Research Report

Social Discounting

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ABSTRACT—***The amount of money a person was willing to forgo in order to give $75 to another person decreased as a hyperbolic function of the perceived social distance between them. Similar hyperbolic functions have previously been shown to describe both time and probability discounting.***

A choice alternative available only after a given delay is worth less than one of the same nominal amount available immediately. Such alternatives are said to be discounted by time. The more delayed a reward is, the lower is its time-discounted value. The function relating discounted value to delay is called a time discount function. In a review of numerous recent studies of time discount functions with human and nonhuman choosers, Green and Myerson (2004) found them well described by the following hyperbolic equation (proposed originally by Mazur, 1987):

$$v = \frac{V}{(1 + kD)} \qquad (1)$$

where v is the discounted value of the reward, V is the undiscounted value of the reward, D is its delay, and k is a constant measuring degree of discounting.[1]

Equation 1 predicts that if a person chooses a larger, later reward over a smaller, sooner reward when both rewards are relatively far off in time, preference may reverse as time passes and the smaller, sooner reward becomes immediately available (Ainslie, 1975; Rachlin & Green, 1972). For example, a child may prefer two candy bars in 7 days to one candy bar in 6 days, but (after 6 days have passed) prefer one candy bar now to two candy bars tomorrow. Such reversals become less frequent as people grow older (Mischel, Shoda, & Rodriguez, 1989). Equation 1 predicts that reversals will be less likely the lower the degree of discounting (k). In line with this prediction, degree of time discounting tends to decrease with age; that is, children discount delayed rewards more steeply than young adults, and young adults discount delayed rewards more steeply than older adults (Green, Fry, & Myerson, 1994). Moreover, alcoholics, cigarette smokers, heroin addicts, and cocaine addicts discount monetary rewards more steeply than do nonaddicts, and they discount the substance to which they are addicted more steeply still (Bickel & Johnson, 2003; Vuchinich & Simpson, 1998). Addicts are thus more likely than nonaddicts to choose an immediate smaller reward over a delayed larger one even when the rewards are unrelated to the addictive substance. Although both the environmental conditions of self-control and the mechanisms underlying it may be highly complex (Rachlin, 1995, 2000), the simple form of Equation 1 is a good description of intertemporal choice between discrete alternatives.

In their review, Green and Myerson (2004) found that the hyperbolic form of Equation 1 also describes choices between probabilistic alternatives. As applied to probabilistic alternatives, the equation becomes

$$v = \frac{V}{(1 + h\theta)} \qquad (2)$$

where v and V are as in Equation 1; θ, calculated as $(1 - p)/p$, is the odds against an outcome with a probability p; and h is a constant measuring degree of probabilistic discounting. If a given gamble of probability p is repeated, θ is proportional to the average time between outcomes. Thus, as Rachlin, Logue, Gibbon, and Frankel (1986) pointed out, probability discounting may be related to time discounting.

There is reason to expect that social discounting may also be related to time discounting. Philosophers since Plato have argued that people's ability to make choices in accord with their own interests in the relatively distant future (discounted over time) is related to their ability to make choices in accord with the interests of a relatively larger social group with which they have common interests (discounted over social distance)—that is, self-control and altruism may have common origins. Some recent behavioral theories of self-control (Ainslie, 2001; Rachlin, 2000, 2002) specifically make this connection. Rachlin and Raineri (1992) speculated that social discounting might be described by an equation with the form of Equation 1, as follows:

$$v = \frac{V}{(1 + sN)} \qquad (3)$$

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[1]The functions were still better described when the denominator of Equation 1 was exponentiated by a second constant, which Green and Myerson attributed to psychophysical scaling of delay. The current results were well described without this additional parameter.

where v and V are as in Equations 1 and 2, N is a measure of social distance, and s is a constant measuring degree of social discounting. Just as (in Equation 1) a larger k describes more impulsive (or less self-controlled) choices, so (in Equation 3) a larger s would describe more selfish (or less altruistic) choices. The purpose of the present experiment was to test the applicability of Equation 3 to social choice.[2]

METHOD

Participants

A total of 310 undergraduates in an introductory psychology class (153 male, 157 female) were presented with a series of written questions.

Procedure

Each participant answered questions printed on a stapled set of eight (8.5 in. by 11 in.) pages. The top page asked for age and gender and contained these instructions:

> The following experiment asks you to imagine that you have made a list of the 100 people closest to you in the world ranging from your dearest friend or relative at position #1 to a mere acquaintance at #100. The person at number one would be someone you know well and is your closest friend or relative. The person at #100 might be someone you recognize and encounter but perhaps you may not even know their name.
>
> You do not have to physically create the list—just imagine that you have done so.
>
> Next you will be asked to make a series of judgments based on your preferences. On each line you will be asked if you would prefer to receive an amount of money for yourself versus an amount of money for yourself and the person listed. Please circle A or B for each line.

The following seven question pages all had the same form:

> Imagine you made a list of the 100 people closest to you in the world ranging from your dearest friend or relative at #1 to a mere acquaintance at #100.
>
> Now imagine the following choices between an amount of money for you and an amount for the #___ person on the list. Circle A or B to indicate which you would choose in EACH line.
>
> A. $155 for you alone. B. $75 for you and 75 for the #___ person on the list.
>
> A. $145 for you alone. B. $75 for you and 75 for the #___ person on the list.
>
> A. $135 for you alone. B. $75 for you and 75 for the #___ person on the list.
>
> . . .
>
> A. $75 for you alone. B. $75 for you and 75 for the #___ person on the list.

The left column (the A column) contained nine items, with the amount changing by $10 from one line to the next and ranging from $155 to $75. For a given participant, the left column was identical on all seven question pages. For half of the participants, the money amounts ran from $155 to $75, as in the example given. For the other half, the money amounts ran in the reverse order, with $75 at the top and $155 at the bottom. The right column (the B column) was identical on all lines on any given page. However, the right column differed from page to page. In the instructions at the top of the page and in each line in the right column, the blank shown here was replaced by a number ($N = 1, 2, 5, 10, 20, 50$, or 100), with a different number used on each of the seven question pages. The seven numbers were in random order over the seven pages.

Thus, the participants were asked whether they would prefer a specific amount of money (ranging from $75 to $155) for themselves alone or $75 for themselves and $75 for various persons on their list, at positions ranging from the 1st to the 100th.

RESULTS

We expected that all participants would prefer $155 for themselves to $75 for themselves and $75 for any person on their list, even the person ranked #1. After all, they could give $75 of the $155 to that person and still have $80 left. We also expected that all participants would prefer $75 for themselves and $75 for even the 100th person on their list to $75 for themselves alone. Thus, we expected that between $155 and $75, there would be a single crossover point where participants would switch from choosing the option in the A column (the selfish option) to choosing the option in the B column (the generous option). The difference between the crossover point and $75, at any value of N, was the maximum amount of money a participant would forgo in exchange for $75 to the person at the Nth position on his or her list.

A crossover point was calculated for each participant at each value of N. The crossover point was the mean of the column A dollar amounts where the switch between columns A and B was made. For example, if a participant chose the selfish option at $155 and $145 and switched to the generous option at $135, the crossover point was calculated to be $140. However, many participants (the majority at $N = 1$ and $N = 2$) chose the generous option even when the alternative was $155 for themselves. In these cases, a crossover point was assumed at $160. When a participant chose the selfish option exclusively for a given value of N, a crossover point was assumed at $70. Only 1 participant

[2]There is a literature of "social discounting" (see Loewenstein, Thompson, & Bazerman, 1989), but in that literature social discounting means either time discounting in a social setting or social utility—utility as a function of one's own and another person's payoff combined (ignoring social distance).

chose the selfish option exclusively at all values of N. In 17 cases, participants changed over twice on the same page or skipped a page. All of the data of these 17 participants were ignored in the subsequent analysis.

We also expected that participants would be more generous (switch at a point closer to \$155) the nearer the social distance (closer to #1) of the person sharing the money. However, 101 participants occasionally crossed over closer to \$155 (i.e., were more generous) with a higher value of N (i.e., a person at a further social distance) than with a lower value of N (i.e., a person at a nearer social distance). Recall that the various values of N were presented randomly; participants were not easily able to make their choices in a purely consistent way as a function of N. We assumed that such reversals reflect an underlying variance or ambivalence in preference; the obtained crossover points for participants who showed such reversals were therefore averaged with the rest.

Figure 1 shows the amount of money subjects were willing to forgo (i.e., the difference between the average crossover point and \$75) at each value of N. The solid line is the best-fitting hyperbolic discount function (Equation 3). There were two free parameters: undiscounted value (V) and degree of discounting (s). The undiscounted value (V), the ordinate value at $N = 0$, is \$83. This parameter determines the height of the function and does not affect its shape. The degree of discounting (s in Equation 3) is 0.052. The fit ($R^2 = .997$) is remarkably good compared with the fit of many human time and probability discount functions (Rachlin & Raineri, 1992), although rarely are discount functions determined using this many participants (293). For comparison, the best-fitting exponential function ($v = Ve^{-sN}$) is shown as a dashed line in Figure 1. Although the variance accounted for by the exponential function is high ($R^2 = .970$), the data points deviate systematically from the dashed line, and every point is closer to the solid line than to the dashed line.

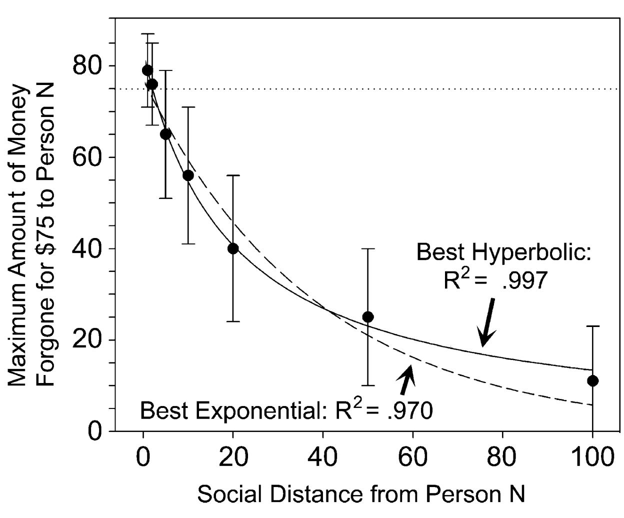

Fig. 1. Average (across participants) maximum amount of money forgone in exchange for \$75 to person N as a function of social distance from that person. The solid line is the best-fitting hyperbolic function (Equation 3). The dashed line is the best-fitting exponential function. The error bars span 1 standard deviation.

Equation 3 was also fit to the data for each participant individually. The median degree of discounting (s) across participants was 0.051, virtually equal to the group average. This equality indicates that the hyperbolic function of Figure 1 is not an artifact of averaging. The median undiscounted value (V) of the individual functions was \$94. The median of the individual R^2s was .866. The mean value of s did not differ significantly between male participants (0.057) and female participants (0.048).

DISCUSSION

These results demonstrate that the concept of social discounting is meaningful. People will forgo a hypothetical amount of money for themselves in order to give \$75 to another person; the amount of money forgone varies in a systematic way with perceived social closeness to the receiver of the money (just as immediate and certain equivalents vary with delay and probability of fixed monetary amounts).

In this experiment, the actual lists that participants would have made were not determined. It does not seem reasonable, however, to attribute social discounting solely to genetic overlap. Although the people high on a participant's list (low N) would more likely be blood relatives than those low on the list, there would surely be friends high on the list and blood relatives not on the list at all. A better candidate for the dimension underlying social discounting would be common interest between parents and siblings, between boyfriends and girlfriends, among suitemates, among classmates, among schoolmates, and so on, in widening circles.

It may be argued that the results of this experiment lack meaning because we used only hypothetical money amounts. However, studies of time and probability discounting that have compared real with hypothetical money rewards (e.g., Johnson & Bickel, 2002) have found similar discount-function shapes with the two methods. There is no reason to expect different results with social discounting.

Why did the undiscounted value (V) in this experiment not equal \$75? Conceivably, the participants may have interpreted the instructions to imply that the \$155 had to be spent and could not be shared, or perhaps they just wanted to express as strongly as possible their social closeness to the top people on their list. Another alternative is that there is an implicit cost of transferring money to another person. For a choice in column A (the selfish choice), this cost would have to be borne by the participant, whereas for a choice in column B (the generous choice), the cost would be borne by the experimenter. Still another possibility is that adding a premium to the expected undiscounted value is a self-control device. The participants may rather have had the experimenter give the money to the Nth person on their lists than to have received the money themselves and then given it to that person because, once having gotten the money, they might have been tempted to keep it. According to this theory, it was worth (an average premium of) $8 to the participants to be committed to their generous intent. However, the actual reason for this unexpected result has yet to be determined.

Also to be determined in future experiments is whether social discounting correlates across individuals with time discounting or probability discounting; whether degree of social discounting, as easily measured by this paper-and-pencil test, predicts behavior in various social interactions, such as prisoner's dilemma games; and whether it correlates with various real-world social disabilities (as degree of time discounting correlates with real-world addictions and other disabilities of self-control).

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