Same-Different Discrimination Learning in a Visual Discrimination Task with Rats

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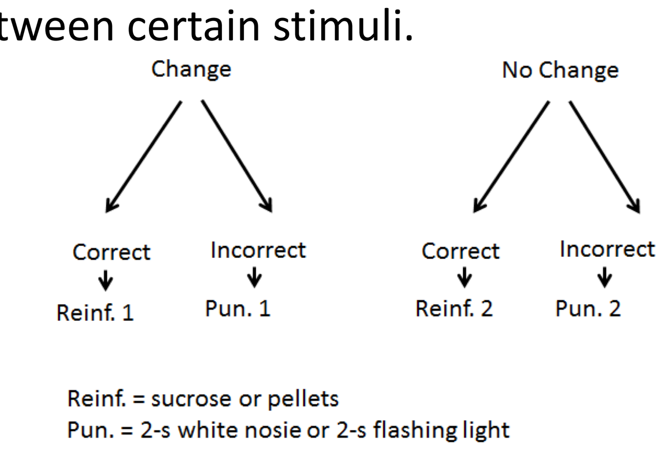
Introduction

- Rats are able to learn to respond in the presence of a stimulus (e.g. a light) and withhold responding in its absence
- Humans also use the same types of environmental cues to determine their behavior- while driving we stop when we see a red stoplight, but keep going when we see a green stoplight.
- Rats are also capable of learning more than one discrimination, and can learn in a single experiment when to lever press or chain pull based on the kind of reinforcement they receive for each behavior.
- Acquisition of this kind of discrimination has been shown to be facilitated by delivering one outcome (sugar water or food pellets) after one response and a different outcome after the other response (Peterson, Wheeler, & Trapold, 1980; Trapold, 1970; Schmidtke, Katz, & Wright, 2010).
- Flemming et al. (2011) ha show in monkeys
- In a same/different task, the subject is expected to learn the concept of "same" and "different", whereas in a discrimination task, the overall goal is for the subject to differentiate between certain stimuli.
- In this study, we use differential outcomes with rats to determine if it has the same effects in rats as it does in other species. For this study, we used pellets and sucrose as the differential outcomes which result from a response to a task presented on an iPad. After the rats learned, they were tested on novel stimuli, the goal of which was to determine if the rats truly learned "same" and "different" by transfer to novel stimuli.



Method

Subjects:
12 male and female Long-Evans rats, experimentally naïve

General Procedure:
The rats interact by touching stimuli on an iPad positioned in their operant box, and correct responses are rewarded with either access to sucrose or food pellets.

Pretraining:
The rats are trained to retrieve food pellets and sugar water from the feeding niche within the operant box. They are then trained to touch a gray circle to activate delivery of sucrose or pellets.

Training:
Rats were then trained to touch all of the learning stimuli (see Figure below) on separate trials. Once the rats were responding reliably to each stimulus, trials were introduced that involved responding to sequences of stimuli. The sequence of a standard training trial is illustrated in the figure below (bottom right). The trial starts with a ready signal (to facilitate attention), followed by the sample stimulus, a delay, a test stimulus, and then the response options (same or different). A touch was required to advance the trial through each display.

Testing:
The rats were given the same procedure as the acquisition program, but interspersed with the learning stimuli were non-reinforced testing stimuli (see Figure).

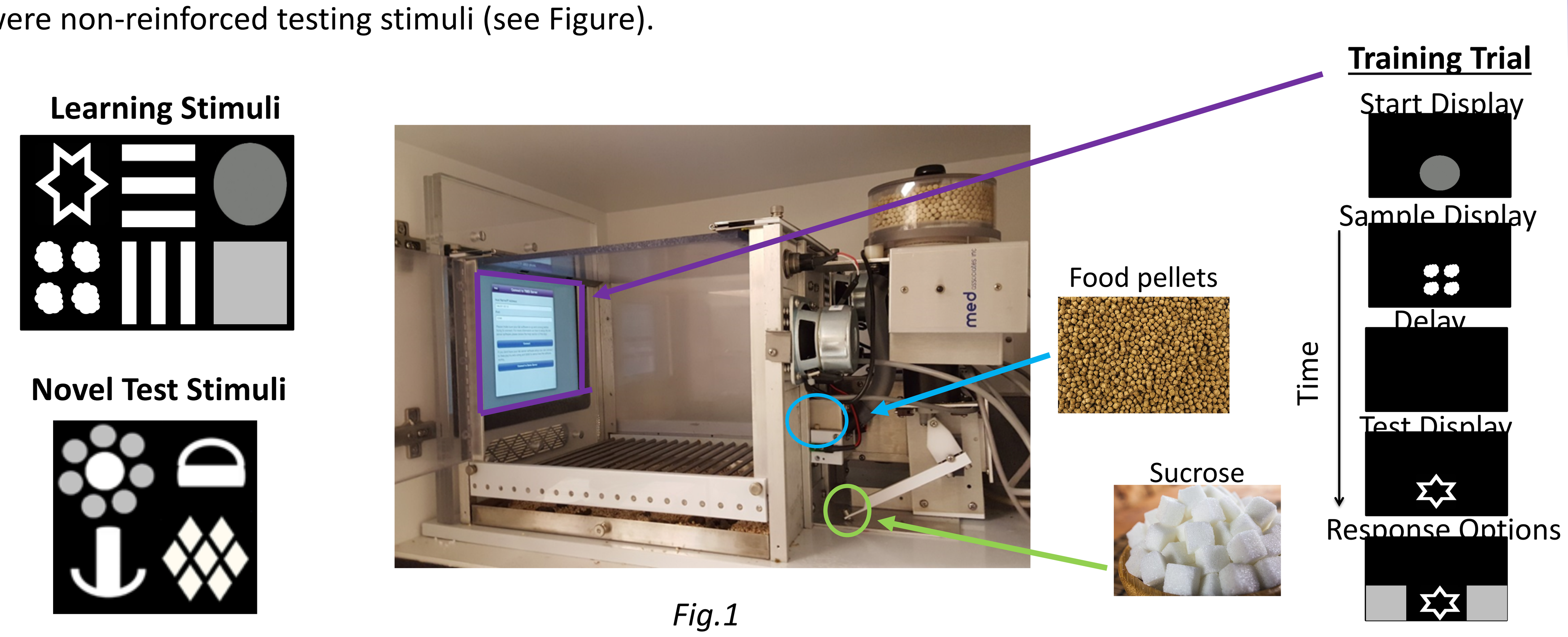


Fig.1

Results

Fig. 2

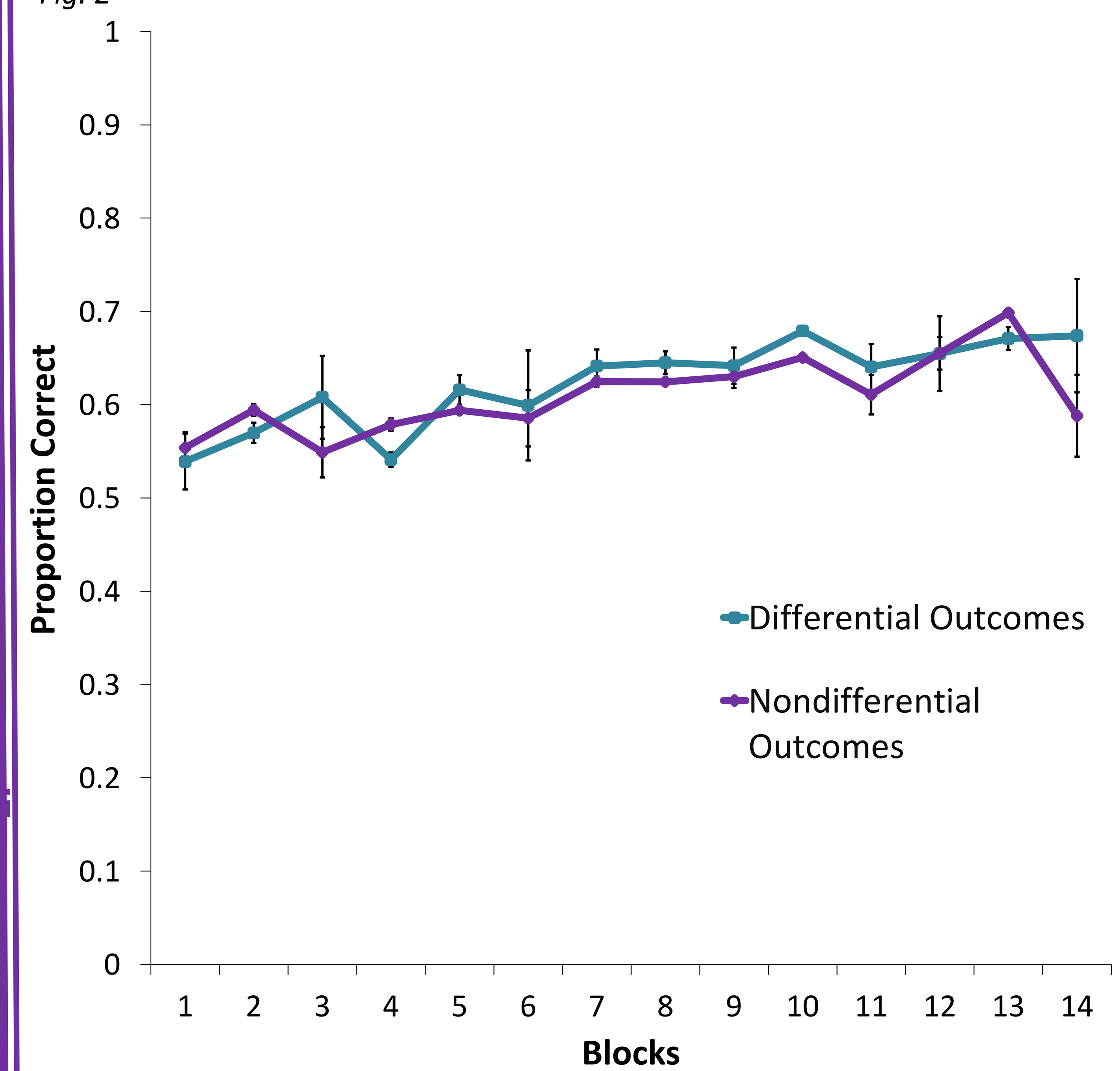


Figure 2. These data are from the learning portion of the experiment. One block consist of 10 sessions. A three-way mixed design ANOVA revealed a marginally significant main effect of Block, $F(11, 121) = 1.86$, $p = .051$. There was no effect of Group, $F(3,11) = .2$, $p = .898$, and no main effect of Trial Type (same and different), $F(1,11) = 3.7$, $p = .081$. There was a significant interaction of Block x Group, $F(11, 33) = 1.7$, $p = .021$. All other interactions were not significant.

Fig. 3

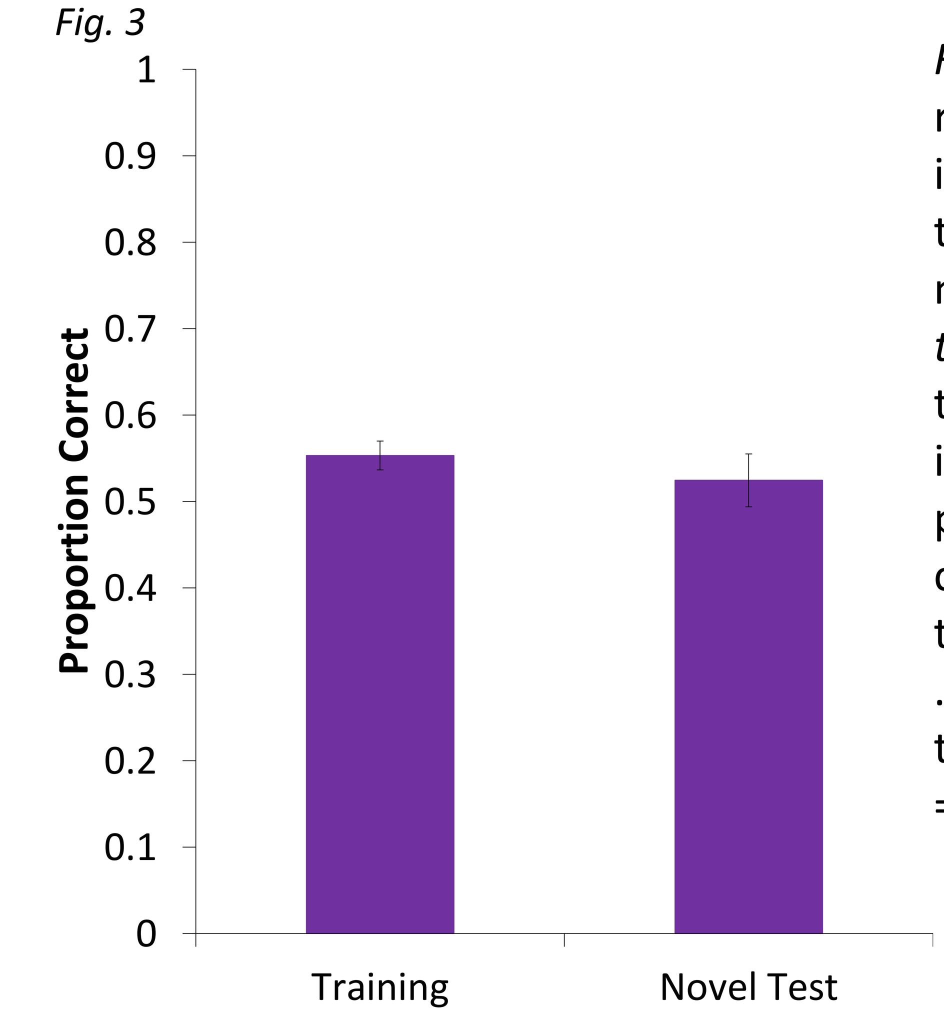


Figure 3. A t-test revealed no difference in accuracy between training trials and novel testing trials, $t(8) = .88$, $p = .406$. A test against chance (.5) indicated that rats performed above chance on training trials, t(8) -= 3.19, $p = .015$, but not on novel test trials, $t(8) = .79$, $p = .453$.

Fig. 4

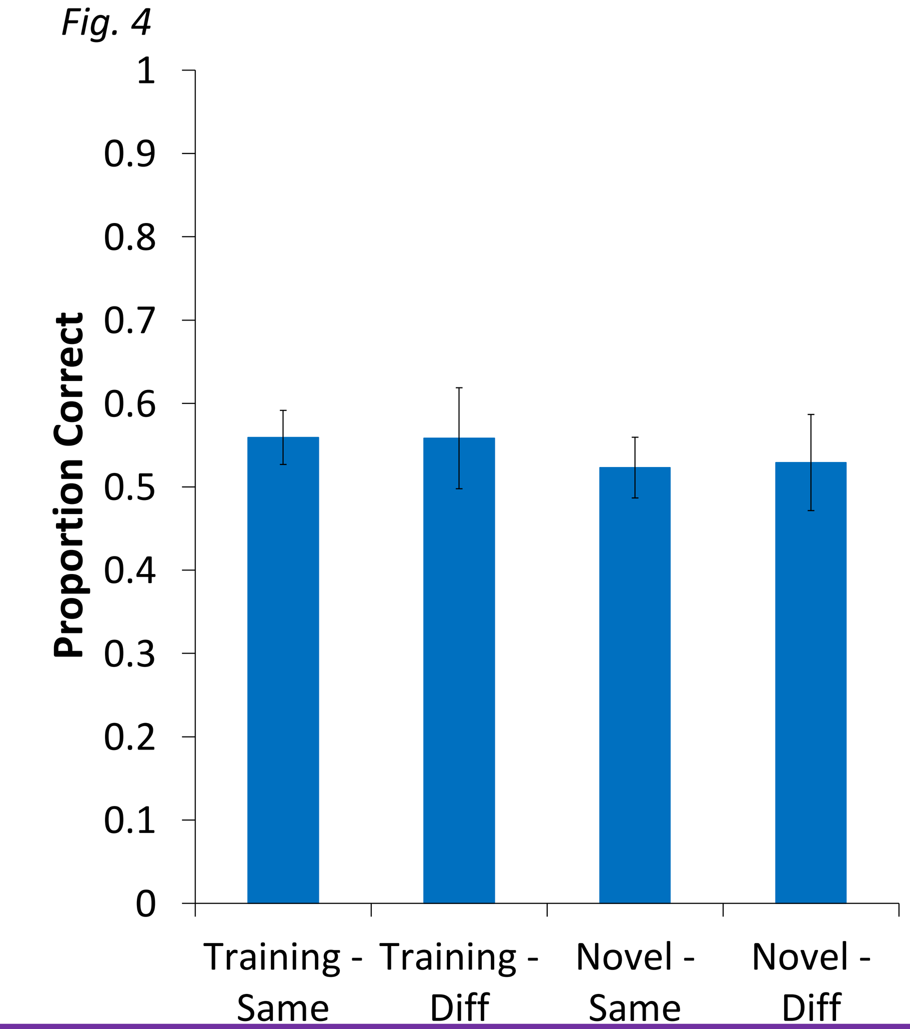


Figure 4. A two-way repeated measures ANOVA revealed no effect of Training vs. Testing, F(1, 7) = .94, p = .362, as well as no effect of Same vs. Different, F(1, 7) > .01, p = .974, and no significant interaction, F(1, 7) > .01, p = .923. Performance on all trial types was less than chance, *ps* < .111.

Conclusions

- Both groups acquired the task, with proportion correct increasing marginally across blocks, however, there was no effect of Group. The differential outcomes failed to result in faster acquisition of the discrimination. This may be due to the fact that the differential outcome procedures seem to facilitate learning early in training. Since it took the rats many sessions to acquire the discrimination, learning may have occurred later on in training, and therefore differential outcomes were not able to facilitate learning.
- Learning did not transfer to the novel stimuli. Rats performed at chance when presented with testing trials using novel stimuli. This may be because the task was too difficult for the rats, and we observed a floor effect.
- In future studies we plan to examine if a differential outcomes procedure can be used in a simpler visual discrimination, in which performance would be expected to surpass the current experiment (~68% accuracy).

References

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