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Abstract

The recent claim that gain discount rates are higher than loss rates is reexamined using the intertemporal choice paradigm developed in Loewenstein (1988). Loewenstein's paradigm explains how different question frames (non-neutral frames) can generate different implied discount rates. The apparent difference is not due to outcome sign alone, however, but rather to the interaction between an outcome's sign and proposed changes in its timing. This paper demonstrates how Loewenstein's framework relates to two previous studies of discounting patterns (Thaler, 1981; and Benzion, Rapoport, & Yagil, 1989) and why the gain/loss discount rate differences reported cannot be attributed solely to outcome sign. This study replicates Benzion et al. (1989) but adds the two neutral scenarios not previously examined. Responses from 74 business students were used to estimate discount rates for six scenarios, four receipt/payment amounts, and four outcome times. The results are consistent with those of Thaler (1981), Loewenstein (1988), and Benzion et al. (1989) for the scenarios they examined. Because the neutral frame used to construct the two new scenarios should not produce the reference point effect (i.e., the sense of gain or loss that results from changing an outcome's timing once the original timing has been accepted), the anticipated difference in receipt and payment discount rates should be small, and the payment rate should be higher due to the discrepancy between the gain and loss portions of the value function and the method chosen for estimating discount rates. This was the result obtained.

KEYWORDS: Discount Rates, Decision Making, Framing, Intertemporal Decisions, Time Preference

1. Introduction

Because most nonroutine economic decisions affect the future welfare of the decision maker, an effective decision process will explicitly address considerations such as opportunity costs, rates of return, interest, the size and timing of cash flows, and economic forecasts. Many formal decision models do. But not all businesses and few individuals actually employ these models. Because many problems involve outcomes that are not easily quantified and, hence, are not easily adapted to formal models, many decision makers rely instead on their own time preferences and on intuitive assessments of future values. Unlike the standard discounting model, subjective discount functions do not always imply constant-rate discounting over time or across outcomes, and inconsistent discounting can lead to inconsistent planning (Strotz, 1955).

For example:

- If discount rates are substantially higher for short delays than for longer time frames, a decision maker may prefer option A from Set 1, but option B from Set 2, below (Thaler, 1981):

Set 1	Set 2
Option A: One apple today.	Option A: One apple in one year.
Option B: Two apples tomorrow.	Option B: Two apples in one year plus one day.

- If discount rates are not constant over time, a dieter may formulate an optimal plan on Friday to begin dieting on Monday, and find that, once Monday arrives, his plan is no longer optimal and must be changed.

- If a decision maker's utility values depend on outcome timing (in the sense of a particular date, τ) as well as on outcome kind and quantity (x) and time distance (t), his implied discount function will not decrease monotonically in t over all delay lengths:

  A decision maker may have positive utility for both mineral water (x) and champagne (x') and may generally prefer mineral water ($u(x,t,\tau) = 10 > u(x',t,\tau) = 5$), except on New Year's Eve (τ') when she prefers champagne ($u(x,t,\tau') = 10 < u(x',t,\tau') = 15$). The discounted value of a bottle of champagne three months hence, therefore, will depend on whether the three-month period ends on New Year's Eve. The value of a sum of discounted utilities for a glass of champagne each night over

three months will depend on whether New Year's Eve is included in the three month period.

- If consumers expect that their financial market borrowing rate will be substantially higher than their lending rate, they may discount changes in financial position at different rates, according to the direction of change (postpone or expedite) (Loewenstein, 1988).

Clearly, some intertemporal inconsistencies can be predicted from particular discounting patterns.

Because different discounting patterns lead to different choices, the ability to predict choices depends both on the reliability of the patterns detected and on the care with which experimental conditions are defined and results interpreted. Recent laboratory studies have revealed several consistent discounting patterns. Stevenson's (1986) work shows that decision makers tend to use a ratio discounting model, which is consistent with the standard approach, but discount rate estimates from other studies reveal rates that tend to vary inversely with both time distance and absolute outcome magnitude, which is not consistent with the standard approach (Thaler, 1981; Benzion et al., 1989). Thaler (1981) and, more recently, Benzion et al. (1989) have also detected an apparent difference between receipt and payment discount rates. This last observation is the subject of this study; the question addressed is whether the discount rate discrepancy reported in Thaler and Benzion et al. is actually attributable to outcome sign or to the interaction between outcome sign and question frame (i.e., to the scenario used to describe the intertemporal choice).

In what follows, the applicability of Loewenstein's reference point model to previous investigations of intertemporal choice is demonstrated and some previous results are reinterpreted based on its predictions for the scenarios studied. Then, predictions are made for the sizes of discount rates elicited using two neutral scenarios relative to the discount rates elicited using the non-neutral scenarios from previous studies. The second section presents background information, theory development and hypotheses; section three describes the experiment used to test the hypotheses, section

four presents results, and section five is a discussion of the results and directions for future research.

2. Background, Theory Development and Hypotheses

2.1 Background

The standard approach to discounting and interest evolved from theories of capital appearing as early as the eighteenth century. One early treatment of the subject was written by Böhm-Bawerk (1923), a political philosopher and economist of the Austrian School who argued that interest rates result (at least in part) from impatience, a pervasive preference for present over future consumption, which, in turn, results from insufficient imagination, weakness of will, and finite and uncertain human lifetimes. His theory was later formalized by Fisher (1930) in what is now considered the conventional discounted utility (DU) model. Although "[t]he phenomenon of impatience was introduced by Böhm-Bawerk as a psychological characteristic of human economic preference in decisions concerning (presumably) finite time horizons, [i]t now appears that impatience . . . is also a necessary logical consequence of more elementary properties of a utility function of programs with an infinite time horizon" (Koopmans, 1960, p.306; see also Koopmans, Diamond, & Williamson, 1964: Diamond, 1965; Koopmans, 1986).

In general, individual rates of time preference are independent of market interest rates and discount functions may depend on outcome magnitudes and on outcome timing (other than time distance). But such dependencies can lead to inconsistent and suboptimal economic choices (Strotz, 1955). If an individual wishes to maximize the utility of his lifetime consumption stream, he will adjust his rates of time preference to market rates and choose a discount function that is independent of outcome magnitudes, and of outcome timing except for time distance, so that discount rates will be constant over time and the direction of change in financial position. Strotz (1955) suggests that

decision behavior exhibiting this sort of consistent discounting pattern is not natural, but learned. Consumers should learn to act as if their discount rates are constant over time and independent of outcome magnitude. Whether they do so consistently and pervasively is an empirical issue.

2.2 Theory Development

2.2.1 Question Frames for Intertemporal Choice

In a study that relates framing issues to discounting patterns and intertemporal choice, Loewenstein (1988) describes three question frames that can be used to elicit information about subjects' relative preferences for consumption times. He states that:

1. One might ask subjects "to specify the most they would pay to obtain an object immediately (the immediate consumption price) and then ask how much they would pay to get the object following a time delay (the delayed consumption price)," or **(Neutral Frame)**

2. one might ask how much subjects "would pay to obtain an object immediately, instruct them to imagine that they have made the purchase, and then ask for the smallest amount they would accept in order to delay consuming," or **(Delay Frame)**

3. one might "ask how much they would pay to obtain the object following a time delay, instruct them to imagine that they have paid that amount, and them ask for the most they would be willing to pay to speed up consumption so as to eliminate the delay" (Loewenstein, 1988, p. 202). **(Speed-up/Expedite Frame)**

The critical difference between the neutral frame and the delay and speed-up frames is that the two non-neutral frames induce subjects to adjust psychologically to owning a good at a particular time.[1] Because subjects are asked to imagine possession, their reference points shift, at least partially, to reflect the adjustment. Then, when desirable consumption is delayed (frame 2), subjects sense a loss (i.e., they interpret the delay of planned desirable consumption, or the delay of an anticipated increase in wealth, as a loss). Similarly, they interpret speeding up planned desirable consumption

[1] If the outcomes were undesirable, subjects would adjust to a decrease in their welfare immediately (frame 2) or at a particular time in the future (frame 3).

as a gain. There is a three-step process associated with frame 2 (frame 3) that consists of: (1) determining an immediate (future) consumption value (For monetary outcomes, the immediate value is given.), (2) adjusting psychologically to immediate (future) possession or consumption, and (3) assessing the loss (gain) that results from postponing (speeding up) consumption to arrive at a suitable premium (cost). The three steps are depicted in Figures 1, 2, and 3 (respectively) below for frame 2 used with desirable consumption. Figure 1 corresponds to Figure 1 in Loewenstein (1988, p. 205) which shows the gain experienced from contemplating consumption of the item. The original reference point, r, is typically taken to be zero.

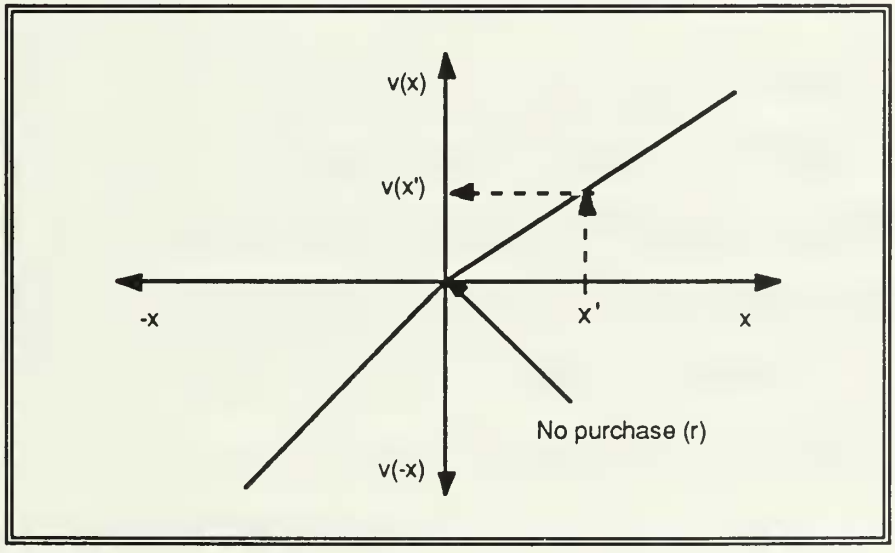

Figure 1

Figure 2 shows the reference point shift that results from adapting (at least partially) to possession of the good (x') at a particular time. The reference point shifts from r = 0 to r' = x'.[2]

[2]It is not necessary for the model's predictions that decision makers adapt completely; that is, it is not essential that r' = x'.

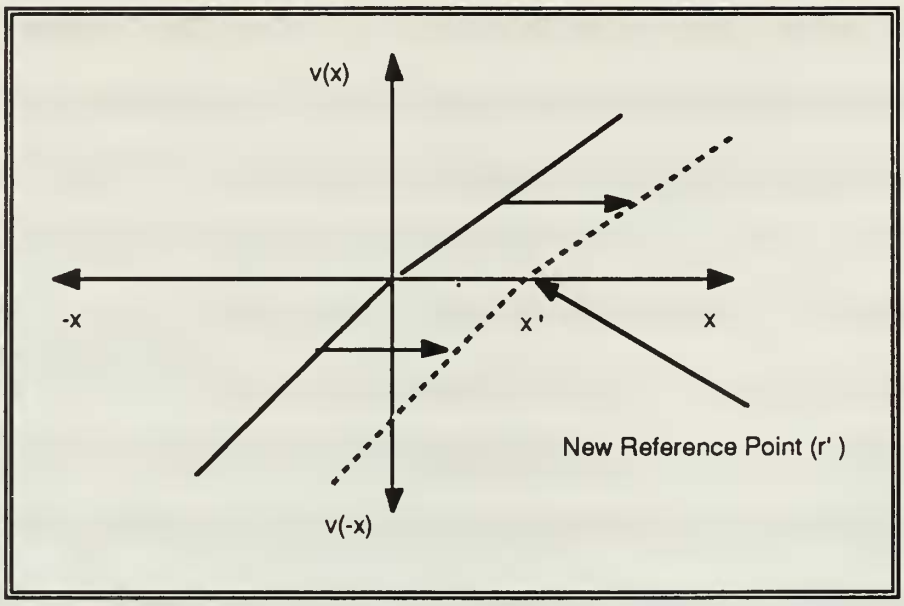

Figure 2

Figure 3 was adapted from Figure 2 in Loewenstein (1988, p. 205). It shows the loss that would be experienced if desirable consumption to which the consumer has adapted were delayed. It also shows the way a consumer might arrive at the premium that just compensates his loss ($g - ß(t)| r-x'|$, for monetary outcomes, where $ß(t)$ is a discount function that depends on t, but not on x).[3] Because value functions typically are steeper for loss than gain, $g > | r - x'|$.

[3]Loewenstein's expression for the delay premium is given in terms of subjective value (i.e., values of the function v(x)). It is $-[1-\delta(t)]v(-x')$, where $\delta(t)$ is some discount function that is decreasing in t (time) (Loewenstein, 1988). A little effort shows that the objective value of the delay premium is $g - ß(t)|r - x'| = g - ß(t)|-x'|$ (>0), where $ß(t)$ is a discount function possibly different from $\delta(t)$ if $v(\cdot)$ is nonlinear.

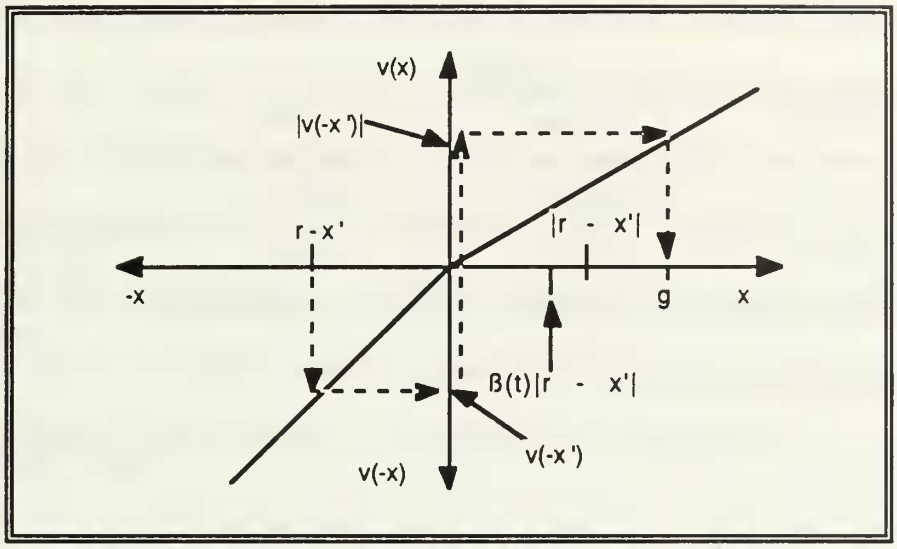

Figure 3

Loewenstein's purpose was to show that question frames 2 and 3 can produce a sense of loss or gain that generates an (apparent) increase in subjective discount rates. He predicted that (1) the three methods would not generate the same implied discount rates, (2) implied discount rates for both delayed and expedited desirable consumption would be higher than the implied discount rate for the neutral situation, and (3) the implied rate for delayed desirable consumption would be higher than the implied rate for expedited planned consumption. All three hypotheses were supported in his sequence of experiments. The three frames do not produce identical implied discount rates and the differences are related to the different psychological reference points induced by the three frames.

The amounts that subjects were willing to pay to speed up desirable consumption and the amounts they demanded to compensate delayed desirable consumption both exceeded the difference between the dollar value of consumption now and the dollar value of consumption later (frame 1). The implied discount rate for delayed consumption (a subjective loss) was greater than the implied discount rate for expedited consumption (a subjective gain). Because only desirable consumption (e.g., a gift certificate) was addressed in his study, Loewenstein made no predictions concerning the relative sizes of discount rates for desirable vs. undesirable consumption (e.g., receipts vs. payments).

He hypothesized that the rates inferred from subject responses elicited using the two non-neutral frames will consist of (at least) two components - one attributable to time preference and one to the reference point shift. "Accurate estimation of discount rates thus [will require] parsing out the relative impact of [time] discounting per se and of reference point shifts" (Loewenstein, 1988, p. 211). Loewenstein also speculated that, once the effect of the reference point shift was removed, discount rates might not "vary according to type of consequence and delay versus speed up" (Loewenstein, 1988, p. 211).

2.2.2 Result Comparisons

Although Loewenstein used only desirable consumption items in his tests, his theory suggests that the delay of planned *undesirable* consumption will be experienced as a gain. Similarly, it seems reasonable to predict that speeding up expected *undesirable* consumption will induce a sense of loss. Six scenarios can be constructed by fully crossing frame (neutral, delay, and speed-up) and outcome sign (receipt or payment). Loewenstein's theory, with this extension, implies that the four non-neutral scenarios have two possible interpretations, subjective loss (for delayed receipts or expedited payments) or subjective gain (for delayed payments or expedited receipts). The gain/loss interpretation depends on the *interaction* between outcome sign and any proposed change in outcome timing, not merely on whether the scenario involves a receipt or payment outcome. Loewenstein included three of the six possible scenarios in his tests; they are identified in Figure 4.

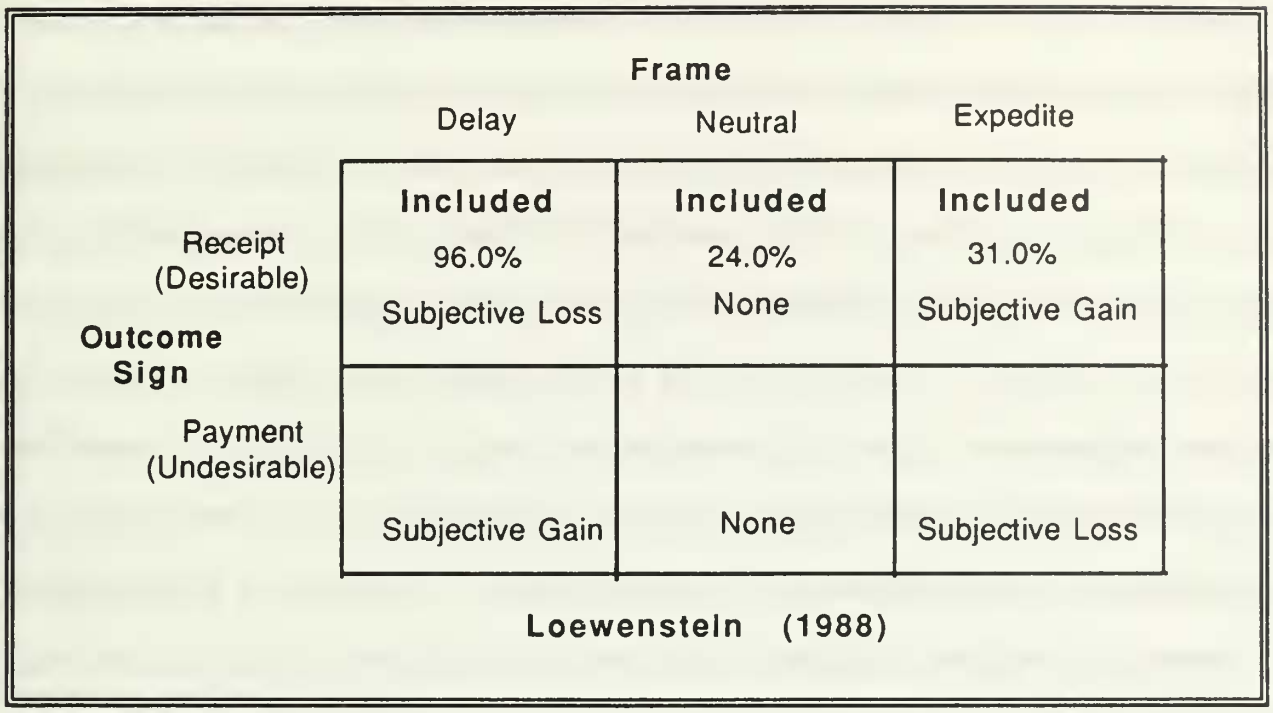

Figure 4

Loewenstein's (1988) results show that:

1. Delaying desirable consumption produces a subjective loss condition,
2. expediting desirable consumption produces a subjective gain condition, and
3. manipulating subjects' reference points to produce loss and gain conditions results in higher implied discount rates than would be reflected by time preferences alone (the neutral frame).

The mean implied annual discount rates that resulted from Loewenstein's first experiment were 96 percent for delayed desirable consumption (receipt/delay, a subjective loss) and 31 percent for expedited desirable consumption (receipt/expedite, a subjective gain), but the mean implied annual discount rate for the neutral condition (frame 1) was only 24 percent.

In an earlier study of discounting patterns, Thaler (1981) tested the following three hypotheses: (1) discount rates vary inversely with the length of time to be waited, (2) discount rates vary inversely with the absolute magnitude of the outcome, and (3) loss and gain discount rates are different. All three hypotheses appeared to hold. Thaler

included both receipt and payment (desirable and undesirable) outcomes, but employed only one question frame (delay) to elicit implied discount rates (i.e., he used frame 2 for both outcome signs). For example, "subjects were told that they had won some money in a lottery held by their bank. They could take the money now or wait until later. They were asked how much they would require to make waiting [three months, one year, or three years] just as attractive as getting the money now" (Thaler, 1981, p. 203). Thaler also asked subjects to imagine they owed a fine (a traffic ticket) and then asked them how much they would be willing to pay in three months, one year, or three years, so that they would be just indifferent between paying the fine immediately or after the delay.[4]

From Loewenstein (1988) we now know that Thaler used a question frame that would shift subjects' reference points. He created subjective loss scenarios for receipts (positive outcomes) and subjective gain scenarios for payments (negative outcomes). As shown in Figure 5, Thaler included two of six possible scenarios in his experiment.[5]

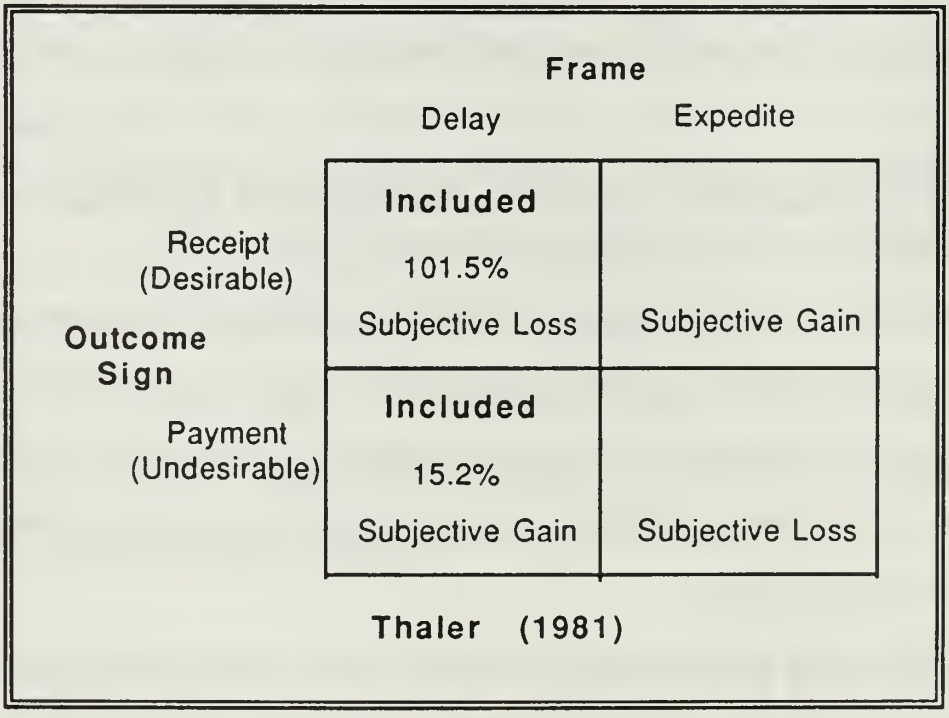

Figure 5

[4] Amounts between $15 and $3,000 were stated in the question, so the immediate positive outcome value was given. Loss amounts were between $15 and $250.

[5] The rates shown in Figure 5 are averaged over receipt or payment magnitudes using only those absolute magnitudes that the two outcome signs had in common.

Thaler noted that delayed receipts generate higher implied discount rates than delayed payments and, because he defined a gain as a receipt and a loss as a payment, he concluded that "implicit discount rates [are] higher for gains". He did not consider perceived changes in financial position. He meant that outcome sign (receipt or payment) influences discount rates and positive outcomes generate a higher implied discount rates than negative outcomes.

Because the data were gathered using one of the two non-neutral frames, more than time preference for receipts and payments is reflected in the difference between the immediate (given) amounts of the prizes/fines and the (subjective) future amounts. Thus, any conclusions about the relative sizes of discount rates for receipts vs. payments are questionable. The delayed receipt is a subjective loss scenario; the delayed fine is a subjective gain scenario; and both interpretations result from reference point shifts. Loewenstein's results show discount rates are not the same when there is a reference point manipulation as when there is none, that subjective loss scenarios produce higher implied rates than subjective gain scenarios, and that the estimated implied rate consists of both a time discount rate and a rate that represents compensation for the subjective loss or gain. Using Thaler's results alone, it is impossible to determine whether the higher implied discount rates for receipts were generated by the positive outcome sign or by the subjective loss scenario (i.e., the interaction between outcome sign and frame). But when they are combined with the results from Loewenstein (1988), it seems reasonable to conclude that the discount rate difference is associated with the subjective loss/gain scenarios.

In a more recent study, Benzion et al. (1989) recognized the importance of both direction of change (frame) and outcome sign, so each outcome magnitude and delay length in their experiment was presented within four scenarios, consisting of delayed

receipts and payments and expedited receipts and payments.[6] Their delay/receipt condition produced the following scenario:

> "Scenario A (postpone a receipt) concerns a case of a person who has just earned $y for his or her work in a financially solid public institute. Upon coming to receive the payment, the person is told that the institute is temporarily short of funds. Instead, he or she is assured payment of another amount of $x, t time periods from now" (Benzion et al., 1989, p. 275). Subjects were asked to provide the amount $x.

All four scenarios suggest changes in current financial position which Benzion et al. (1989) labeled liquidity increases and decreases. Benzion et al.'s liquidity decreases correspond to subjective losses, and liquidity increases to subjective gains associated with the delay and speed-up frames in Loewenstein (1988). Benzion et al. (1989) included one combination (expedite/payment) not found in either Loewenstein (1988) or Thaler (1981) (Figure 6).

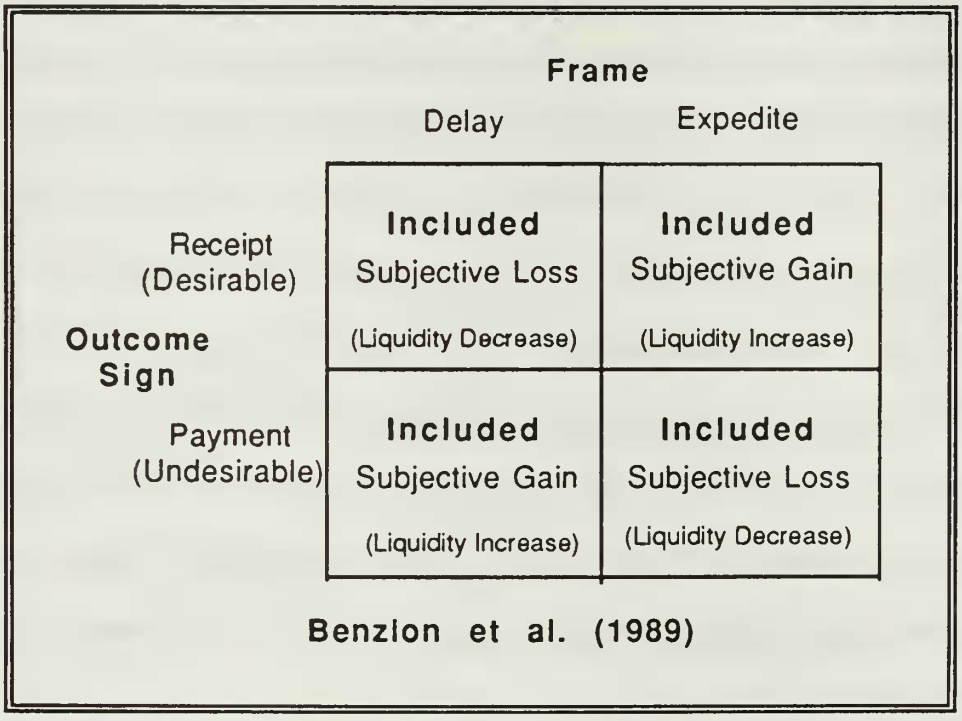

Figure 6

[6]Like Thaler (1981) Benzion et al. (1989) found that discount rates vary inversely with both delay length and absolute outcome magnitude.

The purpose of the Benzion et al (1989) experiment was to test "four hypotheses regarding the behavior of discount rates" (Benzion et al., 1989, p. 270).[7] Two of the hypotheses were consistent with Loewenstein's prediction that discount rates differ according to the direction of reference point shifts. The implied discount rates estimated for each scenario using the formula $F = P(1+ r)^t$, are shown in Figure 7.[8]

		Frame	
		Delay	Expedite
Outcome Sign	Receipt (Desirable)	**Included** 27 % Subjective Loss	**Included** 17.6% Subjective Gain
	Payment (Undesirable)	**Included** 16.7% Subjective Gain	**Included** 24.1% Subjective Loss

Benzion et al. (1989)

Figure 7

Benzion et al. (1989) conclude from these estimates that "discount rates . . . are smaller for losses than for gains" (Benzion et al., 1989, p. 282). The previously uninvestigated combination, expedite/payment (a subjective loss), produced a discount rate that, like the delay/receipt combination (also a subjective loss), is substantially larger than either of the rates produced by the two subjective gain scenarios. It is fairly

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[7]The hypotheses tested were the classical (standard) approach, a market segmentation approach, the one-period implicit risk (OPR) approach and an added compensation (AC) approach. Their results support both "an implicit risk hypothesis . . . and an added compensation hypothesis (Benzion et al., 1989, p. 270). The implicit risk hypothesis asserts that individuals will demand (pay) a premium to compensate the added uncertainty associated with future receipts (payments). The added compensation hypothesis "asserts that individuals require compensation for a change in their financial position" (Benzion et al., 1989, p.270). A multi-period risk approach was also examined but was not supported.

[8]These are the means, across Sum and Time, of the rates shown in Benzion et al (1989)., Table 1, page 276.

clear from these three studies that subjective loss scenarios (liquidity decreases) induce higher rates than subjective gain scenarios (liquidity increases), regardless of outcome sign. Both subjective loss scenarios can be considered borrowing situations; the subjective gain scenarios are lending situations. The observed rate discrepancies may imply anticipated differences in subjects' market borrowing and lending rates.

It is also clear that the discount rates associated with receipts are not consistently higher than those associated with payments. Within liquidity conditions implied discount rates are higher for receipts. Within direction of change, the receipt rate is higher for the delay frame, but lower for the expedite frame.

Thaler (1981) argues that we should expect higher gain than loss rates because people tend to underweight opportunity costs relative to out-of-pocket costs. But if subjects have completely adjusted to owning a lottery prize, its delay may be viewed as an out-of-pocket cost. The high discount rate associated with this out-of-pocket cost reflects a strong dislike for out-of-pocket costs and a commensurate premium demand. Similarly, if subjects have fully adjusted to paying a fine, delaying the payment may be viewed as an opportunity to invest the payment amount for the delay period. The future value is the opportunity cost of failing to delay.

2.2.3 Hypotheses

The studies reviewed above do not provide the evidence necessary to make reliable inferences about the relative magnitudes of receipt and payment (time) discount rates, despite the conclusions stated in Thaler (1981) and Benzion et al. (1989). Loewenstein suggests that the delay and expedite frames produce implied discount rates that consist of two components, one associated with time discounting and one with the reference point shift; whereas, the neutral frame produces rates associated only with time discounting. The neutral frame does not induce a sense of gain or loss because no change in outcome timing is proposed. To help determine whether or not a difference

exists between receipt and payment discount rates and the direction of the difference, if any, an experiment like the one conducted by Benzion et al. (1989) was carried out , but with a neutral scenario added for each outcome sign.

Loewenstein's theory predicts no difference between implied gain and loss (receipt and payment) rates when there is no proposed change in outcome timing to induce it. The apparent rate difference induced in the non-neutral frames is due to the difference in the slopes of the gain and loss portions of the value function (Loewenstein, 1988). An outcome sign/frame combination that suggests a subjective loss is evaluated on the negative, steeper, portion of the value function, resulting in a larger implied discount rate than one evaluated on the gain portion.

The first three hypotheses tested are taken directly from Loewenstein (1988) and follow from his reference point model for intertemporal choice: (H1) Delayed receipt scenarios generate higher implied discount rates than expedited receipt scenarios, (H2) delayed receipt scenarios generate higher implied discount rates than neutral receipt scenarios , and (H3) expedited receipt scenarios generate higher implied discount rates than neutral receipt scenarios.

The next three hypotheses are merely the negative-outcome counterparts of those stated above. Loewenstein's reference point model is easily extended to predict the effect of the three frames on implied discount rates for undesirable consumption (payments): (H4) Implied discount rates for delayed payment scenarios will be lower than implied discount rates for expedited payment scenarios, (H5) implied discount rates for neutral payment scenarios will be higher than implied rates for delayed payment scenarios, and (H6) implied discount rates generated in expedited payment scenarios will be higher than those generated in the neutral payment scenarios.

The model also allows predictions of the relative sizes of discount rates within frames but across outcome signs: (H7) Delayed receipt scenarios generate higher

implied discount rates than delayed payment scenarios, and (H8) expedited payment scenarios generate higher implied discount rates than expedited receipt scenarios.

Comparisons of neutral frame rates with expedited frame rates are more difficult to predict because the size of any difference detected will depend on the extent to which subjects adjust to future receipts or payments. It is clear that differences will be smaller than differences between the neutral and delay frames because the psychological adjustment (the reference point shift) associated with the speed-up frame is smaller than the shift that results from first adjusting to an immediate receipt or payment. This is because subjects are adjusting to consumption, payments, or receipts that will take place in the future, rather than immediately. One might speculate that the size of the reference point shift, and hence the size of the implied rate, will depend on the time distance of the anticipated outcome.

Letting FV(x) represent the future value of a current dollar amount, x, the formula used to compute implied discount rates is $FV(x) = x(1 + r)^t$. Clearly, this discounting model assumes that $v(x) = x$, for all x. But the predictions of Loewenstein's intertemporal choice model are based on the assumption that decision makers have subjective value functions that are steeper for losses than gains. When comparisons of subjective values are made across scenarios, using the formula above, all the difference in subjective value is captured in the computed implied discount rate, so the estimated rate captures both time discounting and the change in value attributable to the frame (the reference point shift). For example, letting $\delta(t)$ represent the discount function, t the length of time to the outcome, $v(\cdot)$ a subject's value function, and r and r' a subject's discount rates for two different scenarios, the delay premium for receipts and delay cost for payments are:[9]

$$-[1 - \delta(t)]v(-x) \; (> 0), \text{ and} \tag{1}$$

$$-[1 - \delta(t)]v(x) \; (< 0), \text{ respectively.} \tag{2}$$

[9]The value function $v(\cdot)$ is assumed to be linear and to have a steeper slope for negative than for positive values of x; the values of v associated with negative values of x are negative; those associated with positive values of x are positive.

The model assumes the same discount factor, $\delta(t)$, across outcome signs. Letting $\delta(t) = (1 + r)^{-t}$, and assuming $r = r'$, it is clear that

$$-[1 - (1 + r)^{-t}]v(-x) > [1 - (1 + r')^{-t}]v(x)$$

because $-v(-x) > v(x)$ when the negative portion of the value function is steeper. But if the value function assumed is $v(-x) = -x$ and $v(x) = x$, for rate computation purposes, when the true value function has $-v(-x) > v(x)$, then

$$-[1 - (1 + r)^{-t}](-x) > [1 - (1 + r')^{-t}]x$$

will result in estimated rates r and r' such that $r < r'$. The estimated discount rates r and r' capture both time discounting and the effect of differing gain and loss slopes. If both outcome signs are (time) discounted at the same rate and have the same slope, then $r = r'$.

If on average subjects exhibit the sort of value functions Loewenstein's theory assumes, then, unless some procedure is used to assess or estimate the values $v(x)$, a rate discrepancy across subjective loss and gain scenarios should always appear and (H9) subjective loss scenarios (delayed receipts and expedited payments) should always generate higher implied rates than subjective gain scenarios (delayed payments and expedited receipts), (H10) neutral scenarios will also produce a rate discrepancy across receipts and payments, the payment rate should be higher, and (H11) the difference should be smaller than the difference between subjective gain and loss rates for the delay frames, but equal to or greater than the difference between the subjective gain and loss rates for the expedite frame. The greater the adjustment (up to x), the smaller the difference.

3. Experiment

3.1 Subjects

The responses of 74 subjects enrolled in upper level undergraduate or masters level accounting courses were used to test the hypotheses above. All subjects had

completed at least one course that included formal instruction in discounting. Response booklets of 14 of the 88 subjects who started the task contained one or more missing values or responses indicating the subjects did not understand the task. Those subjects were dropped.

3.2 Design

The design included four within-subject factors, outcome sign (two levels), frame (three levels - delay, neutral, and expedite), time (four levels - six months, one year, two years, and four years), and amount (four levels - $40, $200, $1000, and $5000). Crossing sign with frame creates the six scenarios investigated. Four of these (delayed receipts (A), delayed payments (B), expedited receipts (C), and expedited payments (D)) were investigated by Benzion et al. (1989). Two scenarios, neutral receipts (E), and neutral payments (F) have been added. A significant sign by frame interaction implies a significant scenario effect. Subjects were asked to respond to 96 (2x3x4x4) experimental questions. The levels of the time and amount factors match those selected by Benzion et al. Scenarios A, B, C, and D were presented as shown in Benzion et al. An example of the neutral frame is shown below (Figure 8). The primary difference between the two neutral frames and those that are expected to induce a reference point effect is that there is no proposed change in outcome timing. Hence, no sense of loss or gain due to a change in outcome timing is generated in these two scenarios.

You owe a debt of $40 in four years to a public institute. What is the (negative) value, -$x,.of that debt to you now? Please indicate -$x on the scale below.

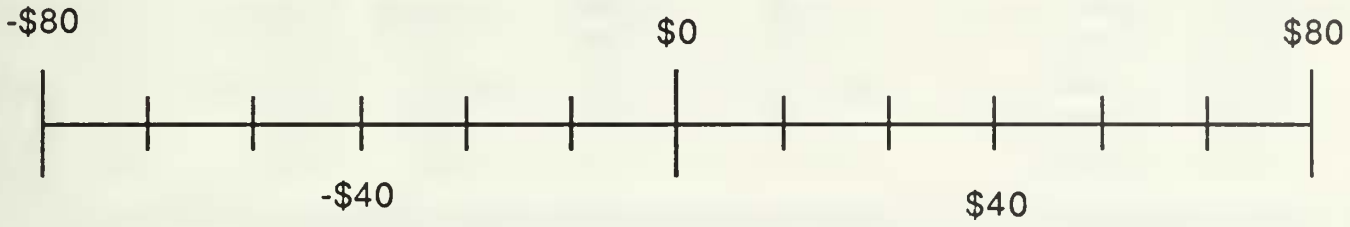

Figure 8

3.3 Task

Subjects were presented the 96 experimental questions in 8 1/2 inch by 11 inch spiral-bound booklets. Subjects were asked to respond to the experimental questions on a scale with endpoints adjusted for the amount considered in each individual question. Several subjects preferred to state dollar amounts and were allowed to do so. The task took approximately 45 minutes to complete.

3.4 Analysis

Scale measurements were converted to dollar amounts and the dollar amounts were used to compute the implied discount rates used in the ANOVA and the cell mean comparisons discussed below.

4. Results

As indicated in Table 1, neither outcome sign nor frame alone is significant at conventional levels, although sign is close at $p = .0632$.[10]

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[10]The confidence level selected for ANOVA effects was $\alpha = .05$, for cell mean comparisons it was $\alpha = .10$. In both cases probability values were computed using the Greenhouse-Geisser epsilon.

Source	df	S S	M S	F	p*
Outcome Sign	1	.432	.432	3.560	.0632
Frame	2	.429	.214	.907	.3970
Time	3	21.202	7.067	39.149	.0001
Amount	3	2.362	.787	9.403	.0011
Sign x Frame	2	5.375	2.688	15.259	.0001
Sign x Time	3	.906	.302	5.696	.0056
Frame x Time	6	1.704	.284	3.769	.0109
Sign x Amount	3	.169	.056	1.645	.1969
Frame x Amount	6	2.053	.342	3.785	.0338
Time x Amount	9	.778	.086	1.831	.1289

*The probability values shown were computed using the Greenhouse-Geisser epsilon

Table 1

The sign x frame interaction is highly significant, however, indicating a strong effect for scenarios A through F. Figure 9, a plot of the sign by frame interaction, shows why.

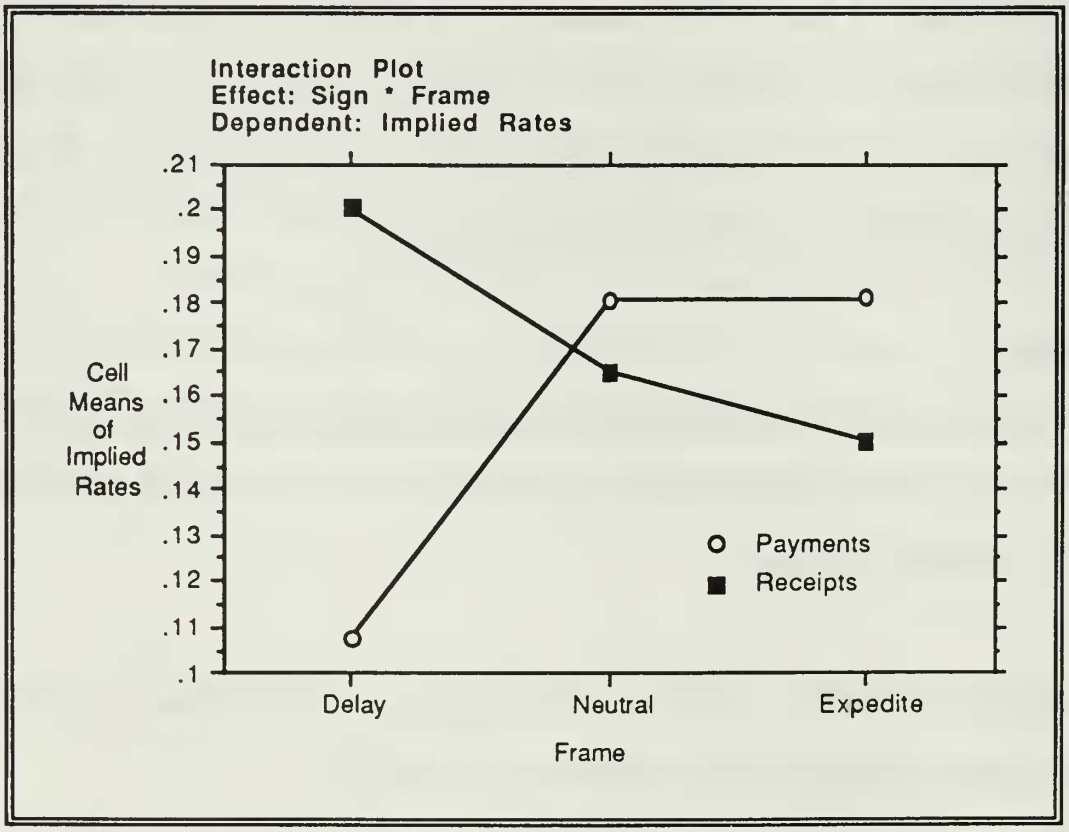

Figure 9

The mean (across frames) discount rate for receipts is 17.2 percent; the mean discount rate for payments is 15.6 percent. Sign is close to significance primarily because of the very low rate generated by the delay/payment condition. Ignoring this condition, the mean payment rate is 18.1 percent, nearly the same and the mean receipt rate. Discount rates are significantly different for particular combinations of outcome sign and frame; payment rates are larger in the expedite frame and smaller in the delay frame.

The direction of discount rate differences for scenarios A through D are essentially the same for this study as those produced in Benzion et al (See Figures 7 and 10). The largest rate was produced by scenario A, delayed receipts; the second largest by scenario D, expedited payments. These two discount rates are not significantly different ($p = .244$). Both scenarios depict potential borrowing situations. The lowest rates were produced by scenarios B (delayed payments) and C (expedited receipts), and they are significantly different ($p = .023$). Both represent potential lending situations. As Benzion et al. suggest, the differences in implied rates associated with the direction of change in liquidity may be due to anticipated differences in borrowing and lending rates.

As expected, all other rates fall between those from scenarios A and B. The delayed receipt rate is significantly greater than both the expedited and neutral receipt rates ($p = .009$, H1, and $p = .054$, H2). The prediction of a smaller neutral than expedited receipt rate did not hold ($p = .361$, H3). Expediting a payment that subjects expect to pay in the future generates an implied rate nearly as great as the delayed receipt rate ($p = .244$); and one that is significantly greater than delayed payments ($p < .001$, H4). The neutral and expedited payment rates are the same ($p = .958$, H6), but significantly greater than the delayed payment rate ($p < .001$, H5). The expedited payment rate is also significantly greater than the expedited receipt rate ($p = .091$, H8), but within the delay frame, receipts generated a higher discount rate ($p < .001$, H7). As predicted, the neutral payment rate is nominally larger than the neutral receipt rate, but the difference is

not statistically significant (p = .327, H10); whereas, both of the other within-frame, between-sign differences were significant (p < .001, within delay and p = .091, within expedite, H11), and both are at least nominally larger than the neutral difference.

		Frame		
		Delay	Neutral	Expedite
Outcome Sign	Receipt (Desirable)	**Included** 20.0% Subjective Loss	**Included** 16.5% None	**Included** 15.0% Subjective Gain
	Payment (Undesirable)	**Included** 10.7% Subjective Gain	**Included** 18.1% None	**Included** 18.1% Subjective Loss

Figure 9

There is no systematic tendency for receipts to be discounted at higher rates than payments. The threat of a liquidity decrease (a potential borrowing situation) has consistently generated higher implied subjective discount rates than a liquidity increase (potential lending situation) whether a receipt or payment was involved (p < .001, H9). When no change in current liquidity is suggested, receipt and payment discount rates appear to be about the same (H10).

There is no significant difference between the mean discount rates associated with the two subjective loss scenarios (delay/receipt and expedite/payment); the two subjective gain scenarios (delay/payment and expedite/receipt) are significantly different. The delay/payment scenario generates exceptionally low rates. Stated another way, the significant difference between the implied rates associated with delayed receipts and those associated with delayed payments is attributable more to the exceptionally low rates in the delay/payment condition than to any exceptionally high

rates induced by the delay/receipt condition. The mean (across time and amount) discount rate associated with scenario B is significantly smaller than every other mean rate. This issue is discussed further below.

5. Discussion

Some very reliable patterns have been uncovered by recent investigations of discounting. Evidence consistently reveals a tendency for subjective discount rates to decrease both with the length of delay and with the absolute magnitude of the outcome and this pattern was evident in the present study as well. A consistent pattern is also emerging with respect to liquidity increases and decreases. People do not like to delay receipts and will charge a hefty premium if they are asked to do so. The implication is that liquidity decreases are discounted at higher rates than liquidity increases, but the implied rate differences are attributable more to the shape of the value function combined with a reference point shift than to any inherent tendency to discount the *utility* (or subjective value) of outcomes at different rates.

On average, implied receipt discount rates appear larger than payment rates, but when the frame of the intertemporal choice question is considered, a different picture emerges. In the current study, most of the implied difference is attributable to the extremely low rates found for the delayed payment experimental condition. This cell indicates that, consistent with several early intertemporal choice studies, once subjects have adjusted psychologically to experiencing a loss at a particular point in time, they are not eager, and may even be averse, to delaying the loss (Loewenstein, 1987; Mischel, Grusec & Masters, 1969). They are much less eager to delay a payment that to expedite a receipt. In contrast, both Benzion et al. (1989) and the current study produced results that imply subjects are about as reluctant to expedite a future payment as they are to delay a current receipt, so the claim that people prefer to experience sure losses sooner rather than later does not to hold in all circumstances. Rather, their

preference appears to be related to whether they have previously adjusted to a particular outcome date. When no change in outcome timing is proposed, there is no apparent tendency for implied discount rates to be different. Alternatively, when no change in outcome timing is proposed, borrowing and lending situations do not arise.

Loewenstein's reference point model predicted a lower rate for the neutral frame than for the speed-up (expedite) frame for desirable consumption (receipts). No difference was detected in this study, nor did the anticipated difference between expedited and neutral payments appear. The expedited payment frame was expected to generate lower rates than the neutral payment frame. Subjects may not have detected a psychological difference between the neutral frame, as it was presented in this study, and the expedite frame, but this explanation is unlikely because the receipt-payment rate difference within the expedite frame is significant and the difference within the neutral frame is not. Perhaps a superior method for estimating implied discount rates would clarify the message concerning the neutral frame. For example, if subjective values were reliably estimated along with discount factors, the discount rate inferred from the factor estimate would no longer contain a component attributable to the gain/loss slope difference. Only time preference would be reflected in implied rates. Spline functions could be useful in such an estimation process.

The result that is not readily explained by the difference in the slope of the positive and negative portions of the value function (coupled with a reference point shift) is the significant difference between the delayed-payment and expedited-receipt rates. This difference may be attributable to dread (Loewenstein, 1987). Just as people derive positive utility from anticipating desirable consumption, they also derive negative utility from dread of negative outcomes, but the effect of dread is hypothesized to be greater than that of anticipation. In fact, the aversiveness of dread can generate negative discount rates for some kinds of outcomes (e.g., Mischel et al., 1969). The disutility of dread accumulates over time, so the length of the delay is important. This hypothesis

implies a larger difference between the delay premiums for receipts and payments than between the speed-up costs for receipts and payments because the effects of both anticipation and dread are reduced in the speed-up (expedite) frame. This is consistent with the results obtained in the current study. Alternatively, the difference may merely reflect a more tenuous adaptation to future than to current outcomes; there is also weak support for this hypothesis across subjective loss scenarios.

Also, six months is a relatively short period of time for most adults. A few subjects mentioned that when a small payment was involved, a short delay was more of an irritation than a blessing. For example, Subject 5 stated that, "The $40 payment was just an annoyance; putting it off for six months or more was a further annoyance. The $5,000 payment was not a mere annoyance, however, and delaying a $5,000 payment was not an annoyance. I wasn't sure about the $200 payment, but the $1,000 payment was like the $5,000 payment." If the sentiment expressed in this statement is a common one, then relatively low, or negative, discount rates might be expected for the delay/payment scenario (B), at least for small amounts and/or short delays.

This paper demonstrated the predictability of relative implied discount rates when the decision maker's reference point is manipulated in certain ways. The results also give some sense of the effect that imagining and adapting to an outcome (e.g., owning a new car, settling a labor or legal dispute, completing a plant expansion) can have on intertemporal decisions and on the planning process in general. To the extent that decision makers' reference points are manipulatable by, for example, salesmen, adversaries, managers, or labor leaders, the effect of creating one particular decision frame rather than another is predictable. For example, the results of this study imply that it is in a car salesman's interest to pursuade consumers to imagine they own a car on his lot, right now. Once a decision maker has adapted to ownership, it will be difficult to walk away without purchasing and wait for another time. Similarly, the U. S. Treasury benefits from taxpayer's relative disinterest in deferring payment of their income taxes once they

have adapted to paying the tax early (via withholding). Further attention should be devoted to exploring the effectiveness of reference point manipulations in particular contexts.

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