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"Impatient to Achieve or Impatient to Receive: How the Goal Gradient Effect Underlies Time Discounting"

Research on both goal gradient (Kivetz et al 2006) and time discounting (Frederick et al) has shown that outcomes are more valued when they are closer in time. This paper separates the effects of achieving the outcome (e.g., earning a reward) vs. getting the outcome (receiving a reward). Across five studies, we find that choices involving tradeoffs between smaller soon and later larger goals parallel time discounting findings, but are not explained by the time discounting of received benefits.

In the first study (N=406), participants allocated non-substitutable resources between two hypothetical projects (10 research hours for two papers). Across four between-subjects conditions, the papers differed on when the papers were due (both in three weeks vs. the first in three weeks and the second in five weeks) as well as when the papers would be graded (both in 3 weeks, the first in 3 weeks and the second in five weeks, or both in five weeks). The due date represents the goal that people are working towards, while the grade is the outcome that could be discounted over time. Allocations were significantly higher for the first project when the first deadline was sooner (β=.11, p=.002), consistent with the goal gradient, but the timing of the outcome did not have a significant effect (receiving the grade, β =.038, p=.283), suggesting minimal time discounting. These results were replicated in two additional studies.

In Study 2a (N=380), participants allocated 10 tickets between two hypothetical lotteries, Lottery A in which they could win $10 or Lottery B, in which they could win $14. Nine versions were tested, between subjects. Participants could find out whether they won in either 1 week, 3 weeks or 5 weeks, and winners would receive the prize in either 1, 3 or 5 weeks. Outcomes for Lottery B were never earlier than for Lottery A, and receipt of the prize for each lottery either occurred at the same time as finding out whether they won, or at a later time. This design allowed us to separately quantify the effect of goal completion timing (goal gradient) and prize receipt timing (time discounting), in a regression analysis predicting allocation between the two lotteries based on the differences in timing.

Participants generally split their tickets (even when one lottery dominated the other), allocating 5.7 tickets to Lottery A and 4.3 tickets to Lottery B, on average across the conditions. However, for each additional week later that people found out about Lottery B (relative to Lottery A), they allocated .26 fewer tickets to Lottery B (p=.001), controlling for the timing of getting the rewards. For each additional week later that people received the Lottery B reward (relative to Lottery A), they only allocated .15 fewer tickets to Lottery B (p=.04), controlling for the timing of finding out about the reward. A modified discounting model estimates a modest weekly time discount factor of .95 for receipt of the reward and a corresponding goal discount factor of .88 for learning the outcome. In contrast, a traditional time discounting model which ignored the timing of goal outcomes would estimate a more severe weekly time discounting factor of .89.

Study 2b (N=379) tested the same nine lottery scenarios, between subjects, except that participants chose one of the two lotteries. We replicated the allocation findings in Study 2a with

binary choices as well.

Next, we tested whether the effect of outcome resolution timing (e.g., goal gradient) yielded a time-inconsistent discount rate, akin to hyperbolic discounting, even when the timing of being able to use the reward was fixed. In Study 3 (N=171), we used titration tasks analogous to those used in time discounting tasks. Participants read a scenario about choosing between two airline flights, each of which would earn points in a different frequent flyer program. They then made a series of choices to determine their indifference point between one program in which they earned fewer points but also needed fewer points to earn a reward and a program in which they earned more points but needed more points to earn the same reward. The results revealed a goal gradient pattern of choices analogous to hyperbolic discounting, despite the fact that the timing or receiving the reward was fixed. For example, earning 500 points was worth more points in second program when it was the last 500 needed than when it was 500 out of 1000 ($p < .01$).

In Study 4, 72 participants allocated tickets between two real lotteries, each offering a $50 prize, that differed by a week in the timing of when they would learn the outcome, but which paid the prizes at the same time. Participants varied in how far in the future the sooner drawing would be held (from 11 days away to 1 day away). Because both lotteries pay the prize at the same time, a time discounting account would predict no difference between the two lotteries. In contrast, the closer the drawings were when the participants made their choice, the more tickets they allocated to the lottery with the sooner drawing ($r=-.29$, $p=.01$).

In situations where people learn about earning a reward at one time but actually receive the reward at another later time, we observe separate disassociated larger goal gradient and smaller time discounting effects. Our findings suggest that time discounting may explain part of some goal gradient findings. However, goal gradient effects explain a substantial part of many time discounting, and estimated discount rates are substantially lower when separately accounting for goal gradient effects.