



# Effects of Environmental Enrichment on Visual Discrimination Learning with Rats

Sarah Jones, Lauren Cleland, Sydney Wilson, Cheyenne Elliott, & Kenneth Leising  
Department of Psychology, Texas Christian University



## Introduction

- Environmental enrichment involves introducing novel stimuli that the animal can perceive and interact with into an environment. Previous research has shown that environmental enrichment decreases fearfulness and anxiety, while encouraging exploration towards novel stimuli (Friske & Gammie, 2005).
- Environmental enrichment has been linked to improved cognition, but little research has considered the effects of an enriched environment on discrimination learning.
- In a spatial conditional discrimination task, a stimulus serves as a cue for determining which direction a response should be made to receive an outcome.
- A differential outcomes procedure, in which characteristically different responses are paired with unique outcomes has been shown to facilitate discrimination learning (Peterson, Wheeler, & Trapold, 1980; Trapold, 1970; Schmidtke, Katz, & Wright, 2010).

### Aim of Study

- The proposed research will investigate whether environmental enrichment can facilitate discrimination learning in rats and examine the exploration and anxiety of rats when placed on a plus maze. During enrichment, the behavior of the rats in their homecage and in the enriched environment condition was recorded to examine the amount of interaction. After enrichment, rats will be tested in the open field and then discrimination learning task.
- We hypothesized that rats in the enriched environment would display less anxiety in the plus maze and acquire the discrimination task more quickly than the control rats.

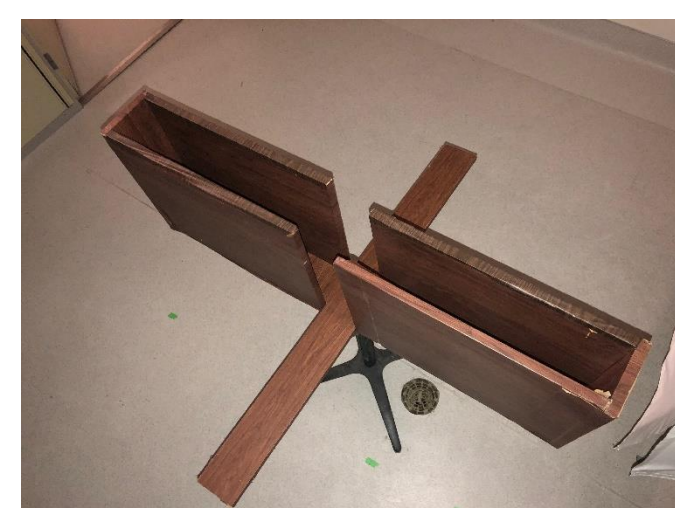
## General Method

**Subjects.** Eight female experimentally naïve Long-Evans rats were exposed to an enriched environment and eight to the control condition.

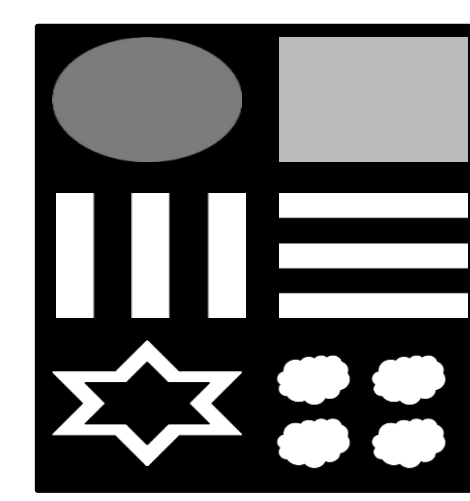
**Enrichment.** During enrichment, each pair of rats (i.e., cagemates) in the enriched environment condition went into the play cage every day for two hours exposing each of the four pairs of rats to a total of 67.5 to 90 hours in the playcage over 45 days. Rats in the play cage were recorded for 2 hours and were scored by the amount of time they spent with each toy (e.g. running wheel). Rats in the control group were removed from their cages and handled daily throughout the 45 days. Both conditions of rats were recorded in their homecage for 12 minutes and scored for behaviors of grooming their partner, grooming themselves, rearing, and drinking water.



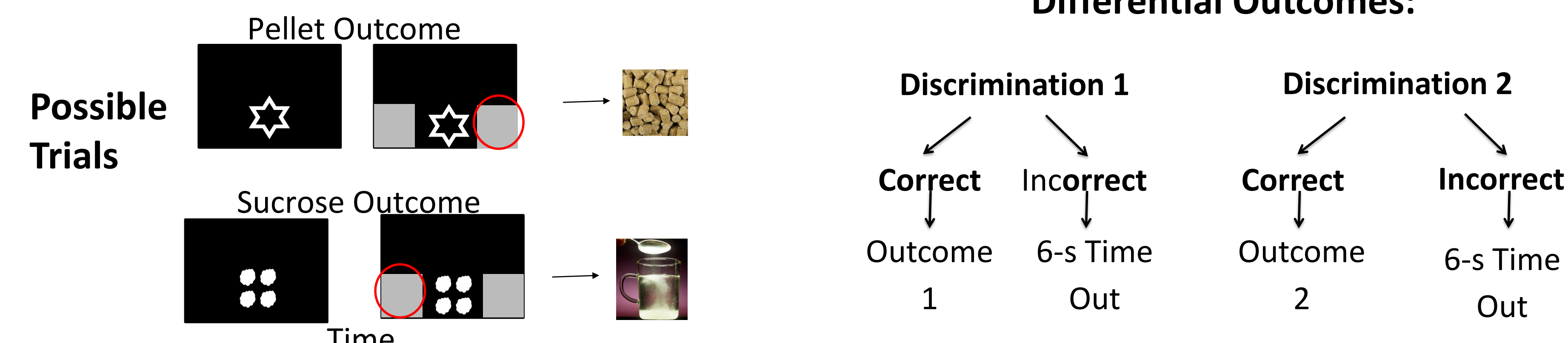
**Plus Maze.** Following 45 days of enrichment, rats were tested for anxiety and exploration behavior by placing them on a plus maze and measuring the amount of time that was spent on each arm. The plus maze includes two open arms and two closed arms (i.e., with walls enclosing the arm). The open arms were classified as the north and south arms and the closed arms were classified as the west and east arms.



**Visual Discrimination.** Rats were trained on a spatial, visual discrimination task in an iPad-equipped operant chamber. Rats were first presented with a stimulus (star, cloud, horizontal, or vertical stripes). After a touch to the stimulus, two grey squares appeared to the left and right of the stimulus. For each stimulus, a touch to one of the squares was considered a correct response and led to reinforcement with either sucrose or pellets, while a touch to the other square was incorrect and led to a 6-s time out.



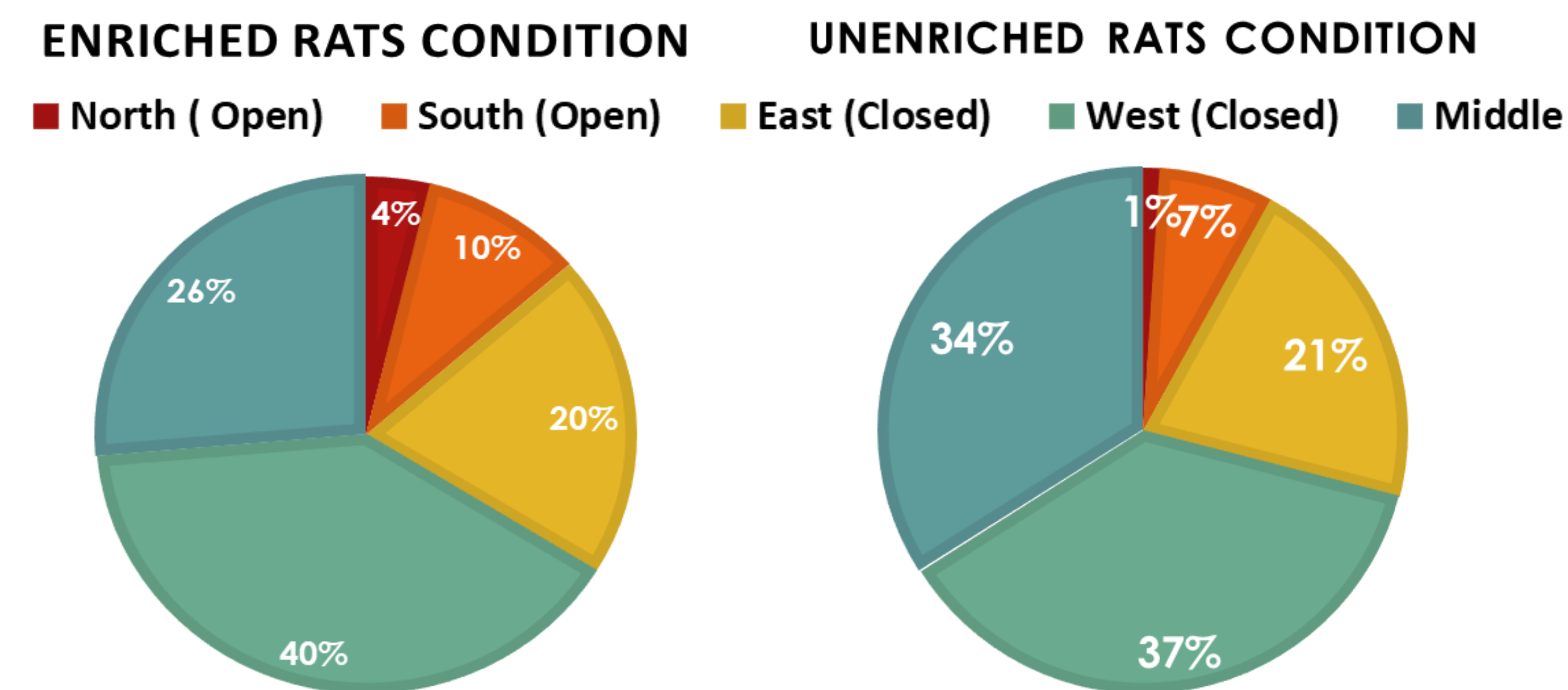
### Differential Outcomes:



## Results

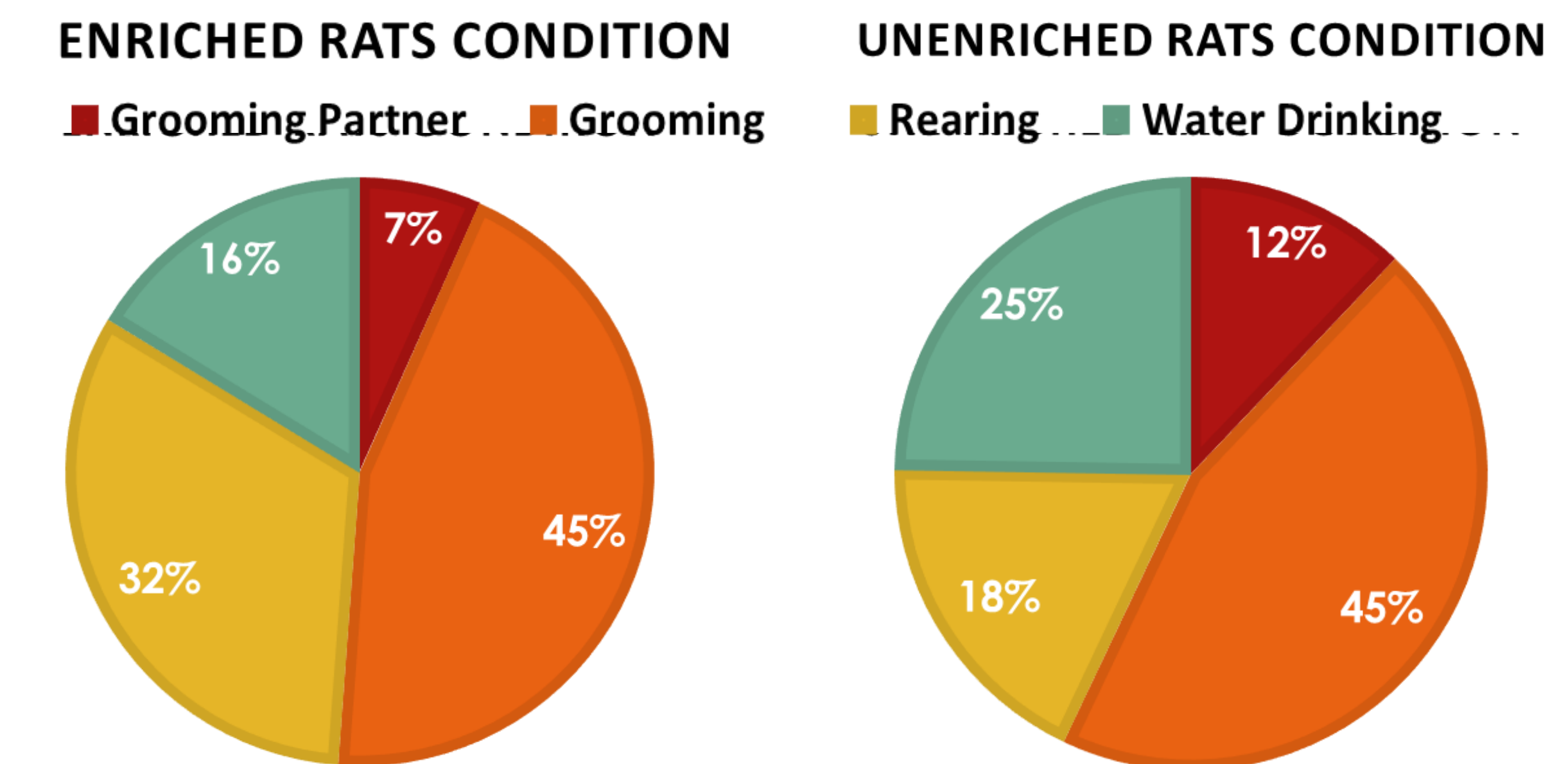
### Percentage of Exploration on Plus Maze in Seconds

Figure 1



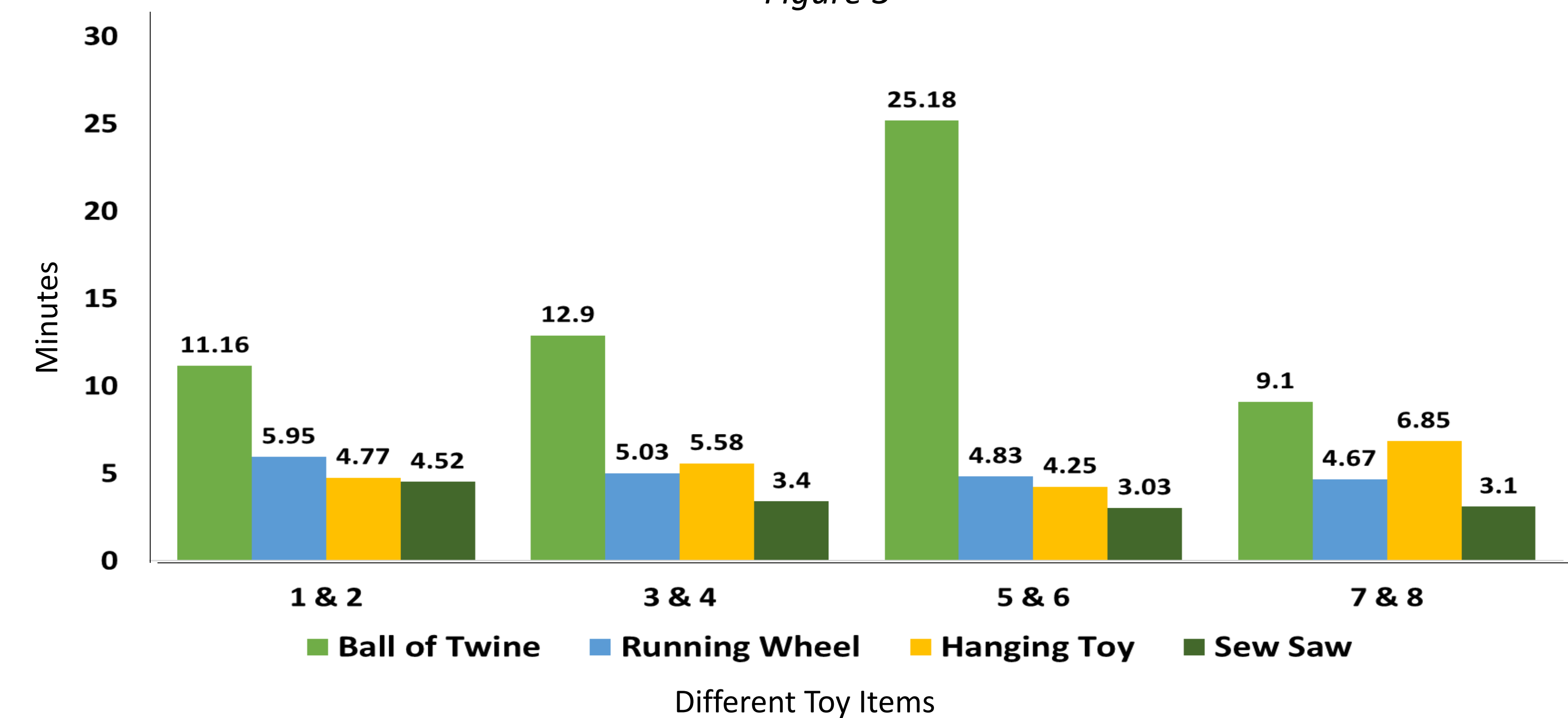
### Activities in Homecage in Seconds

Figure 2



### Time Spent with Each Play Item

Figure 3



- Figure 1. There were no differences between conditions (enriched vs. nonenriched),  $F(1, 14) = 2.97, p = .11$ , and no interaction of Condition by Area on Maze,  $F(4, 56) = .93, p = .46$ . There was an effect of Area on Maze,  $F(4, 56) = 46.24, p \leq .001$ . Time spent in all areas of the maze differed from each other, with the most time being spent on the west closed arm followed by the middle arm, then the east closed arm, south open arm, and finally the least time was spent on the north open arm.
- Figure 2. Amount of time spent on each activity in the homecage differed,  $F(3, 9) = 23.4, p \leq .001$ . Both conditions spent the more time grooming themselves than any other activity. They also spent more time drinking water than grooming another.
- Figure 3. There was a main effect of Toy,  $F(3, 9) = 5.1, p = .03$ . Rats in the enriched condition preferred to spend their time playing with the twine ball, suggesting that twine ball was the preferred activity. All toy items differed from zero time,  $ps < .05$ .

## Conclusions

- Both conditions spent the most time in the closed arms of the plus maze, indicating no differences in exploratory behavior. Enrichment did not seem to facilitate exploration of the open arms.
- Rats in the enriched condition preferred to spend their time playing with the twine ball, suggesting that twine ball playing is highly enjoyable and preferred by rats.
- Rats did not differ in how they spent their time in their homecage. Rats spent the majority of their time grooming themselves in their homecage.
- Future tests will examine whether or not enrichment facilitates learning of a conditional discrimination task.

### References

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- Flemming, T. M., Thompson, R. K., Beran, M. J., & Washburn, D. A. (2011). Analogical reasoning and the differential outcome effect: Transitory bridging of the conceptual gap for rhesus monkeys (*Macaca mulatta*). *Journal of Experimental Psychology: Animal Behavior Processes, 37*(3), 353-360. doi:10.1037/a0022142