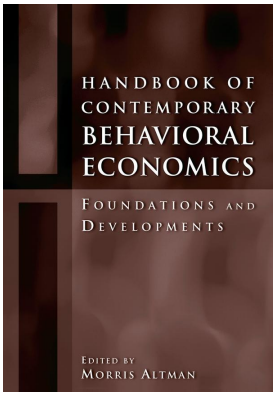

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Discounting, Self-Control, and Saving

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CHAPTER 15

DISCOUNTING, SELF-CONTROL, AND SAVING

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Establishing the causes of saving has occupied scholars since Aristotle (384–322 B.C.), who considered whether the accumulation of wealth was laudable or objectionable. In the two past centuries in particular, household saving has been subject to extensive theoretical and empirical research. This is due, in part, to its increasing importance for national economies. In spite of this we only have a partial understanding of households' motivations for saving. We know some variables that might be used as predictors for household saving, such as income and age, but the underlying psychological processes governing the choice between saving and spending are still not well understood.

Saving or dissaving during a period of time is a product of several decisions of varying significance, such as whether to buy a cheap or expensive product, whether to spend now or later, and whether to borrow or save. Saving is a result of continuous intertemporal decisions, where outcomes (payments and consumption of goods) appear at different points in time. When studying saving we have to assume that consumers have some awareness of their overall economic situation when they make spending or saving decisions and also some expectations about their future economic situation. We must also assume that they make a judgment of the consequences of the decisions and that some factors will play a part across the majority of these decisions. Studies of saving involve identifying such factors. Only these factors will serve as useful determinants and predictors of saving over extended periods and have a potential for being useful for analyses at the aggregate level.

In this essay, we will review research on two of the psychological concepts that have been considered important in the savings literature: time preference and self-control. First we will briefly review the ideas of the creators of the concept of time preference to explicate the psychological processes assumed to govern intertemporal decisions. We will then proceed to review the findings from empirical tests of time preference and its determinants. Next we will discuss the consequences of hyperbolic discounting and the role of self-control before we examine the empirical findings concerning the relationship between saving and time preference. After that we will review and evaluate the saving models that incorporate hyperbolic discounting and self-control. Finally, we will discuss challenges for future research and suggest some concepts that can serve as alternatives to time preference.

THE CONCEPT OF TIME PREFERENCE

The first models of saving focused on the intertemporal choice between consuming now or later and on factors that may influence this choice. Although several economists in the nineteenth century had discussed similar ideas, Böhm-Bawerk (1889) and Fisher (1930) are considered the creators of the concept and theory of time preference.[1] They were concerned with why interest

rates exist and how they are formed. They tried to answer the question of why people want rewards for saving money by lending it to others and why they are willing to pay compensation in order to borrow money. The core of their theories is the trade-off between spending and investing, the choice between immediate enjoyment and possible greater deferred enjoyment. By focusing on this intertemporal dilemma, they point to a central problem of human life: giving up immediate pleasures in order to obtain long-term goals. They recognized that saving and investing are results of how people handle this intertemporal conflict.

Fisher introduced the concept of time preference, which he explains as reflecting a person's impatience for consumption. In his model, time preference is an important determinant of saving. He formally defined the rate of time preference (also called the subjective discount factor or the rate of impatience) as "the (percentage) excess of the *present* marginal want for one more unit of *present* goods over the *present* marginal want for one more unit of *future* goods" (1930, 62). The rate of time preference is a derivative of marginal desirability, that is, the preference for present over future goods. With this definition, Fisher also stressed the importance of discounting, as it is the *present* want for future goods that is assumed to form the basis for decisions. Future costs or benefits must be discounted into present equivalents in order to enable meaningful comparisons and choices.

Fisher's theory of time preference included factors that will explain differences both between *and* within individuals. Individuals may have different discount rates in different situations or at different points in time. These individual differences are seldom included in economic models of intertemporal choice, as Fisher suggested that they would be harmonized in the capital market. He argued that at the macro level, the real interest rate reflects the aggregate time preference of all individuals in the society. People who derive high utility for increased consumption and therefore are impatient to spend (that is, who have a high rate of time preference) will borrow money from those who are less impatient (who have a lower rate of time preference). He also assumed decreasing marginal utility from consumption. For each extra unit the impatient people could consume, the lower the marginal utility for extra consumption and the less compensation they would be willing to pay in order to consume even more. This was illustrated with the following demand schedule:

> For each successive one hundred dollars added to his present income, assuming that income is stable and certain, a certain prospective borrower is willing to pay out of next year's income, as follows:
>
> For the first $100, $120, with an impatience rate of 20%.
> For the second $100, $115, with an impatience rate of 15%.
> For the third $100, $110, with an impatience rate of 10%.
> For the fourth $100, $106, with an impatience rate of 6%.
> For the fifth $100, $105, with an impatience rate of 5%.
> For the sixth $100, $104, with an impatience rate of 4%. (Fisher 1930, 97)

Likewise, the less the patient people consume in the present, the higher the marginal utility for extra forgone consumption and the more compensation they will demand in order to give up further consumption. Consequently, in a perfect capital market with no liquidity constraints, the process of lending and borrowing will continue until the compensation offered and the compensation demanded for extra units of consumption are equal. That is, it will continue until every person in the society has the same marginal rate of impatience. This process of harmoniz-

ing rates of time preference, which show the opposing forces between the motivation to spread consumption over time due to diminishing marginal utility and the motivation to concentrate consumption in the present due to a positive time preference, describes the formation of the interest rate in a society. At the macro level, the aggregate degree of impatience of all individuals determines the rate of interest. At the individual level, the relationship is opposite. For individuals (each having a negligible influence on the market interest rate) the interest rate will be fixed, and it is their individual rate of impatience that varies and determines their tendency to lend or borrow. A person is assumed to harmonize his or her rate of time preference with the market interest rate. Therefore, the real interest rate in the market is often used as a proxy for time preference. This rate is therefore also considered to represent all the different motives underlying intertemporal choice. The same rate of time preference is assumed to apply to all forms of consumption.

Fisher also formulated his theory in mathematical terms. In the part of his 1930 book that is devoted to this, little of the psychological insight that characterized the first part of the book is on display. The assumptions about the formation of the market interest rate as described above are taken for granted, so the economic models of intertemporal choice rely on the assumption of the individual rate of time preference being equal to the market real interest rate. Thus, intertemporal choices can be described by using the apparatus of indifference curves (or Fisher curves).

Fisher's theory of interest (as formulated in the stylized mathematical version) formed the basis for the discounted utility (DU) model, which was formally developed by Samuelson (1937), Koopmans (1960), Lancaster (1963), and Fishburn and Rubinstein (1982). This model, built on strict axioms concerning preferences and utility functions, describes how rational individuals with rational preferences will distribute consumption between the present and the future. Although even the inventors of the DU model realized it lacked mundane realism (see Frederick, Loewenstein, and O'Donoghue 2002; Loewenstein 1992), the model has been the most powerful tool to date for analyzing intertemporal decisions, including saving decisions.

EMPIRICAL RESEARCH ON TIME PREFERENCE

In the past decades, empirical research has found that the DU model is a poor descriptor of intertemporal choice. First, the general conclusion that can be drawn from numerous empirical studies is that the assumption that all individuals have the same time preference is not supported. This has been demonstrated in studies using hypothetical choice situations and in those where real-world behavior is observed. In general, the time preference rates found in empirical studies exceed market interest rates. For example, Hausman (1979) studied actual purchases of air conditioners and derived subjective discount rates ranging between 5.1 and 89.0 percent (the mean discount rate was 26.5 percent). Gately (1980) reported discount rates between 45 and 300 percent in a similar study of refrigerator purchases. Houston (1983) found a mean discount rate of 22.5 percent in an experimental study of choice of an "untried energy-saving durable good." Thaler (1981) found median discount rates as high as 345 percent over a one-month horizon, while Benzion, Rapoport, and Yagil (1989) found mean discount rates as high as 59.8 percent among university students responding to hypothetical choice situations.[2] Samwick (1998) estimated time preference rates from wealth data and found a median annual rate of time preference equal to 7.63 percent. One-quarter of the time preference rates were below 2.93 percent and another quarter were above 14.66 percent, with 14 percent above 20 percent.[3] Odum and Rainaud (2003) showed that discount rates differed significantly between different substances, with money being less steeply discounted than alcohol and food. For example, $100 delayed by one year was

worth $47.50 now, whereas $100 worth of food was worth only $22.50 now. Several similar examples can be found in Frederick, Loewenstein, and O'Donoghue 2002.

The discount rates found in empirical studies tend to be very high. This means that the future is given less, and sometimes very much less, weight than the present. This is contrary to the assumptions of the rational model. Some discounting of the future is appropriate (because of the possibility of death, default, or unanticipated events), but it should be relatively low, as the probability of these events is itself low. The rational model requires the decision maker to be able to predict future tastes, and some recent research indicates that this is not the case. It seems that most people have a general tendency to devalue future events either because of a lack of imagination or because of the way the brain is constructed. Ross and Newby-Clark have conducted several studies in order to compare people's views of their pasts and futures, which turn out to be qualitatively different. They have found that the variation in evaluations of personally significant episodes is much higher for the past than for the future. Respondents report both positive and negative events in the past, while they typically anticipated a homogeneously ideal future. They further reported that people needed more time to anticipate negative future events than positive future events, and they also needed more time to respond when asked to judge how likely they thought the negative events were compared to the positive events (Ross and Newby-Clark 1998; Newby-Clark and Ross 2003).

Loewenstein, O'Donoghue, and Rabin's (2003) review of the literature on taste change suggests that people understand qualitatively the direction in which their future tastes will change but systematically underestimate the magnitude of these changes. This has been found true for people waiting for a kidney transplant when predicting what their quality of life would be one year later (Jepson, Loewenstein, and Ubel 2001) and cigarette smokers when asked to predict their own risk of becoming addicted (U.S. Department of Health and Human Services 1994, cited in Loewenstein, O'Donoghue, and Rabin 2003). People have also been found to exaggerate the degree to which their future tastes will be like their current tastes. Read and Van Leeuwen (1998) asked hungry and satiated respondents to choose between healthy and unhealthy snacks to be received one week later either after lunch or in the afternoon. Respondents who were hungry at the point of the interview but expected not to be when receiving the snack the next week (after lunch) correctly predicted the direction in change in taste but underestimated its magnitude. This failure to predict future feelings may result in overconsumption in the present relative to the consumption level that would maximize intertemporal utility if the future tastes had been predicted correctly.

Discount rates have also been found to vary considerably between individuals. These differences could be attributed to an imperfect capital market, as the latter was an important underlying assumption in Fisher's argument. Another interpretation is that factors other than time preference might be playing an important role in intertemporal choices and so distort people's estimates of subjective discount rates.

Either way, the results suggest that Fisher (1930) assumed too much temporal consistency. He did suggest that individuals differ in their time preference, and he argued that individuals' time preference might change when one of the factors determining time preference changed. For example, he suggested that the rate of time preference could change as an individual ages, as has recently been supported in research by Read and Read (2004).[4] Nevertheless, it seems that he expected a person at any given moment to use the same rate of time preference across all intertemporal choice situations. The results from the empirical studies reported below show that this is not the case. In fact, decision-specific factors seem to be the most important determinants of rates of time preference found in empirical studies.

Loewenstein and Prelec (1993) reported results from experiments indicating that people gener-

ally like sequences of events that improve over time and dislike sequences that deteriorate (where the individual events making up the sequence are the same). This means that the discount rate is not necessarily positive but in some situations it may be negative. Hence, the discount rate used in a particular intertemporal decision may depend on whether the decision maker perceives the decision as a single event or as a decision in a sequence of events. Prelec and Loewenstein (1998) also find a form of debt aversion in some settings. When people are asked if they would like to pay for a holiday before or after the holiday has taken place, the majority answer that they want to pay before. Similar experiments show that this sort of debt aversion occurs where debt is construed as either consuming something before paying for it or getting advance payment for future work. Prelec and Loewenstein discuss two different mechanisms that may motivate people to prepay for a product. One is the anticipation of enjoying the product without having to think about the payment, as "the pain of paying" may reduce the utility of consuming the product. The other is to avoid paying for consumption that has already been enjoyed. Then the pain of paying is not being buffered by the joy of consumption. This debt aversion does not, however, apply to all products. When asked about the preferred timing for paying for, say, a washing machine or Internet access, the majority preferred paying after receiving the product. This is in line with the findings by Hirst, Joyce, and Schadewald (1992), who reported the results of a series of experiments that revealed a preference for matching the duration of a loan with the life of the durable. The way consumers are asked to pay for a certain product may therefore influence the decision to buy.

Findings from several studies suggest that individuals react very differently to situations involving receipt of money compared to those involving paying money, and to speed-ups as opposed to delays (Benzion, Rapoport, and Yagil 1989; Loewenstein 1988; Nyhus 1997; Shelley 1993). These results have been attributed to shifts in reference points. Loewenstein (1988) and Shelley (1993) argued that the effects of outcome sign (receipt versus payment) and question framing (delay versus speed-up) should be combined when the results are interpreted. They defined delay of reward and speed-up of payment as "immediate losses" because these situations involve a worsening of present well-being. Likewise, speed-up of reward and delay of payment were defined as "immediate gains," because these situations involve an improvement in present well-being. They argued that the present state is used as a reference point. The sign of the change for the present situation determines whether a situation is considered a gain or a loss. This theory has much in common with prospect theory (Kahneman and Tversky 1979), which proposes that the value function for losses is steeper than that for gains. It also holds that outcomes are evaluated in terms of deviations from reference points instead of absolute values. However, the intertemporal reference point model also suffers from the same weakness as prospect theory: our knowledge about which reference point a consumer uses and how it is formed or chosen is very limited. In situations outside the laboratory, where the researcher cannot manipulate the reference point, we know very little about whether a particular outcome is perceived as a gain or a loss.

Nyhus (1997) found that people not only change their discount rate from one situation to another but also change their impatience levels relative to others. She investigated the consistency in answers to twelve time preference questions using responses from a Dutch sample of over 4,000 individuals. She found that, in general, correlations between answers to different time preference questions were low, but they were higher for questions involving the same framing (i.e., high between items involving delaying receipt of money and between items that involved delaying payment). This suggests that not only does the size of the discount rates used for different situations change, but also that people change their relative position in the distribution of responses when the situations are framed differently. A person who appears to be the most impatient in one situation may be among the more patient in another.

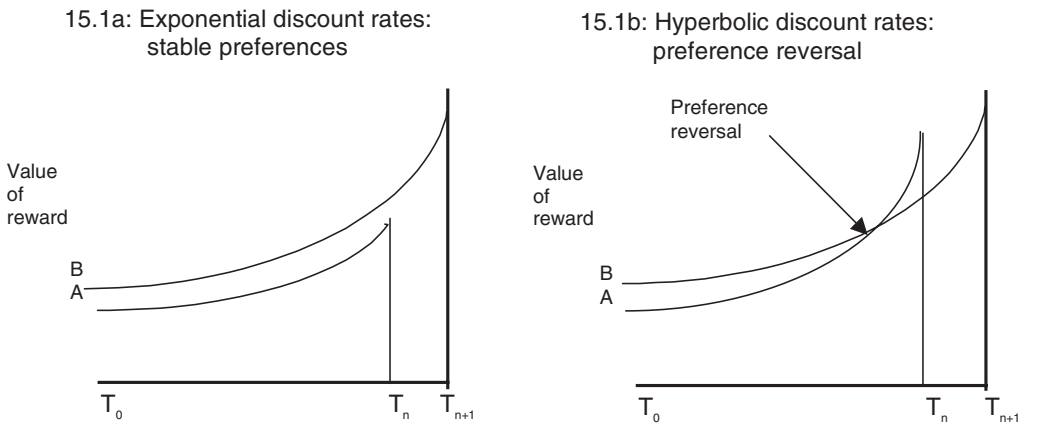
All the results reviewed above suggest that there are fundamental measurement problems in empirical studies of time preference. In many studies people are faced with hypothetical choices between money now or in the future, and it is not clear that such hypothetical choices reflect actual choices and therefore real time preferences. Even when real money is used in experiments, the amounts involved are small, which makes generalization difficult. Studies of real-world choices (which do involve substantial sums of money) are contaminated by uncontrolled variables. And different combinations of present and future gains and losses give rise to alternative measures of time preferences, which are likely to result in different estimates of the discount rates. Frederick, Loewenstein, and O'Donoghue have provided the most extensive review of the empirical studies of time preference, and conclude: "In contrast to estimates of physical phenomena such as the speed of light, there is no evidence of methodological progress; the range of estimates is not shrinking over time" (2002, 377).

Knetsch (2000) argues that the methods used in most time preference studies are likely to produce biased estimates. In most studies, people are asked to choose between two gains (do you prefer \$1,000 today or \$1,000 + x in one month?) or two losses (do you prefer to pay \$1,000 today or pay \$1,000 + x in one year?). He suggests that questions combining gains and losses (how much would you be willing to give up today in order to get \$1,000 in one month, or how much would you demand today in order to accept a loss of \$1,000 in one year?) will provide more realistic answers, as these kind of choices are more often encountered in everyday life. They also correspond more to most cost-benefit analyses. So far, this way of asking questions to identify time preference has been little used.

Another important finding from empirical research on intertemporal choice is that an individual's rate of time preference tends to change as a function of time (being high for the present and immediate future and lower for periods in the future). The findings suggest that instead of discounting future events with a constant discount rate (which can be illustrated by exponential curves), individuals use higher discount rates for the near future than for the remote future (which can be illustrated by hyperbolic curves). The curves found in experimental designs differ in their specific forms, but they share this common hyperbolic characteristic. Thaler (1981) described the phenomenon with the following example: most people prefer two apples in one year and one day to one apple in one year, but when asked to choose between one apple today and two apples tomorrow, most people will want an apple today. This means that their discount rate for the future apples is much lower than for the apples available in the present or near future. The result is a change in tastes over time and time-inconsistent behavior.

Figure 15.1a (from Ainslie 1992) illustrates an individual's preferences and behavior under stable time preferences. The graphs illustrate the present value assigned to the two alternatives after discounting it to the present value. At T_0 the individual prefers alternative B, which is larger but is available at a later point in time than alternative A. As T_n approaches, alternative B is still considered superior because the decision maker uses the same discount rate when evaluating the alternatives. The preference curves are exponential and proportional to each other. They never cross. The decision maker waits for alternative B, which is available at T_{n+1}. Figure 15.1b shows the preferences and behavior under hyperbolic discounting. At T_0, the individual prefers alternative B to A. However, as the time of availability for A approaches, the decision maker starts using a higher discount rate, which causes a shift of preferences. When the two alternatives are discounted with a much higher rate, the alternative closest in time has the highest present value. The change in discount rates produces more curved preference curves, and the curves cross. Alternative A is chosen, in spite of the preference for alternative B when choosing from a more remote temporal distance.

Figure 15.1 **Effects of Exponential and Hyperbolic Discounting**



Ainslie (1975) reviewed numerous studies of this kind of inconsistent behavior, which he denotes "impulsivity." Impulsive behavior has been found among birds, animals, children, and adults. Preferences for two goods available at two different points in time are better described by hyperbolic curves than by exponential ones. The effects of overvaluation of the present were theoretically outlined by Strotz as far back as 1956. He showed that if time preference changes as a function of time, the result is dynamically inconsistent behavior. A conflict will occur between today's preferences and tomorrow's preferences. People do things they would not have done if they had made the decision to act from a remote perspective, and they do not follow their own plans.

At least five explanations for this apparently dynamic inconsistent behavior have been put forward. Some of them argue that the observed behavior is not inconsistent at all, while others try to model internal inconsistent preferences. Loewenstein (1996) argued that the economic theory of intertemporal choice is misspecified because it does not include "visceral" factors (or "passions"). He points to the weakness of the theory of changing discount rates, which fails to explain why inconsistent behavior is only induced in some situations and not in others. He attributed "inconsistent behavior" to the role of visceral factors, which he described as important dimensions of human reality such as hunger, thirst, mood, emotion, drive, desire, physical pain, and so on. The traditional economic man has no passions in the sense of yearning or craving, and for this reason every deviation from deliberative and stable preferences is left unexplained by the economic models. They are interpreted as a change in tastes and irrational time-inconsistency. Loewenstein's (1996) point was that if the role of visceral factors is included in models of choice over time, impulsive behavior will not be viewed as an irrational shift in preferences.[5] The preferences remain stable, but other factors that interact with them in determining behavior must be taken into account when predicting behavior.

Hoch and Loewenstein (1991) and Loewenstein (1996) claimed that visceral factors can explain why some types of behavior are associated with impulsive behavior and others are not. Hoch and Loewenstein argued that shifts in reference points are important for impulsive behavior. Reference points might change because of physical and temporal proximity that makes not consuming painful. Or it might change through unfavorable social comparisons with peers or others. They defined consumer self-control as a struggle between the two psychological forces of

desire and willpower. In their model, self-controlling strategies were divided into two classes: attempts to directly reduce desire, and willpower tactics that seek to overcome desire. Loewenstein (1996), on the other hand, argued that impulsive behavior is caused not so much by the immediate availability of the events, goods, or outcomes as by the immediacy and intensity of visceral factors. At high levels of intensity, passions gain complete control, and perceptions of self-interest become unable to influence behavior. As the level of intensity increases, an individual will focus his attention and effort on the present and on himself as opposed to other points in time and other people. Loewenstein further argued that passions are more systematic in their effects than previously supposed, so it is possible to model the interaction between interests and passions.

Empirical studies support some of the aspects of Loewenstein's (1996) theory. Some buying is a result of tempting situations (immediacy of goods). Research in prepurchase processes suggests that there are substantial differences among consumers in the amount of prepurchase deliberation (e.g., Rogers and Shoemaker 1971). According to a review of household prepurchase decision making by Olshavsky and Granbois (1979), 20–25 percent of durable goods and clothing purchases, up to 50 percent of supermarket purchases, and 33 percent of transactions in variety stores and drugstores are "impulsive purchases" in the sense that shoppers do not state intentions to buy these items in store entrance interviews. Indirect support for the role of visceral factors is also provided by the fact that for decades marketers have investigated how to stimulate impulsive buying by manipulating the atmosphere, smell, structure, and display of products in shopping centers and supermarkets.

Metcalfe and Mischel (1999) have proposed a "hot-cool" model based on knowledge of biological predispositions in the human brain. It is to some extent similar to Loewenstein's model of visceral influences but is more detailed in terms of describing the processes at work in the brain. They propose a model consisting of two interactive systems. The "cool" system is an emotionally neutral "know-system": cognitive, complex, slow, and contemplative. It consists of a network of informational cool nodes that are interconnected to each other and generate rational and planful behavior. The activation of the cool system increases with age, except under high stress levels that may reduce the system's effect. The emotional "hot" system, on the other hand, is a "go-system," specialized for quick emotional processing. It is simple and fast, consisting of relatively few representations or "hot spots" that trigger reflexive actions. The hot system develops early in life and is dominant in young infants. Both the hot and cool systems are heavily influenced by biological dispositions, learning, and maturation. The way the hot and cool systems are assumed to interact is that both are activated by external referents. The hot spots and cool nodes that have the same external referent are linked to one another and thereby link the two systems. Hot spots can therefore be evoked by activation of the corresponding cool nodes and vice versa. Self-control problems typically arise if hot spots do not have, or cannot access, the corresponding cool representation, so that the cool system regulation of hot impulses is nonexistent. The child's increased ability to delay gratification as it grows older is explained by the developmental lag between the two systems. The hot system is present at birth, whereas the cool system develops with age. Stress seems to reduce access to the cool system, making the individual unable to divert activity away from the hot system.

An alternative perspective on inconsistent behavior is to model an economic man with two selves similar to Freud's theory of the ego and the id (Schelling 1978; Thaler and Shefrin 1981). This framework attributes observed time-inconsistent behavior not to changing tastes but to a short-sighted self gaining more control of behavior than a long-sighted self. Thaler and Shefrin (1981) modeled the internal conflicts between short-term and long-term preferences (e.g., eating versus losing weight) as a principal-agent problem. They argued that there is a constant conflict

between the "planner" (the self that maximizes long-term utility) and the "doer" (the myopic self that maximizes only present utility). Ainslie (1992, 1993) advocated a similar perspective under the label "picoeconomics." He modeled the intrapersonal struggle as a repeated prisoner's dilemma and argued that the two (or more selves) are continuously bargaining.

George (2001) put forward yet another model to resolve the observed paradoxes in behavior and stated preferences, arguing that we have two sets of preferences: first-order and second-order (see also George's essay in this volume). The first-order preferences are preferences about things. The second-order preferences are preferences about the first-order preferences, that is, alternatives in a choice set are allowed to be preference rankings of things rather than themselves things. An example would be the choice between a healthy meal (H) and a burger meal (B). Time-inconsistent behavior is a result of the simultaneous occurrence of a regular, or first-order, preference for B (B > H) and a second-order preference for H [(H > B) > (B > H)]. Hence, a felt or experienced first-order preference can be a preference one would have rather not felt. This model differs from the multiple-self (or multiple-utility) models in one important way. The multiple-self models retain the assumption of one ranking per agent at a single moment while also treating an agent as in fact two, three, or more agents, each having its own ranking. Instead, this model allows agents to have preferences about preferences, and the assumption about complete preference orderings and comparable alternative actions need not be relaxed. George uses this model to explain unhealthy eating, gambling, credit, entertainment, and sexual behaviors.

Finally, Gifford (2002) has put forward a biology-based model of choice as an alternative to these approaches. Gifford claims that time inconsistencies in behavior are simply a specific example of the kind of inconsistencies that occur when people make choices between alternatives that differ in their level of abstraction. If you are choosing between a piece of one kind of cake that is physically present and another that is represented only by a printed word on a piece of paper, you are likely to choose the type of cake that is present. Change which kind is present and you get a reversal of choices. Gifford's view is that since the future is always abstract, choices between present and future consumption will often be choices of this type. Underlying Gifford's approach is the idea that humans have essentially two systems for making choices. One is based on emotional and motivational systems that have evolved to enhance inclusive fitness, and incorporates a high discount rate that is shared by nonhuman animals. The other rests on our cognitive ability and depends on the fact that we can think symbolically. This incorporates a lower discount rate that has been acquired culturally. Which system dominates will depend on the situation and on an individual's ability to inhibit particular responses.

TIME PREFERENCES AND SAVING BEHAVIOR

Fisher (1930) argued that time preference was the most important determinant of saving, as it captured the interaction effects of socioeconomic and personality factors. However, only a few empirical studies have focused on the impact of time preference on saving and borrowing behavior, and the results so far are ambiguous. Antonides (1988) found differences in the discount factors between people who saved and people who did not save. The average monthly discount factor of the savers was 1.4 percent, while it was 2.6 percent for the nonsavers. Ritzema (1992) found that time preference was significantly related to the likelihood of having financial problems and to total debt. Webley and Nyhus (2001) found that people with debt problems had higher time preferences (measured by delayed payment scenarios) than those with mild or nonexistent debt problems. Donkers and van Soest (1999) found a negative relationship between time preference and the probability of owning a house, while they found a positive relationship with the probabil-

ity of holding risky assets. Daniel (1994), on the other hand, using the same data, did not find a significant relationship between time preference and five different measures of saving behavior.

The lack of conclusive results concerning the relationship between time preferences and saving behavior might be the consequence of the measurement problems involved when estimating time preference. A second reason may be that most studies are cross-sectional. If we think about the way time preference is supposed to work, we have to take diminishing marginal utility into account as well. In a panel study, we may expect to find that high time preference in one period is associated with lower saving or increased borrowing in the next period. In a cross-sectional study, it is not as straightforward to say anything about the relationship between time preferences and financial behavior. One usual expectation would be to expect that high debt is associated with high time preference. However, if we also consider the existence of diminishing marginal utility, high debt could equally well be associated with low time preference, since credit-financed consumption may have made the consumer less impatient to consume more. This will depend on the consumer's aspiration level with respect to consumption. It is therefore a mistake to expect a particular relationship between saving and borrowing and time preference at a certain point in time. Time preference should be used to predict future behavior, and its effect should be studied using longitudinal data. A third reason may be that time preference is not the only factor that influences intertemporal choices. For example, Julander (1975), studying the effect of bookkeeping on saving, reported that both an index intended to measure lack of impulse control and an index intended to measure ability to delay gratification correlated with some of his saving measures. A person governed by visceral sensations will have problems with rational planning due to the tendency to form temporary preferences. But most people manage their financial affairs satisfactorily to the extent that they avoid debt problems, usually get up in the morning, do their duties at school and work, and resist most consumption temptations exposed in shopping centers and supermarkets. Not all situations involving intrapersonal conflicts of interest produce time-inconsistent behavior. Mechanisms other than impatience and temptation must be playing an important role. In some way, people must be able to follow their long-term plans by committing themselves to them. The applied techniques have been called self-controlling strategies, impulse control (Ainslie 1992, 2001), or "tricks we play on ourselves to make us do the things we ought to do or to keep us from the things we ought to forswear" (Schelling 1978, 290).

SELF-CONTROL

Concepts such as self-control and thrift have been linked to saving at least since Adam Smith included a chapter on self-command in *The Theory of Moral Sentiments* (see Loewenstein 1992; Wärneryd 1989, 1999). The theories that incorporate the role of self-control implicitly recognize that refraining from pleasure can be difficult. Within this perspective, behavior is a result not only of the experienced intensity of the temptations but also of the ability to exercise self-control in situations where there is a conflict between short-term and long-term goals. Self-control may be defined as those efforts made by the individual to avoid or resist behaving inconsistently, or it may be defined as a deliberate choice to accept pain in order to gain something (Schelling 1984). When Strotz (1956), Elster (1979), and Ainslie (1992, 1993) discussed the problem of nonexponential discounting and intertemporal inconsistency, they used the story from Homer's *Odyssey* about Ulysses and the Sirens as an example of how inconsistent behavior can be avoided.[6] The story neatly demonstrates two main techniques for controlling impulses and resisting temptations: prior commitment and avoiding exposure. Ulysses precommitted himself by letting others tie him to the mast so that he could not execute any change in the ship's direction. He controlled

his crew by preventing their exposure to the harmful Siren song. In Loewenstein's (1996) terms, Ulysses used techniques to overcome impulses to act upon visceral sensations. By controlling his actions through precommitment, he acted in accordance with his more stable preferences.

Strotz (1956) suggested that future actions might be controlled by precommitment and the strategies of consistent planning. Using strategies of consistent planning means that an individual should choose the best of the plans that she believes it is possible to follow. Similar techniques have been proposed by Ainslie (1992, 1993), who argues that the process underlying impulse control can be modeled as a repetitive, intertemporal prisoner's dilemma. He argues that one choice will set precedents for later ones. Since a person wants to act rationally in her future choices, she might act rationally in the present too, since she believes that it will serve as an example of future behavior. "If she makes an impulsive choice, she will have little reason to believe she will not go on doing so, and if she controls her impulse, she has evidence that she may go on doing that" (Ainslie 1992, 336). According to Ainslie's framework, self-control is most likely to be observed for choices that will be repeated (i.e., that are one in a series of similar choices). Elster (1979) proposed many ways of precommitting oneself by invoking social mechanisms. By making (side) bets with others, people exaggerate the negative aspects of failing to achieve their long-term goals. Another self-controlling strategy is to punish oneself when one behaves myopically. Thaler and Shefrin (1981) compared intrapersonal conflicts with the conflicts described in principal-agent theories. Following the suggestions about how principals might control agents, they suggest that one's future actions can be controlled by altering incentives (monitoring available resources) or altering rules (by establishing self-imposed rules of thumb, habits, and routine). In this way, it will be in the shortsighted self's interest to behave in accordance with the longsighted self's preferences.

Both Katona (1975) and Bernheim (1995) reported that people say they save less than planned or that they would like to save more, which give some indication of self-control problems with respect to saving and spending. Romal and Kaplan (1995) report that savers have a higher score on Rosenbaum's Self-Control Schedule than spenders. Some empirical evidence suggests that self-controlling strategies can be found in economic management. Examples of such strategies are fixed saving arrangements, deliberate overpayment of income tax (Cox and Plumley 1988), participation in Christmas clubs or other saving clubs, and even installment buying, since this produces a stream of obligations to pay (Caplovitz 1963).[7] Other research suggests that people use mental budgets, so that a moment of weakness that leads to an impulsive purchase is compensated for by decreased expenditure on other things (Heath and Soll 1996). Self-controlling techniques and methods used to accommodate deviations in original plans might therefore be important for saving. In spite of this, the extent and role of self-controlling strategies in economic affairs have not yet been subject to much empirical testing. For example, methods for monitoring one's own time preferences by avoiding exposure have received very little attention from researchers. Such techniques could be not going to shopping malls or avoiding mail and telephone marketing. Webley and Nyhus (2001) found that people experiencing debt problems used the technique of not going shopping more often than others, and Sonuga-Barke and Webley (1993) report that in an experimental saving game some children will avoid going into a sweet shop. Other techniques could involve the choice of friends and neighborhood, as exposure to other peoples' possessions can give rise to desires for the same lifestyle and products (Duesenberry 1949; Schor 1998). The delay of gratification experiments carried out on children support the idea that avoiding exposure enhances ability to delay gratification. The children participating in the experiments tried to wait for the delayed larger rewards by avoiding thinking about the immediate available awards. They distracted themselves by sing-

ing, playing games, and even sleeping. Distraction from the available rewards was found to be an important factor in waiting behavior (Mischel and Ebbesen 1970).

BEHAVIORAL SAVING MODELS

Alongside the development of theories of time preference and self-control, a number of behavioral saving models have been developed. Three models, two of which are firmly rooted in behavioral economics, will be described and evaluated below.

The Behavioral Life Cycle Model

The most influential economic theories assume that the prime motive for saving today is so that one can consume tomorrow; in other words, people are simply making choices between spending now and spending later. Most theoretical effort has been concentrated on the issue of how individuals deal with variations in income across their life span. The best-known of these theories is the life cycle hypothesis (LCH) developed by Modigliani and Brumberg (1954). They started off with an assumption that people want to have a stable consumption (or utility) across all periods in their remaining lifetime (due to diminishing marginal utility) and an observation of the most common income profile of a worker over his or her working life. Further, they suggested that people are rationally determining how much they can consume over the remainder of their life by taking their assets and all future earnings into account and that in any given year the difference between this level of consumption and income will be the amount saved (or the amount borrowed). Young people borrow to pay for consumption, the middle-aged save for retirement, and the old spend those savings (the so-called hump-shaped age/saving profile). The model assumes quite a substantial decision-making capacity and knowledge about the future, as pointed out by Thaler: "The essence of the life-cycle theory is this: in any year compute the present value of your wealth, including current income, net assets, and future income; figure out the level annuity you could purchase with that money; then consume the amount you would receive if you in fact owned such an annuity" (1990, 193–94).

Friedman's (1957) permanent income hypothesis is similar to the LCH. Friedman claimed that people have a notion of what their mean permanent income will be across a time period and aim to consume a fixed proportion of it during that time. Their actual income and consumption may well vary from the permanent income, and saving or borrowing will take up the slack. One important difference between this and the life cycle hypothesis is that the permanent income is not the same as expected lifetime earnings. Friedman recognized that individuals make calculations based on a time horizon that does not necessarily extend to their deaths.

Although the LCH has been modified in order to make it more realistic since it was first proposed (e.g., by including a rising income profile, uncertainty with respect to future income, and length of life) it still relies, in the majority of studies, on strict assumptions about time preferences. The model assumes that time preference is adjusted to expected lifetime resources. This means that the model would not predict overspending. The marginal utility of extra consumption in the present is assumed to never be so high that overspending occurs. However, many reports on behavior in our Western consumer society suggest that it does (see, for example, Schor 1998). New models of saving and consumption have therefore been developed so as to adapt the theory to observations such as a general decline in saving in Western countries (Maital and Maital 1994; Parker 1999) and a growing number of cases of personal bankruptcy (Stavins 2000).

In 1988, Shefrin and Thaler, who had completed several studies of self-control, launched the

behavioral life cycle model (BLCH). The incorporation of self-control reflects recognition that refraining from consumption is difficult. In the LCH framework, it is not considered a problem for the consumer to distribute her income over the life span. However, as discussed previously, research on intertemporal decision making has revealed that such a model appears too simplistic. Although people have preferences for saving in order to have a smooth consumption stream, they also have preferences for immediate gratification. Therefore, as previously noted, Shefrin and Thaler (1988) modeled saving and consumption decisions as an internal conflict between two mutually inconsistent personalities, one concerned with the long run (the "planner") and one with the short run (the "doer"). They argued that modeling these two competing forces is consistent with findings from brain research and that it corresponds to the interaction between the prefrontal cortex and the limbic system. Apart from the use of sheer willpower (which is effortful), the planner controls the doer's expenditures by introducing rules of thumb and so-called mental accounts. The purpose of mental accounts is that each is associated with different levels of spending temptation, which means that also the fungibility assumption underlying the LCH is relaxed. Shefrin and Thaler (1988) propose that three mental accounts are useful in studies of saving: current income, current assets, and future income.[8] They argue that the temptation to spend from these accounts varies, so the propensity to consume from the different accounts also varies. The temptation to spend is assumed greatest for current income and least for future income, and the self-control needed to refrain from spending is higher for current income than for wealth (past income) and future income. This contrasts with the LCH framework, in which such mental labeling of money is absent.

An implication of this theory is that the propensity to consume from income is dependent on which mental account it is put into or how the income is viewed. If, for example, a windfall is entered into the "wealth account," the propensity to consume the windfall would be lower than if it is entered into the "present income account." For this reason, Shefrin and Thaler (1988) argued that lump sum bonuses are treated differently than increases in regular income. The saving rate can be affected by the way increments to wealth are described. Another important implication of the BLCH framework is that saving would be inadequate without social security and pensions. This opinion was reiterated by Maital and Maital (1994) when they criticized the deregulation of the credit markets. Adopting the doer-planner framework of the BLCH, they pointed to the fact that externally imposed restrictions as well as self-imposed constraints on spending and debt have been weakened in the past decades. They attributed the general decline of saving in the West to this weakened precommitment and argued that saving will not increase again until precommitment mechanisms are reestablished. It is increasingly easy to borrow money, and automatic teller machines provide easy access to savings. Some banks even offer automatic loans if a consumer overdraws his bank balance.

The BLCH has been only partially tested, but it is supported by some empirical findings. Shefrin and Thaler (1988) presented some results from a small survey designed to study the differences in propensity to consume from an increase in regular payments ($200 in twelve months), a lump sum payment ($2,400), or a future payment ($2,400 plus interest in five years). They found that although the total amount of the payments was identical, the students in their sample would use more of the regular payments than of the lump sum payment. Most of the respondents claimed that they would not increase their present consumption based on a promise of money five years on. This was interpreted as support for the assumption of the existence of mental accounts and that people have different propensities to consume for different mental accounts.

In addition, Shefrin and Thaler (1988) derived ten predictions from their theory:

1. Changes in discretionary saving from a change in pension saving is less (absolutely) than 1.0 and declines sharply as age falls.
2. The change in discretionary saving from a change in pension saving increases with income or wealth.
3. Without sufficiently large compulsory schemes, postretirement consumption is less than preretirement consumption.
4. The saving rate increases with permanent income.
5. Holding wealth constant, consumption tracks income.
6. The marginal propensity to consume bonus income is lower than that for regular income.
7. For (non-negligible) windfalls, the marginal propensity to consume is less than the marginal propensity to consume regular income but greater than the annuity value of the windfall. The marginal propensity to consume out of windfall income declines as the size of the windfall increases.
8. Holding lifetime income constant, home ownership increases wealth at retirement.
9. The marginal propensity to consume inheritance income will depend on the form in which the inheritance is received.
10. The marginal propensity to consume dividend income is greater than the marginal propensity to consume increases in the value of stock holdings.

To find support for these predictions, Shefrin and Thaler (1988) reviewed numerous studies in which investigators have distinguished between different types of wealth and incomes, and they found support for the ten predictions derived from the BLCH. In addition, Shefrin and Thaler found that results from studies of the effect of pension saving and social security wealth on saving supported the BLCH. Finally, they reported findings that support the assumption that the propensity to save increases with income.

Levin (1998) carried out the first study designed to test the BLCH using a large panel data set (the Retirement History Survey). He conducted a comparative study to investigate which of the two models (the LCH or the BLCH) could best explain variation in consumption. He tested the effects of level of wealth as well as the form of the wealth on the expenditures on ten different goods. The results are strongly in favor of the BLCH, as they reject the fungibility assumption, they support a different propensity to consume for different wealth components, and they show that the labeling of income (into which mental account it is entered) affects spending. These results were valid both for liquidity-constrained subjects and for unconstrained subjects. However, Levin did not find support for the assumption that the marginal propensity to consume past (illiquid) wealth was higher than that for future wealth. Levin explained this finding by the increase in the value of social security in the period of the data collection. The increase in one period might have influenced the confidence that it would continue to rise in the future.

Other studies have been conducted in order to test some of the underlying assumptions of the BLCH. For example, Heath, Chatterjee, and France (1995) found support for the existence of mental accounting principles.[9] Heath and Soll (1996) found that people do apply mental budgeting and that these mental budgets affect our consumption. People use resources differently depending on how they are labeled. They found evidence that consumers earmark money for certain product categories and that labels affect expenditures within the categories in predictable ways. In particular, they found that the mental budgets were quite inflexible. Karlsson, Gärling, and Selart (1999) found that willingness to buy was greater when the subjects in their experiments were asked to imagine they received a temporary income increase as opposed to a temporary

income decrease (holding total assets equal). They also found support for the existence and use of mental accounts in specific buying decisions. Webley and Plaisier (1998) found some evidence for mental accounts in eight- to twelve-year-old children, who spent money from different sources (pocket money, holiday money, birthday money) quite differently. In a rather different study, Selart, Gärling, and Karlsson (1997) analyzed data from a nationwide Swedish sample (996 individuals) and a student sample (277 randomly selected undergraduate students) in order to replicate the results of Shefrin and Thaler. In this study, they found that subjects expected to consume more when they were asked to imagine that an income increase would be received as an immediate lump sum than when the income increase would be received as future monthly increments. Selart and colleagues interpreted this as being contrary to the predictions of the behavioral life cycle hypothesis. There is, however, a possibility that the respondents perceived the alternative, including monthly increments, also as future income, and the findings are then in accordance with the BLCH in that people were more willing to spend money from current assets than from future income.

Prelec and Loewenstein (1998) elaborated the idea of mental accounting and suggested a "double-entry" mental accounting theory in which the pain of paying as well as the thought of paying was taken into account. They introduced a mental accounting theory in which one set of entries records the net utility of consumption (which means that the disutility of associated payments are subtracted) and the other set of entries records the net disutility of payments (after subtracting the utility of associated consumption). An underlying assumption of their theory was that prepaid consumption can be enjoyed as if it were free and that the pain associated with payments made prior to consumption (but not after) is buffered by thoughts of the benefits financed by the payment. They conducted several experiments to investigate this assumption, and they found that people are debt-averse: they prefer to pay before consuming and to be paid after finishing work. They also found that the degree to which consumption calls to mind thoughts of payments is important.

Graham and Isaac (2002) used a survey-based data set in order to test whether consumers could solve the optimization problems as assumed by the life cycle model. They asked university faculty members to choose to receive a nine-month (academic year) salary either over nine months or over twelve months. According to neoclassical theory, respondents should prefer the nine-month option, since this alternative is more valuable in a present-value sense (assuming a positive interest rate). They found that the behavior of even highly educated consumers deviates considerably from the neoclassical predictions in that they prefer to postpone the receipt of income (76 of the 109 respondents). Graham and Isaac interpret this as evidence that many consumers believe that a smooth income stream helps them to control spending. While a preference for income smoothing is a difficulty for the neoclassical model, it is consistent with the predictions of the behavioral life cycle model.

The behavioral life cycle hypothesis does a good job of accounting for the (limited) data and is explicitly behavioral. The two-self model is naive, but it is one step on a road to creating a behavioral economic model. This approach is still firmly based on the idea of rational action: both the doer and the planner "act" rationally according to their preferences. The ideas about the effect of framing also suffer from the same weaknesses as prospect theory (Kahneman and Tversky 1979) and the reference point model (Loewenstein 1988): since we know little about how reference points are formed, we know little about how different people will frame a certain payment, and therefore it will be difficult to predict behavior. Shefrin and Thaler (1988) noted that people might differ in their mental accounting practices, but did not elaborate on how these differences can be identified so that they can be taken into account when testing the model. The framing of a

lump sum payment might, for example, depend on the ratio between the present income and the size of the lump sum, so that high-income people will have a greater tendency to put lump sum payments into the present income account than people with low income. Alternatively, the effect of the size of the lump sum might interact with saving motives. Many possible factors that might influence the framing of an income component need to be explored. Moreover, the theory should be elaborated in order to incorporate factors that influence the marginal propensity to spend from the different accounts. Although this model is based on ideas about human decision making that are more realistic, we know little about the extent to which these assumptions correspond more to actual behavior than those of the LCH.

The Buffer Stock Model

Inclusion of a precautionary motive is the principal innovation of the LCH in the past decade (Browning and Lusardi 1996). Being pessimistic or uncertain about future income will obviously affect the financial decisions that people make. Those who face greater income uncertainty will consume less. One implication of the existence of this motive is that the path of consumption is not necessarily independent of the path of income. If the future variability of income increases, saving for the future will increase too. Likewise, an agent facing higher income uncertainty will also save more (Carroll and Samwick 1997; Hubbard, Skinner, and Zeldes 1995). The magnitude of the effect depends on the level of current assets and income relative to expected future income.

The precautionary motive alone cannot explain why so many households have very little wealth. Deaton (1992) and Carroll (1997) therefore proposed inclusion of a competing factor. They attributed low saving to so-called buffer stock behavior, which implies that there is an upper limit for precautionary saving. The assumptions underlying buffer stock models are that people are impatient (have a high rate of time preference) and fear the possibility of having no consumption opportunities in the future (the precautionary motive). Carroll (1997) argued that people therefore have a (typically small) wealth/income ratio target for their saving. If wealth is below the target, prudence dominates, as people are afraid of destitution in later periods. If wealth is above this level, impatience dominates and the available resources will be consumed. Carroll (1997) suggested that it is the possibility of poverty later in life that stops people from borrowing when they are young. The more uncertainty that is associated with future income, the higher the buffer stock saving. The interaction between precautionary saving motives and impatience is that consumption will track income in the early part of life, while (significant) saving will only be observed in later years. Carroll (1997) and Carroll and Samwick (1997) found empirical support for the buffer stock model. Gourinchas and Parker (2002) found that it is young people who engage in buffer stock saving, while older people (older than forty-two years) accumulate liquid assets for retirement in line with the standard LCH. Similarly, Zhou (2003) found that young households in Japan were more likely to save for precautionary purposes than were older households. Gourinchas and Parker interpreted these findings as being a result of the life cycle profile of expected income, which causes saving motives to change over the life cycle. Samwick (1998) reported findings suggesting that households save only to maintain a buffer stock until retirement is only a few years away.

Hubbard, Skinner, and Zeldes (1995) tested a buffer stock model (assuming a rate of time preference of 10 percent and a consumption floor of $1,000) against a model with lower time preference rates (3 percent) and incorporation of the asset-based means testing of welfare programs used in the United States. The latter model fit the data better than the buffer stock model. In particular, it provided a better explanation of why many households showed a strong persistence

in low levels of wealth: saving while receiving transfers is discouraged, as higher wealth is a disqualification for receiving further transfers. The buffer stock model predicts that households will have a strong motive to rebuild their buffer stock at all levels of income and wealth. The buffer stock model therefore failed to explain why 56 percent of the households that had assets worth less than $1,000 in 1984 still had less than $1,000 total wealth in 1989. Carroll and Samwick (1997) argued that they found evidence of the buffer stock model performing better than the model of Hubbard, Skinner, and Zeldes (1995). Consumers facing greater income uncertainty held more wealth. In particular, they found that buffer stock saving is important for consumers younger than fifty years of age. After this age, people engage in retirement saving. Furthermore, they reported that sensitivity to uncertainty decreased with rising time preferences.

There is other evidence that is consistent with the buffer stock model. Dunn (2003) has shown that income uncertainty has an important effect on the timing of home purchases. Consistent with the buffer stock model, households that face greater income uncertainty buy a new home when the ratio of the value of their existing home to permanent income is lower than the ratio for similar households with less uncertain incomes.

The buffer stock model of saving is one example of how the opposing forces of impatience and a precautionary saving motive can be incorporated into the LCH framework.

The Golden Eggs Model

Building on work by Strotz (1956) and Phelps and Pollak (1968), Laibson (1997) introduced hyperbolic discount functions to the LCH framework and elaborated and tested the model in several studies (e.g. Laibson, Repetto, and Tobacman 2003; Angeletos et al. 2001). The result is the so-called golden eggs model, in which the theory of hyperbolic discounting is transformed from a psychological peculiarity into a tool that can be used in macroeconomic analyses.

Laibson (1994) proposed a model assuming a declining discount rate between the present period and the next, and a constant discount rate in the following periods. He used this model to explore the consequences of hyperbolic discounting for consumption and saving behavior. In two successive papers (Laibson 1997, 1998) he explored the effects of illiquid assets ("golden eggs") on saving behavior. He regarded illiquid assets (such as a house), whose sale must be initiated one period before the sale proceeds, as a commitment technology that will limit overconsumption. Illiquid wealth will prevent the consumer from smoothing the consumption stream in periods with low income. The model can explain the observation of household consumption flows tracking household income too closely compared to what the LCH would predict. The model also explains why consumers have asset-specific marginal propensities to consume, but with an explanation different from Shefrin and Thaler's mental account theory. An implication of the model is that new financial innovations that have increased liquidity (e.g., instantaneous credit) and eliminated commitment opportunities are responsible for the ongoing decline in U.S. savings rates. Laibson also suggested that the changes in financial markets may reduce welfare by providing "too much" liquidity.

In three other papers, Laibson and his collaborators compared the performance of models assuming exponential and hyperbolic discount functions, respectively, with a special focus on the so-called debt puzzle (Angeletos et al. 2001; Harris and Laibson 2001; Laibson, Repetto, and Tobacman 2003). The debt puzzle was identified by Gross and Souleles (2002) using a large panel data set of thousands of credit card accounts from several different card issuers. They found a substantial coexistence of credit card debt with illiquid assets in addition to a coexistence of credit card debt with liquid assets. Two-thirds of United States households had credit cards by the

end of 1998, and more than half of these revolve debt on their cards. Still, a large fraction of this group holds a substantial sum of liquid assets. This behavior, which also breaks with the assumption of money being fungible, cannot be explained by the LCH assuming exponential discount functions. By simulating and comparing the savings and asset allocation choices of households with exponential and hyperbolic preferences, respectively, Laibson, Repetto, and Tobacman (2003) showed that the hyperbolic consumption model can explain this anomaly. They found that a "hyperbolic household" would borrow more frequently in the revolving credit market, hold relatively more illiquid wealth and relatively less liquid wealth, exhibit greater consumption-income co-movement, and experience a greater drop in consumption than an "exponential household." The psychological ideas underlying the hyperbolic model are that a person's current willingness to accumulate for retirement is greater in the present than the willingness he or she expects to have at a later state in his or her life. For this reason, the person will accumulate illiquid assets for retirement so that he or she imposes restrictions on the spending of future selves, who are likely to act impatiently. Since the simulated behavior of the hyperbolic households matches observed consumption data better than that of the exponential households, the model seems to be capable of accounting for a wide range of apparent LCH anomalies, such as (1) variation in time preference over the life cycle, (2) consumer self-reports of "undersaving," (3) disproportionate retirement accumulation in illiquid assets, (4) marginal propensities to consume that are specific to particular assets, and (5) declining national savings rates in developed countries. The model also supports the notion of mental accounts in the sense of people having asset-specific marginal propensities to consume. Bertaut and Haliassos (2002) set out to solve the same puzzle and proposed that self-control consideration can be a likely explanation.

CHALLENGES FOR FUTURE RESEARCH

It is clear that our understanding of discounting, self-control and saving has developed considerably since the pioneering work of Fisher. We now have a much more sophisticated understanding of the psychological processes that underpin saving decisions, and this knowledge has been used to produce macroeconomic theories that are predictive. This development of the economic theories of saving and consumption is an excellent example of how psychology and economics can be fruitfully linked. Although the intertemporal conflict between present enjoyment and future profit was identified by Adam Smith and has been acknowledged by many economists since, it has taken a long time for this psychological insight to be incorporated into economic models of saving. Psychologists, and some economists, have for decades studied behavior associated with ability to delay gratification, willpower, and hyperbolic discounting, and the large body of evidence of behavior that challenged the assumptions of the neoclassical model was, in the end, difficult to ignore. The most recent models of saving incorporate both impatience and self-control in such a way that the standard analytic tools in economics can still be used.

However, we believe that further progress is necessary in four main directions. First, we need to start analyzing how people think about time, to explore how they conceive of things available in the future. Second, the difficulties involved in measuring both time preference and self-control must be overcome. Third, the relationship between time preferences and related concepts such as time perspective and future orientation and length of planning horizon needs to be resolved. Existing psychological scales for measuring these concepts may well tap the concept of time preference and may be used instead of time preference measures, and the psychological theories that underpin these concepts may then have a role to play in theory development. Fourth, we need to have a much better understanding of how saving, self-control, and discounting develop during

childhood, adolescence, and adulthood. Only in this way will we know how we can influence saving behavior in the long term.

How Do People Think About the Future?

One of the striking things about theoretical development in this area over the last few years is that while considerable effort has been put into analyzing the agent (e.g., decomposing her into a planner and a doer), time itself has been seen as unproblematic. So under both exponential and hyperbolic discounting, time is a smooth continuous variable. But if we think back to Thaler's (1981) example of most people preferring two apples in one year and one day to one apple in one year, we can see that a simple explanation is that the two periods—one year, and one year and one day—are seen as equivalent. If people segment time (now, tomorrow, next week, next year, etc.) and think of it as a discontinuous variable, we would not expect to find the kind of neat curves displayed in Figure 15.1.

Even if people do see time as continuous, they may think about the future in different ways. Atance and O'Neill (2001), for example, proposed that there are two kinds of ways people can think about the future. In episodic future thinking, people project themselves into the future to preexperience an event, whereas semantic future thinking is more generalized and script-based (and so depends on an understanding of how a particular event *generally* unfolds). This raises the question of whether the way in which people think about the future has an impact on the steps they take in the present: does a tendency to think about the future in episodic ways encourage people to save, for example?

Time may also change the way people think about the same events, an idea pursued by Trope and Liberman (2003). Trope and Liberman have put forward "construal-level theory." This suggests that how far away in time events or decisions are changes the way people mentally represent those events or decisions. The farther away in time an event is, the more likely that it will be represented in terms of high-level abstract features. Conversely, an event near in time will be more likely to be represented in a concrete and low-level way. So reading a novel in a year's time might be construed as "broadening my horizons," whereas the same activity carried out this afternoon might be seen as simply "flipping pages." This difference in the way people think about events depending on when they occur clearly has relevance for how they evaluated alternatives. In one of Trope and Liberman's studies, they explored the effect of temporal distance on the evaluation of two radio sets: one had poor sound and a good built-in clock, the other had good sound but a poor clock. As predicted, the relative preference for the latter was greater the further in the future the options were rated. Construal-level theory also provides an alternative explanation for the results of delay of gratification experiments. If amount is central (and so a high-level feature) and delay peripheral (and so a low-level feature), then people would choose according to amount in the far future more than they do in the near future—which is the standard finding. Note that this also suggests that if, for a particular individual making a particular kind of choice, delay is a more central feature, the results might be reversed.

Trope and Liberman's approach has the potential to help us understand the impact of time on people's choices. Leaving aside the merits of their particular approach, however, we clearly need more theorizing on the conceptualization of time.

Measurement of Time Preference and Self-Control

One important parameter in all saving models is the discount rate people use when making saving decisions. Some of the challenges associated with measuring time preference have been consid-

ered previously in this chapter and are discussed at considerable length by Frederick, Loewenstein, and O'Donoghue (2002). They provide a thorough review of empirical studies in this domain, which reveal what they characterize as "spectacular" disagreements. The variability in estimates of discount rates is tremendous (from –6 percent to infinity), though there is a predominance of high rates, which are well above market interest rates. Their view is that this variability is a result of measurement techniques that confound time preference with other factors (such as uncertainty about the future reward and visceral factors). This not only creates variability but may also account for the high discount rates, as most of the confounding factors would tend to push rates upward. The researchers provide a helpful distinction between time discounting and time preference. They define time discounting as any reason for caring less about a future consequence, including factors that diminish the expected utility generated by a future consequence, such as uncertainty or changing tastes. Time preference, on the other hand, refers more specifically to the preference for immediate utility over delayed utility. Time preference in this sense will necessarily be difficult to estimate, as the researcher needs to control for all the other reasons for discounting the future. While this is difficult, it is not impossible. Of more concern is whether time preference is actually a unitary concept—that is, whether it is stable, predicts behavior across a range of situations, and has measures that intercorrelate. Frederick, Loewenstein, and O'Donoghue are agnostic on this: "in our view the cumulative evidence raises serious doubts about whether there is, in fact, such a construct—a stable factor that operates identically on, and applies equally to, all sources of utility" (2002, 392).

Self-control is also not straightforward to measure, though it is clearly highly relevant to saving. Part of the problem is the difficulty of distinguishing self-control achieved through willpower (resisting temptation takes energy) from self-control resulting from the exercise of skill (using techniques such as precommitment). Baumeister and Vohs (2003) have shown that while willpower is a folk concept, it also captures some important properties of self-control. Their studies suggest that people have a limited pool of resources that they can use, so successfully resisting one temptation makes it less likely that an immediately following temptation can be resisted. Precommitment means that one avoids the need to use willpower. Though it is clearly very relevant to the kind of saving that Katona (1975) labeled "contractual saving," we do not know if people differ in their ability to use precommitment techniques. On the spending side, while it is possible to identify a wide range of money management techniques (such as withdrawing a fixed amount of cash before entering a supermarket, thereby limiting the amount that is spent), and people are able to describe their own approach quite successfully, to date it has not proved possible to devise a reliable questionnaire-based measure of these techniques (Webley and Nyhus 2001).

Time Preference and Related Concepts

As we said at the outset, saving models must include variables that are likely to affect the majority of consumption and spending decisions. Results from empirical investigation suggest that although the subjective discount factor fits the bill theoretically, the discount factors found in both experiments and field studies seem to be more influenced by situational factors than by individual characteristics. However, the notion that people vary in their evaluation of the future is plausible. We suggest that it might be appropriate to use other concepts from the psychological literature as substitutes for discount rates, such as length of planning horizon or future orientation.

Empirical studies indicate that people differ with respect to how far into the future they think and plan. While some people plan years ahead, others limit their planning to weeks. Most empirical studies have found a positive relationship between time horizon and saving (e.g., Alessie,

Lusardi, and Kapteyn 1995; Nyhus 2002; Julander 1975, Wärneryd 2000). Moreover, those with debt problems have been found to have a shorter time horizon than mild debtors and nondebtors (Lea, Webley, and Walker 1995; Webley and Nyhus 2001).

Nyhus (2002) used a crude measure of time horizon and found that it correlated significantly with many different definitions of wealth, for example, with financial wealth ($r = .190$, $p < .01$) and total wealth ($r = .256$, $p < .01$). Regression analyses showed that this positive relationship also is present in multivariate analyses where socioeconomic and other psychological variables were controlled for. Further, Nyhus found that the longer the time horizon, the lower the probability that a household has debt.

Only a few studies have looked at the relationship between time horizon and time preference. By definition, consumption beyond the time horizon is given the value of zero and is not discounted. The time horizon can then be elicited by identifying the discount rate used. For example, Landsberger (1971) found discount rates between 17 and 45 percent and concluded that people's horizon is between two and six years. Alternatively, the discount rate can be inferred from the time horizon people use. For example, Lusardi (1998) used a self-reported planning horizon as an index for time preference. Samwick (1998) compared his estimates of time preference rates with the respondents' self-reported most important planning horizon with respect to saving and spending decisions, in order to validate his time preference estimates. He found that average values of time preference rates decline steadily with the planning horizons that ranged from "the next few months" (average rate = 10.43 percent) to "ten years or more" (average rate = 5.91 percent). This suggests that measures of time horizon may help validate time preference measures.

Future orientation, on the face of it, seems likely to be very closely linked to time preference. Strathman et al. (1994), for example, produced a "concern for future consequences" scale and found that those who were more concerned about the future smoked and drank less than others and engaged in more environmentally concerned behavior (such as recycling glass). Similar results were found by Ebreo and Vining (2001). Likewise, Keough, Zimbardo, and Boyd (1999) reported that those having a more present time perspective are more likely to report using alcohol, drugs, and tobacco. Hodgins and Engel (2002) showed that pathological gamblers had significantly shorter time horizons than social gamblers. However, Zimbardo's approach to time perspective (see Zimbardo and Boyd 1999) should give us pause. Zimbardo's time perspective inventory (ZPTI) has five valid and reliable factors. These are past-negative, past-positive, present-fatalistic, present-hedonistic, and future orientation. While future orientation correlates highly with Strathman's consideration of future consequences scale (and with conscientiousness), Zimbardo and Boyd pointed out that the assumption that scoring low on a scale of future orientation is equivalent to scoring highly on a scale of present orientation or that not being present oriented is the same as being future orientated is false. So it is possible to score highly on future orientation and, for example, also on present-hedonism (which includes such items as "taking risks keeps my life from becoming boring" and "I do things impulsively").

Future orientation does have the desirable characteristics that Frederick, Loewenstein, and O'Donoghue (2002) identified: that is, it is stable and does predict behavior across a range of situations. However, close inspection of the items that make up the scale suggests to us that it might be better to think of this as a measure of future planfulness (one typical item "I believe that a person's day should be planned ahead each morning"). It is clearly possible to plan time use (whether for the day or the month) while valuing the future significantly less than the present, so this is not the same concept as time preference. We suspect that it will prove to be a good empirical predictor of saving: the difficultly is how one can incorporate broader psychological concepts such as this into economic theory.

THE FORMATION OF TIME PREFERENCE AND SELF-CONTROL

The question of how saving, self-control, and discounting develop during childhood, adolescence, and adulthood is a crucial one for Western governments, which are concerned with the decline in saving rates and encouraging individuals to save for their pensions. It should also be of great interest to behavioral economists, though most to date have followed the lead of mainstream economists and ignored children and developmental issues.

Fisher proposed that upbringing might have an important effect on time preference and this idea receives some empirical support. For example, Mischel (1958) found that children from the Trinidadian black subculture, in which immediate self-reward was the prevailing gratification pattern, displayed a greater preference for immediate rewards than children of Trinidadian Indians, who more often exhibited self-denying delayed-gratification behavior.

These differences in ability to delay gratification when young are predictive over the long term. Mischel, Shoda, and Rodriguez (1992) carried out experiments on a group of four-year-olds' ability to delay gratification and compared the results with the children's achievements more than ten years later. They found that children who could defer gratification longer than others when they were four years old were later described as being more successful in school and coping better with frustration and stress than those who were not able to wait. Those who delayed longer at four had significantly higher education levels at age twenty-eight (Ayduk et al. 2000).

Maital and Maital (1977) also suggested that socioeconomic factors have an important influence on delay-of-gratification behavior. Their evidence points to time preference patterns being firmly established for life by adolescence. They further argued that differences in time preference among individuals play an important role in determining both the distribution of income at a particular point in time and the transmission of economic inequality from one generation to another. However, we cannot tell from this work whether the ability to delay gratification in childhood is relevant for saving behavior in adulthood (though it seems likely). And the studies mentioned above do not directly imply that the *time preference* of the children varied—it may be that they have simply learned better techniques for self-control.

A more recent study by Bernheim, Garrett, and Maki (2001) suggests that the teaching of self-controlling techniques is important. They studied the influence on asset accumulation in adulthood of taking courses in household financial decision making in high school. These courses covered topics such as budgeting, credit management, balancing checkbooks, and compound interest. Some states never adopted these consumer educational programs, while others adopted them at different times, making it possible to compare subsequent saving across states and over time. Bernheim, Garrett, and Maki found that asset accumulation was higher in the states that had adopted these educational programs than in those that did not. Moreover, those who as children had been encouraged to save using a bank account saved more than others as adults. Similarly, those who characterized their parents as having saved more than average saved more than others.

While children are assumed to adopt the time preferences and ability to delay gratification of their parents, there is, in fact, very little conclusive evidence on this issue (see Wood 1998 for a review). Seginer, Vermulst, and Shoyer (2004) have studied the link between perceived parenting style and adolescents' motivation to engage in future thinking, the cognitive representation of the future, and future-related behaviors. They looked at the domains of work and career and marriage and family. They found that autonomous-accepting parenting was indirectly linked to future orientation (via self-evaluation). Pursuing a similar line of investigation, Webley and Nyhus (2006) have recently investigated the idea that the behavior of parents (particularly that related to intertemporal choice) influences the economic behavior of their children. They used Dutch panel data to compare

the future orientation, conscientiousness, and saving of children ages sixteen to twenty-one with those of their parents. Their results show that parental behavior (such as discussing financial matters with children) and parental orientations (conscientiousness, future orientation) have a weak but clear impact on children's economic behavior as well as on economic behavior in adulthood. Hence, we can see evidence of an overall economic orientation being passed down through the generations, though the exact mechanisms through which this is achieved remains obscure.

CONCLUSION

We have tried in this essay to give a balanced account of behavioral economic (and economic psychological) work in the linked areas of time preference, self-control, and saving. It is our belief that considerable strides have been made in recent years in these areas, both theoretically and empirically, and that over the next few years there will be further fruitful developments. Our main concern is how individual differences can be conceptualized, properly measured, and incorporated into economic theory (in saving and in other areas). Time preferences can clearly be incorporated into theory, but they show too much situational variance to be a good individual difference measure. Future orientation, as conceived of by Zimbardo, is a good individual difference measure, but it is hard to see how to use it in a formal model. Reconciling these very different approaches will be a major challenge for the future.

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NOTES

1. See Frederick, Loewenstein, and O'Donoghue 2002, Loewenstein 1992, and Wärneryd 1999 on the writings of early economists such as Rae, Senior, Mills, and Jevons.
2. The mean discount rates in these studies varied with the characteristics of the questions used to measure them. The mean rate given here is from the question with the lowest amount and the shortest time period.
3. Samwick (1998) also found the rate of time preference of 5.32 percent of the sample to be lower than –15 percent. He attributes all findings of negative rates to a strong bequest motive or inheritance. Inclusion of inheritance (or initial wealth) gives higher estimates of the rate of time preference.
4. Read and Read (2004) measured discount factors for several contexts and delays in people of various ages. They reported systematic but complex relationships between age and discounting. The major trends were for the elderly to discount the most and for the middle-aged to discount less than either the elderly or the young. Hence patience increases until middle age and decreases thereafter.
5. According to Loewenstein (1996) there are three important differences between preferences and visceral factors: (1) Visceral factors change more rapidly than preferences because they are correlated with external circumstances such as stimulation and deprivation. Consequently, it is more difficult to defend oneself against them. (2) Visceral factors draw

on different neuropsychological mechanisms than preferences do. Neurological research has found that the core of the brain (the limbic system) uses chemical regulation to control body functions, and different configurations of these chemicals are experienced as hunger, thirst, sleepiness, elation, depression, and so on. The role of this part of the brain is also critical in the regulation of behavior. Preferences, on the other hand, consist of information stored in memory concerning the relative desirability of different goods and activities. (3) We have a limited ability to imagine hunger, pain, anger, or other passions when we are not experiencing them. Human memory is not suited to storing information about visceral sensations. For example, we can recognize pain when we reexperience it, but we cannot recall pain at will by reexperiencing it in our imagination. Often we might regret and feel ashamed about behavior induced by visceral factors, since we cannot remember the intensity of the pain, hunger, or arousal in later periods. Similarly, it will be difficult to consider visceral sensations when planning future behavior.

6. Ulysses, preparing for a sea voyage, was warned by Circe that he would be tempted by the irresistible song of the Sirens, which would so enchant him that he would never get home. In other words, he was warned about the possibility that he would act in a dynamically inconsistent way. Still, wishing to sail his ship past the Sirens and finish his voyage, Ulysses prepared himself: he had his men bind him to the ship's mast before he came within earshot of the Sirens so that he could not yield to the temptation. He plugged the ears of his crew with wax so that they would not hear the song and be tempted themselves. This way, Ulysses managed to both enjoy the Sirens' song and to finish his journey.
7. Christmas clubs are organizations that help people save for the extra expenditures many have before Christmas (e.g., presents). Money is paid (sometimes regularly) by members into an account, no interest is earned on the accumulated assets, and the account cannot be drawn on until a specified date (e.g., December 1). Since saving in a regular interest-bearing savings account is a better alternative, it must be the labeling of the account (as "Christmas spending") as well as the inability to withdraw the money before the set date that are the attractive characteristics.
8. Shefrin and Thaler (1988) admitted that the rules applied by households will differ from one household to another and might be context specific. Winnett and Lewis (1995) have suggested a different tripartite classification (liquidity, windfall/regular, capital/labor), and Kojima and Hama (1982) have found that Japanese housewives have nine "psychological purses" (see Webley 1995). However, Shefrin and Thaler argue that there are some common elements that can be used for aggregate predictions, which are the three mental accounts they propose.
9. A review of evidence of physical labeling of money can be found in Zelizer 1993. People have been found to use sets of envelopes, china pitchers, tin cans, and so on for dedicating different parts of their income to particular expenses.

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