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Context Specificity of Avoidance Behavior in Rats

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Introduction

- Avoidance learning is one-way animals change their behavior in response to changing environmental contingencies.
- Avoidance behavior is characteristic of several anxiety-based disorders, which are the most common class of mental health disorders in the United States.[1]
- In a passive avoidance paradigm, one side of a two-compartment chamber is paired with a footshock; following this learning, rats will avoid entering the shock-associated side of the chamber. Others have demonstrated this behavior is reliably reduced by changing the context, or surrounding environmental cues.[2]
- While the dorsal hippocampus has been linked to the context dependency of avoidance learning[3], the role of the retrosplenial cortex (RSC), which is necessary for several other types of context-specific memory[4], is less understood in this paradigm.
- **The current work aimed to examine the role of the RSC in passive avoidance learning and memory.**

Methods

Animals & Apparatus:

- 18 Long-Evans rats (9 males, 9 females)
- 2 groups: Context A Retrieval, Context B Retrieval
- Room 1 and Room 2 (described below) were counterbalanced as Context A and B

Experiment	Room 1	Room 2
1 (1.0 mA shock)	Fluorescent lights, water cleaner	Red lights, bleach cleaner
2 (1.0 mA shock)	Fluorescent lights, water cleaner	Red lights, Windex cleaner, 70 dB white noise
3 (0.7 mA shock)	Fluorescent lights, water cleaner	Red lights, Windex cleaner, 70 dB white noise
4 (0.7 mA shock)	Fluorescent lights, orange-scented cleaner, covered transport	Red lights, Windex cleaner, 70 dB white noise

Behavioral Design:

Training
Context A
24 hrs

Testing
Context A

Context B

Behavioral Procedure:

Training

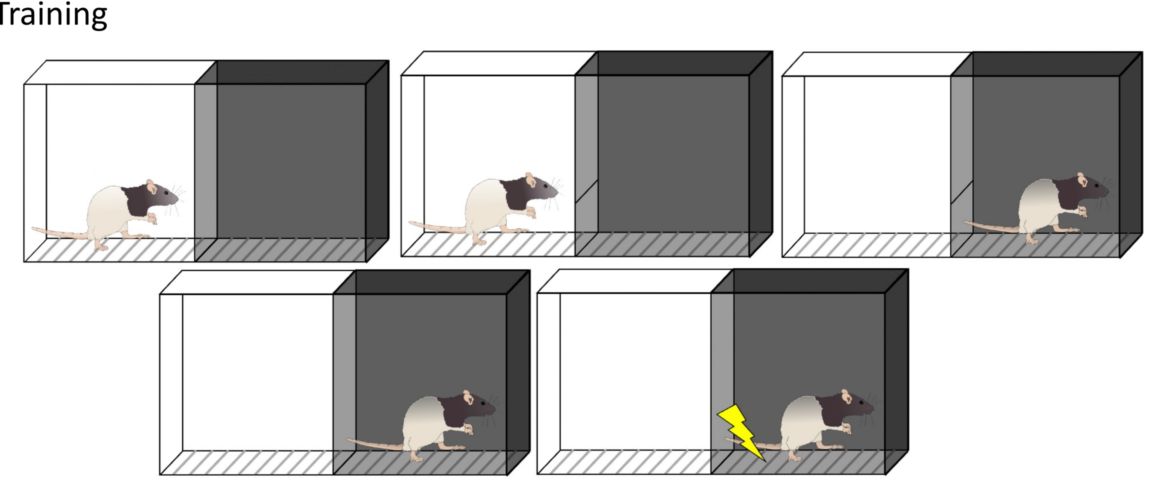


Figure 1: During training, rats were held in the experimenter's hand for 20-30 s and then placed on the white side of the box. The door was raised after 30 s. Latency to cross to the black compartment was recorded. After the animal crossed, the door closed and a 2-s footshock (Experiments 1 & 2: 1.0 mA; Experiments 3 & 4: 0.7 mA) was delivered. 10 s following the footshock, the animals were removed from the chamber and returned to the colony.

Testing

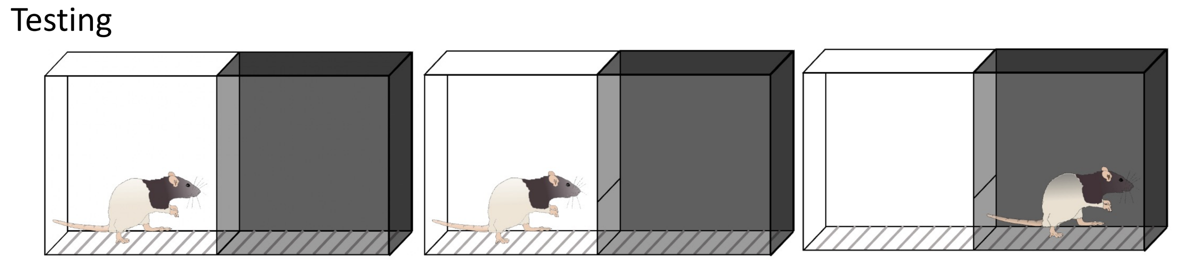


Figure 2: 24 hours later, the animals were tested in Context A or Context B. Testing was identical to training, except for following the initial 30-s period, the door remained open for 540 s and no shocks were delivered. Latency to cross to the black box was recorded and animals who failed to cross received a score of 540 s. The animals were then removed from the box and returned to their colony.

Results

Figure 3: The original experimental setup does not create contexts distinct enough for the animals to discern environmental cues (M = 489.5).

Experiment 1

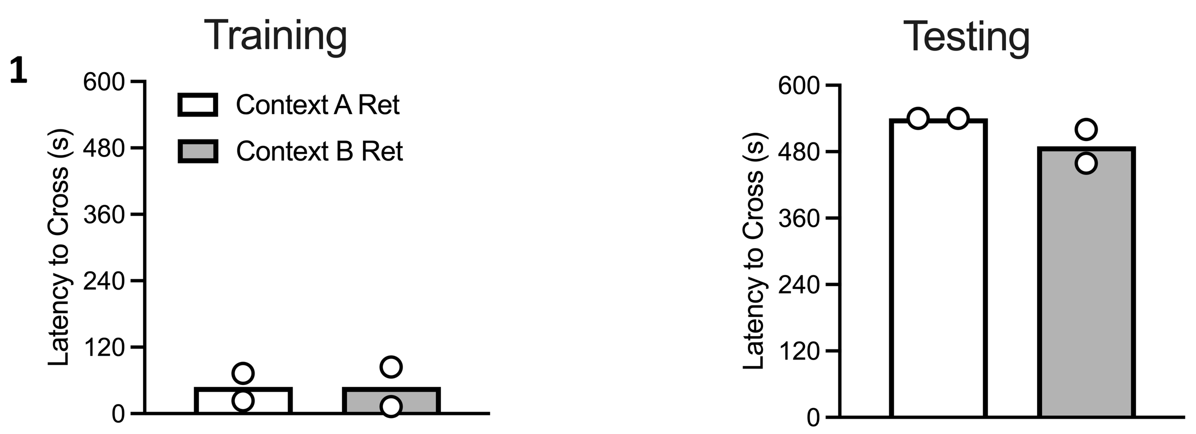


Figure 4: The addition of white noise and changing to a different smell (Windex cleaner) in Room 2 made the contexts more discernable (M = 334.85).

Experiment 2

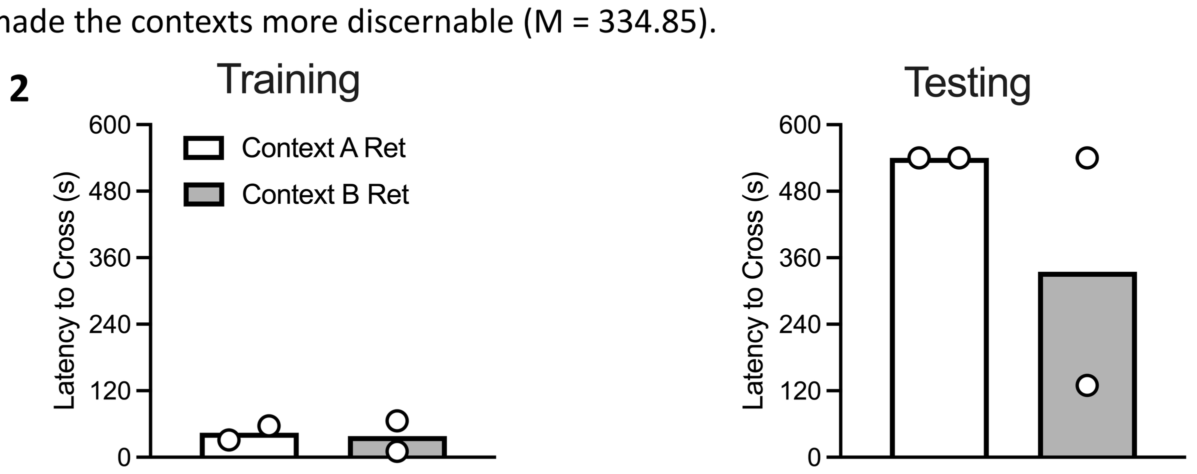


Figure 5: Changing the shock intensity reduced generalization to a novel context (M = 280.95).

Experiment 3

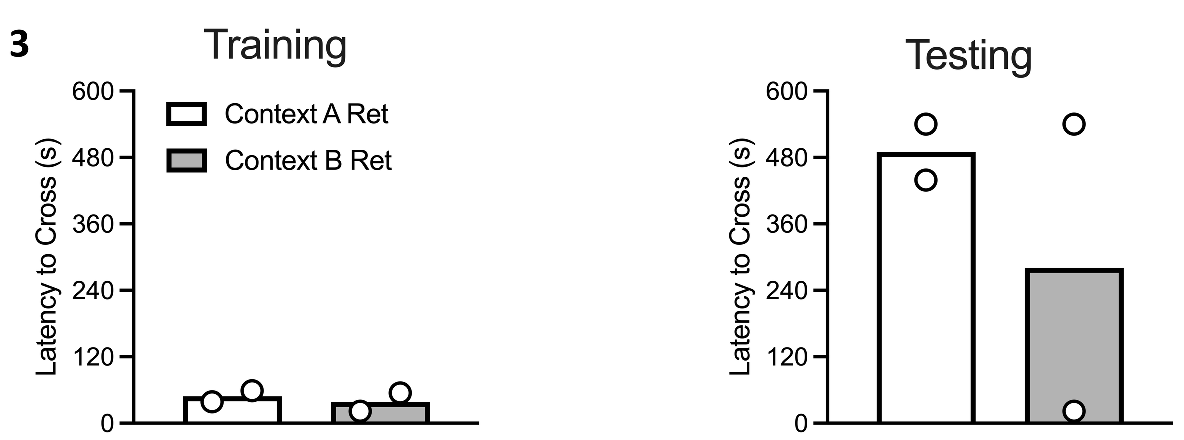


Figure 6: Modifying Room 1 (orange-scented cleaner) and covering transport to both rooms gave us the clearest context discrimination (M = 229.63).

Experiment 4

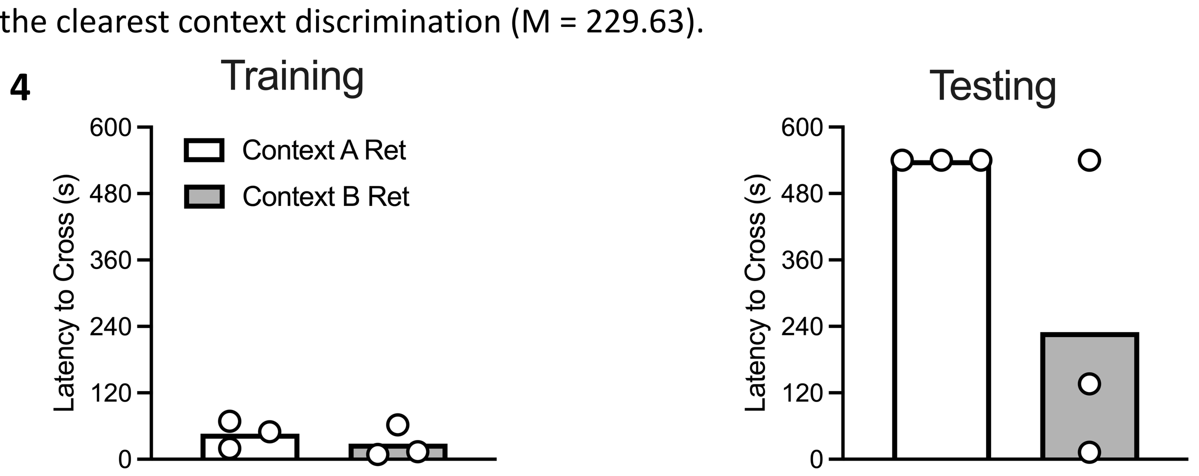
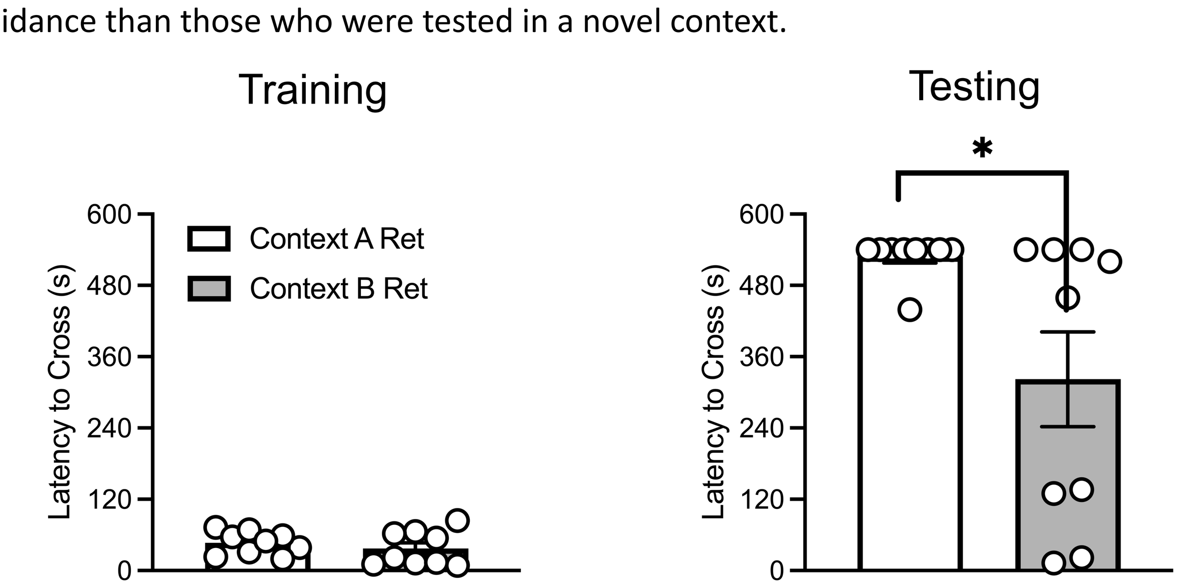


Figure 7: Combined results from all pilots. Animals tested in the training context showed more avoidance than those who were tested in a novel context.



Conclusions

In the present experiments, we demonstrated that significant contextual changes are needed to produce a context-switch effect in the passive avoidance paradigm. As we progressively modified each environment to make them as distinct as possible, we observed reduced avoidance behavior when testing occurred outside of the training context. Together, these results demonstrate that this type of learning can be modulated by context.

While we saw the greatest context change in Experiment 4, the animals in the present experiments overall did demonstrate a context change (Figure 7). **In future work, we will therefore replicate this experiment using the final experimental parameters (Experiment 4) with a higher N.** Tissue will then be collected to determine changes in neural activity in the RSC when tested in either the same context as training or a different context, as the RSC is necessary to integrate contextual information in fear memory. In this replication, we will also be including a no retrieval/no test control to get a baseline measure of neural activity.

Avoidance behavior is a hallmark symptom of anxiety-based disorders, including PTSD. A better understanding of how these behaviors are controlled by environmental cues as well as their associated neural and molecular correlates will aid in developing novel therapeutic strategies for disorders characterized by avoidance behavior.

References

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