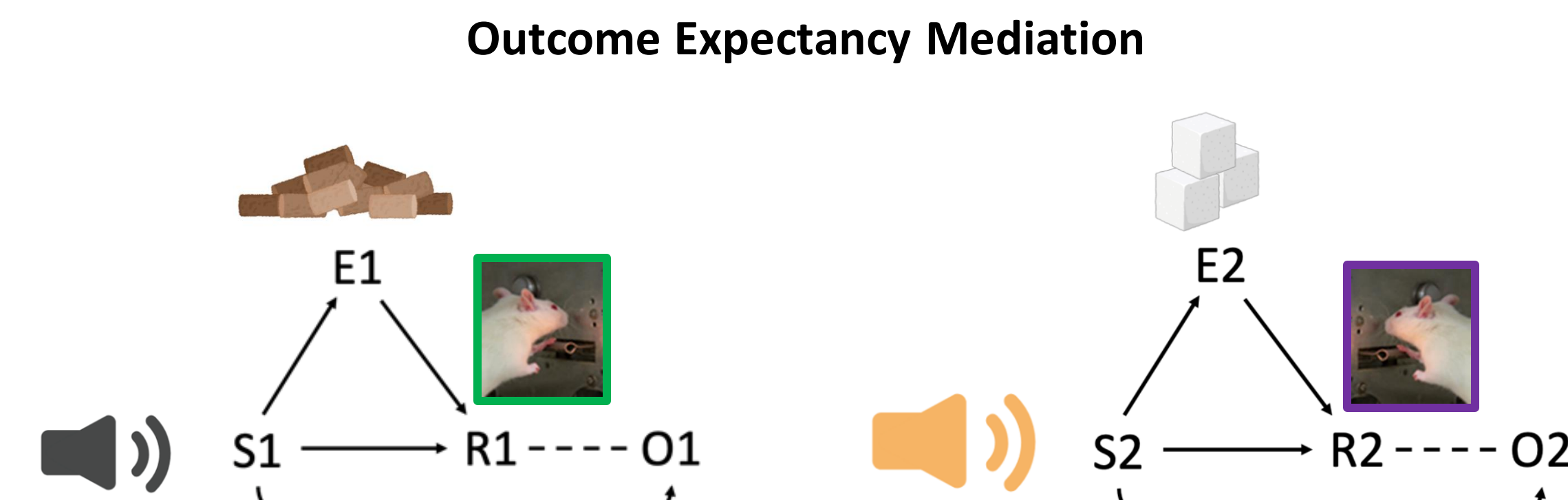
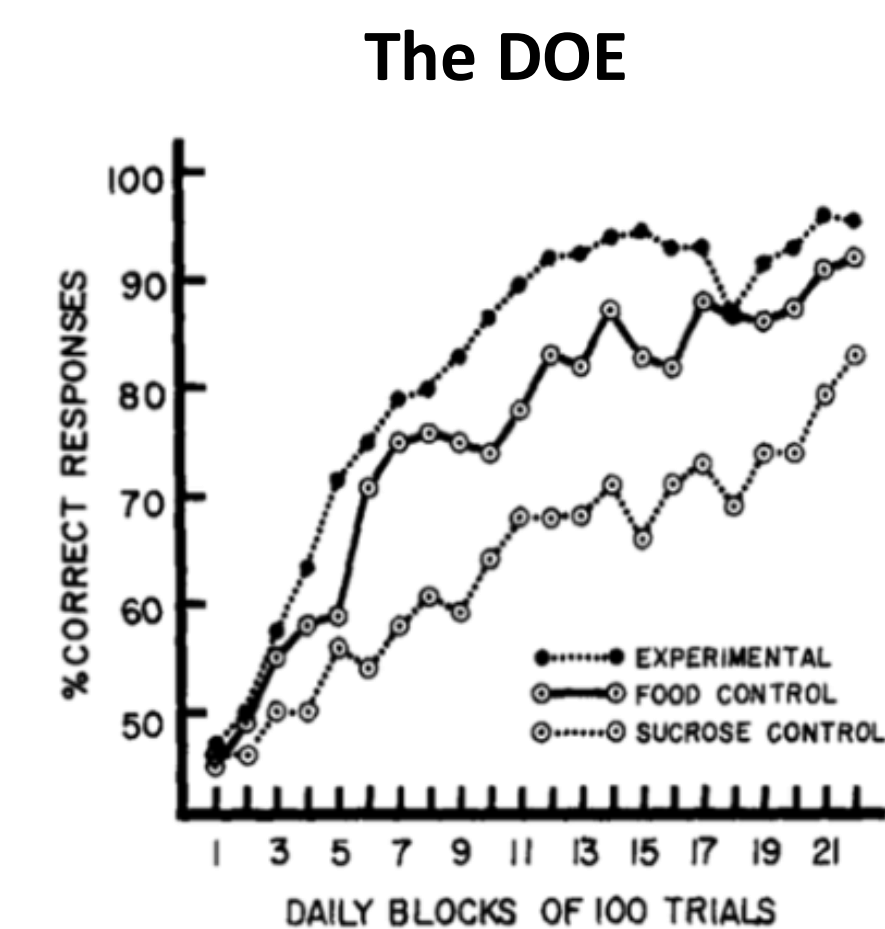


Introduction

- 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 (DO) procedures have demonstrated that learning is facilitated when one response (e.g., pressing the left lever) is reinforced with one outcome (e.g., sugar water) and another response (e.g., pressing the right lever) is reinforced with different outcome (e.g., food pellets) (Trapold, 1970).



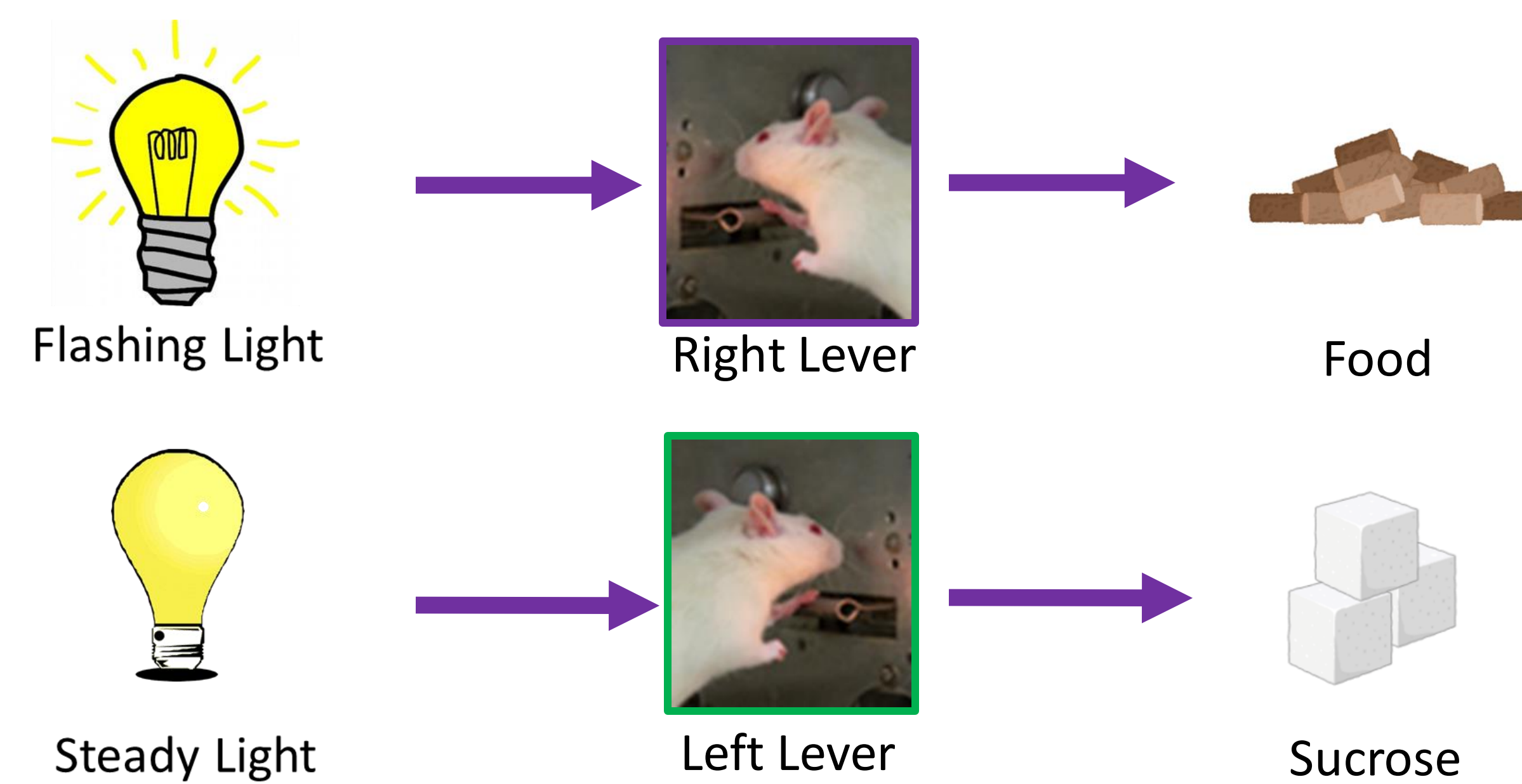
- The DOE has been found with outcomes that differ in terms of magnitude and probability of reinforcement (Carlson & Wielkiewicz, 1976; Urcuioli, 1990), as well as outcomes differing in only non-hedonic properties (i.e., sensory outcomes), such as different locations for rewarded foods (Friedrich & Zentall, 2011).
- Previous DO research in rats has primarily used auditory discriminations (e.g., Trapold, 1970). Research in our lab has examined whether the DOE can be found using visual stimuli (e.g., a flashing and steady light) with sucrose and chocolate-flavor pellets as outcomes. This research has found that, due to their high value, the chocolate-flavored pellets may have interfered with learning.
- The current experiment examined whether the kind of reinforcers (two highly valued vs. two moderately valued) used in a DO procedure affects the acquisition of a visual discrimination in rats.
- Rats were reinforced for pressing a lever on the right side (right lever, RL) of an operant box in the presence of one visual stimulus (e.g., a flashing light, FL) and a lever on the left side (left lever, LL) of an operant box in the presence of another visual stimulus (e.g., a steady light, SL). Rats in the DO group received a different outcome for each correct response (FL → RL → sucrose; SL → LL → pellets). Rats in the control group received both sucrose and pellets for both responses (i.e., mixed-outcomes [MO]). Half of the rats in the DO and MO groups received a 30% w/w sucrose solution and chocolate-flavored pellets as reinforcers and the other half received an 18% w/w sucrose solution and chow pellets as reinforcers.

Methods

Subjects: Thirty-two experimentally-naïve male and female Long-Evans rats, with eight rats per group.

Apparatus: All tests occurred in a standard operant chamber which included two retractable levers with a food dispenser capable of delivering sucrose solution and food pellets (chow or chocolate-flavored).

Group	Pretraining	Discrimination Training
DO Choc	R1-O1 R2-O2	S1: R1 – O1 S2: R2 – O2
DO Pell	R1-O3 R2-O4	S1: R1 – O3 S2: R2 – O4
MO Choc	R1-O1/O2 R2-O1/O2	S1: R1 – O1/O2 S2: R2 – O1/O2
MO Pell	R1-O3/O4 R2-O3/O4	S1: R1 – O3/O4 S2: R2 – O3/O4



Note. R1 and R2 refer to the reinforced response (i.e., LL or RL), O1 and O2 represent either the chocolate-flavored pellet or a 30% (w/w) sucrose solution, and O3 and O4 represent the chow pellet or an 18% (w/w) sucrose solution. S1 and S2 refer to the flashing or steady light.



Results

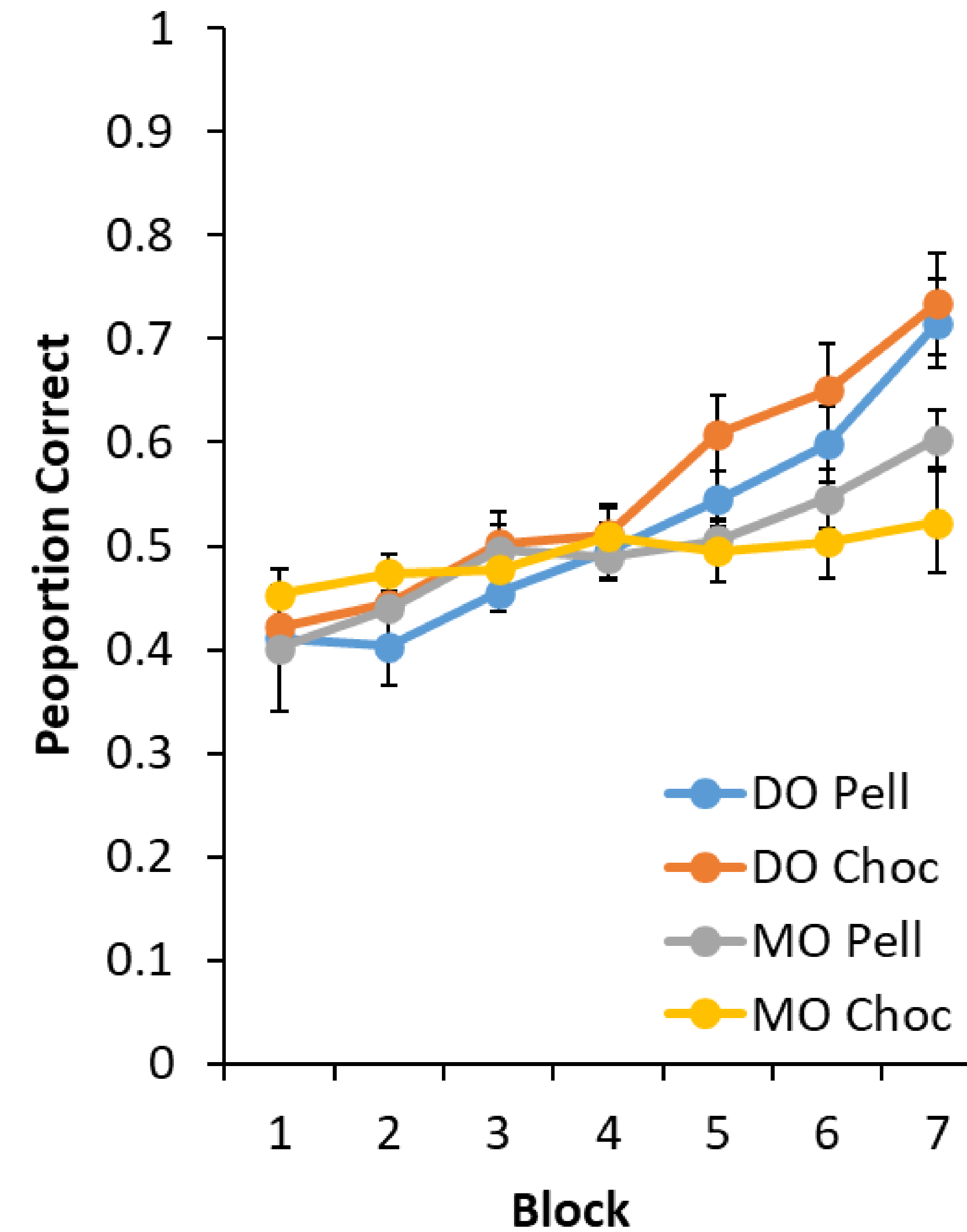


Figure 1. A repeated measures ANOVA was performed on proportion correct with group (DO Pell, DO Choc, MO Pell, MO Choc) as the between-subjects factor and block (1-7) as the repeated measure. There was a main effect of group, $F(3, 28) = 3.17, p = .04$, of block, $F(6, 168) = 23.79, p < .001$, and a significant Group x Block interaction, $F(18, 168) = 2.12, p = .007$. Follow-up tests using a Bonferroni correction performed on the interaction revealed no group differences in blocks 1-4, $ps = 1.00$. There was a marginal difference between group DO Choc and MO Choc on blocks 5 and 6, $ps = .06$. On block 7, both DO groups (Pell and Choc) differed significantly from group MO Choc, $ps < .02$.

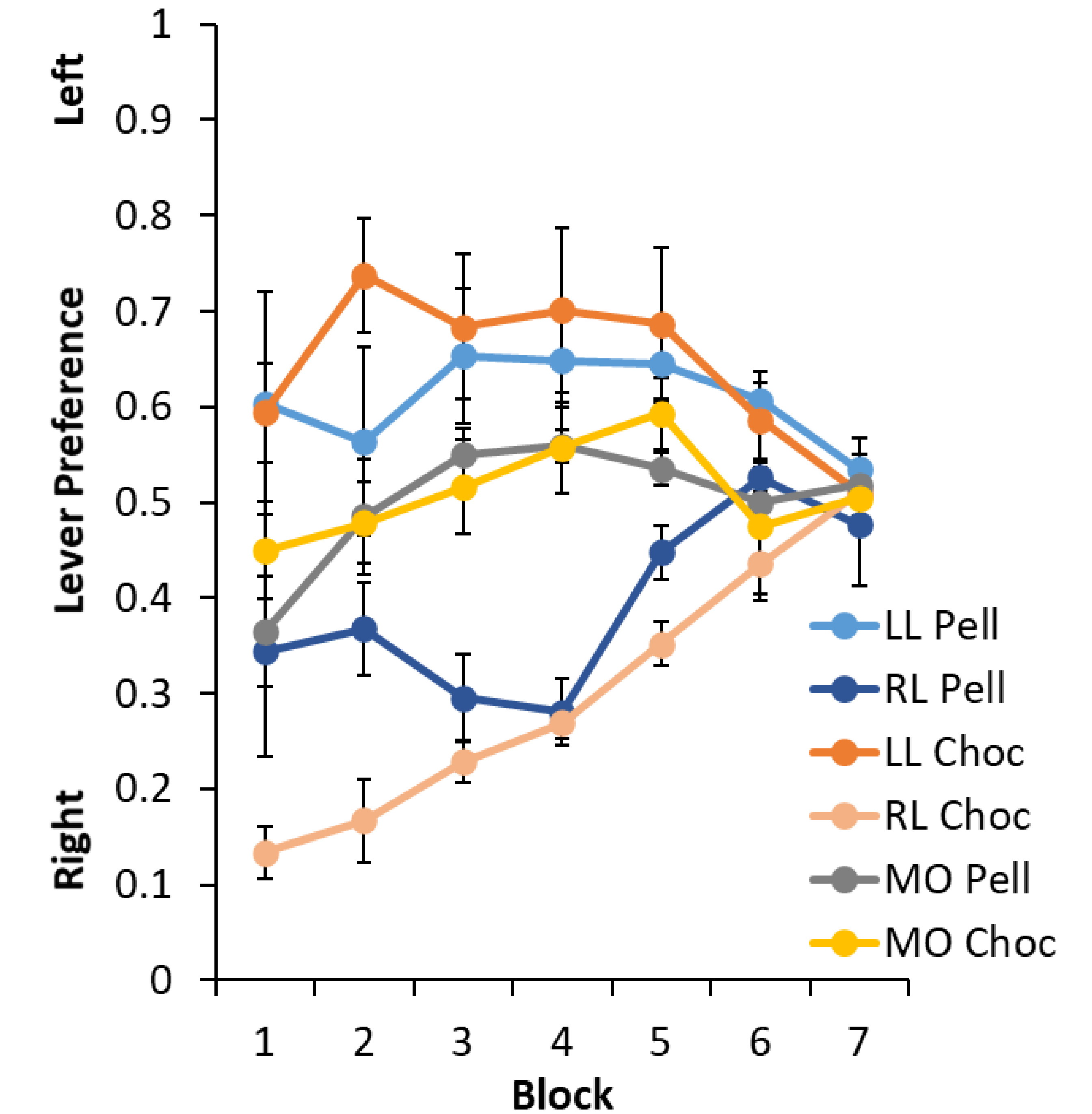


Figure 2. The number of responses to the left lever (LL) divided by responses to the left and right lever (RL). A group mean of .5 indicates no bias toward either lever. t -tests were performed against a constant (.5) for each group across blocks. A Bonferroni correction was applied and a p value $\leq .007$ was deemed significant. For group LL Pell, block 6 differed marginally from .5, $t(3) = 5.95, p = .009$ but all other blocks did not differ from .5, $ts(3) < 3.53, ps > .04$. For group RL, there was a marginal RL preference on block 4, $t(3) = 6.20, p = .008$. All other blocks did not differ from .5, $ts(3) < 4.14, ps > .02$. For group LL Choc, none of the blocks differed from .5, $ts(3) < 3.98, ps > .03$. Blocks 1-5 all differed from .5 for group RL Choc, $ts(3) > 6.56, ps < .007$, but blocks 6 and 7 did not, $ts(3) < 1.65, ps > .20$. For group MO Pell, none of the blocks differed from .5, $ts < 2.35, ps > .01$. No block differed from .5 for group MO Choc, $ts(3) < 2.45, ps > .04$.

Discussion

- Both differential outcomes groups acquired the discrimination at a faster rate than the MO chocolate pellet group, but not faster than the MO chow pellet group.
- The two DO groups acquired at a similar rate and no differences were present across session blocks. Although marginal, a difference between the DO chocolate and MO chocolate groups emerged before the difference between the DO chow pellet and the MO group, possibly the result of the higher motivational value of the chocolate pellets.
- Because differences were found between the DO groups and the MO Choc group but not the MO Chow group, it might suggest that the highly-valued chocolate pellet interferes with learning when its delivery is unpredictable.
- Regarding lever preference, only group RL Choc had a significant bias.

References

- Trapold, M. A. (1970). Are expectancies based upon different positive reinforcing events discriminably different? *Learning and Motivation*, 1(2), 129-140.
- Urcuioli, P. J. (1990). Differential outcomes and many-to-one matching: Effects of correlation with correct choice. *Animal Learning & Behavior*, 18(4), 410-422
- Carlson, J. E., & Wielkiewicz, R. M. (1976). Mediators of the effects of magnitude of reinforcement. *Learning and Motivation*.
- Friedrich, Andrea & Zentall, Thomas. (2011). A differential-outcome effect in pigeons using spatial hedonically nondifferential outcomes. *Learning & behavior*. 39. 68-78. 10.3758/s13420-011-0021-y.