Discounting of Delayed Food and Water in Rats

Shasta M. Rebalkin, Jade A. Mooneyham, Macie K. Nielsen, Jeremy M. Haynes, Annie Galizio, Caroline C. Towse, Kailey Morrissey, Amy L. Odum

Department of Psychology, Utah State University, Logan, Utah

Introduction

**Delay Discounting:**
- Reduction in the value of outcomes as a function of their delay.
  - e.g., $100 now is more preferable over $100 in a year.
- Measuring the degree of delay discounting involves assessing preferences between outcomes that vary in amount and delay.
  - e.g., one food pellet now vs. three food pellets in thirty seconds.
- Strong preferences for immediate outcomes are associated with problem behaviors such as cigarette smoking (Friedel et al., 2014; Mitchell, 1999).

**Goals:**
- Examine if rats discount qualitatively different outcomes similarly.
- Examine delay discounting in rats across time, early to mid-adulthood, to assess test-retest reliability as well as to track changes that occur over time.
- Examine if discounting has trait-like characteristics of test-retest reliability and response consistency, in terms of how correlated discounting of food is with discounting of water.

**Benefits of using non-human subjects:**
- Eliminates the tendency to respond in a manner that will be viewed by others as favorable (social desirability).

Methods

**Subjects:**
- Twenty-eight male Long Evans rats:
  - Pair housed with a 12 hour light/dark cycle

**Apparatus:**
- 4 Coulbourn operant chambers were used
  - Each chamber had a house light and two retractable levers
  - Between each lever was a liquid dripper/ pellet trough

**Procedure:**
- Smaller-sooner reward (SSR): 1 food pellet or 1 0.1 mL dipper of water
- Larger-later reward (LLR): 4 food pellets or 4 0.1 mL dippers of water
- Adjusting Delay (Mazur, 1987; Wahab, Panlilio, & Solinas, 2018)
- Outcome type altered every other session (e.g., food-water-food-water)

Results

**Procedure continued**

**Dependent Variable: Mean-adjusted delay (MAD)**
- Average delay to larger-later reward
  - \( D_i = \text{delay to LLR on the } i^{th} \text{ trial} \)
  - \( n = \text{number of trials within session (45)} \)
  - \( \sum_{i=1}^{n} (D_i) \)

**Results Continued**

Figure 1. Data from a single subject, L53, depicting the contingency in which rats’ choices during a session adjusted the delay to longer later reward. The x-axis is trial and the y-axis is the current delay time in seconds. Up-ticks represent a choice for the larger later reward and down-ticks represent a choice for the smaller sooner reward. Every five consecutive responses for the larger-later reward resulted in a five second delay increase whereas every five consecutive responses for the smaller sooner reward resulted in a five second delay decrease. Switching between responses for the smaller sooner reward and larger later reward resulted in no adjustment.

Figure 2. Mean adjusted delay (MAD) as a function of age, averaged across subjects, separately for food and water. The trend lines are from a regression model indicating that as they aged, MAD increased, indicating a decrease in discounting. The error bands indicate 95% confidence intervals around the trend lines. Datapoints at top of figure indicate blocks of sessions that were significantly correlated with the final block of sessions.

Figure 3. This figure shows MAD for water as a function of MAD for food in the final block of sessions. Discounting for water is associated with discounting for food.

Conclusions

- Overall, we found that discounting decreased over time, demonstrated by an increase in MAD over time (Figure 2).
- We found that discounting for food is correlated with discounting for water (Figure 3).
- We found evidence of trait-like characteristics of discounting (Figures 2 & 3).

References