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Conflicting motives in evaluations of sequences

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Abstract Prior research involving choices among sequences differing in trend has typically documented a preference for improving sequences. However, when we investigated sequence preferences using allocation and pricing tasks we found no evidence for a preference for improving sequences. We propose that different measurement procedures highlight or suppress varied considerations that drive preferences toward present consumption, future consumption or temporal neutrality. We discuss our results in the broader context of constructed preferences and convergent validity.

Keywords Time preference · Sequences · Constructed preferences

Any actively researched topic will generate divergent findings, but few areas rival intertemporal choice in the consistency with which prior findings are called into question. Four decades of research have yielded a welter of conflicting results. Imputed discount rates vary dramatically across studies, and little consensus has been achieved regarding what, exactly, discount rates reflect (Frederick et al. 2002).

Some of the variation across studies can be accounted for by existing theoretical perspectives. For example, the finding that more discounting occurs in the near future than in the more distant future can be described (some would say "explained") in terms of hyperbolic discounting (Strotz 1955; Ainslie 1975).[1] However, regardless of which specific parameters or functions one adopts, much of the variation across studies

[1]Neuroscientists debate whether time discounting reflects a unitary neural process (Kable and Glimcher 2007) or a complex interaction between different neural systems with different temporal properties (McClure et al. 2004, 2007) with hyperbolic time discounting representing only a convenient 'reduced form' representation. The simpler perspective has the benefit of parsimony, but the more complicated 'dual process' perspective helps to explain, among other things, why impulsivity is increased by emotions (Hariri et al. 2006) and cognitive load (Hinson et al. 2003).

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requires additional variables. Among the vast array of findings, estimated discount rates depend on the *direction of comparison*—whether consumers are contemplating the delay or acceleration of some anticipated consumption (Loewenstein 1987; Weber et al. 2007) and the manner of *temporal referencing*—whether the interval in question is described as units of time, such as "in 7 months" or by the corresponding temporal benchmark, such as "on November 5th" (Read et al. 2005; LeBoeuf 2006; Frederick et al. 2008). Discount rates are also sensitive to the specific aspects of the outcomes being contemplated—smaller outcomes tend to be discounted more than large ones and positive outcomes more than negative ones (Thaler 1981). The correct interpretation of such differences remains subject to debate (see, e.g., Green et al. 1997; Loewenstein and Prelec 1992).

Given variation in apparent discounting across circumstances, and across various descriptions of the same circumstances, we question the usefulness of attempting to produce any single parametric specification of discounting, and urge, instead, an approach that focuses on the reasons, considerations, motives, and perspectives that influence evaluations of temporal prospects. We illustrate the approach through an investigation of preferences for sequences. While prior research has generally used choice-based elicitation procedures, we investigate sequence preferences using allocation and pricing tasks. We show that these alternative procedures do *not* reveal the preference for improving sequences that has been commonly found in past research using choice tasks. We propose that alternative elicitation methods affect preferences by highlighting or suppressing considerations which motivate a preference for present consumption, future consumption, or temporal neutrality.

1 Decisions as the end products of multiple competing motives

In his influential treatise *Principles of Morals and Legislation*, Jeremy Bentham (1789) elaborated the various sources or types of pleasures and pains that impel or inhibit human behavior. He assumed, however, that all of these diverse motives could be distilled into one common motive which he labeled "utility," and this is the main aspect of his work that economists embraced.

Much contemporary psychological research has followed Bentham by conceptualizing decision making in terms of diverse motives or goals (Markman and Brendl 2000; Simonson 1989; Shafir et al. 1993; Van Osselaer et al. 2005). However, in contrast with Bentham, this research has not tended to assume that these diverse motives could be easily distilled into a single overarching one. Instead, such research has viewed decision making as a process in which task characteristics and contextual factors determine the subset of goals that influence decision making in a particular circumstance. For example, the goal of compromising will likely be more important when respondents choose among three options, where a "compromise" may be possible, than when they price three options, where the concept of compromise does not apply. "Query Theory" (Johnson et al. 2007; Weber et al. 2007) assumes that decision makers query their memory for a subset of information relevant to the decision and that preferences are subject to the processes and dynamics of memory coding and retrieval. Other research shows that the goals governing decisions can be evoked without the decision makers' awareness. For example, respondents did better on word search puzzles if the previous

puzzle "happened" to contain words related to performance, such as "win" or "compete" (Bargh et al. 2001); the priming manipulation caused one particular goal—finding a lot of words—to gain ascendance over other possible goals, such as minimizing effort.

2 Multiple motives in evaluations of sequences

Most research on intertemporal choice has been guided by the assumption that people are impatient—that they care less about, or "discount" future outcomes. In a typical study, respondents choose between an immediate reward and a delayed reward of equal or greater value. The results usually reinforce the assumption guiding the experimental design: immediate rewards are nearly always preferred to equivalent delayed rewards and are often preferred to much greater delayed rewards (for an overview, see Frederick et al. 2002).

However, in the early 1990s, several researchers found—in an apparent contradiction to the predictions of discounting models—that people typically prefer improving *sequences* (in which the better outcomes are delayed) to declining sequences (in which the better outcomes come first). For example, Loewenstein and Sicherman (1991) found that 83% of respondents preferred a five-year salary profile that gradually increased from $23,000 to $27,000 to one that gradually decreased from $27,000 to $23,000 (see also Chapman 2000; Frank and Hutchens 1993; Hsee et al. 1991; Loewenstein and Prelec 1991,1993; Ross and Simonson 1991). Loewenstein and Prelec (1991, p. 351) conjectured that a sequence formulation makes individuals more farsighted by shifting their psychological perspective and later (1993) proposed a model in which choices reflected a compromise between impatience, a preference for improvement, and the desire to spread consumption across time. Below, we outline a more comprehensive framework.

3 A nine factor framework of considerations in sequence preferences

Table 1 summarizes nine reasons why one might care about the profile of a sequence of events: three for preferring increasing sequences, three which support a preference for declining sequences and three which favor 'flat' sequences in which consumption is distributed equally across time. The three reasons for preferring improving sequences include: (1) *anticipatory utility*; delaying good things extends the period over which they can be pleasurably anticipated and accelerating bad things decreases the period of dread (Berns et al. 2006; Loewenstein 1987)[2]; (2) *contrast effects*; the

[2] It is not clear why anticipatory utility or disutility applies more forcefully in studies using sequences. Sometimes, the preference for improving sequences may merely express a preference that a study involving single outcomes would also reveal. For example, Loewenstein and Prelec's (1993) finding that 90% of respondents prefer the improving "sequence" of weekends [host unpleasant aunt, party with friends] to the deteriorating "sequence" [party with friends, host unpleasant aunt] clearly reflects a desire to get the aunt's visit over with, but it remains unclear whether the sequence formulation, *per se*, has any effect; it is quite possible that respondents would choose to get the visit with the unpleasant aunt over with quickly even if the decision involved only the temporal placement of that event.

Table 1 Nine factor framework of sequence preferences

Factors favoring improving sequences	Factors favoring deteriorating sequences	Factors favoring flat sequences
Anticipation and dread	Uncertainty	Diminishing marginal utility
Contrast effects	Opportunity cost	Equity among selves
Extrapolation	Pure time preference	Divide equally heuristic

deferral of consumption to future time periods permits one to enjoy a series of gains relative to one's "adaptation level" (Helson 1964)[3], and (3) *extrapolation*; as respondents may spontaneously transform the presented sequence into the corresponding longer sequences. For example, the sequence (2, 3, 4) may be preferred to (4, 3, 2) because those sequences are reinterpreted as (2, 3, 4, 5...) and (4, 3, 2, 1...), which, of course, offer different totals as well as different trends. Respondents are often instructed not to extrapolate the presented sequences to future periods, but may do so anyway, rejecting experimenters' assurances that a declining salary sequence implies nothing about future salary prospects or that one's health will immediately return to normal despite declining continually for a year.[4]

The three reasons supporting declining sequences are the same as those supporting discounting generally: (1) *uncertainty* that later outcomes will actually occur, (2) *opportunity costs* of delaying outcomes that could have been profitably invested, and (3) *pure time preference*—caring less about utility that is more temporally remote.

The three reasons to prefer flat sequences are: (1) *diminishing marginal utility* from consumption, (2) desire for equality among temporal 'selves' (see Frederick 2003), and (3) a "*divide-equally heuristic*", which respondents could either apply in the service of the first two considerations or mindlessly adopt without deliberating too deeply about the optimality of the resulting allocation (see Benartzi and Thaler 2001).

3.1 Narrow research paradigms in the analysis of sequence preferences

A complete account of sequence preference requires both an enumeration of different motives and an account of the determinants of the relative prominence of different motives in different situations. Although decision researchers have championed the "constructed preferences" paradigm (Payne et al. 1992; Slovic 1995), arguing that

[3] Contrast effects are presumably cued more strongly in studies involving sequences (multiple outcomes with an explicitly specified temporal relation) than in single outcome studies (which evoke no specific comparison). Indeed, several studies have found that thoughts about contrast effects help to explain preferences for improving sequences (Loewenstein and Sicherman 1991; Novemsky and Ratner 2003; Read and Powell 2002).

[4] A fourth, probably rare, motive for preferring improving sequences is anticipated utility from memory (Elster and Loewenstein 1992). An improving episode is desirable if one expects to derive utility from looking back upon it, and believes that later outcomes are more memorable than earlier ones. For example, if a baseball fan expects his memory of a doubleheader to be dominated by what happens in the second game, he may hope the star pitcher pitches the second game rather than the first. Excepting one study involving rats (Brunner 1999), research on retrospective evaluations suggests that improving sequences are remembered more favorably than declining or flat ones (see, e.g., Ariely and Carmon 2000; Fredrickson and Kahneman 1993; Kahneman et al. 1993; Redelmeier and Kahneman 1996; Ross and Simonson 1991; Schreiber and Kahneman 2000; Varey and Kahneman 1992).

revealed preferences are sensitive to the elicitation procedures used to measure them, they often seem reluctant to test the claim, adopting very similar experimental procedures across studies, thereby exaggerating the robustness of the phenomenon being studied. For example, the consistent finding that discount rates are lower with longer delays is typically explained in terms of "decreasing impatience" or "hyperbolic discounting," because longer periods necessarily include later periods. However, Read (2001) pointed out that nearly all of the studies allegedly demonstrating this phenomenon confounded interval timing and interval length; if estimated discount rates are lower when measured between the present and 6 months than when measured between the present and 3 months, that could be because 6 months is later than three months (as hyperbolic time discounting assumes) or because the six month interval is twice as long as the three month interval. When these factors were disentangled, results attributed to hyperbolic discounting could be explained in terms of the fundamentally distinct concept of subadditivity—the tendency to put disproportionate weight on small differences. Analogously, Fox and Tversky (1995) noted that all prior research on ambiguity aversion involved direct choices between ambiguous and unambiguous gambles, which highlights ambiguity and comparative ignorance. When gambles varying in their degree of ambiguity were assessed in isolation, they found that ambiguity aversion diminished or disappeared.

Research on sequences provides yet another example in which methodological innovations fundamentally altered the conclusions drawn about preferences. As noted, until the early 1990s, research on intertemporal choice was guided by the presumption that people discount the future. It was assumed that after identifying the correct functional form of the discount function the valuation of sequences would be a simple matter of adding up the discounted value of their components. However, when preferences between sequences were actually examined, this assumption was unfounded; preferences between sequences could not be derived from the sum of preferences for their component parts (Loewenstein and Prelec 1993).

Prelec and Loewenstein (1997, p. 101) concluded that "*people have a strong preference for sequences that improve over time*"—a claim supported by both their research and the research of others (e.g., Barsky et al. 1997; Chapman 2000; Frank and Hutchens 1993; Hsee et al. 1991). However, though methodologically innovative with respect to prior research, the research on sequences was also conceived somewhat narrowly, as nearly every study used essentially the same methodology: respondents either rated or chose between multiple sequences differing in trend. This focuses attention on trend, and, hence, on just those considerations favoring improving sequences (such as contrast effects or extrapolation).

In the spirit of those who have urged the use of different measurement methodologies to refine understanding of theoretical constructs (Cronbach and Meehl 1955; Garner et al. 1956; Campbell and Fiske 1959), we reexamine sequence preferences using two elicitation procedures that have not formerly been applied: allocation and pricing. Rather than emphasizing the features of the preference stimuli (whether the objects of evaluation are perceived as single or multiple outcomes) we focus on the motives that a measurement procedure highlights or suppresses. Notably, when assessed via these alternative elicitation procedures, we find little evidence that improving sequences are evaluated more favorably.

In line with other research on goal activation in decision making, we propose that sequence preferences will be determined by the salience or accessibility of motives that

various elicitation procedures evoke. For example, research suggesting that "divide equally" functions as a simplifying heuristic in interpersonal allocation studies (Allison and Messick 1990; Harris and Joyce 1980; Messick 1993; Roch et al. 2000) suggests that allocating consumption among multiple periods would evoke the idea of distributional equity, and favor flat sequences. We test this prediction next, by assessing the types of sequences people would create when allocating a fixed quantity of goods (or bads) over a series of time periods.

3.2 Measuring sequence preferences via allocation

In the first of two similar studies, 100 residents awaiting potential jury duty at the Pittsburgh civil court answered three questions. The first asked them to imagine that they would be restricted to watching only 30 movies over the next 8 years, and to indicate how many they would watch each year. The second asked them to imagine they had been given 30 coupons for a free half-hour massage which could be redeemed at any time over the next 8 years, and to indicate how many they would choose to experience in each year. The third (reproduced below) asked them to imagine that they would suffer 30 intense headaches over the next 8 years and to indicate how many they would elect to endure in each year.

Try to recall the worst headache you have ever had. Suppose that over the years 2001 to 2008, you would suffer 30 more headaches that were equally severe. If you could choose when these severe headaches would occur, indicate how you would allocate them, by completing the blanks below, so that they total to 30.

In the year 2001 I would have _____ headache(s)
In the year 2002 I would have _____ headache(s)
In the year 2003 I would have _____ headache(s)
In the year 2004 I would have _____ headache(s)
In the year 2005 I would have _____ headache(s)
In the year 2006 I would have _____ headache(s)
In the year 2007 I would have _____ headache(s)
In the year 2008 I would have _____ headache(s)
TOTAL = 30

A follow up study conducted with 90 MIT undergraduates used a similar design. Respondents specified their preferred allocation of 20 events over a 5 year interval. The three domains were headaches, massages, and sushi dinners, asked in that order.

Tables 2 and 3 report, for each domain, the mean number of outcomes allocated to each year and the percent of subjects who generated declining, flat, or improving sequences.[5] Overall, respondents generated flat sequences about half the time. When

[5] Following Loewenstein and Prelec (1993), generated sequences were characterized according to a metric ranging from −1 (deferring all goods to the final year, or enduring all bads the first year) to +1 (consuming all goods the first year, or deferring all bads to the final year). This was computed by comparing the decumulative of the generated sequence with the decumulative of the sequence that would be produced by evenly spacing consumption across time periods. In the first study, respondents could not generate perfectly flat sequences because thirty is not evenly divisible by eight. Although this was by design (to force respondents to choose a period in which to reduce consumption), the most common response was (4, 4, 4, 4, 4, 4, 4, 2), suggesting that respondents wanted a flat sequence. Thus, we categorized as "flat" any sequence with a decumulative index between −0.10 and +0.10.

Table 2 Average number of 30 good or bad events allocated over an 8 year time period, and percentage of respondents who generated declining, flat, or improving sequences

Domain	Aggregate data								Individual level data		
	# allocated to that year								Created sequence		
	1	2	3	4	5	6	7	8	Declining	Flat	Improving
Movies	3.9	3.4	3.8	3.8	3.8	3.8	3.8	3.2	19%	55%	26%
Massages	4.8	4.3	4.1	3.7	3.5	3.5	3.4	2.9	34%	46%	20%
Headaches	6.4	3.6	3.0	2.9	2.8	2.7	2.8	5.8	27%	39%	34%
									27%	47%	26%

deviating from equal allocation, improving and declining sequences were equally common.[6]

4 Summary

In both allocation studies, the modal preference is for flat sequences. We suspect that the allocation procedure often evokes a "divide-equally heuristic." It may also force respondents to explicitly recognize that a better distant future comes at the expense of a worse nearer one—a tradeoff that is less stark when respondents choose among pre-specified sequences.

The data also reveal that two putative measures of time preference, ostensibly both involving decisions about distributing utility across time (how many massages and headaches to allocate to each year), were almost completely unrelated: $r=0.03$ in the study 1a and 0.05 in the study 1b. The lack of correlation between respondents' allocation of pleasure (massages) and pain (headaches) dramatically illustrates the failure of theories which conceptualize intertemporal choices in terms of some unitary discount factor and invoke this hypothesized construct to explain individual differences in behavior. Respondents presumably have reasons for allocating these events as they do, but the principal explanatory factor does *not* appear to be interpersonal differences in the weighting of future utility.

By contrast, if one conceptualizes intertemporal preferences as the expression of a confluence of several distinct factors that different situations evoke to different degrees, the lack of correlation between the headache and massage domains makes more sense. When allocating headaches, thoughts of dread may motivate respondents to get them all

[6] There were significant differences across domains in the degree of improvement sought or deterioration permitted—in particular, a markedly greater disposition to accelerate bads than to postpone goods, which suggests that aversive anticipation or "dread" is more potent than pleasurable anticipation. In study 1a, paired *t*-tests performed on the decumulative indices revealed that the sequences generated for headaches were significantly more improving than sequences for movies ($t(94) = 7.43$; $p < 0.0001$), which, in turn, were significantly more improving than sequences for massages ($t(93) = 2.30$; $p < 0.05$). In study 1b, the sequences generated for headaches were significantly more improving than sequences for massages ($t(89) = 7.17$; $p < 0.05$) and sushi dinners ($t(88) = 8.13$; $p < 0.0001$). The allocation of massages and sushi dinners did not differ significantly from each other ($t(88) = 1.54$; $p > 0.10$).

Table 3 Average number of 20 good or bad events allocated over a 5 year time period, and percentage of respondents who generated declining, flat, or improving sequences

Domain	Aggregate data					Individual level data		
	# allocated to that year					created sequence		
	1	2	3	4	5	Declining	Flat	Improving
Headaches	7.8	3.9	3.3	2.6	2.4	12%	32%	56%
Massages	5.0	4.1	3.9	3.6	3.5	27%	61%	12%
Sushi dinners	5.9	4.1	3.5	3.1	3.4	37%	55%	8%
						25%	50%	25%

over with as quickly as possible, yet this desire may be offset by one's recognition of the difficulty of coping with too many aversive consequences too closely spaced. Similarly, someone who finds massages only mildly pleasurable may satiate quickly, increasing the motivation to spread them out, whereas a massage lover may not satiate easily, reducing the motivation to spread them out. This supposition was supported in the second study, in which respondents indicated whether they had ever had a professional massage, and how many times they had eaten sushi in the past three months. The forty respondents who had previously experienced a massage allocated an average of 6.03 massages to year 1, compared to 4.10 allocated by the forty-nine massage virgins ($t(87)=2.77$; $p<0.01$). Similarly, the sixty-one respondents who had eaten sushi at least once in the past three months were more impatient than the twenty-six who had not—allocating more dinners to year 1 (6.05 vs. 5.46), and significantly fewer dinners to year 5 (2.84 vs. 4.58; $t(85)=2.32$; $p<0.05$).

Individuals clearly differ in their experience of dread, their ability to cope with repeated painful episodes, and the pleasure they derive from pressure on muscle tissue. When seen this way, the lack of correlation between massage allocation and headache allocation seems scarcely more mysterious than finding that preferences between red and white wine fail to correlate with preferences between red and white wallpaper.

4.1 Measuring sequence preferences via pricing

The following four studies examine whether the preference for improving sequences commonly seen in choice data would be diminished or reversed in pricing tasks. We expected that pricing procedures would evoke an "economic mindset" and prompt thoughts of opportunity costs, interest rates, and other considerations supporting the economic logic that one should accelerate rewards and postpone debts.

4.1.1 Study 2a. Matching payment sequences

As shown in the inset below, this study instructed respondents (181 Princeton undergraduates) to "match" two sequences—to specify a delayed reward that would create an improving sequence as attractive as a specified declining sequence. Since Lab A confers a total of $3,000 in a *declining* sequence ($2,000 up front and $1,000 later), a

preference for improving sequences implies that Lab B could offer less than $3,000 if its payments were increasing, and, thus, less than $2,000 in the future period.

Suppose that you have agreed to participate in a one year medical study to earn some extra money. Two different labs are conducting the same study.

Lab A has offered to pay you $2000 now for signing up and an additional $1,000 in one year, when the study is complete.

Lab B has offered to pay you $1,000 now for signing up and an additional $____ in one year, when the study is complete.

Please fill in the blank so that Lab B's payment plan is equally as good as Lab A's payment plan.

Though the stimulus in this task bears the hallmarks of a "sequence"—it involves multiple outcomes whose temporal relation is salient—the responses yield no trace of a preference for improving sequences. The mean response was $2,711, and only 4 of 181 respondents produced responses below $2,000.

4.1.2 Study 2b. Preferring vs. paying

In this study, modeled after one by Loewenstein and Prelec (1993), 340 respondents (248 University of Arizona undergraduates and 92 travelers at the Pittsburgh International Airport) expressed a preference for consuming two dinners (one at a fancy French restaurant and one at a not-so-fancy Greek restaurant) in one of two sequences (French first or Greek first). As shown in the inset below, half of the respondents indicated which sequence they *preferred*, whereas the other half indicated which they were willing to *pay more for*.

Assume that the two restaurants described below are located near you, that you have no scheduling conflicts, and that the dinner includes everything (appetizers, drinks, desserts, and gratuity).

Cafe Matisse	*Zorba's Grill*
Fare: French	Fare: Greek
Entree prices: $$$$	Entree prices: $$
Quality: * * * *	Quality: * *

Now, consider the following two [situations/*certificates*]:

[Situation/*Certificate*] A: You get free dinner for two at Cafe Matisse on the last Friday of *this* month, and free dinner for two at Zorba's Grill on the last Friday of *next* month.

[Situation/*Certificate*] B: You get free dinner for two at Zorba's Grill on the last Friday of *this* month, and free dinner for two at Cafe Matisse on the last Friday of *next* month.

Which of these [situations/*certificates*] would you [prefer?/*pay more for*?] A or B?

As anticipated, the improving sequence was favored more often by those asked which sequence they *preferred* than by those asked which they would *pay more for* (51% vs. 37%; $\chi^2=5.98$; $p<0.05$). Respondents may consider it economically irrational to pay more when the more valued event is more delayed, since people rarely pay for delay, but are sometimes compensated for it. This interpretation is supported by a follow up study in which 140 Princeton undergraduates answered *both* questions (with the order counterbalanced). When both "perspectives" were simultaneously

activated, nearly everyone (131/140) answered consistently, with about two thirds preferring the declining sequence in both questions. Thus, respondents appeared to coordinate on their pricing response rather than their preference—they resolved conflicting intuitions around their belief that it is irrational to value the more delayed event more highly.[7]

These results are analogous to those reported by Hsee (1999). He found that 68% of respondents predicted that an ascending sequence of four dinners ($20, $27, $38, $50) would confer a better overall experience than a declining sequence worth $10 more ($50, $42, $33, $20), yet 51% still chose the declining sequence. Hsee was pointing to a discrepancy between predicted utility and preference, whereas we are distinguishing preference from willingness-to-pay. In combination, the two results suggest that comparable or larger discrepancies would also be found between predicted utility and willingness-to-pay (see also Amir and Ariely 2007; Kahneman and Varey 1991).

4.1.3 Study 2c. Compensation demanded for improving or declining sequences of bads

In two studies, 390 students from Princeton and Carnegie Mellon University were shown the vignette depicted in the inset below, involving a psychology experiment consisting of three tasks to be performed on three consecutive days: one task that is very unpleasant, a second that is moderately unpleasant, and a third that is merely boring.

Suppose that you were thinking about participating in a psychology experiment, in exchange for a cash payment. The experiment requires you to perform three boring or unpleasant tasks, on Monday, Tuesday, and Wednesday of next week, as described below.

MONDAY: You will receive a moderately painful electric shock to your left index finger and then have a blood sample withdrawn to measure the level of stress hormones.

TUESDAY: You will place your hand in ice water for ninety seconds and rate the level of discomfort you feel at various times.

WEDNESDAY: You will count the number of times the word "the" appears in each of six paragraphs selected from a recent novel.

What is the *smallest* amount of money that you would have to be paid to agree to participate in this three-part experiment?

$ _____

In a study conducted at Princeton, respondents were randomly assigned to one of three groups. One group (N=131) chose between the two sequences. A second group (N=65) indicated the minimum compensation they would demand to endure the improving sequence (the exact question shown in the inset above). A third group (N=64) indicated the minimum compensation they would demand to endure the corresponding declining sequence (counting, ice water, shock).

[7] Though the two frames were next to each other, and respondents were free to consider both before responding to either, there was, nevertheless, a significant order effect ($\chi^2 = 6.17$; $p < 0.05$) suggesting some tendency to coordinate on their first response. If the "pricing" frame was first, 76% (51/67) indicated they would pay more for the declining sequence, but if the "choice" frame was first, this fell to 56% (41/73).

Among those choosing between sequences, 73% preferred the improving sequence over the declining sequence (χ^2=15.02; p<0.001). However, the two sequences were not priced differently, either in this study, or in a follow up study (N=150), conducted at Carnegie Mellon University, in which each respondent priced *both* the improving and declining sequences (with order counterbalanced).[8]

4.1.4 Study 2d. Eating three ounces of ketchup: choice vs. compensation demanded

Participants in this study were 242 Boston residents preparing to watch the 4th of July fireworks display who were recruited to fill out a twelve page survey in exchange for a lottery ticket or ice cream bar. The second page of the survey depicted the scenario below, along with a photo of a three-ounce plastic cup.

Suppose that a professor researching disgust is paying people to eat three fluid ounces of Heinz ketchup. (This is exactly six level tablespoons, and would fill the cup shown below, which is drawn to scale.) Those who sign up for the study will be paid today, in cash. (However, participants must provide a bank account number, and their payment will later be deducted if they fail to complete the study at the scheduled time.)

If you signed up for the study, when would you prefer to eat the ketchup?

Later today	Tomorrow	3 months from today

Respondents were randomly assigned to either a choice group (N=119), in which they indicated when they would prefer to eat the ketchup (as shown above), or to a pricing group (N=123), in which they indicated how much they would demand to eat the ketchup at each of those three times (e.g., "If I had to each the ketchup *later today*, I would do it for as little as $_____, but no less.").

The two elicitation procedures implied very different preferences. In the choice group, 81% preferred to eat the ketchup today rather than later, yet in the pricing group only 14% of demanded *less* compensation to eat the ketchup today than on the two later dates.[9] This pronounced preference reversal was preserved if those who demanded the same compensation for the three possible times were excluded from the analysis: although respondents overwhelmingly preferred to eat the ketchup today, most who priced the sequences differently demanded *more* money to eat it today.[10]

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[8] The median compensation demanded was $30 in the separate pricing study conducted at Princeton, and $50 in the joint pricing study conducted at Carnegie Mellon. In the joint pricing study, 16% demanded more for the improving sequence, 19% demanded more for the declining sequence, and 65% demanded the same compensation for both. The higher compensation demanded by Carnegie Mellon students does *not* appear to be due to the difference between joint and separate pricing. The median values using separate evaluation were also higher at Carnegie Mellon, and by roughly the same amount.

[9] We omitted seven respondents from this analysis: four who were willing to eat that quantity of ketchup for free and three who demanded a million dollars, which we interpreted as a protest response.

[10] The ketchup question was followed by a ten-item IQ test, which included four items from the Raven's Progressive Matrices Test, the three items constituting the Cognitive Reflection Test (Frederick 2005), and three other similar items. Notably, the preference reversal was just as marked for "smart" respondents—the 52% (129/248) who scored a "5" or higher. Intriguingly, within the choice group, the ninety-six respondents who chose to get the ketchup eating over with scored significantly higher than the twenty-three respondents who chose to delay it (4.81 vs. 3.39; $t(117) = 2.62$; $p = 0.01$).

5 Discussion

In four studies, we found no evidence of preference for improving sequences in pricing—responses indicate either that temporal ordering makes no difference, or a preference for declining sequences: for accelerating rewards (e.g., dinners) and postponing "debts" (e.g., agreements to eat disgusting quantities of ketchup).

How should such results be reconciled with prior evidence—which we replicate here—that people prefer improving sequences in choice tasks (e.g., Chapman 2000; Frank and Hutchens 1993; Hsee et al. 1991; Loewenstein and Prelec 1991, 1993; Loewenstein and Sicherman 1991). We suggest that when respondents evaluate various numeric or graphical representations of sequences (say, sets of bar graphs representing annual salaries over the coming 6 years) they encode only the most basic features of those stimuli—that some go up and some go down. At that superficial level of analysis, the conceptual superiority of improvement over deterioration is sufficient to generate a considerable "preference" for improving sequences. The limits of this preference are revealed when evaluations are conducted using procedures which provide alternative perspectives and lay bare other considerations. For example, the matching procedure in study 2a effectively forced respondents to consider the tradeoffs entailed; to answer the question: "How many additional *future* dollars would compensate for getting 1,000 fewer *current* dollars?"

6 Conclusions

The time preference literature is often summarized as a list of stylized facts (e.g., people are impatient, discount functions are hyperbolic, people prefer improving sequences). This characterization falsely suggests the existence of a small set of robust psychological phenomena which measurement procedures merely record. In reality, many of the widely-cited, stylized "facts" remain facts only by virtue of an unwitting convergence in research methodologies. Those studying time preferences should use more diverse measurement procedures and devote more attention to the question of how respondents resolve inconsistencies among them. The correct characterization of someone's "true preference" should surely reflect how that person orders competing goals and not just the relative accessibility of specific goals given some specific task representation—particularly since the chosen procedure may increase the accessibility of *irrelevant* perspectives. Explicitly pairing two events as part of a sequence encourages respondents to consider interactions between those events and invites them to imagine emotions they may not experience. It seems unlikely, for example, that someone consuming their foie gras would think "Wow, this French dinner is really great compared to that dinner I ate at home thirty days ago."[11]

[11] People tend to select diverse snacks when scheduling successive consumption events that are spaced far apart (Simonson 1990), but this effect is diminished if respondents are reminded of the large interval between the experiences (Read and Loewenstein 1995). Indeed, even when contrast effects are more plausible, they are not always found. For example, Williams (1942) measured the liking of a series of ten 3-minute classical musical selections and found no influence of the selection which immediately preceded them. Similarly, Ratner et al. (1999) found that people did not derive more enjoyment from listening to an average song when it followed a less preferred song than when it followed a more preferred song and Novemsky and Ratner (2003) found that respondents who consumed two jellybeans in a row expected, but did not experience, contrast effects.

Like others (e.g., Liberman et al. 2004), our findings suggest that respondents possess a variety of cognitive schemas, each of which can be evoked or suppressed by subtle contextual features. Thus, we believe that the major challenge for decision researchers lies not in honing parametric specifications, but in acquiring a broader understanding of the varied constituents of preferences and the problem representations that bring them to the fore.

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