Negative Time Preference

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The man who lives within his income is naturally contented with his situation, which, by continual, though small accumulations, is growing better and better every day. He is enabled gradually to relax, both in the rigour of his parsimony and in the severity of his application; and he feels with double satisfaction this gradual increase of ease and enjoyment, from having felt before the hardship which attended the want of them.

Adam Smith
The Theory of Moral Sentiments

Planning for the future invariably requires one to choose among alternative sequences of outcomes. Even simple short-term scheduling decisions about work, play, chores, vacations, etc., involve choosing between sequences, because events that take up time cannot be rescheduled without changing the timing of other activities.

Most economic analyses of preferences between temporally spaced sequences rely on the discounted utility model, along with the assumption of positive time preference and diminishing marginal utility.[1] Barring any preferential interactions across different time periods, the predictions of this model for determining the optimal sequencing of a given set of events are simple: Place the best event at the start, then proceed in descending order until the worst event is reached at the end. Thus a declining series of consumption levels ought to be preferable to an increasing series, holding total consumption constant.

In this paper, we present a short selection of findings (reported more fully in our 1990 paper) that sharply contradict the normative sequencing rule just described. To most persons, a deteriorating series of utility levels is a rather close approximation to the *least* attractive of all possible patterns, regardless of the nature of events that are being ordered. As a secondary violation of the discounted utility model, the preferences of many people are not additive. Such additivity violations often reflect a concern for spreading utility levels evenly over time that is not attributable to diminishing marginal utility within periods.

I. Sequences vs. Simple Outcomes

Several recent studies have documented an apparently negative rate of time preference for choices among outcome sequences. Loewenstein and N. Sicherman (1991) found that a majority of museum visitors preferred increasing wage profiles over those that are flat or decline over time (holding total value constant). Pointing out that the flat and declining wage profile could produce a *dominating* consumption stream through a suitable savings program, did not have much impact on preference. C. Varey and D. Kahneman (1990) found that subjects strongly preferred brief sequences of decreasing discomfort, even at the cost of experiencing overall greater discomfort, while W. T. Ross and I. Simonson (1990) showed that people prefer sequences that end on a good note.

Preference for improvement is an overdetermined phenomenon, driven in part by anticipatory savoring and dread (Loewenstein, 1987), and in part by loss aver-

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[1]The applications of this model have been remarkably diverse, ranging from savings behavior, educational investment, labor supply, bargaining, to criminal behavior and addiction. In recent years, however, its descriptive validity has come under challenge (see our forthcoming article, and Loewenstein and Richard Thaler, 1990).

sion (A. Tversky and Kahneman, 1990) and habit forming changes in the adaptation level (J. Duesenberry, 1949). Savoring and dread contribute to the preference for improvement because, for gains, improving sequences allow decision makers to savor the best until the end of the sequence. With losses, getting the worst outcomes over with quickly eliminates dread. Adaptation and loss aversion induce preference for improvement because, over time, people tend to assimilate to ongoing stimuli and to evaluate new stimuli relative to their assimilation level. Thus, changes in, rather than levels of, consumption are the carriers of value. Improving sequences afford a continual series of positive departures (gains) from one's adaptation level; declining sequences provide a series of relative losses.

Savoring and dread apply to single outcomes as well as to sequences, but assimilation and loss aversion apply only to sequences. The fact that two motives operate for sequences but only one for simple outcomes suggests that the tendency to defer desirable outcomes will be stronger when those outcomes are embedded in sequences. Such a pattern is illustrated by a survey conducted with undergraduates at Harvard University, who were asked the following three questions:

1. Which would you prefer if both were free?
   A. Dinner at a fancy French restaurant (86%)
   B. Dinner at a local Greek restaurant (14%)

For those who prefer French:

2. Which would you prefer?
   C. Dinner at the French restaurant on Friday in 1 month (80%)
   D. Dinner at the French restaurant on Friday in 2 months (20%)

3. Which would you prefer?
   E. Dinner at the French restaurant on Friday in 1 month and dinner at the Greek restaurant on Friday in 2 months (43%)
   F. Dinner at the Greek restaurant on Friday in 1 month and dinner at the French restaurant on Friday in 2 months (57%)

We anticipated that more people would delay the fancy French dinner when it was combined in a sequence with the Greek dinner than when it was expressed as a single outcome prospect. This is indeed what happened. Of the 86 percent of subjects who preferred the fancy French dinner, 80 percent preferred a more immediate dinner (option C) over a more delayed dinner (option D). However, when the French dinner was composed into a sequence with the Greek dinner, a slight majority (57 percent) preferred to have the better dinner come later. Even with single-outcome events there is some motivation to defer the French dinner—witness the 20 percent of subjects who opted for the longer delay. However, this tendency is stronger for sequences than for individual items.

A similar pattern is observed when "Dinner at home" is substituted for the Greek dinner. Since most people eat dinner at home on most nights anyway, embedding the French dinner in an explicit binary sequence does not introduce any real modification of the problem, but the subject is reminded that the choice is "really" between complete sequences. Like other framing effects, such reminders cause preferences to shift, in this case in favor of the improving sequence.

II. What Is a Sequence?

If impatience and the desire for improvement are simultaneously present within a single individual, what determines the prepotent motive on a given occasion? A reasonable conjecture is that the desire for improvement depends on the "integrity" of the sequence—the extent to which the events that comprise it are of a similar type, are regularly spaced, and are not stretched too far apart.

The following example illustrates how the integrity of sequence can be reduced in a predictable way. Visitors to a science museum were asked to choose between alternative scheduling of two visits to a city where the respondent once lived, one to be spent with "an irritating, abrasive, aunt who is a horrendous cook," the other with "former

work associates whom you like a lot." Each subject made three choices, as described below. Response frequencies are reported in parentheses.

	This weekend	Next weekend	
A.	friends	aunt	(10%)
B.	aunt	friends	(90%)

	This weekend	26 weeks from now	
C.	friends	aunt	(48%)
D.	aunt	friends	(52%)

	26 weeks from now	27 weeks from now	
E.	friends	aunt	(17%)
F.	aunt	friends	(83%)

Observe that it is not possible to interpret the three modal choice patterns as the result of a *single* time preference function, denominated in absolute time. Responses to the first and third questions suggest a negative rate of time preference over a 1-week interval, irrespective of whether the week is close or far. By interpolation, one may conclude that the aunt would be scheduled in the earlier of *any* consecutive 2 weekends. Yet, for many subjects, the negative time preference over adjacent weekends does not compound into a negative time preference for the complete 6-month interval, as shown by responses to the second question.

Applied uniformly to all choices, negative time preference would require harsh reductions in present consumption in favor of the future. The fact that one does not observe such sacrifices, even given the additional inducements of a positive interest rate, is normally taken as evidence for positive time preference (M. Olson and M. J. Bailey, 1981).

We propose a different interpretation: Negative time preference is applied selectively, to those events that are seen as part of a meaningful sequence, having a well-defined starting and ending point. As the previous example shows, a pair of adjacent weekends defines a minimal but coherent

sequence, while a pair of weekends separated by 6 months does not.

The saliency of particular intervals is not an objective matter, but depends rather on perceptual framing. By deliberately manipulating the subjective frame, it is possible to induce normatively peculiar patterns of choices, as the following example shows. Subjects were asked to indicate their preferred times to eat two free dinners at the restaurant of their choice. One group was given no time constraint concerning when they could eat the dinners. A second, *constrained* group was told that the dinners must be consumed within the next 2 years. We anticipated that constrained subjects would prefer to delay the dinners more than unconstrained subjects, because the introduction of an explicit planning interval reminds the subjects that, by selecting a particular pair of dates, they are also choosing *not to consume* the meals on all of the other dates. As predicted, the mean preferred delay for the first dinner was 3.3 weeks for the unconstrained group and 7.7 for the constrained. Mean preferred delay times for the second dinner were 13.1 and 31.1 weeks.

These results are inconsistent with the axiom of revealed preference. The imposition of a time constraint on an initially unconstrained population should only affect the responses of that fraction of the population whose preferred delays are longer than permitted by the constraint. The population averages should, therefore, be longer in the unconstrained condition.

III. Nonadditive Preferences

Aside from a preference for improvement, choices between sequences also reveal a sensitivity to certain global or "gestalt" properties, having to do with how evenly the good and bad outcomes are arranged over the total time interval. Consider the following problem presented to 37 Yale University undergraduates (from Loewenstein, 1987). Subjects were first given a choice between A and B, then between C and D. Percentages choosing each of the options are presented in the right-hand column.

Alter-native	Weekend 1	Weekend 2	Weekend 3	Choices
A	Fancy French	Eat at home	Eat at home	16
B	Eat at home	Fancy French	Eat at home	84
C	Fancy French	Eat at home	Fancy Lobster	54
D	Eat at home	Fancy French	Fancy Lobster	46

In the first problem, the majority of subjects preferred to postpone the fancy dinner to weekend 2, in keeping with the improvement principle. However, in the second problem, the insertion of the common lobster dinner in weekend 3 caused preference to shift slightly in favor of having the French dinner right away. This is a violation of additive separability, which implies that an individual preferring sequence A over B should continue to prefer A over B if any elements shared by the two sequences are altered in the same way.

Intertemporal additivity has never been viewed as normatively compelling, since there are many situations in which it is reasonable for consumption at one point in time to influence the marginal utility of consumption at another. Models of the "habit formation" type (Duesenberry; R. A. Pollack, 1970; G. M. Constantinedes, 1990) assume that instantaneous utility depends negatively on past consumption. Other models incorporate the rate of consumption change into the utility function (R. Frank, 1989), or a preference/aversion for utility variation between adjacent periods, as in I. Gilboa's elegant formulation (1989).

Can the separability violation described above be reasonably attributed to some sort of loss aversion, following an adaptation to a reference point? An aversion to utility *reductions* from one period to the next would seem to work in favor of alternative D over C, while leaving preferences between A and B unchanged (to a first approximation). Hence it would predict the opposite violation pattern to the one actually observed.

Furthermore, we have observed the same preference pattern when common "Eat at home" weekends are inserted between the original weekends 1 and 2, and 2 and 3, in all four alternatives (thereby creating 5-weekend sequences). Because the neutral

filler weekends should reduce adaptation, and altogether eliminate differential interactions between adjacent periods, they should attenuate the separability violations. The results with the 5-weekend version of the problem were essentially equivalent, however: Only 11 percent of respondents opted for option A over B, while 49 percent preferred C over D.

The problem here is that habit formation/loss aversion models do not well capture the global properties that people find attractive in sequences. The relative advantage of sequences B and C is due to the fact that they both "cover" the 3-week interval better than their respective alternatives. In other words, they interleave the good and indifferent events in a more nearly uniform manner.

We have developed a theoretical model that measures both the degree of improvement and spreading of any sequence in terms of cumulative utility sequences (see our 1990 paper). The model defines improvement over time as the sum of deviations of the cumulative sequence that would be obtained by spreading total utility evenly over time from the cumulative utility stream of the sequence being evaluated. Evenness of spread is represented by the sum of the absolute value of these deviations.

The derivation of our notions of improvement and uniformity is depicted in Table 1, using the last illustrative example on the assumption that the "Eat at home" event has utility zero, and the "Fancy French" and "Fancy Lobster" events have utility one. Note that a simple preference for improvement would lead to a preference for B over A and D over C, while discounting alone would produce the opposite pattern. The desire for spreading outcomes over time, however, designated in the row marked Spread (lower numbers signify more even spreading of outcomes), can explain the preference for B over A and for C over D.

In several longer surveys (see our 1990 paper), we have systematically mapped out preferences over multiple period sequences. The judgments of the average person could be briefly described as follows: There is a strong liking for improving sequences, mod-

TABLE 1—DERIVATION OF IMPROVEMENT
AND SPREAD MEASURES

| | Alternative | | | |
	A	B	C	D
Sequence	1,0,0	0,1,0	1,0,1	0,1,1
Cumulative Flat	1,1,1	0,1,1	1,1,2	0,1,2
Seq. Flat	.33,.33,.33	.33,.33,.33	.66,.66,.66	.66,.66,.66
Cumul.	.33,.66,1	.33,.66,1	.66,1.33,2	.66,1.33,2
Difference	−.66,−.33,0	.33,−.33,0	−.33,.33,0	.66,.33,0
Improvement	−1	0	0	1
Spread	1	.66	.66	1

erated by a penalty for deviation from global uniformness, and a small premium for sequences that start well.

IV. Conclusion

Previous psychological work on time preference has focused almost entirely on the tradeoff that arises when two outcomes of different dates and different values are compared. The tacit premise was that such judgments will reveal an individual's "raw" time preference, from which one can then synthesize preferences over more complex objects—retirement plants, intertemporal income profiles, and such. This view we feel is fundamentally incorrect: As soon as an intertemporal tradeoff is embedded in the context of two alternative *sequences* of outcomes, the psychological perspective, or "frame" shifts, and individuals become more farsighted, usually wishing to postpone the better outcome to the end. The same person who prefers a good dinner sooner rather than later, if given a choice between two explicitly formulated sequences, one consisting of a good dinner *followed* by an indifferent one, the other of the indifferent dinner *followed* by the good one, may well prefer the latter alternative. Sequences of outcomes that decline in value are greatly disliked, indicating a negative rate of time preference.

A byproduct of the sequence frame is that subjects who are given a time interval, within which to schedule some enjoyable activity, may schedule it later on average than people who are given no time frame at all. Apparently, as soon as the relevant interval is specified, a person becomes concerned with shifting the good events out to the end. This result has implications for life cycle choices; for example, it suggests the possibility that some individuals would choose an earlier retirement in the absence of a mandated retirement point.

The sensitivity of time preference to the sequence "frame" casts new light on the often-repeated charge that certain groups of people (consumers, managers, members of a particular nation or culture) have an excessively steep rate of time preference. Such a claim is a psychologically imprecise definition of the problem, at best. The differences that do prevail should instead perhaps be traced to different styles of mental bookkeeping, which will alone produce different degrees of impatience even with a common underlying rate of time preference. Any operation, custom, or habit that causes the stream of purposeful activity to fragment into a series of isolated choices, each involving a simple intertemporal tradeoff, and each unrelated to a larger plan, encourages impatient choices. Whereas the integral sequence frame, by fusing events into a coherent sequence, promotes concern for the future, thereby creating an appearance of negative time preference.

REFERENCES

Constantinides, G. M., "Habit Formation: A Resolution of the Equity Premium Puzzle," *Journal of Political Economy*, June 1990, *98*, 519–43.

Duesenberry, J., *Income, Saving, and the Theory of Consumer Behavior*, Cambridge: Harvard University Press, 1949.

Frank, R., "Frames of Reference and the Quality of Life," *American Economic Review Proceedings*, May 1989, *79*, 80–85.

Gilboa, I., "Expectation and Variation in Multi-Period Decisions," *Econometrica*, September 1989, *57*, 1153–69.

Loewenstein, G., "Anticipation and the Valuation of Delayed Consumption," *Economic Journal*, September 1987, *97*, 666–84.

_____ **and Prelec, D.,** "Anomalies in Intertemporal Choice: Evidence and an Interpretation," *Quarterly Journal of Economics*, forthcoming.

_____ **and** _____, "Preferences over Outcome Sequences," Harvard Business School Working Paper, 1990.

_____ **and Sicherman, N.,** "Do Workers Prefer Increasing Wage Profiles?," *Journal of Labor Economics*, January 1991, *9*.

_____ **and Thaler, R.,** "Anomalies: Intertemporal Choice," *Journal of Economic Perspectives*, Fall 1989, *3*, 181–93.

Pollak, R. A., "Habit Formation and Dynamic Demand Functions," *Journal of Political Economy*, July/August 1970, *78*, 745–63.

Olson, M. and Bailey, M. J., "Positive Time Preference," *Journal of Political Economy*, February 1981, *89*, 1–25.

Ross, W. T., Jr. and Simonson, I., "Consumers' Evaluation of Purchase and Consumption Experiences: A Preference for Happy Endings," unpublished manuscript, 1990.

Tversky, A. and Kahneman, D., "Reference Theory of Choice and Exchange," unpublished working paper, 1990.

Varey, C. and Kahneman, D., "The Integration of Aversive Experiences Over Time: Normative Considerations and Lay Intuitions," working paper, University of California-Berkeley, 1990.