Evaluation of Probability Discounting: A Comparison of Real and Hypothetical Rewards and a Molecular Analysis of the Effect of Recent History on Discounting

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Introduction

Discounting, or the devaluing of outcomes, is a common area of research in the field of Experimental Analysis of Behavior (EAB). Delay discounting is the devaluing of a desired outcome as a function of the delay to the outcome (Johnson & Bickel, 2002). Probability discounting is conceptually similar to delay discounting, but the subjective devaluing of rewards is a function of the probability of the outcome occurring (Myerson, Green, & Morris, 2011). Both delay discounting and probability discounting research are used to make conclusions about decision-making behavior, such as the choices concerning substance abuse and gambling (Holt, Green, & Myerson, 2003).

Discounting research is commonly conducted with hypothetical rewards rather than real rewards. Past research has analyzed whether or not there is a reward effect on discounting (e.g., delay and probability) has resulted in inconsistent conclusions.

The current within-subjects study reevaluated whether there is a reward type effect in the probability discounting of real and hypothetical rewards, using a practical computer task with roulette-type wheels. The participants chose between a small likely reward and a larger less likely reward. Two roulette-type wheels (e.g., likely-win wheel and risky-choice wheel) represented each option. The participants chose between the two wheels in a hypothetical reward condition and a real reward condition.

Method

Participants

The participants were nine college students from the University of Wisconsin – Eau Claire. The participants had not taken an Experimental Analysis of Behavior course and did not have prior knowledge of discounting.

Apparatus

The participants received a packet at the beginning of each data collection session. During each data collection session, the participants sat at a computer away from other participants. Custom website-based software was used to display two roulette-type wheels (e.g., likely-win wheel and risky-choice wheel) to the participants. The two wheels were divided into 20 wedges. The wedges were either white or red, and indicated a “win” or “no win”.

Procedure

The current study consisted of two parts. The first part of the study determined whether there is a reward type effect in probability discounting research. The reward type part of the study consisted of two conditions—the hypothetical reward condition and the real reward condition.

In the both conditions, the participants had personal data collection sessions with one researcher in a classroom. At the beginning of each session, the participants received a booklet explaining the day’s task and space for the participants to record their decisions. For each session, the participants were asked to choose between a likely-win wheel with a constant 95% chance of winning and a risky-choice wheel that ranged from 90% to 5% chance of winning. The sessions consisted of four rounds of 18 spins of the wheels. The likely-win wheel decreased in value at the beginning of each round, as the risky-choice wheel remained at a constant value always greater than the value of the likely-win wheel.

At the beginning of the hypothetical reward condition, the participants were told that to earn as many points as possible but the points did not directly impact any real reward. The only difference in the real reward condition was that the participants were told to earn as many points as possible and the points would directly impact which participant earned a $5 gift card to a department store.

Results

The degree to which the participants discounted the rewards were measured with indifference points. An indifference point is the probability of the risky-choice wheel at which the likely-win wheel and the risky-choice wheel are of equal subjective value. An exponential discounting function was fit to the indifference points in the real reward condition and the hypothetical reward condition (Grace, 1999).

The real reward condition graph displays the average indifference points for all of the participants. The r-squared value for the real reward exponential function was .99, which demonstrates high predictability of the discounting of real probabilistic rewards. See the table below the real reward graph for the average indifference points for the real reward condition. The first row in the real rewards table signifies that 95% chance of winning 40 points is subjectively equal to 27.78% chance of winning 50 points.

In the hypothetical reward condition graph, the average indifference points are graphed and an exponential function was fit to the points. The r-squared value of the hypothetical reward exponential function was .68, demonstrating low predictability and high variance. See the table below the hypothetical reward condition for the average indifference points for the hypothetical reward condition.

Discussion

The results of the current study suggest that individuals discount, or devalue, probabilistic hypothetical rewards less than real rewards, especially at high and low objective values of the rewards. The real reward condition resulted in predictable discounting, in comparison to the unpredictable discounting resulting from the hypothetical reward condition. The results demonstrate that probability discounting is affected by reward type.

These findings propose a change to how probability discounting research is conducted, by demonstrating that hypothetical rewards did not emit the same degree of discounting as real rewards. According to the current study, real rewards should be used in discounting research to better represent realistic discounting behavior, such as the decision-making behaviors associated with substance abuse and gambling.

One limitation of the current research is that the participants experienced the hypothetical reward condition first, and may not have fully understood the task or computer program during the hypothetical reward condition. However, Madden et al. (2004) found no difference between within-subjects and between-subjects research evaluating a reward effect on delay discounting research.

Future research should continue to compare the effect of real and hypothetical rewards on both delay and probability discounting. Further research should attempt to replicate the results of the current study in various types of practical probability discounting tasks.

The second part of the current study is a molecular analysis of probability discounting, evaluating the effect of recent history of wins or losses on the discounting of probabilistic rewards. Therefore, by analyzing the indifference points in terms of the wins to loss ratio before the indifference point, the second part of the study will determine if experienced wins and losses affects discounting.

References


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