Behavioral & Physiological Evidence for Differential Learning of Fear, Safety, & Reward

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Introduction

- Neurobiologically, posttraumatic stress disorder (PTSD) is theorized to be driven by amygdala hyper-activity in response to threat1, however this research has ignored the fact that fear responding occurs after fear discrimination, while prior research shows that individuals with PTSD exhibit difficulty in discriminating between fear and safety when measured behaviorally (e.g., self-report) and at the neural level (e.g., amygdala reactivity).2,3
- Together, this suggests a difficulty in discriminating fear vs. safety cues in PTSD as an underlying deficit.4-6
- In rodents, discrete sub-populations of cells in the amygdala code fear (foot shock) vs. reward (sucrose) vs. safety cues7, and these cells are different from those that contribute to learning about fear vs. reward when paired with a safety cue.
- The study of the amygdala during differential learning of fear, safety, and reward is therefore thought to be consequential for better understanding the pathophysiology of PTSD; however, no study has yet translated these findings to humans.

Research Aim

- In this pilot study, we adapted a rodent task of stimulus discrimination to humans as a first step in a translational affective neuroscience program of research in the study of stimulus discrimination deficits in those with PTSD.

Methods

N = 20 Marquette undergraduate students (demographics available upon request) completed a fear, reward, and safety (FSAR) task adapted from rodent work (Fig. 1). Fear cues were co-presented with white-noise burst; reward cues with $0.25, and safety cues with no outcome.

Ability to discriminate was tested two ways:
1. Behaviorally, participants provided self-report ratings of likeability of cues on a 1-10 scale (1 = very bad; 10 = very good)
2. Physiologically, we measured skin conductance response (SCR; Biopac MP160) to cues

Results

- Behaviorally participants were able to discriminate among cues (ANOVA: p < 0.001), such that pairing of safety with threat/reward altered likability (p’s < 0.001); SCRs differed between cues (ANOVA: p = 0.010), such that Fear was more arousing > Reward + Safety (p = 0.018)
- As the amygdala is the neural source for SCR, SCR differences to cue types and differential SCR habituation (to fear) vs. sensitization (to reward) suggest that the amygdala codes cues differentially in neural, replicating rodent research.
- Future research will extend these findings in clinical samples of PTSD and with the use of neuroimaging to study amygdala reactivity to cues.

Conclusions & Future Directions

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References


Graphs and Figures

Figure 1. Fear, Safety, And Reward (FSAR) Task

Figure 2. Behavioral Results

Figure 3. SCR Results

Figure 4A & 4B. SCRs to Fear Cues Declined Over Time (Habituation) (p < 0.001) & SCRs to Reward Cues Increased Over Time (p = 0.003) (Sensitization)