Sugar and chocolate and levers, oh my: Examining the differential outcomes effect in a visual discrimination with rats

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Introduction

- In nature, it is adaptive for an animal to learn to make different responses to different stimuli (e.g., climb some trees to obtain ripe fruit but forage near the base of others).
- Research using differential outcomes procedures has demonstrated that learning is facilitated when one response (e.g., pressing the right lever) is reinforced with one outcome (e.g., chocolate-flavored pellets) and another response (e.g., pressing the left lever) is reinforced with a different outcome (e.g., sugar water) (Trapold, 1970).
- While previous research has used auditory discriminations in a differential outcomes procedure (Trapold, 1970), the current research aimed to extend this differential outcomes effect in rats with a visual discrimination procedure. The current procedure also included a ready response to start a trial.
- Rats were reinforced for pressing a lever on the left side (left lever) of an operant box in the presence of one visual stimulus (e.g., a flashing light) and for pressing the right lever in the presence of another visual stimulus (e.g., a solid light). In the experimental group, the rats received a different outcome for each correct response (flashing light→left lever→sugar water; solid light→right lever→chocolate pellets). In the control group, one group received only sucrose for both responses, whereas another group received only chocolate pellets (e.g., steady light → left lever → sugar water; solid light → right lever → sugar water).

Method

Subjects: Sixteen experimentally naïve male and female Long-Evans rats, with four rats per group.

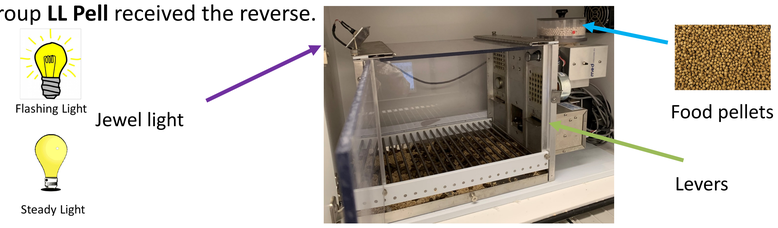
Apparatus: All tests occurred in a standard operating chamber which included two retractable levers with a food dispenser capable of delivering sucrose and chocolate flavored pellets (see Figure below). A jewel light was positioned on the top of the operant box toward the back of the chamber (facing the levers), and a speaker capable of generating a high and low frequency tone was positioned above the left lever. The tone did not signal which lever was reinforced, but instead, signaled the availability of a reinforcer.

MagTrain: Rats were trained to drink and retrieve pellets from the feeding niche. Pellets and sucrose were randomly delivered on a variable-time (VT) 60-sec schedule. Each outcome was associated with a high or low tone (e.g., a 3500 Hz for sucrose and 2500 Hz for pellets).

Phase 1: Rats were trained to lever press. On each trial, one of the two levers was inserted into the chamber. If a rat pressed the lever, then it retracted and a 1-s tone and the reinforcer were presented. The reinforcer delivered on a trial was selected randomly without replacement.

Phase 2: Identical to the previous phase, but rats were required to insert their head into the magazine to initiate a trial. Rats were gradually trained to press multiple times for reinforcement, increasing from one response (fixed-ratio 1) to a fixed-ratio 10 (i.e., 10 responses were required to complete a trial).

Phase 3: Both levers were inserted into the chamber and the flashing or steady light signaled which of the two levers would be reinforced. (e.g., flashing light → right lever → chocolate-flavored pellets). The rat's first response committed it to that lever for the remainder of the trial (i.e., the opposite lever retracted). If an incorrect response was made, the rat was required to make an additional 9 responses and no reinforcement was delivered. Group **Control Suc** received sucrose for responses to both levers, whereas **Control Pell** received pellets after responses to both. Group **RL Pell** received pellets for right lever presses and sucrose for left lever presses. Group **LL Pell** received the reverse.



Results

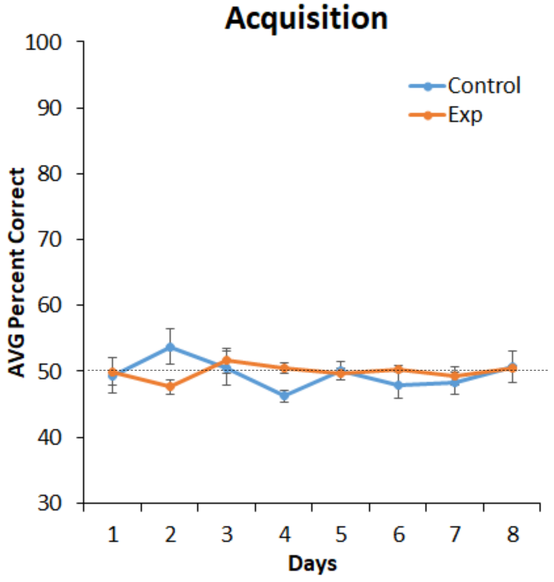


Figure 1. Number of trials with a correct response divided by the total number of trials for each session of 60 trials. Neither group showed evidence of acquisition. This observation was supported by a repeated measures ANOVA with Session as a within-subject factor and Group (Exp. and Control) as a between-subjects factor that revealed no main effects (Fs < 1.0) and no interaction (F > 1.0).

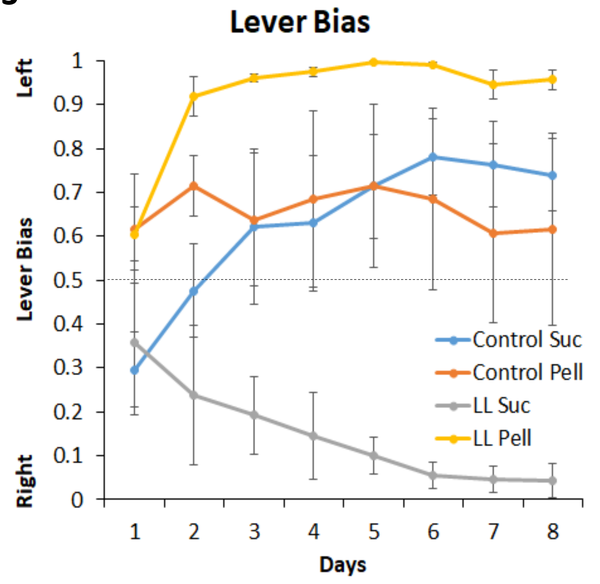


Figure 2. The number of responses to the left lever divided by responses to the left and right lever. A group mean of .5 indicates no bias toward either lever. A repeated measures ANOVA with Session as a within-subject factor and Group (Exp. and Control) as a between-subjects factor revealed a main effect of Group, $F(3, 12) = 13.13$, $p < .01$, and an interaction between Group and Session, $F(21, 84) = 2.34$, $p < .001$. A Tukey's Honestly Significant Differences test revealed that all groups differed from Group 3, ps < .05, but did not differ from each other. In other words, all groups but group 3 preferred the left lever.

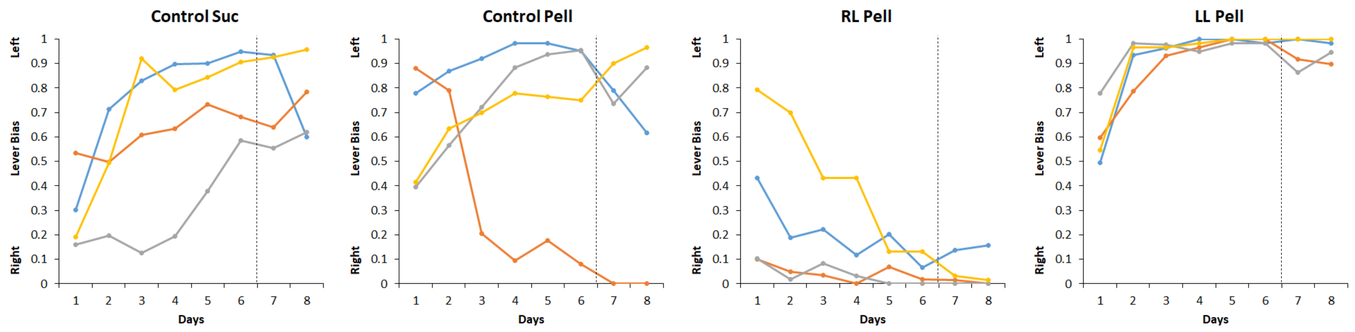


Figure 3. Side bias for all rats in each group. During Days 1-6, the speaker generating the tone was above the left lever. On Days 7-8, the speaker was moved to the center of the chamber. Group RL Pell and LL Pell had clear biases for all rats toward the lever delivering pellets. In the control groups, 6 of 8 rats had a bias toward the left lever during Days 5-6. Changing the position of the speaker affected 3 of 8 control group rats.

Conclusions

- All groups failed to acquire the task and there was no difference between experimental and control groups. The differential outcomes failed to result in faster acquisition of the discrimination, likely due to a reinforcement bias for the chocolate-flavored pellets.
- Rats in the control group showed an interesting preference for the lever with the speaker above it.
- In future studies, we plan to examine if a differential outcomes effect can be seen if the chocolate flavored pellets are replaced with chow-pellets. We also plan to follow up on the finding of a left lever bias in the control condition.

References

Trapold, M. A. (1970). Are expectancies based upon different positive reinforcing events discriminably different? *Learning and Motivation, 1(2)*, 129-140.