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The Psychology of Intertemporal Discounting: Why are Distant Events Valued Differently from Proximal Ones?

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Abstract

Research in intertemporal choice has been done in a variety of contexts, yet there is a remarkable consensus that future outcomes are discounted (or undervalued) relative to immediate outcomes. In this paper, we (a) review some of the key findings in the literature, (b) critically examine and articulate implicit assumptions, (c) distinguish between intertemporal effects arising due to time preference versus those due to changes in utility as a function of time, and (d) identify issues and questions that we believe serve as avenues for future research.

Introduction

Intertemporal choice refers to a choice between options whose consequences occur at different points in time. Examples of intertemporal choice include: Receiving $10 today, or $12 in a week, choosing between chocolate cake and fruit for dessert, saving versus spending money now, promising to write a journal article or teach an extra course in the next academic term, choosing a major in college, and deciding whether to smoke a cigarette. In each of these cases, a decision maker needs to trade off the utility (or value) of one outcome that is temporally proximal (typically immediate) with another one that is temporally distant. In the examples above, the proximal outcome is $10, the taste of the chocolate cake, or the happiness derived from current spending; the distant outcome is $12, the health consequences of eating rich foods, or the hardships associated with not saving enough for a rainy day. In the terminology of intertemporal choice, the temporal distance between an immediate and later outcome is referred to as the "delay".

Given the definition of intertemporal choice proposed above, it is evident that most—if not all—choices that individuals and organizations make in the real world are intertemporal. However, while past studies cover a wide range of choice situations, there is a remarkable consensus in the literature that future outcomes are discounted (or undervalued) relative to immediate outcomes. Put differently, an identical (positive) outcome will become increasingly attractive the closer it is located in time to the time of decision-making.

There is, however, much less consensus about the psychological antecedents of intertemporal discounting. Why are future outcomes not as valuable as present outcomes? What implications does this have for future researchers in the area of intertemporal choice? What are some of the key questions and directions in which the work in this area can be extended? These are some of the questions we address in this paper.

The rest of this paper is organized in three sections. First, we briefly review some of the key ideas in the vast literature on intertemporal choice and articulate the vocabulary used in the field. Second, we delve into a discussion of the antecedents on discounting, and make a distinction between (a) discounting caused by changes in utility as a function of time, and (b) pure time preference, that is, the desire to not delay consumption. Finally, we identify and discuss issues and questions that we feel researchers in this area should explore in greater detail.

1. The Vocabulary and Findings of Research on Intertemporal Choice

1.1. The Vocabulary

The dominant normative model in the literature is the discounted utility model (Samuelson, 1937), in which present utility is simply the weighted sum of discounted instantaneous values over a given time horizon. Past research used two terms to capture the degree of discounting; the discount rate (typically denoted by r), and the discounting factor (typically

denoted by δ). To illustrate how these terms are calculated, consider a standard experimental paradigm that measures indifference between outcomes (typically money) spread over time. Subjects are given a dollar outcome ($\$x_1$) that occurs at an earlier point in time (t_1). They are then given a second, later point in time (t_2) and asked to indicate the dollar value they would like to receive at that time so they would be indifferent between the two dollar-time combinations.

Then, if $(x_1, t_1) \approx (x_2, t_2)$, and the interval between t_1 and t_2 is represented by d, the discount rate and the discounting factor can be calculated through the following relationships:

$$u(x_1)(1 + r)^d = u(x_2) \quad (1)$$

$$\text{Also } u(x_1) = u(x_2)(\delta)^d \quad (2)$$

Larger values of r and smaller values of δ represent a greater degree of discounting.

1.2. The Pervasive Devaluation of the Future

Research on intertemporal choice (e.g., Ainslie, 1992; Akerlof, 1991; Mischel and Staub, 1965; Thaler, 1981) includes numerous demonstrations of the "pervasive devaluation of the future" (Ainslie and Haslam, 1992, p. 59). Specifically, there is evidence to support the notion that the value of both future costs and benefits is smaller than their value in the present (for reviews, see Ainslie and Haslam, 1992, Frederick et al., 2003). Thus, individuals are willing to accept a small sum of money today in exchange for a larger sum in the future (Thaler, 1981), individuals are willing to purchase cheaper air conditioners with higher future operating costs instead of more expensive units that are cheaper over their lifetime (Hausman, 1979), and individuals almost always underestimate the effort involved in doing tasks as trivial as mailing a package for a friend (Akerlof, 1991) or cutting, filling and mailing a rebate coupon (Soman, 1998). In all these cases, the value of the future consequence (money, time or effort) appears smaller when viewed in the present.

From an economic perspective, the discounted utility function handles intertemporal tradeoffs with elegant simplicity, with the δ in equation (2) accounting for the loss in value due to time. However, the literature also documents numerous findings that challenge the descriptive accuracy of this model. One major challenge comes in the form of dynamic inconsistency. As an example, Kirby and Herrnstein (1995) offer subjects a choice between a small-but-earlier reward and a larger-but-later reward. After showing a preference for the small-earlier reward when offered immediately, they then added a delay to both outcomes such that the temporal interval between them was maintained. Subjects typically switched to the larger-later outcomes, even for very small amounts of added delay. A similar preference shift occurs when individuals approach a set of outcomes in time. An individual, for example, might prefer a larger-later reward to a smaller-earlier reward when they are both one year away, but when they get temporally close to the smaller-earlier outcome, it looms large and they switch their preference (Ainslie and Haslam, 1992; Hoch and Loewenstein, 1991; Read and van Leeuwen, 1998; Rook, 1987; Strotz, 1955).

One family of discount functions that was proposed to explain dynamic inconsistency is known as hyperbolic discounting (Mazur, 1987), and is represented by:

$$v_t = V/(1 + kt) \tag{3}$$

where t is the delay and k is a constant discounting parameter representing the degree of discounting. The magnitude of the k parameter plays a big role in determining the temporal profile of the discounting function (Soman, 2004). In addition to hyperbolic functions, another family of models of this bias towards the present is referred as quasi-hyperbolic discounting functions (e.g., Laibson, 1997; O'Donoghue and Rabin, 1999; Zauberman, 2003). These quasi-hyperbolic models are such that more weight is given to outcomes in the first period compared to all subsequent periods, and this overweighting increases as the first period draws nearer.

Other sets of findings cause problems for the standard discount utility model. In particular, a vast body of research on the discounting of single outcomes suggests that the discount rate is not stable, but appears to vary as a function of several contextual factors. The magnitude effect suggests that the discount rates are higher for smaller dollar amounts relative to larger ones (cf. Kirby, 1997). The direction effect suggests that the discount rate obtained by increasing delay to an outcome is greater than that obtained by reducing the delay (Loewenstein, 1988). The sign effect suggests that discount rates are lower for losses than for gains (Thaler, 1981), although there have been demonstrations of the reverse effect as well (see Read, 2004 for a review). The delay effect suggests that the discount rate is smaller for larger delays (Thaler, 1981). And the interval effect suggests that the discount rate depends on the time interval between the two outcomes used to impute the discount rate–the greater the temporal interval, the smaller the discount rate (Read, 2001).

1.3. The Discounting of Mixed Outcomes

While much of the early literature on human intertemporal discounting behavior used monetary outcomes, recent research has started looking at the discounting of non-monetary and mixed outcomes. For example, researchers have tried to understand time discounting of health outcomes (see Chapman, 2003) and found that many of the effects demonstrated with money persist in the domain of health. Similarly, other researchers have studied delayed discounting in the domain of addictive substances (Bickel and Johnson, 2003).

Researchers have recently also started investigating the discounting of mixed outcomes—outcomes that have both a gain and a loss component. Soman (1998) studied monetary incentives offered for the completion of effort (e.g., consumers completing the effort of redeeming a mail-in rebate in exchange for cash, professors committing to teach an extra class for additional compensation); situations with a monetary gain and a loss of effort. His results show that when the mixed outcome is in the future, it appears to be more attractive than when the same outcome is closer in time, suggesting different discounting profiles for effort and money. Figure 1 uses hyperbolic discounting to show why such reversals of preference occur as a function of time. In this figure, the reward (R) is

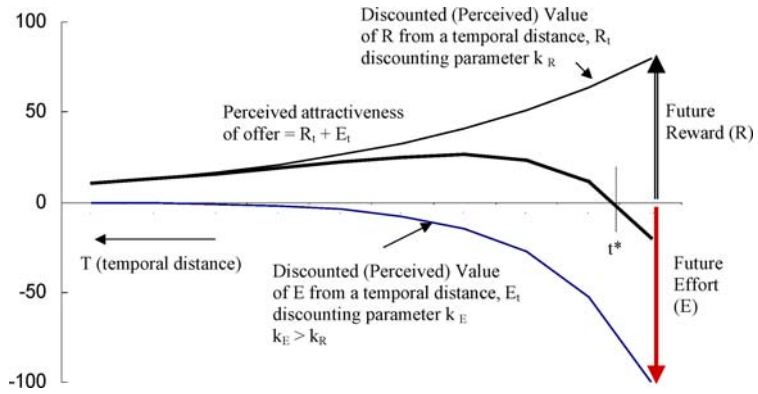

Figure 1. Hyperbolic discounting of money and effort (source: Soman, 2004) *NOTE*: Hyperbolic discounting lines are generated by using the equation $R_t = R/(1 + k_R t)$ and $E_t = E/(1 + kE_t)$, where R_t and E_t represent perceived (discounted) values of R and E respectively at a temporal distance of t. In the above graph, t is increasing towards the left. The think line represents the perceived attractiveness of the offer at time t.

represented by positive quantities and effort (E) by negative quantities. Discounted values of R and E at any given point in time are captured by the hyperbolic functions plotted on the figure, and the solid line represents the sum of these quantities. Since the k parameter for effort E is greater than that for R, the figure shows why a transaction that looks unattractive from temporally proximity, looks attractive when viewed from a temporal distance. These results are consistent with temporal construal theory (e.g., Trope and Liberman, 2003). Simple experimental manipulations in which subjects are asked to expend effort prior to making choices can actually weaken this effect (Soman and Liu, 2004). Note that this "illusion of delayed incentives" (see Soman, 1998) is a form of dynamic inconsistency.

A similar illusion of attractive future transactions has been documented by Zauberman and Lynch (2005). They make the observation that most individuals believe that they will be less busy on a given day in the distant future than they will be in the present. Their resource slack model predicts that for transactions involving money and time, individuals overestimate their future resource availability (slack), and underestimate their constraints to a much greater degree for time relative to money. Hence, as they approach the event, time becomes relatively more scarce than money and carries a higher value, resulting in a reduced attractiveness of the transaction with time. Zauberman and Lynch (2005) demonstrated that the relative gain or loss of slack overt time can explain the rate of discounting for time and for money, as well as the extent of hyperbolic discounting.

1.4. Impulsivity and Self Control

As noted earlier, findings of dynamic inconsistency suggest that while individuals might make well-reasoned and prudent choices for the future, the temporal proximity to the stimuli

often leads them to impulsively switch from their earlier selection. This behaviour has often been represented by using models of multiple selves. For instance, the farsighted decision maker who prefers the larger-later reward in the future is referred to as the "planner," while the impulsive self within us who falls prey to temptation is referred to as the "doer" (Thaler and Shefrin, 1981). Similarly, Metcalfe and Mischel (1999) refer to the two selves as the hot and cool systems, and Ainslie (1992) discusses a family of multiple selves, and models individual decision making as a game of strategic bargaining among these multiple selves, each embedded within a point in time.

O'Donoghue and Rabin (1999) have argued that individuals are sophisticated, yet dynamically inconsistent. Put differently, they are aware of their inconsistency, but are sophisticated to try and control this problem. Decision makers often attempt to avoid succumbing to temptations, from the mythical Ulysses who had himself tied to the mast of his ship so that he could sail past the Sirens (Elster, 1979), to the consumer who freezes her credit cards in ice to minimize her chance of using them impulsively (Rook, 1987). Note, however, that we need to use caution about assumptions that require foresight of these intertemporal forces. Descriptively, these assumptions is inconsistent with findings on consumer mis-prediction and the "hot-cold empathy gap" (e.g., Loewenstein, 1996).

The need to impose self-control exists in most individuals due to a conflict between short-term and long-term consequences of options. In the marketing literature, Wertenbroch (1998) defines products offering positive consequences in the short term (e.g. the pleasure from eating chocolate cake) but negative consequences in the longer term (e.g., bad health) as "vices." Conversely, "virtues" are products offering positive consequences in the long term (e.g., good health on eating vitamins) but negative consequences in the short term (e.g., the bitter taste of the pill). Because individuals are myopic, they over-emphasize short-term benefits relative to long-term benefits. Without formal self-control devices, such individuals may over-consume vices and under-consume virtues (Schelling, 1984; Wertenbroch, 1998). Formal self-control devices have been referred to as "personal rules" or "pre-commitments" in the literature (Ainslie, 1992; Strotz, 1955; Thaler and Shefrin, 1981), and essentially entail a cost that the planner imposes on certain behaviours that the doer might engage in.

2. Interpreting the Results of Choice Experiments

While the notion of discount functions is a handy and elegant means of modelling intertemporal choice, we step back and address three key issues in this vast body of research. First, we revisit the experimental paradigm used to measure discounting and critically examine the underlying assumptions and whether these assumptions are valid. Second, we ask the question—is there a true individual specific, discount rate? Or is the discount rate a researcher's label of a preference that is constructed in response to a decision task? Third, we discuss issues of pure time preference vs. changes in the utility function, and use Freud (e.g., 1933) "horse and rider" metaphor to decompose intertemporal choice effects into these two categories.

2.1. Assumptions Made in Intertemporal Discounting Experiments

As discussed earlier, a typical experiment to measure intertemporal discounting asks a participant to indicate the $\$x_2$ that should occur at time t_2 that would make this outcome indifferent to $\$x_1$ received at time t_1. Once the indifference point is obtained, the researcher fits equations (1) and (2) to estimate a discounting rate (r), or the discounting factor (δ), respectively. Discount rates and factors obtained in this fashion can only be interpreted under the following assumptions (see also Read, 2004):

(a) Both the present and delayed outcomes occur with certainty: It is reasonable to expect this assumption to be violated in several situations. In particular, while immediate outcomes may presumably be certain (the decision maker can see, feel, or saliently experience the outcome), there might be a number of uncertainties associated with the future. These might be associated with the outcome (e.g., there is no guarantee that the experimented will pay me one year from now), or with the individual (e.g., I may not even be around to collect the money). Research shows that adding uncertainty to future outcomes can increase discounting (Benzion et al., 1989).
(b) All outcomes are consumed immediately: Given that the equations treat x_1 and x_2 as point outcomes, occurring at t_1 and t_2 respectively, the underlying assumption is that there are no consequences of these outcomes at any other points in time. This simplifying assumption is particularly problematic, since it is difficult to identify a consumption episode where all resulting consequences are limited to the moment of consumption.
(c) The outcomes are context independent. As a simple example, consider an individual who expects his income to increase with time. For this individual, the future outcome evaluated in the context of his future wealth may indeed carry a lower utility than the present outcome evaluated in the context of his present wealth. Further, this assumption also implies that individuals ignore opportunity costs associated with the outcomes. This assumption is clearly problematic.
(d) The utility of the outcome (x) is multiplicative in x. In other words, the function linking $u(x)$ to x is linear. Of course, a large body of research in judgment and decision-making shows that this may be a very restrictive assumption.
(e) Utility from outcomes is timing independent. Expressed more formally, this assumption states that $u(x_1)$ is independent of when it occurs. Read (2004) provides some simple examples to show that this assumption is also problematic—ice is more valuable in the summer than winter, and a blanket is more valuable in the winter than in summer.

The above suggests that the interpretation of imputed discount rates and discount factors in the typical intertemporal choice study may not be justified. In fact, the rates follow a specific continuous functional form imposed by the researcher, often based on a relationship between two discrete points in time. We reinforce the recommendation (Read, 2004) urging researchers to (a) focus more attention on the assumptions, (b) ensure that they are satisfied before interpreting the data in terms of discount rates, and (c) if the assumptions are not

justified, to minimize their effects in the best possible manner, and (d) to be cautious about the interpretation of the results.

2.2. *Is There a True Discount Rate?*

Is there a true, individual specific discount rate? A meta-analysis by Frederick et al. (2003) shows that the imputed discount factor δ varies widely across experimental studies, across individuals, across choice domains and across time. Thus, Figure 2, reproduced from Frederick et al. (2003) shows imputed δ's based on data from a large number of studies done from 1978 to 2002. Frederick et al. (2003) highlight three noteworthy observations—first, that there is considerable variation in δ, with the equivalent annualized discount rates ranging from -6% to infinity. Second, there is no evidence of methodological progress in that the range of estimates does not seem to be shrinking with time. And third, high levels of discounting predominate.

This analysis, in conjunction with the earlier discussion on the five assumptions leads is to the crucial question of what exactly is time preference. Noting the "spectacular disagreement among dozens of studies," Frederick et al. (2003, p. 61) argue that the lack of a singular δ might be caused by the fact that researchers typically confound pure time preference (as manifested by impatience, and defined by how the decision-maker values the present relative to the future for an identical outcome) with a whole host of other factors that change the utility of the outcome as a function of its temporal location. These factors might include uncertainty, opportunity costs (Zauberman and Lynch, 2005), utility from anticipation and dread (Loewenstein, 1988), contrast effects, and changes in taste (Frederick, 1999).

One prominent psychological theory consistent with the notion that time changes the utility of an outcome—and hence creates intertemporal effects—is the temporal construal

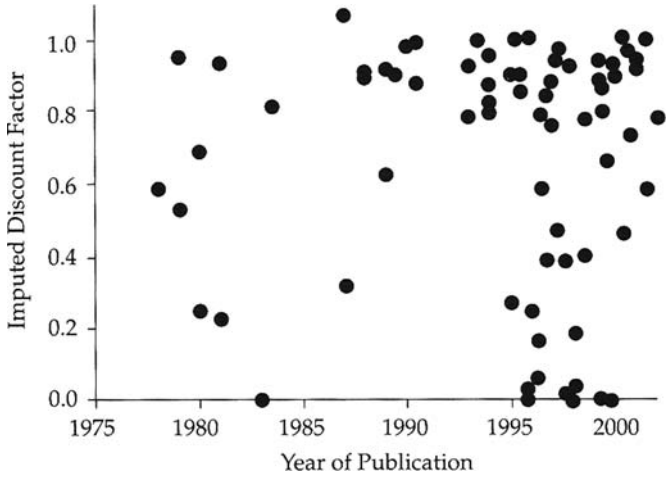

Figure 2. Discount factor by year of study publication (source: Frederick et al., 2002).

theory (Trope and Liberman, 2003; Liberman and Trope, 2000). The central tenet of the theory is that attributes of the choice options vary in their level of centrality to the option, with high-level attributes relating to the goal underlying the option, and low-level attributes relating on more concrete tasks needed to attain the goal. For example, a task like "learning a new language" might be associated with high-level attributes like the joy of learning, the ability to enhance communication skills, and to be exposed to a broader range of communications and cultures. However, there are also low-level attributes associated with this task; e.g., going to classes, mastering a new script, and memorizing rules of grammar. According to temporal construal theory, the cognitive representation (construal) of delayed outcomes is dominated by high-level attributes, while the construal of immediate outcomes is dominated by low-level attributes. Hence, an option that is rich in high-level attributes but poor in low-level attributes (e.g., the benefits of learning a new language given the tedious efforts required to learn it) will appear very attractive from a temporal distance, but unattractive from temporal proximity.

A second theory that influences the utility of the outcome as a function of time is the resource slack theory (Zauberman and Lynch, 2005) discussed earlier. According to this theory, the opportunity costs associated with spending time increase at a greater rate than the opportunity cost associated with spending money, resulting in a change in the utility of a mixed outcome (involving money—time tradeoffs) as a function of time.

2.3. The Horse and the Rider Metaphor

Building on Freud's "horse and rider" metaphor, we use the horseman analogy—a rider controlling an untamed beast—in order to develop a vocabulary for thinking about the relative effects of utility and time preference. Imagine that an observer in an equestrian event sees a rider on a horse move from one point to another. Two separate forces can result in an identical displacement, the first force is the natural tendency of the untamed animal (e.g., Loewenstein, 1996), and the second is the rider's skill and control over the animal. Merely observing the net displacement does not allow an inference about either the tendency of the horse (impulsive drives) or the skill of the rider (deliberative tradeoffs), since a very large number of combinations of the two could have conspired in producing the same observed displacement.

Because of the need to isolate the distinct effects of impulsive drives (e.g., Loewenstein, 1996) and more deliberative cognitive factors (e.g., Trope and Liberman, 2003; Zauberman and Lynch, 2005), experiments should not simply try imputing a discount factor from the observed choices. Rather, experimental design should offer the same choice while manipulating a factor that is hypothesized to influence time preference. This procedure allows the rider to stay on the horse, while manipulating factors that influence the tendency of the horse (but not the rider).

Examples of such approach are provided by Ariely and Loewenstein (2004), Li (2005) and Wilson and Daly (2003). Li (2005), for example, offered subjects choices between several pairs of options, one of which was a smaller-earlier reward and the other a large-later one. Across several conditions, she exposed subjects to an array of stimuli, ranging from pictures

of tempting desserts and attractive women, to the mere presence of the scents of cookies and popcorn in the experimental room. Results show that all else held constant, exposure to appetitive stimuli changes time preference by shifting choices towards the smaller-earlier reward.

3. Looking Forward: More Questions

After reviewing current literature, we suggest that intertemporal choice research is at a crossroad. While we believe that a great deal has been done in terms of documenting intertemporal discounting effects, future efforts need to focus on (a) disentangling the effects of time preference from changes in utility, (b) understanding the psychological antecedents of both time preference and utility changes, and (c) developing richer, descriptive and fertile models that explain intertemporal choices. In the first two sections of this paper, we have offered a number of recommendations and words of caution for researchers in this area. In this section, we offer additional food for thought and write about issues we feel are worthy of future investigation.

3.1. Normative Behaviour in Intertemporal Choice

When offered a choice between a smaller-earlier and a large-later reward, what should an individual normatively choose? When the outcomes are monetary, and all the five assumptions in Section 2.1 have been satisfied, the normative criterion is based on Irving Fisher's assertion that "rational decision makers will borrow or lend so that their marginal rate of substitution between present and future money will equal the market interest rate." In other words, discount rates that exceed the opportunity cost of capital represent irrational behaviour—a mistake (Read, 2004).

Using this approach in determining normative behaviour quickly falls apart for non-monetary outcomes. Since there is no direct intertemporal market for goods like effort, skills, consumer products, and social events, the normative behaviour in such situations is debatable. However, there is one—albeit imperfect—indicator. Given O'Donoghue and Rabin's assumption of dynamically inconsistent, yet sophisticated consumers, we can infer that an individual has a self control problem if we do observe an attempt to impose self control, say via precommitment (Ainslie, 1992; Wertenbroch, 1998). However, sometimes the imposition of self-control can be an automatic behaviour, so caution should be taken in making this interpretation too strictly.

3.2. The Real Self

Research shows that our vision of the world depends on our temporal perspective. When individuals are temporally distant from an outcome, they construe it at the high-level. When they are temporally close, they tend to see the details and focus on the low-level attributes. And after the outcome, when individuals look back retrospectively, research

suggests that they have biased recall and tend to remember mixed outcomes as more positive than they were when actually experienced. If individuals are indeed a bundle of multiple temporal selves, a key philosophical question relates to which of these is the real self, and which represent biases? Does reality correspond to what the individual anticipates, to what s/he experiences, or to what s/he recalls? More interestingly, what is happiness and well-being driven by? Related to the points above, one indicator is whether, in retrospect, people's preference is aligned with their earlier preference or their actual decision. Beyond speculation, we found no research that addresses this key question.

3.3. δ

Assuming that we can disentangle time preference from the other factors that can lead people to devalue future outcomes, is there really an individual specific discount factor δ? Are these time preferences hardwired, or are they a function of context? Are they retrieved or constructed? Do individuals learn, and therefore is there a temporal pattern to δ? Finally, does it make sense to think of discount factors for groups, or even larger collectives (like nations)? For instance, newspapers and newsmagazines comment that some emerging nations like China and Mexico have such a strong desire to make progress in the present that they consume resources at a rate that is detrimental to future progress. Do these nations display high discount rates and low δ's? These are intriguing questions that admittedly have imperfect (or no) answers in the present.

3.4. The Perception of Time and Intertemporal Decisions

We discussed several alternate psychological accounts that might be used to explain intertemporal choice behavior. One particularly intriguing account has to do with the perception of time, and in particular, how the perception of time in the present can influence discounting behavior for delayed outcomes. Past research has generally examined elapsed duration and shown that individuals retrospectively overestimate the duration of an elapsed interval (e.g., Hornik, 1984). Block and Zakay (1997) provide an attention based account for time estimation. Researchers have also attempted to uncover strategies for reducing the negative effects of the perception of time. For instance, Katz et al. (1991) found that distractions during the waiting period (e.g., a newsboard or television) made the wait more palatable, and that "filled time" and "fun" made time move faster. We propose additional factors that we believe will influence perceived time—mental engagement, perceptions of progress, and cultural factors.

We believe that an understanding of the perception of time should be a critical factor in understanding intertemporal discounting. There are two key questions of interest. First, should the delay in the discounting function be measured by clock time, or by perceived time? Second, if it is perceived time, is it the current perception of time that drives perception of the delay? In a preliminary experiment, Soman and Liu (2004) find that intertemporal choice can be influenced by the tempo of the music that subjects hear as they wait for the experiment.

Looking into how sensitivity to prospective duration influences intertemporal choice, Zauberman et al. (2005) find that people are not sensitive to the prospective time horizon of a given stream of events, but are very sensitive to frequency cues that occur over that duration. They demonstrate that participants attend more to frequency cues than to the time horizon (Experiment 1), and that participants only incorporate duration into their decisions when it is made accessible: When duration is primed, preference are less similar between short and long time horizons (Experiment 2) and hyperbolic discounting is reduced (Experiment 3). However, additional work is needed to understand how perception of time is incorporated into intertemporal decisions.

3.5. Utility from Anticipation

Another stream of research that demonstrates intertemporal effects by changing the utilities of the outcomes is the research on the evaluation of sequences (see Ariely and Carmon, 2003 for a review). For instance, Loewenstein and Prelec (1991) show preference for an improving sequence over a declining sequence of the same ingredient outcomes, suggesting negative discounting. Although some of these findings might be due to contrast effects which make the later outcomes seem better in the improving sequence, they also reflect an increase in utility from anticipation (Loewenstein, 1997), which is enhanced by delaying the best outcomes to the end. When studying the drivers of subjective well-being (e.g., Kahneman, 1999), the idea of utility from anticipation and how retrospective utility is formed are critical. However, in this paper we focused mostly on factors that might lead to devaluation of future outcomes. Yet we acknowledge that future efforts to provide a descriptively accurate account of intertemporal preferences need to take these factors into account.

3.6. Richer Models

Despite its elegant simplicity, we believe that the standard discounted utility model is merely a paramorphic representation; an "as if" model. Given the richness of the phenomena we are trying to capture, we recommend that the field develops bottom-up models that do not start with the assumption of a single self. We envision that these models are characterized by the presence of multiple selves that (a) have different representations of the same object, (b) have differing utilities for the outcomes, (c) are weighted differently over time to capture discounting, and (d) have a diversity of outlook, yet a unity of rewards!

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