Anxiety and Fear as a Function of Threat Certainty and Sex Differences
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INTRODUCTION
Mental health illnesses are an issue of increasing prevalence in today’s society. One study found that approximately 30% of the adult population in the United States meet the requirements and criteria to be diagnosed with an anxiety disorder at some point over the duration of their lives. (Kessler, Chiu, Demler, & Walters, 2005) Thus, there is a strong need for the development of new treatments for anxiety. This study focuses on refining measures of anxiety and fear in an animal model by assessing freezing and rearing in two different conditions. Moreover, because sex differences in the prevalence of affective disorders in humans are well documented, we included both male and female rats to investigate sex-related differences in behavior within this paradigm. We utilized unpredictable and predictable footshock paradigm with the goal of increasing or prolonging a state of either fear, respectively. Rearing behavior was used as a measure of anxiety and freezing behavior to assess fear. We hypothesized that unpredictable footshock would elevate anxiety-related behaviors compared to predictable footshocks and more so in female rats than males. These results could aid in the construction of a more efficient animal model to use in research for the study of anxiety disorders and potential therapeutic interventions.

METHODS

I. Rearing and Freezing

Day 1
Floor contact with hind limbs only.

Day 2
Counted by blind observer per 20 sec interval.

Day 3
Used as index of risk assessment when threat is certain.

II. Freezing

Day 1

Lack of all but respiratory movement.

Day 2
Counted by blind observer per 8 sec interval.

Used as an index of fear when threat is certain or imminent.

RESULTS

Day 1

By Condition

Rearing

By Sex

Freezing

By Sex

Statistical Analysis

Rearing: A 2x2 mixed repeated measures ANOVA was used to analyze the data for both the main effects (time, condition, and sex) and interaction-effects (time x condition, and sex x time).

Freezing: A 2x2 mixed repeated measures ANOVA was used to analyze the data for both the main effects (time, condition, and sex) and interaction-effects (time x condition, and sex x time).

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SUMMARY AND DISCUSSION

Day 1

Rearing decreased in response to footshocks and freezing increased.

There were no significant differences due to experimental condition or sex.

Subjects were driven to a fearful state by the footshock exposure on the first training day.

Day 2

Rearing increased during the context test day.

Freezing was increased and persisted longer in the random footshock condition.

There was a trend towards females freezing less than males.

Animals in the random condition showed better contextual fear memory than the consistent condition, and males trended toward greater fear conditioning than females.

Day 3

Rearing was elevated in 2x2 decreased rapidly following exposure to the reinstatement footshock.

Reinstatement periods last in the random footshock condition than in the consistent footshock condition.

These data are consistent with findings that unpredictable stimuli are learned more rapidly than predictable stimuli.

Male rats exhibited extended freezing following the reinstatement footshock, consistent with a stronger fear memory trace than females.

There are sex differences in reinstatement of the fear memory, which is likely related to amygdala-dependent fear memory and aggressive behavior in males.

Overall

This experiment demonstrates that, as according to the Rescorla-Wagner Learning Model, surprising stimuli are more readily acquired in fear-memory. Although manipulating threat certainty did not induce a state of anxiety in the animals, we demonstrated significant behavioral differences in fear expression in both conditions and sex over time. Furthermore, this study highlights the importance of utilizing both male and female subjects within animal models of emotion because sex-related differences exist in emotional responsiveness in both human and non-human animals alike.

REFERENCES
