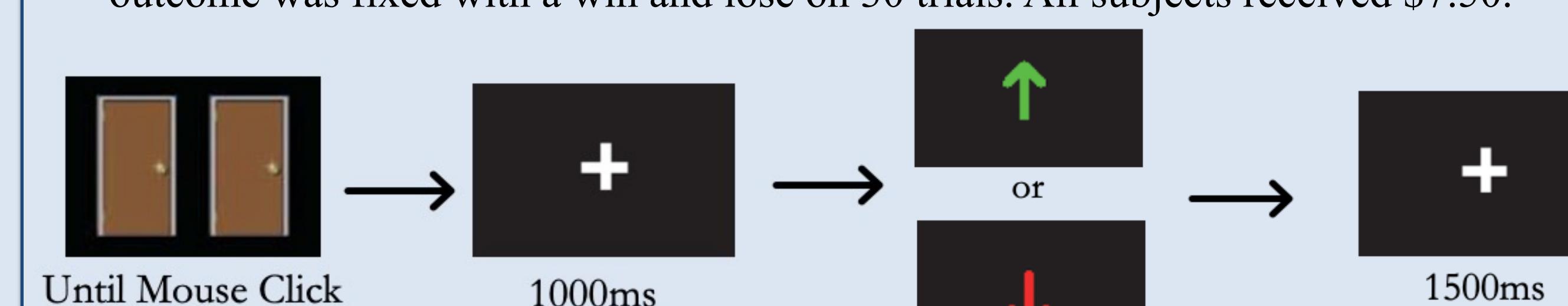
- The Mini-International Neuropsychiatric Interview for Children and Adolescents (MINI -KID; Sheehan et al., 1998)
- Self-Injurious Thoughts and Behaviors Interview (SITB-I; Nock et al., 2007)

Self-report Measure

- The Moods and Feelings Questionnaire (MFQ; Costello & Angold, 1988)
- The Beck Scale for Suicide Ideation (SSI; Beck, et al., 1979)

EEG Task

- The Gambling Task (Carlson et al., 2011) probed neurophysiological response to Reward and No-Reward. Subjects were informed that the goal of the task was to earn as much money as possible. During the task, participants were presented with two identical doors and asked to select the left or right door, after which a fixation cross “+” appeared. Following the fixation cross, participants were given feedback: (a) green “↑” for a win of \$0.50 or (b) red “↓” for a loss of \$0.25. However, the outcome was fixed with a win and lose on 30 trials. All subjects received \$7.50.



ERPs

- RewP was probed from 200ms - 300ms post-feedback using the average ERP amplitudes from electrodes FCz and Cz.

Time-Frequency Analyses

- Delta power was probed from 500ms - 900 ms post-feedback at electrode FCz.
- Theta power was probed from 350ms - 450ms post-feedback at electrode FCz.

Results

Figure 1. ERPs to Reward vs. No-Reward

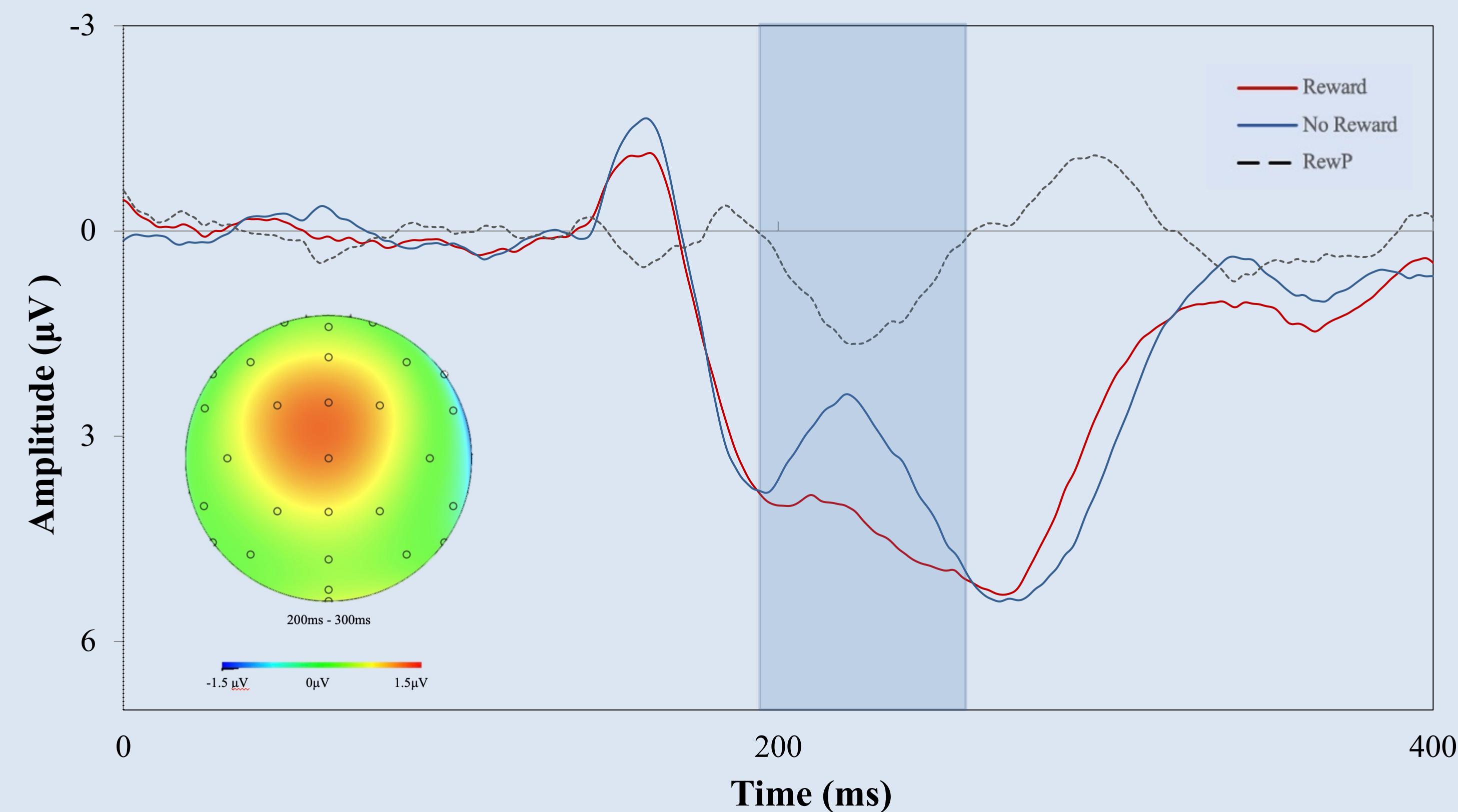


Figure 1. The topographical map indicates that activity is maximal at electrodes FCz and Cz. The RewP is maximal between 200-300ms post-feedback whereby Reward (red line) is significantly greater than No-Reward (blue line), $t(32) = 3.43, p = 0.002$. The difference wave reflects Reward vs. No-Reward (black line).

Figure 2. Time Frequency Analysis of Delta and Theta

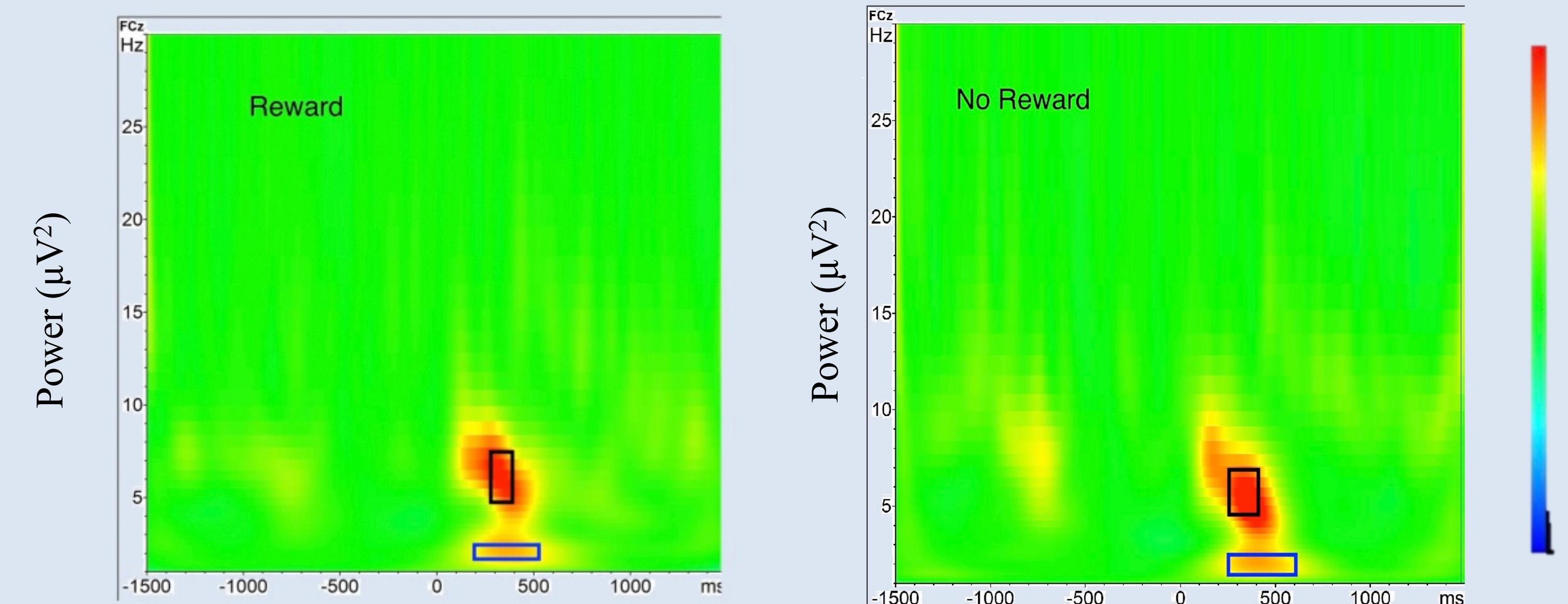


Figure 2. The Black rectangle marks the peak activity of theta power (4-7 Hz), and the blue rectangle marks the peak activity of delta power (1-3 Hz). Interestingly, theta for No-Reward was greater than Reward, $t(32) = 2.61, p = 0.01$. However, in contrast to our hypothesis, delta power condition effect was non-significant, $t(32) = 1.68, p = 0.10$.

Figure 3. RewP and Depression Association

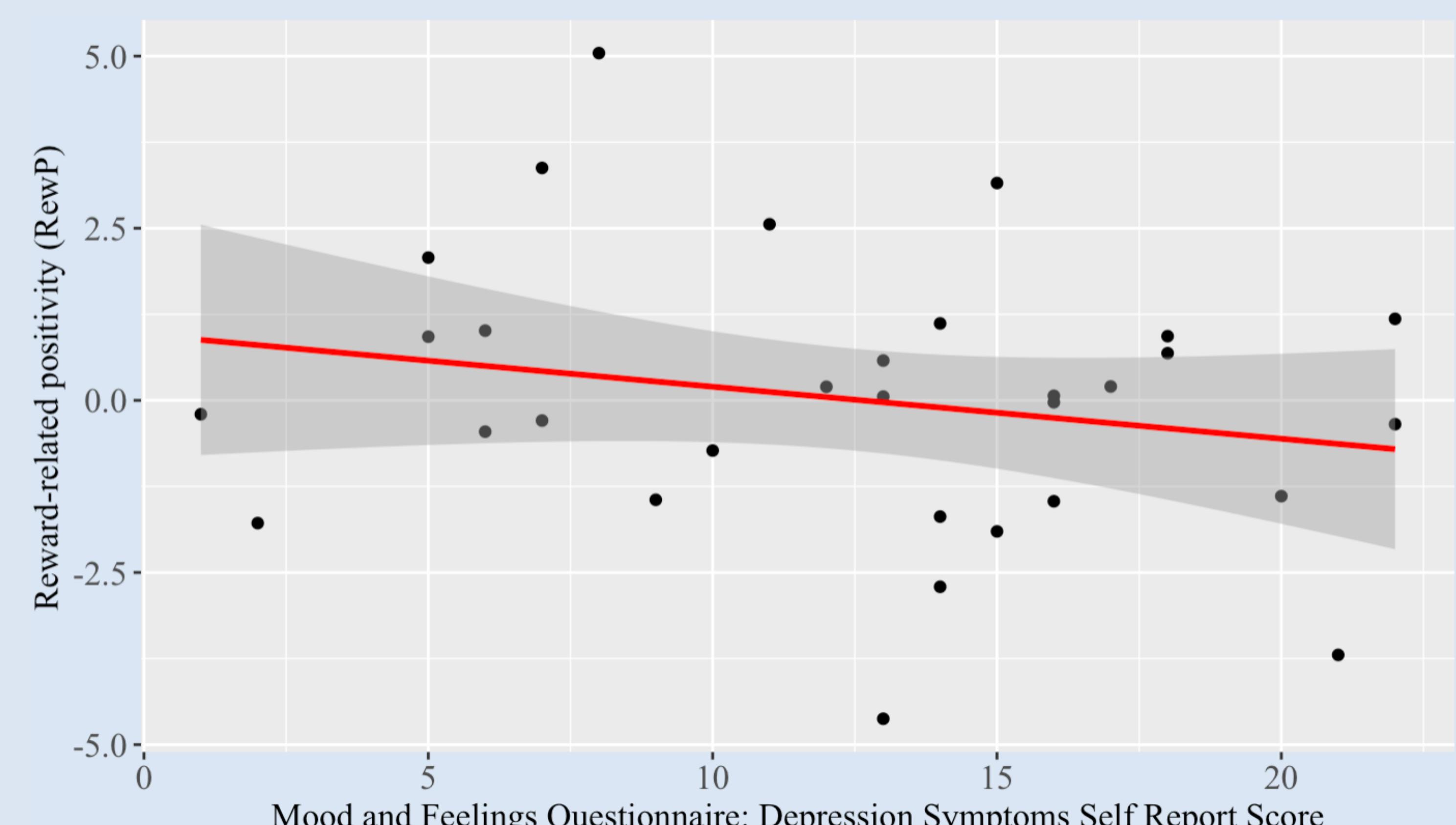
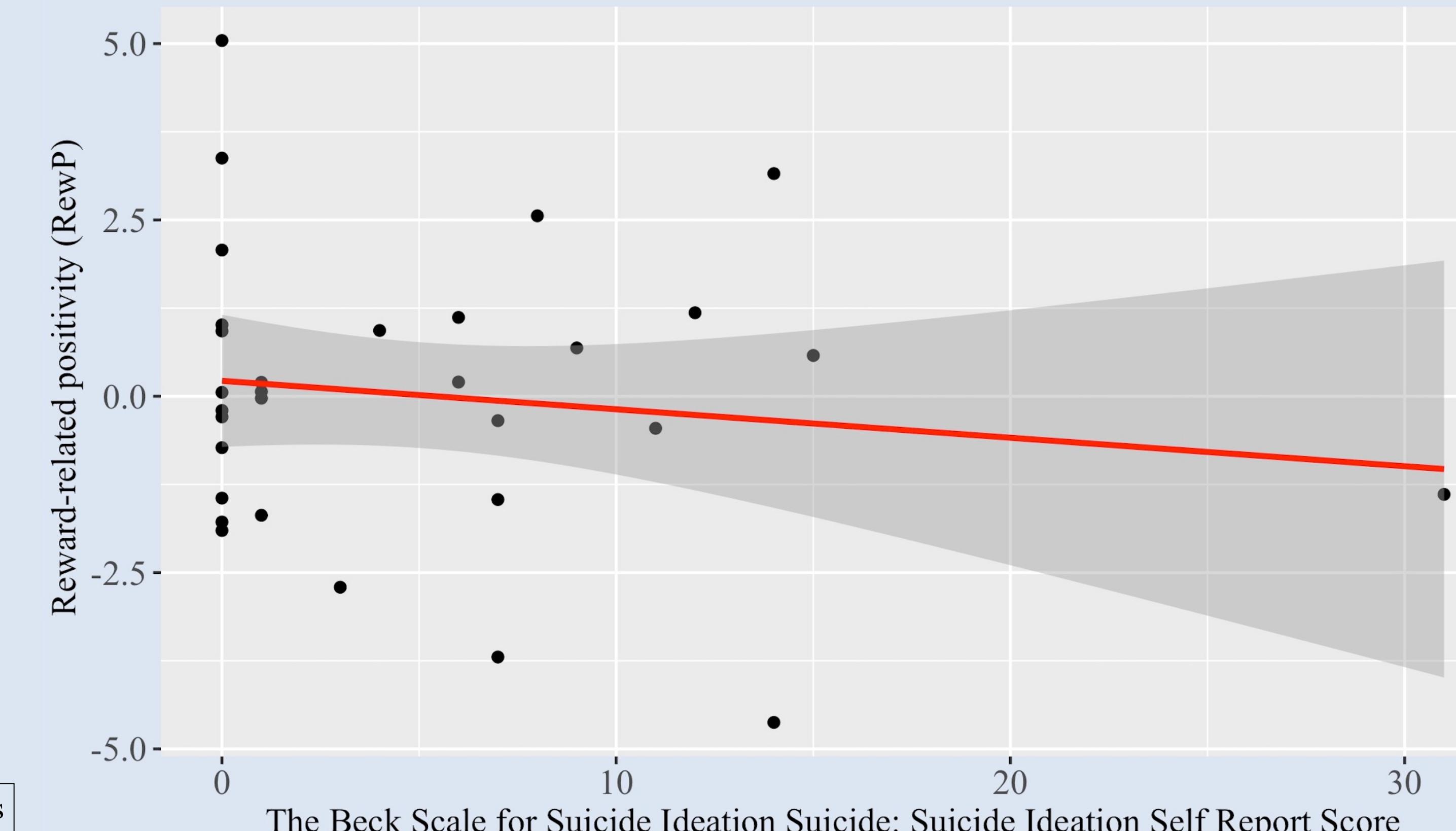


Figure 3. Although the association between the RewP and depression symptom severity was in the hypothesized direction, the correlation was non-significant, $r(29) = -0.21, p = 0.25$.

Figure 4. The Relationship of RewP and Suicidal Ideation



Discussion

Conclusion

- We received partial support for our hypotheses. Namely, RewP amplitudes were greater for Reward versus No-Reward. Further, theta power was enhanced following No-Reward versus Reward. However, there were no condition effects for delta power.
- No significant correlations emerged. That said, the direction of effects for both depression symptom and suicidal ideation severity were in the expected direction. Data collection remains ongoing, and therefore, it may be that with more participants there will be power to detect this relationship.

Limitations and future direction

- These are preliminary analyses, and thus, the sample size is fairly modest. Re-analysis with the larger and complete data set will be essential.
- Given the symptom severity of the participants, many adolescents were medicated. SSRIs are known to normalize reward-related activity, and thus, may have impacted our ability to detect specific associations with symptoms.
- Future research also will test whether neurophysiological processes prospectively predict suicidal thoughts and behaviors.

Acknowledgements

A sincere thanks to Columbia University’s Summer Internship Program in Psychological Science. Also, thanks to everyone at the Translational Research on Affective Disorders and Suicide Laboratory for their efforts on this project and for a wonderful summer. And, of course, a special thanks to the families and funding (U01 MH116923) that support this work on adolescent suicidal thoughts and behaviors.