CHAPTER 9

Intertemporal Choice

9.1 Introduction

As the many examples in the previous chapter suggest, the model of exponential discounting can be used to accommodate a variety of behavior patterns. For this reason, and because of its mathematical tractability, the model is heavily relied upon in a variety of disciplines. Yet it fails to capture some of the things people do. In this chapter we focus on two phenomena that are not easily described in using the standard model. One is that people are time inconsistent; that is, their preferences appear to change for no reason other than the passing of time, as when a drug addict who woke up in the morning completely determined to clean up his act gives in and takes more drugs in the afternoon. Because people sometimes anticipate time-inconsistent behavior, they *choose not to choose*; that is, they take action intended to prevent themselves from taking action. Another phenomenon is the fact that people seem to have preferences over utility profiles; that is, they care about the shape of their utility stream, and not just about the (discounted) individual utilities. We will also study how behavioral economists go about capturing these phenomena. Time inconsistency will be captured by means of a model of hyperbolic discounting, a highly versatile model. We will see that the model of hyperbolic discounting does a good job of capturing time inconsistency, but that it is inadequate to account for preferences over profiles.

9.2 Hyperbolic discounting

As we saw in the previous chapter, the exponential discounting model can capture a great deal of behavior, including – perhaps surprisingly – forms of addiction. Yet the image of the rational addict does not sit well with observed behavior and first-person reports of many addicts. As the beat poet William S. Burroughs writes in the prologue to his autobiographical novel *Junky*:

> The question is frequently asked: Why does a man become a drug addict? The answer is that he usually does not intend to become an addict. You don't wake up one morning and decide to be a drug addict ... One morning you wake up sick and you're an addict.

Later in this chapter, we will discuss other behaviors that are hard to reconcile with the model of exponential discounting.

Exponential discounting implies the agent's behavior is **time consistent**, meaning that his or her preferences over two options do not change simply because time passes. If you are time consistent and feel (today) that **a** is better than **b**, then you felt the same way about **a** and **b** yesterday, and you will feel the same way about them tomorrow.

It is relatively easy to prove that anybody who discounts the future exponentially will be time consistent. But first we will need to review some notation. We continue to let $U^t(\mathbf{a})$ denote the utility from the point of view of time t of receiving some utility stream **a**. Let u_t refer to the utility received at time t. Then, $U^t(u_{t'})$ refers to the utility, from the point of view of t, of receiving $u_{t'}$ at time t'. As an example, if $u_{tomorrow}$ refers to the utility you will receive tomorrow from eating ice-cream tomorrow, then $U^{\text{today}}(u_{tomorrow})$ is the utility, from the point of view of today, of eating ice-cream tomorrow. This number would normally be high, but not as high as $U^{tomorrow}(u_{tomorrow})$, which is the utility you will receive tomorrow when you eat ice-cream tomorrow.

Suppose you are facing two rewards **a** and **b**, as in Figure 8.3 on page 189. Let us say that **a** gives you u_t at time t, and that **b** gives you u_{t+1} at time $t + 1$. Imagine that, from the point of view of time t, you strictly prefer **a** to **b**, that is, $U^t(\mathbf{a}) > U^t(\mathbf{b})$. If so, given that you are an exponential discounter, $U^t(\mathbf{a}) > U^t(\mathbf{b})$ implies that $u_t > \delta u_{t+1}$. Now let us look at what is going on before t, for example, at time $t - 1$. Would it be possible to weakly prefer **b** to **a**? If you did, $U^{t-1}(\mathbf{b}) \geq U^{t-1}(\mathbf{a})$, and $\delta^2 u_{t+1} \geq \delta u_t$. Since $\delta > 0$, we can divide by δ on both sides, which gives us $\delta u_{t+1} \geq u_t$, which is a contradiction. So at $t - 1$, you must strictly prefer **a** to **b**. What about $t - 2$? The same conclusion obtains and for the same reason. What about $t - 3$? We could go on.

In brief, if you discount the future exponentially, you must be time consistent. Graphically, what this means is that you either prefer **a** to **b** at all times (as in the dotted line in Figure 9.1), or you prefer **b** to **a** at all times (as in the dashed line in Figure 9.1), or you are indifferent between the two options (as in Figure 8.3 on page 189). At no point will the two lines cross. Your preference over **a** and **b** will never change simply because time passes.

The bad news, from the point of view of this model, is that people violate time consistency with alarming regularity. In the morning, we swear never to touch alcohol again; yet, by the time happy hour comes around, we gladly order another martini. On January 1, we promise our partners that we will stop smoking and start exercising; yet, when opportunity arises, we completely ignore our promises. Time inconsistency is nicely embodied in the figure of Ilya Ilyich Oblomov, who may be the most prominent procrastinator in all of literature. Here is how he appears on the first page of the book:

> [In] his dark-grey eyes there was an absence of any definite idea, and in his other features a total lack of concentration. Suddenly a thought would wander across his face with the freedom of a bird, flutter for a moment in his eyes, settle on his half-opened lips, and remain momentarily lurking in the lines of his forehead. Then it would disappear, and once more his face would glow with a radiant insouciance which extended even to his attitude and the folds of his night-robe.

If this is unfamiliar, good for you! Otherwise, you will probably agree that time inconsistency is common. Graphically, we seem to discount the future in accordance with Figure 9.2. That is, at time $t - 1$ (and possibly right

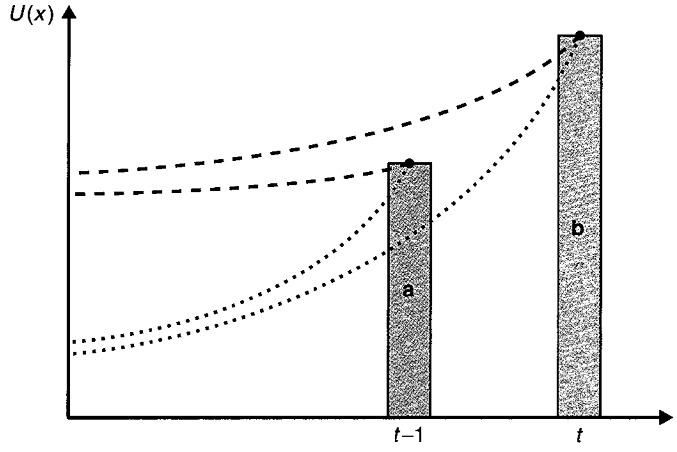

Figure 9.1 Time-consistent preferences

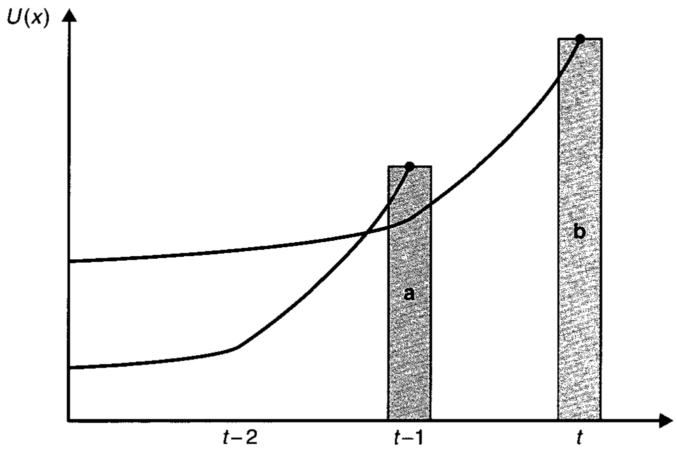

Figure 9.2 Time-inconsistent preferences

before it), we want the smaller, more immediate reward; earlier than that, we want the larger, more distant reward.

It turns out that this kind of behavior can be usefully modeled with a slight variation of Definition 8.10 on page 186.

Definition 9.1 The beta–delta function *According to the* ***beta–delta function****, the utility $U^0(\mathbf{u})$ of utility stream $\mathbf{u} = \langle u_0, u_1, u_2, \ldots \rangle$ from the point of view of $t = 0$ is:*

$$U^0(\mathbf{u}) = u_0 + \beta\delta u_1 + \beta\delta^2 u_2 + \beta\delta^3 u_3 + \ldots$$
$$= u_0 + \sum_{i=1}^{\infty} \beta\delta^i u_i$$

If you act in accordance with this formula, you evaluate utility streams by adding the utility you would receive now, $\beta\delta$ times the utility you would receive the next round, $\beta\delta^2$ times the utility you would receive in the round after that, and so on. The only difference relative to the exponential discounting function is that all utilities except u_0 are multiplied by an additional β, which is assumed to be a number such that $0 < \beta \leq 1$. Notice that while δ is raised to higher powers (δ, δ^2, δ^3, . . .) for later rewards, β is not. This form of discounting is called **quasi-hyperbolic discounting**. Here, I loosely refer to it as **hyperbolic discounting**. The resulting model is called the **beta–delta model**.

The introduction of the parameter β makes an interesting difference. When $\beta = 1$, an agent who discounts the future hyperbolically will behave exactly like an agent who discounts the future exponentially. For, if $\beta = 1$, the hyperbolic discounter will maximize the following expression:

$$U^0(\mathbf{u}) = u_0 + \beta\delta u_1 + \beta\delta^2 u_2 + \ldots = u_0 + \delta u_1 + \delta^2 u_2 + \ldots,$$

which is identical to the delta function (Definition 8.10). When $\beta < 1$, however, things are different. In this case, all outcomes beyond the present time get discounted more than under exponential discounting, as shown in Figure 9.3. Compare this figure with Figure 8.2 on page 188. As you can tell, the hyperbolic curve is relatively steep between t and $t - 1$, and relatively flat before $t - 1$.

Exercise 9.2 The beta–delta function Suppose that you are facing a utility stream of 1 utile at $t = 0$, 3 utiles at $t = 1$, and 9 utiles at $t = 2$. For each of the following parameter values, apply the beta–delta function to determine the discounted utility of the stream.

(a) $\beta = 1/3$ and $\delta = 1$.
(b) $\beta = 1$ and $\delta = 2/3$.
(c) $\beta = 1/3$ and $\delta = 2/3$.

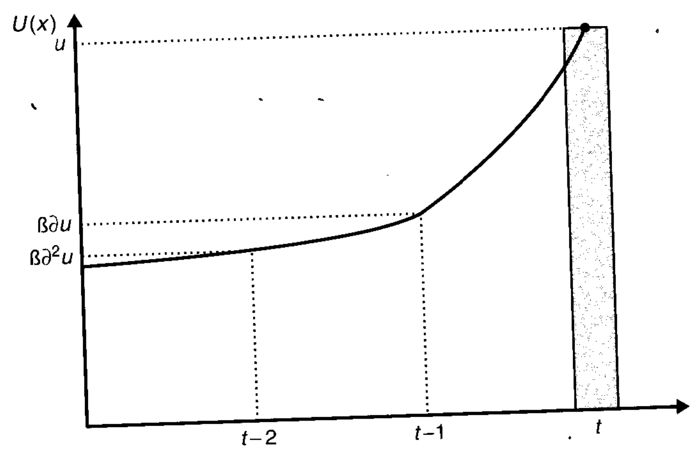

Figure 9.3 Hyperbolic discounting

When an agent discounts the future hyperbolically, if given a choice between a smaller, earlier reward and a bigger, later reward, the picture may well end up looking like Figure 9.2. The result is what Russians call "Oblomovitis" – in the novel, and sometimes in real life, a deadly condition. The fact that hyperbolic discounting may lead to time-inconsistent behavior can be shown algebraically, too.

Example 9.3 Hyperbolic discounting Suppose that you are on a diet, but have to decide whether to have a slice of red-velvet cake at a party some random Saturday. Eating the cake would give you a utility of 4. If you have the cake, however, you will have to exercise for hours on Sunday, which would give you a utility of 0. The other option is to skip the cake, which would give you a utility of 1, and to spend Sunday relaxing in front of the television, for a utility of 6. Thus, you are facing the choice depicted in Table 9.1. You discount the future hyperbolically, with $\beta = 1/2$ and $\delta = 2/3$. Questions:

(a) From the point of view of Friday, what is the utility of eating the cake (**c**) and of skipping it (**d**)? Which would you prefer?
(b) From the point of view of Saturday, what is the utility of eating the cake and of skipping it? Which would you prefer?

Table 9.1 Red-velvet problem

	Saturday	Sunday
c	4	0
d	1	6

(a) From the point of view of Friday, Friday is $t = 0$, Saturday is $t = 1$, and Sunday is $t = 2$. From this point of view, eating the cake is associated with utility stream $\mathbf{c} = \langle 0, 4, 0\rangle$ and not eating the cake is associated with utility stream $\mathbf{d} = \langle 0, 1, 6\rangle$. Consequently, from the point of view of Friday, the utility of eating the cake is:

$$U^0(\mathbf{c}) = 0 + 1/2 * 2/3 * 4 + 1/2 * (2/3)^2 * 0 = 4/3.$$

Meanwhile, from the point of view of Friday, the utility of skipping the cake is:

$$U^0(\mathbf{d}) = 0 + 1/2 * 2/3 * 1 + 1/2 * (2/3)^2 * 6 = 5/3.$$

From the point of view of Friday, therefore, you will prefer to skip the cake and stick to your diet.

(b) From the point of view of Saturday, Saturday is $t = 0$ and Sunday is $t = 1$. From this point of view, eating the cake is associated with utility stream $\mathbf{c} = \langle 4, 0\rangle$ and not eating the cake is associated with utility stream $\mathbf{d} = \langle 1, 6\rangle$. Consequently, from the point of view of Saturday, the utility of eating the cake is:

$$U^0(\mathbf{c}) = 4 + 1/2 * 2/3 * 0 = 4.$$

Meanwhile, from the point of view of Saturday, the utility of skipping the cake is:

$$U^0(\mathbf{d}) = 1 + 1/2 * 2/3 * 6 = 3.$$

From the point of view of Saturday, therefore, you will prefer to eat the cake.

This example shows time inconsistency at work. Ahead of time, you prefer to stick to your diet and resolve to refrain from having the cake. And yet, when the opportunity arises, you prefer to ignore the diet and eat the cake. This means that you are exhibiting **impulsivity**. If impulsivity is not familiar to you, you belong to a small and lucky subsample of humanity. As the example shows, you can be impulsive and impatient at the same time. The next exercise illustrates the interaction between the two.

Exercise 9.4 Impulsivity and impatience Suppose you are offered the choice between option **a** (8 utiles on Thursday) and **b** (12 utiles on Friday).

(a) Assume that $\beta = 1$ and that $\delta = 5/6$. From the point of view of Thursday, which one would you choose? From the point of view of Wednesday, which one would you choose?

(b) Assume that $\beta = 1$ and that $\delta = 1/6$. From the point of view of Thursday, which one would you choose? From the point of view of Wednesday, which one would you choose?

(c) Assume that $\beta = 1/2$, and that $\delta = 1$. From the point of view of Thursday, which one would you choose? From the point of view of Wednesday, which one would you choose?

(d) Assume that $\beta = 1/2$, and that $\delta = 2/3$. From the point of view of Thursday, which one would you choose? From the point of view of Wednesday, which one would you choose?

Hyperbolic discounting can account not just for the fact that people emphasize their present over their future well-being, but also that they change their minds about how to balance the present versus the future. Thus, it can account for the fact that people fully intend to diet, stop smoking, do homework, and quit drugs, and then completely fail to do so. Here is another example.

Exercise 9.5 Cancer screening Most colon cancers develop from polyps. Because early screening can detect polyps before they become cancerous and colon cancer in its early stages, many doctors advise patients over a certain age to have a colonoscopy. Unfortunately, colonoscopies are experienced as embarrassing and painful. The typical person, when young, resolves to have a colonoscopy when older, but changes his or her mind as the procedure approaches. Assume that two patients, Abelita and Benny, have the choice between the following: (**a**) having a colonoscopy at time 1 (utility = 0) and being healthy at time 2 (utility = 18); and (**b**) avoiding the colonoscopy at time 1 (utility = 6) and be unhealthy at time 2 (utility = 0).

Abelita discounts the future exponentially. Her $\delta = 2/3$.

(a) At $t = 0$: What is her utility of **a**? What is her utility of **b**?

(b) At $t = 1$: What is her utility of **a**? What is her utility of **b**?

Benny discounts the future hyperbolically. His $\beta = 1/6$ and his $\delta = 1$.

(c) At $t = 0$: What is his utility of **a**? What is his utility of **b**?

(d) At $t = 1$: What is his utility of **a**? What is his utility of **b**?

(e) Who acts more like the typical patient?

(f) Who is more likely to end up with health issues?

The beta–delta function also permits you to go the other way. Knowing a person's preferences, the function permits you to compute their beta and/or delta. Consider the following exercise.

Exercise 9.6 Suppose that you discount the future hyperbolically, that is, in accordance with the beta–delta function, and that from the point of view of Thursday you are indifferent between options **a** (1 utile on Thursday) and **b** (3 utiles on Friday).

(a) If $\beta = 1/2$, what is δ?

(b) If $\delta = 4/9$, what is β?

Exercise 9.7 Suppose that you discount the future hyperbolically. Assume that both β and δ are strictly greater than zero but strictly smaller than one. At $t = 0$, you are given the choice between the following three options: **a** (1 utile at $t = 0$), **b** (2 utiles at $t = 1$), and **c** (3 utiles at $t = 2$). As a matter of fact, at $t = 0$ you are indifferent between **a** and **b** and between **b** and **c**.

(a) Compute β and δ.

(b) Suppose, in addition, that at $t = 0$ you are indifferent between **c** and **d** (x utiles at $t = 3$). What is x?

Exercise 9.8 Suppose that you discount the future hyperbolically. Assume that both β and δ are strictly greater than zero but strictly smaller than one. At $t = 0$, you are given the choice between the following three options: **a** (2 utiles at $t = 0$), **b** (5 utiles at $t = 1$), and **c** (10 utiles at $t = 2$). As a matter of fact, at $t = 0$ you are indifferent between **a** and **b** and between **b** and **c**. Compute β and δ.

Exercise 9.9 Wicksteed's blanket The theologian and economist Philip Wicksteed offers the following observation: "[We] lie awake (or what we call awake next morning) half the night consciously suffering from cold, when even without getting out of bed we could reach a blanket or a rug which would secure comfortable sleep for the rest of the night." Suppose that staying in a freezing bed gives Wicksteed 1 utile now ($t = 0$), 1 utile in the middle of the night ($t = 1$), and 1 utile in the early morning ($t = 2$). If he reached for the blanket, he would suffer 0 utiles now but enjoy 5 utiles in the middle of the night and in the early morning. A patient man, Wicksteed might have had a delta of one. What is his beta, given that he does *not* reach for the blanket?

The next two sections contain more exercises on hyperbolic discounting.

9.3 Choosing not to choose

Another feature of human behavior is that we sometimes choose not to choose, in the sense that we take action to prevent ourselves from taking action. As recounted by Homer, Ulysses famously allowed himself to be tied to the mast of his ship so that he could listen to the sweet but seductive song of the sirens without risking doing anything stupid (see Figure 9.4). The rest of us are willing to pay a premium to buy snacks in small packages, soft drinks from overpriced vending machines, and beer in small quantities. Though we know that we could save money by buying in bulk, we fear that doing so would lead to overindulgence, leaving us fat, drunk, and no better off financially. In a well-known study about procrastination and precommitment, executive-education students were allowed to set their own deadlines for three required papers. At the beginning of the term almost three-quarters, 73 percent, set deadlines that fell before the last week of class, even though they knew missed deadlines would lead to lower grades. Apparently the students were so afraid they would not get the work done without deadlines and external penalties that they were willing to take the risk.

This kind of behavior is theoretically puzzling. From the point of view of exponential discounting, choosing not to choose makes no sense. According to this model, if you do not want to indulge now, you will not want to indulge later either. But such behavior is not obviously entailed by the hyperbolic discounting model either. If you discount your future hyperbolically, you may very well plan not to overindulge but then overindulge anyway. Thus, neither one of the models that we have explored so far is appropriate for capturing common behaviors such as those above.

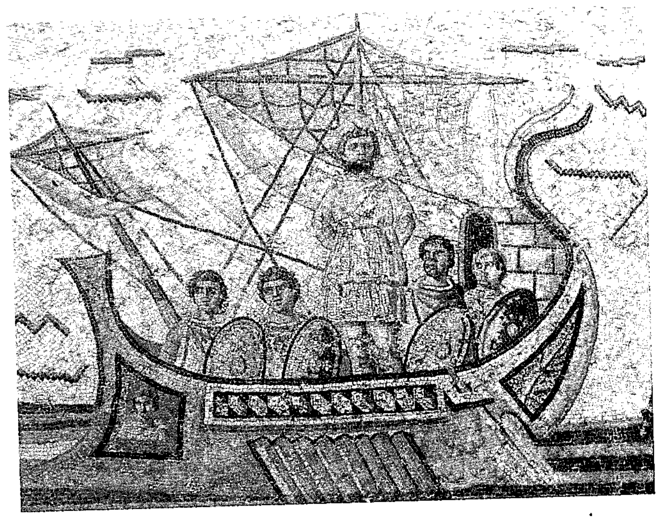

Figure 9.4 Ulysses and the Sirens. Detail of mosaic from Dougga, Tunisia. Photograph by Dennis Jarvis. Used with permission.

Behavioral economists approach the issue by drawing a distinction between **naive** and **sophisticated** hyperbolic discounters. When people are time inconsistent – meaning that they prefer x to y ahead of time, but y to x when the time arrives – they are said to have **self-control problems**. Naive time-inconsistent individuals – or *naifs*, for short – are unaware of their self-control problems. Naifs make their choices based on the inaccurate assumption that their future preferences will be identical to their current preferences. Sophisticated time-inconsistent individuals – or *sophisticates*, for short – are aware of their self-control problems. Sophisticates make their choices based on accurate predictions of their future behavior. An example might help.

It is October and you want to save for presents for the upcoming holiday season. You know that saving in October and November allows you to get some really nice presents for your loved ones in December. Saving and saving again is no fun, but your utility stream 3–3–27 ends on a high note when friends and family open their presents and love you again. You can also save in October, splurge in November, and still end up with decent presents in December, for a utility stream of 3–9–15. It goes without saying that you can just spend and spend, in which case your utility stream is 6–6–9. See Table 9.2(a) (ignoring the last line for now).

Table 9.2 Layaway payoff matrices

	Oct	Nov	Dec
save–save	3	3	27
save–spend	3	9	15
spend–spend	6	6	9
layaway	2	3	27

(a) October

	Nov	Dec
save	3	27
spend	9	15

(b) November

Let us first assume that you are an exponential discounter with $\partial = 1$. If so, you will choose **save–save**:

$$U^{Oct}(\textbf{save–save}) = 3 + 3 + 27 = 33$$
$$U^{Oct}(\textbf{save–spend}) = 3 + 9 + 15 = 27$$
$$U^{Oct}(\textbf{spend–spend}) = 6 + 6 + 9 = 21$$

Let us now consider the possibility that you are a hyperbolic discounter with $\partial = 1$ and $\beta = 1/3$. If so, you will also choose **save–save**:

$$U^{Oct}(\textbf{save–save}) = 3 + \tfrac{1}{3}(3 + 27) = 13$$
$$U^{Oct}(\textbf{save–spend}) = 3 + \tfrac{1}{3}(9 + 15) = 11$$
$$U^{Oct}(\textbf{spend–spend}) = 6 + \tfrac{1}{3}(6 + 9) = 11$$

So far so good.

The problem is that having saved in October, you may be tempted to splurge in November; now you have savings, after all, that risk burning a hole in your pocket. You can continue to **save** in November and enjoy the expected 3–27 utility stream. Or you can **spend**, in which case you get 9–15. See Table 9.2(b) for the options available to you in November. The exponential discounter, being time consistent, would of course continue to **save**:

$$U^{Nov}(\textbf{save}) = 3 + 27 = 30$$
$$U^{Nov}(\textbf{spend}) = 9 + 15 = 24$$

A hyperbolic discounter, however, would **spend**:

$$U^{Nov}(\textbf{save}) = 3 + \tfrac{1}{3} * 27 = 12$$
$$U^{Nov}(\textbf{spend}) = 9 + \tfrac{1}{3} * 15 = 14$$

That is, come November, there is no way the hyperbolic discounter would stay on the **save–save** path charted in October. An unsophisticated, or naive, hyperbolic discounter is unable to anticipate his future behavior. Thus, he will get on the wagon in October, choose **save–save**, but fall off it and splurge in November; in spite of the very best intentions, therefore, he will end up with **save–spend**. A sophisticated hyperbolic discounter is able to anticipate her behavior and knows in October that **save–save** is not going to happen. Having eliminated **save–save** from her menu, the sophisticate might as well **spend–spend**, since she is indifferent between the remaining two options.

This is bad news not only for the hyperbolic discounter but also for purveyors of expensive goods; if customers are unable to save for the fancy stuff, nobody will be able to sell it. Department stores and other sellers therefore have every incentive to offer a **layaway** plan: for a small administrative fee of one, payable in October, stores will hold on to customers' savings in November, so as to make spending them then impossible. The fact that department stores offer a layaway plan does not eliminate any of the other options available in October; it merely adds one with a utility stream of 2–3–27, represented by the last line in Table 9.2(a).

No exponential discounter would choose **layaway**, since U^{Oct}(**layaway**) = 2 + 3 + 27 = 32, which is inferior to **save–save**. For our hyperbolic discounter, the discounted utility would be U^{Oct}(**layaway**) = 2 + ⅓(3 + 27) = 12. The unsophisticated hyperbolic discounter, who evaluates the options available in October without consideration of whether he can stick to the plan in November, will note that **save–save** looks better than **layaway** and choose **save–save** in October, fall off the wagon in November, and end up with **save–spend**. The sophisticated hyperbolic discounter, who eliminates **save–save** from her menu knowing that she will be unable to stick to it, finds that **layaway** beats both **save–spend** and **spend–spend**. She signs up for the **layaway** plan, is prevented from splurging in November, and gets the nice presents in December. Notice that the introduction of **layaway**, although inferior to **save–save** in terms of utilities, actually helps the sophisticated hyperbolic discounter do better than she would have done otherwise.

Here is another example of the behavior of an exponential discounter, a naive hyperbolic discounter, and a sophisticated hyperbolic discounter.

Example 9.10 Johnny Depp 1 Your local cinema theater offers a mediocre movie this week ($u_0 = 3$), a good movie next week ($u_1 = 5$), a great movie in two weeks ($u_2 = 8$), and a fantastic Johnny Depp movie in three weeks ($u_3 = 13$). Unfortunately, you must skip one of the four. For all questions below, suppose that $\delta = 1$ and $\beta = 1/2$. Will you skip **a** the mediocre, **b** the good, **c** the great, or **d** the fantastic movie?

If you are an exponential discounter, you will skip the worst movie. At $t = 0$, you know that $U^0(\mathbf{a}) = 5 + 8 + 13 = 26$ is better than $U^0(\mathbf{b}) = 3 + 8 + 13 = 24$, which is better than $U^0(\mathbf{c})$, and so on. Because you are an exponential discounter, and therefore time consistent, you stick to your plan.

If you are a naive hyperbolic discounter, you will procrastinate until the very last moment and miss the fantastic movie. At $t = 0$, you choose between $U^0(\mathbf{a}) = ½(5 + 8 + 13) = 13$, $U^0(\mathbf{b}) = 3 + ½(8 + 13) = 13.5$, $U^0(\mathbf{c}) = 3 + ½(5 + 13) = 12$, and $U^0(\mathbf{d}) = 3 + ½(5 + 8) = 9.5$. You watch the mediocre movie, fully intending to skip the good one. But at $t = 1$, everything looks different. From there, you no longer have the option to skip the mediocre movie. You choose between $U^1(\mathbf{b}) = ½(8 + 13) = 10.5$, $U^1(\mathbf{c}) = 5 + ½ * 13 = 11.5$, and $U^1(\mathbf{d}) = 5 + ½ * 8 = 9$. You watch the good movie, fully intending to skip the great movie. At $t = 2$, though, you choose between $U^2(\mathbf{c}) = ½ * 13 = 6.5$ and $U^2(\mathbf{d}) = 8$. Thus, you watch the great movie and at $t = 3$ have no choice but to skip the fantastic movie.

If you are a sophisticated hyperbolic discounter, by contrast, you will skip the good movie. Your sophistication allows you to predict that self-control problems at $t = 2$ would prevent you from watching the fantastic movie. Consequently, the choice at $t = 1$ is between skipping the good movie for a utility of $U^1(\mathbf{b}) = 10.5$ or else end up with $U^1(\mathbf{d}) = 9$. So you know at $t = 0$ that at $t = 1$ you will choose **b**. At $t = 0$, therefore, the choice is between $U^0(\mathbf{a}) = 13$ and $U^0(\mathbf{b}) = 13.5$. Thus, you will watch the mediocre movie, skip the good one, and watch the great and fantastic ones.

This example shows how sophistication helps people anticipate the problems posed by time-inconsistent behavior. Behavior of this kind is probably common. At night, many people are determined to get up early the next morning, even though they anticipate that tomorrow morning they will want to sleep late. In order to prevent their morning self from sleeping late, therefore, they set alarms and put them on a window ledge across the room, behind a cactus. There are alarms that, when they go off, roll off the bedside table and under the bed or across the room, forcing your morning self to get up and chase them down, by which time (the idea is) you will be too awake to go back to bed. There are alarms that unless you get up and turn them off promptly will start shredding money. If any of these techniques sound familiar, you are a sophisticated hyperbolic discounter. Notice that the demand for schemes such as layaway plans and devices such as rolling alarm clocks shows not only that people exhibit time inconsistency, but also that they are fairly sophisticated in anticipating and subverting their own inconsistent behavior.

Bizarrely, however, sophistication can also exacerbate self-control problems. We have already come across one such case, namely, the sophisticated hyperbolic discounter who having eliminated **save–save** decides that she might as well **spend–spend**. She will therefore act even more myopically than the unsophisticated hyperbolic discounter, who attempts to **save–save** and at least ends up with **save–spend**. What follows is another, even more striking example of this phenomenon.

Exercise 9.11 Johnny Depp 2 This exercise refers to Example 9.10. Suppose instead that you can only watch one of the four movies. Will you watch **a** the mediocre, **b** the good, **c** the great, or **d** the fantastic movie?

(**a**) Show that an exponential discounter will watch **d** the fantastic movie.
(**b**) Show that a naive hyperbolic discounter will watch **c** the great movie.
(**c**) Show that a sophisticated hyperbolic discounter will watch **a** the mediocre movie.

The problem is that sophisticated hyperbolic discounters tend to **preproperate**, that is, doing something now when it would be better to wait. Preproperation in one sense is the very opposite of procrastination, which is a problem that naive hyperbolic discounters have. Paradoxically, then, there are situations in which naifs are better off than sophisticates. Sometimes individuals who are well aware of their self-control problems would do better if they did not try to anticipate their future behavior to the extent that they do.

9.4 Preferences over profiles

The model of hyperbolic discounting, especially when augmented with a story about naifs and sophisticates, can capture a number of phenomena that are simply inconsistent with the model of exponential discounting. Yet, there are many conditions under which both exponential and hyperbolic discounting fail to accurately capture people's actual behavior. The following exercise makes this clear.

Exercise 9.12 Cleaning the house It is Sunday morning ($t = 0$), and you are determined to accomplish two things today: cleaning the apartment and going to the movies. You can either clean during the morning (at $t = 0$), and go to the movies during the afternoon (at $t = 1$) or go to the movies during the morning (at $t = 0$) and clean in the afternoon (at $t = 1$). You hate cleaning: it only gives you a utility of 2. You love the movies: it gives you as much as 12.

For the first two questions, assume that you discount the future exponentially with $\delta = 1/2$. From the point of view of $t = 0$:

(a) What is the utility of cleaning first and going to the movies later?
(b) What is the utility of going to the movies first and cleaning later?

For the last two questions, assume that you discount the future hyperbolically with $\beta = 1/3$ and $\delta = 1/2$. From the point of view of $t = 0$:

(c) What is the utility of cleaning first and going to the movies later?
(d) What is the utility of going to the movies first and cleaning later?

What this exercise suggests is that whether you discount the future exponentially or hyperbolically, you will always schedule the pleasant experience first and the unpleasant one later.

This implication contrasts sharply with people's observed behavior. Personal experience suggests that, when choosing between sequences of events, people will make a point of scheduling the unpleasant experience first and the pleasant one later. "We must try to make the latter part of the journey better than the first, so long as we are en route," as the ancient Greek philosopher Epicurus said. In this case, personal experience and ancient wisdom are supported by evidence. In one study, the researchers presented people with verbal descriptions and graphical representations of increasing and decreasing salary profiles, and elicited preferences over the profiles. The authors conclude that all things equal, by and large, a large majority of workers prefer increasing wage profiles over flat or decreasing ones.

Such a **preference for increasing utility profiles** could in principle be captured by relaxing the assumption (which we made tentatively in Chapter 8) that δ is less than one. If δ exceeds one, a rational discounter will postpone pleasant events as much as possible. When $\delta > 1$, it follows that $r < 0$, which is why the resulting preference is called **negative time preference**. Yet, this solution is awkward, because the very same people who clean in the morning and go to the movies in the afternoon simultaneously discount the future with $\delta < 1$ and $r > 0$ (that is, exhibit **positive time preference**) in other contexts.

In addition, there is evidence that people also exhibit a **preference for spread**. That is, people sometimes like to distribute multiple desirable events over time. While some children eat all their Halloween candy in one sitting, others prefer to distribute the eating evenly over days or weeks. This kind of preference cannot be accounted for either by positive or negative time preference. Finally, people often exhibit a **preference for variation** over time, as they avoid choosing to consume the same good over and over again. "Variation in everything is sweet," the ancient Greek poet Euripides wrote. As a result, people diversify over time. (We will return to the theme of diversification in the next section.)

All this suggests that people have **preferences over profiles**: they care about the *shape* of the utility stream as well as about (discounted) individual utilities. People often save the best for last: perhaps they want to end on a high note, hope to get the unpleasant experience over with, or rely on the prospect of a pleasant experience to motivate themselves to take care of the unpleasant one. People also wish to distribute pleasant and unpleasant events over time and they value variety. Such preferences over profiles cannot be captured in the context of either one of the discounting models we have discussed so far. Yet preferences over profiles seem to be an important phenomenon.

Example 9.13 Economics professors Rumor has it that even economics professors frequently elect to receive their annual salary in twelve rather than nine installments, even though they would maximize their discounted utility by asking to be paid in nine. Obviously, they have the option of saving some of their money to smooth out consumption. A preference for a smooth income profile would explain this phenomenon.

The shape of utility profiles has received a lot of attention in the literature on the **peak–end rule**, which is used to assess the desirability of utility streams or "episodes." When people follow this rule, they consciously or unconsciously rank utility streams based on the average of the peak (that is, the maximum utility during the episode) and the end (that is, the utility near the end of the episode) and choose accordingly. Insofar as people act in accordance with the peak–end rule, the shape of the utility profile – and not just the (discounted) sum of utilities – will be critically important.

The peak–end rule has some interesting implications. Consider Figure 9.5. A person who applies the peak–end rule will assess episode (a) as superior

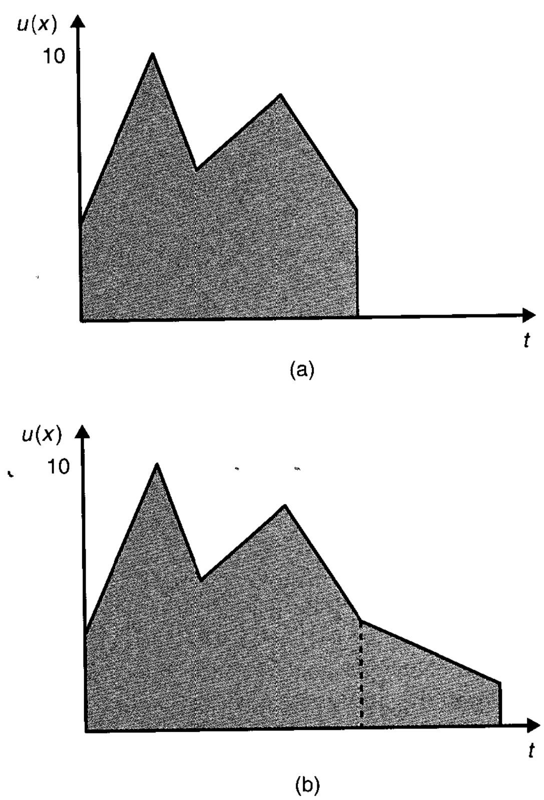

Figure 9.5 The peak–end rule

to episode (b). If this is not immediately obvious, notice that the peak utility of the two episodes is identical and that episode (a) has a higher end utility than episode (b). If you apply the peak–end rule to make the choice between (a) and (b), therefore, you will choose (a). But there is something odd about this ranking: episode (b) has all the utility of episode (a) and then some. The peak–end rule entails **duration neglect**, meaning that the *length* of an episode will be relatively unimportant, contrary to exponential and hyperbolic discounting models.

Would anyone apply the peak–end rule? In a famous study of patients undergoing a colonoscopy – as in Exercise 9.5 – the researchers confirmed that retrospective evaluations reflect the peak and end utility and that the length of the episode was relatively unimportant. Bizarrely, *adding* a painful tail to an already painful episode made people think of the episode as a whole as *less* painful and therefore *more* desirable.

Exercise 9.14 The peak–end rule Suppose you add a pleasant tail to an already pleasant episode. If people assess the episode as a whole in accordance with the peak–end rule, will this make people think of the episode as a whole as more or less pleasant?

Exercise 9.15 The peak–end rule, cont. This exercise refers to Figure 9.6. Would a person who follows the peak–end rule choose the episode represented by the solid line or the episode represented by the dashed line?

The peak–end rule can perhaps explain why people keep having children, even though systematic data suggest that parents are on the average less happy than non-parents, and that parents on the average are less happy when taking care of their children than when they are engaged in many other activities. As long as the most intense joy generated by children exceeds the most intense joy from other sources, and holding end experience constant, people will rank having children above other experiences. Duration neglect entails that long sleepless nights and the like will be relatively unimportant in the final analysis.

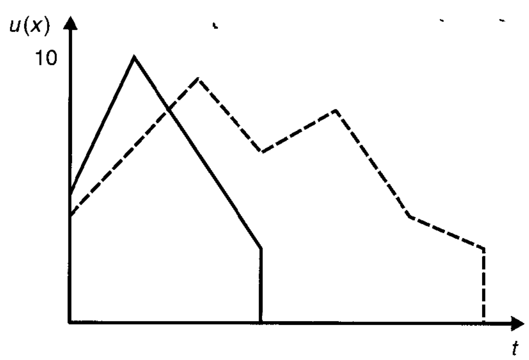

Figure 9.6 The peak–end rule, cont.

Exercise 9.16 College Many adults will tell you that their college years were the best years of their lives. This is puzzling since actual college students are not, on the average, fantastically happy. Use the concept of the peak–end rule to explain why people remember their college years so fondly.

There are choices that superficially look as if they must be the result of a preference over profiles but that really are not. For one thing, insofar as the anticipation of a pleasant event is itself pleasurable, you can rationally postpone the pleasant event. Suppose that it is Saturday, and that you are choosing whether to eat candy today or tomorrow. If you eat it today, you get 6 utiles today and 0 utiles tomorrow; if you postpone eating it until tomorrow, you get 2 utiles today (from the anticipation of the pleasant event) and 6 tomorrow (from the pleasant event itself). Given this sort of scenario, a rational discounter can postpone the eating of the candy until Sunday, even if he or she discounts the future somewhat. And this kind of narrative is consistent with standard theory.

9.5 Misprediction and miswanting

Implicit throughout this chapter and the last is the idea that many decisions depend on predictions of future preferences. When we go grocery shopping, we need to be mindful not only of the preferences we have when doing the shopping, but of the preferences that we will have when it is time to prepare and eat the food. When we choose a course of study, we have to consider the desires we will have while pursuing the degree, but also those we will have on the job for the rest of our careers. When we deliberate about whether to form a family and have children, we cannot ignore the preferences we will have 20, 40, or 60 years hence. And if we are time inconsistent and sophisticated about it, we have to anticipate how our preferences will change over time – or else we will not be able to choose not to choose as outlined in Section 9.3.

As it turns out, people are not able to predict their future preferences all that well. This fact should not be surprising. Many of the behavior patterns we have discussed in this book are surprising to social scientists and lay people alike. Consequently, there is little reason to think that a random decision-maker would be aware of them. Behavioral economists have identified a number of different ways in which people's predictions about their own preferences are systematically off target.

Underprediction of adaptation A number of studies suggest that people fail to appreciate the extent to which they will adapt to new conditions, such as a new endowment (see Section 3.5). Thus, people are unable to predict, ahead of time, just how attached they will be to an object after it has been incorporated in their endowment and loss aversion kicks in. In one study, participants who did not currently have a branded coffee cup reported that, if they had one, they would be willing to sell it for between \$3 and \$4; once they were awarded one, they said they would need between \$4 and \$6 to give it up.

Underprediction of adaptation helps explain marketing practices such as the no-questions-asked return policy from Section 3.5. If people underpredict the extent to which their preferences will change once some good has been incorporated into their endowment, they will underestimate the difficulties associated with returning the good once it has been brought home, and consequently help make the policy an effective tool for sellers.

Diversification bias Meanwhile, people often overestimate the degree to which their future selves will enjoy variety over time. In a famous study, undergraduate students were offered a choice of snacks to be delivered at the end of class on three subsequent class meetings over the course of as many weeks. When participants made separate choices on each of the three occasions, only 9 percent chose three different snacks. By contrast, when participants had to make all three choices during the first class meeting, 64 percent chose three different snacks. Such results suggest that people exaggerate the degree to which their future selves will favor variety and consequently diversify too much. Maybe variety in everything really is sweet – but not, apparently, as sweet as we think.

Projection bias You are probably familiar with projection: roughly, the unconscious process of attributing to others features of one's self. Projection bias is based on the idea that people project their current preferences onto their future selves. As a result, they will behave as though their future preferences are more like their current preferences than they actually are. The cliché according to which you should never go grocery shopping when extremely hungry or extremely full embodies the insight: when we are extremely hungry, we overestimate how much we will want to eat under more normal circumstances, and when we are extremely full, we underestimate it.

Another famous study asked office workers to choose between healthy and unhealthy snacks that would be delivered either at a time when they could expect to be hungry (late in the afternoon) or satiated (immediately after lunch). Some made the choice right after lunch; some in the late afternoon. Those who were scheduled to receive the snack at a time when they were likely to be hungry were more likely to opt for the unhealthy snack, presumably reflecting an increased taste for unhealthy snacks when hungry. However, those who were hungry when they made the decision were more likely to opt for unhealthy snacks than those who were satiated. Consistent with projection bias, people who were hungry when they made the decision acted as though they anticipated being more hungry when they actually received the snack a week later – like they would if they projected their current hunger onto their future self.

Example 9.17 Fasting Some religious traditions encourage fasting as a way to identify with less fortunate fellow human beings. The underlying insight is consistent with projection bias: it is only when we ourselves are hungry that we can begin to appreciate what it is like to actually starve.

Projection bias can explain underprediction of adaptation: we underestimate the extent to which our preferences will change after we incorporate something into our endowment and loss aversion kicks in.

Hot–cold empathy gaps The term "hot–cold empathy gap" refers to our inability when in a "hot" emotional state to empathize with people (ourselves or others) when in a "cold" state, and *vice versa*. The result is that when we are in a hot state – whether we are experiencing hunger, thirst, anger, embarrassment, or sexual arousal – we tend to underestimate how different our preferences are when we are in a cold state, and the other way around. Hot–cold empathy gaps occur both prospectively and retrospectively, and also across individuals. Empathy gaps are a direct result of projection bias.

One pioneering study found that sexual arousal dramatically increased college-aged males' reported willingness to engage in immoral and risky sexual behavior. Researchers compared students' answers to questions such as "Would you keep trying to have sex after your date says 'no' ?" and "Would you always use a condom if you didn't know the sexual history of a new sexual partner?" when in a normal (presumably not aroused) and in a sexually aroused state (while masturbating). The results suggest that young men when in a cold state underestimate how willing they are, when in a hot state, to engage in immoral and risky sexual behavior. As the authors put it: "people seem to have only limited insight into the impact of sexual arousal on their own judgments and behavior" – which is important not the least from a prevention standpoint.

Miswanting Many of our preferences are based on affective forecasts: predictions of how we would feel under various circumstances. For example, it is not uncommon to form preferences over careers, spouses, cars, or whatever based on predictions of how happy we would be if we had this or did that. Unfortunately, there is sometimes a mismatch between wanting and liking – between what we want because we think that we will like it when we get it and what we in fact like when we get it. When this happens, we are victims of miswanting. A major source of miswanting is **impact bias**: the tendency to overestimate the enduring impact of future events on our emotional lives. While many of us imagine that winning a million dollars would make us lastingly happy and becoming paraplegic lastingly sad, research suggests that both lottery winners and paraplegics return close to baseline happiness levels surprisingly soon. Similarly, marriage, divorce, fame, and fortune have a much smaller effect on our emotional lives, including our happiness, than people tend to imagine.

Impact bias may be driven in part by underprediction of adaptation: part of the story, certainly, is that lottery winners, paraplegics, and everybody else adapt to changing conditions to a much greater degree, and sooner, than they anticipate. Another source of miswanting is the **focusing illusion**: the tendency for whatever you are attending to to seem more important than it is. A person thinking about money, or a new car, or a bigger house, is likely to overestimate the emotional impact of getting more money, a new car, or a bigger house. But as Kahneman puts it: "Nothing in life is as important as you think it is when you are thinking about it."

Exercise 9.18 Sidgwick What kind of misprediction is described in the following passage, by the nineteenth-century moral philosopher Henry Sidgwick?

> In estimating for practical purposes the value of different pleasures open to us, we commonly trust most to our prospective imagination: we project ourselves into the future, and imagine what a particular pleasure will amount to under hypothetical circumstances. This imagination seems to be chiefly determined by our experience of past pleasures … but partly also by the state of our mind or nerves at the time.

Exercise 9.19 Buffet lines Perhaps you too have the following experience when picking up dinner from a buffet, where you can serve yourself exactly what kind of food you want. At the end of the meal, people find there is food on their plate they have no interest in eating. This is puzzling: if people were able to correctly predict their preferences, all the food would get eaten. Use the concepts of (**a**) diversification bias, (**b**) projection bias, and (**c**) hot–cold empathy gaps to explain how a person can choose food he or she will later have no interest in eating.

Systematic misprediction and miswanting have many adverse consequences. The phenomena discussed in this section make us strangers to ourselves, in that they may leave us shocked and surprised at the bizarre tastes of the person we thought we knew the best – namely, ourselves. To the extent that the right decision depends on accurate predictions, moreover, misprediction and miswanting can lead to bad decisions – even by our own lights. Impact bias and the focusing illusion, for example, can make us overestimate the degree to which wealth will allow us to satisfy our preferences, as a result of which we risk working too much and spending too little time with family and friends.

Then again, Adam Smith believed that exactly this kind of mistake is a driver of economic progress. Smith describes a "poor man's son, whom heaven in its anger has visited with ambition," and who imagines that great wealth will lead to great happiness. Only in "the last dregs of life," Smith continues, does he learn that the pursuit is all in vain and wealth and greatness mere "trinkets of frivolous utility." But here is the kicker:

> And it is well that nature imposes upon us in this manner. It is this deception which rouses and keeps in continual motion the industry of mankind. It is this which first prompted them to cultivate the ground, to build houses, to found cities and commonwealths, and to invent and improve all the sciences and arts, which ennoble and embellish human life.

As if "by an invisible hand," Smith concludes, the poor man's pursuit for wealth and greatness, though misguided, ends up promoting the greater good.

If you want to avoid misprediction and miswanting, Sidgwick proposed keeping close tabs on your and others' emotional reactions. He advocated what he called the **empirical–reflective** method:

> [We] must substitute for the instinctive, implicit inference just described a more scientific process of reasoning: by deducing the probable degree of our future pleasure or pain under any circumstances from inductive generalizations based on a sufficient number of careful observations of our own and others' experience.

Sidgwick's empirical–reflective method has recently been endorsed by leading psychologists, although they do not call it that. Sonja Lyubomirsky, for example, says we should "shelve" our gut reactions and instead systematically think things through based on our own and other people's experiences. Gilbert has even suggested that we refrain from trying to imagine what doing something will be like, for us, before we do it. He believes we can make far more accurate predictions by simply asking somebody else who is currently doing that thing to report what it feels like in the present. If you want to know what it is like to have children (cf. Exercise 6.43 on page 150), he believes you should not try to imagine what it would be like, for you, to have children; you should ask people who have children what it is like for them right now. You might, for example, just ask your parents, if they are still alive. That is probably the last piece of advice many people want to hear, but Gilbert swears by it.

Table 9.3 The happiest and unhappiest jobs of 2015

	Happiest	Unhappiest
1	Principal	Security guard
2	Executive chef	Merchandiser
3	Loan officer	Salesperson
4	Automation engineer	Dispatcher
5	Research assistant	Clerk

Exercise 9.20 Happiest professions Table 9.3 shows the result of a recent survey about the happiness of people in various professions: the middle column lists the five happiest professions, and the right-hand column the five unhappiest. You might think that you would be happiest if you were a lawyer or a doctor or something. Although he (probably) does not know you, Gilbert thinks you are wrong. What profession does he think would make you the happiest? Explain why he believes that he knows more about how happy you would be in each of the professions than you do.

9.6 Discussion

In this chapter, we have discussed the manner in which people make choices when time is a factor. We discovered several phenomena that are difficult to reconcile with the model of exponential discounting which we explored in Chapter 8. For many of these phenomena, the divergence appears significant and systematic, and therefore predictable. Again, knowledge of these phenomena permits us not only to explain and predict other people's behavior, but also to influence it, and to resist other people's efforts to influence ours.

There are many other phenomena that are at odds with the exponential discounting model we learned in Section 8.3. The **sign effect** says that gains are discounted at a higher rate than losses. The **magnitude effect** says that large outcomes are discounted at a lower rate than small ones. Consider also the likelihood that preferences change as a result of becoming sleepy, hungry, thirsty, excited, or old. Such changes are important not just because they mean that people's behavior can be expected to change over time in predictable ways, but also because people can be expected to respond to their own predictions about how their preferences will change. For example, many people know that they will buy too much food when shopping on an empty stomach and try to modulate their behavior accordingly. Economists have built models in which preference change is endogenous, but it may be more parsimonious to postulate the existence of a preference relation that evolves over time.

Behavioral economists take these phenomena to provide evidence that the exponential-discounting model and the assumption of stable preferences are descriptively inadequate. Some of these phenomena also cast doubt on the normative correctness of the model. It is true that some violations of exponential discounting – involving serious procrastination, extreme impulsivity, or similar – can harm the individual. While some degree of sophistication can help mitigate the effects of hyperbolic discounting, it can also hurt, as Exercise 9.11 showed. But then, there is real disagreement about the rationality of time discounting (see Section 8.4). The discussion about utility profiles in the previous section helps underscore these concerns. It can be argued that it is perfectly rational to desire a life of increasing utility, of ups-and-downs, or any other shape of the utility profile. If so, models of exponential and hyperbolic discounting both fail as a normative standard. And if exponential discounting is not the uniquely rational way to assess deferred outcomes, this would put in question its widespread use in disciplines such as cost–benefit analysis and finance.

In Part 5 we will consider strategic interaction, which will add yet another layer of complexity to the analysis.

ADDITIONAL EXERCISES

Exercise 9.21 Retirement savings When young, many people fully intend to save for retirement. However, when they start making money after college, they are often tempted to spend it immediately. Assume that Ximena and Yves have the choice between the following two options: (**a**) saving for retirement at time 1 ($u_1 = 0$) and retiring in style at time 2 ($u_2 = 12$); and (**b**) having more disposable income at time 1 ($u_1 = 6$) and retiring poor at time 2 ($u_2 = 0$).

Ximena is an exponential discounter. Her $\delta = 2/3$.

(a) At $t = 0$: What is her utility of **a**? What is her utility of **b**?

(b) At $t = 1$: What is her utility of **a**? What is her utility of **b**?

ADDITIONAL EXERCISES cont.

Yves is a naive hyperbolic discounter. His $\beta = 1/3$ and his $\delta = 1$.

(c) At $t = 0$: What is his utility of **a**? What is his utility of **b**?

(d) At $t = 1$: What is his utility of **a**? What is his utility of **b**?

(e) Who is more likely to experience regret?

(f) Who is more likely to retire in style?

Exercise 9.22 Addiction Suppose that life has three periods: youth, middle age, and old age. In every period you decide whether to do drugs ("hit") or not ("refrain"). The utility of hitting depends on whether you are addicted ("hooked") or not. If you are not hooked, the utility from hitting is 10 and the utility from refraining is 0. If you are hooked, the utility from hitting is −8 and the utility from refraining −25. In youth, you are not hooked; after that, you are hooked just in case you hit in the preceding period. Assume $\partial = 1$ and $\beta = 1/2$. What do you do if you are **(a)** time consistent, **(b)** time-inconsistent and naive, and **(c)** time-inconsistent and sophisticated?

Exercise 9.23 Weights and shackles Seneca offered the following advice:

> [Reflect] that prisoners at first find the weights and shackles on their legs hard to bear, but subsequently, once they have determined to endure them rather than chafe against them, necessity teaches them to bear them bravely, habit to bear them easily. In whatever life you choose you will find there are delights and relaxations and pleasures, if you are willing to regard your evils as light rather than to make them objects of hatred. In no respect has Nature done us a greater service, who, as she knew into what tribulations we were born, devised habit as a means of alleviating disasters, swiftly making us grow accustomed to the worst sufferings.

This passage suggests Seneca was well aware of at least one phenomenon discussed in Section 9.5. Which one?

Exercise 9.24 Match each of the vignettes below with one of the following phenomena: *hyperbolic discounting*, *preference over profiles*, and *choosing not to choose*. If in doubt, pick the best fit.

(a) Allie goes to bed at night fully intending to get up at 5 am and study hard before noon. When the alarm goes off, she smacks it hard and goes straight back to sleep.

(b) Bert wants to save more, but simply does not feel that he has enough money left at the end of the month. To encourage himself to save, he sets up an automatic transfer – on the first of each month – from his checking account to a savings account from which withdrawing money is a pain.

(c) Cherry can only afford a really nice meal at a restaurant once every semester. She makes sure to schedule it at the very end of the semester, so that she has something to look forward to when eating her Ramen noodles.

ADDITIONAL EXERCISES cont.

(d) Darius knows that his wife would be so much happier, and his marriage so much healthier, if he spent more time cleaning the house. He keeps thinking that it would be great to clean the house. Yet, when it comes down to it, there is always something on TV that prevents him from doing his part.

(e) Epicurus, or one of his followers, wrote: "Life is ruined by procrastination, and every one of us dies deep in his affairs."

(f) Unlike some people she knows, Filippa will not finish a whole tub of ice-cream in one sitting. Rather, she will allow herself exactly one spoonful every day.

(g) A website helps you pursue to your goals by requesting your credit-card number and the name of the non-profit organization you find most odious. If you fail to reach whatever goals you set for yourself, it will charge your card and send the money to the non-profit you despise.

(h) As Henry Sidgwick wrote: "In fact there is scarcely any point upon which moralizers have dwelt with more emphasis than this, that man's forecast of pleasure is continually erroneous."

Problem 9.25 *Drawing on your own experience, make up stories like those in Exercise 9.24 to illustrate the various ideas that you have read about in this chapter.*

FURTHER READING

The quotation from *Junky* at the beginning of Section 9.2 is from Burroughs (1977 [1953], p. xv). A helpful review of violations of the exponential discounting model is Frederick et al. (2002), reprinted as Chapter 1 of Loewenstein et al. (2003). The hyperbolic discounting model is due to Ainslie (1975); *Oblomov* is Goncharov (1915 [1859], p. 7) and Wicksteed (2003 [1933], pp. 29–30) describes the blanket-related dilemma. Naive versus sophisticated hyperbolic discounting is discussed in O'Donoghue and Rabin (2000), from which the Johnny Depp-related example and exercise were adapted (pp. 237–8). The study of procrastination and precommitment is Ariely and Wertenbroch (2002), and the layaway example was inspired by Tabarrok (2013). The advice about making the latter part of the journey better than the first appears in Epicurus (2012 [*c* 300 BCE], p. 182) and the study of workers' preferences is Loewenstein and Sicherman (1991); the line from Euripides is cited in Aristotle (1999 [*c* 350 BCE], p. 119). The peak–end rule is discussed in Kahneman et al. (1997) and the colonoscopy study in Redelmeier and Kahneman (1996). Loewenstein and Angner (2003) examine preference change from a descriptive and normative perspective. The data in Section 9.5 come from Loewenstein and Adler (1995) on underprediction of adaptation, Simonson (1990) on diversification bias, Read and van Leeuwen (1998) on projection bias, and Ariely and Loewenstein (2006) on hot–cold empathy gaps (the conclusion cited appears on page 95). Gilbert et al. (2002) explain impact bias and Kahneman (2011, pp. 402–406) the focusing illusion. Sidgwick (2012 [1874]) appears to have discovered projection bias (p. 121) and named and described the empirical–reflective method (p. 111, 122); Lyubomirsky (2013, p. 11) and Gilbert (2006, Ch. 11) endorse something similar. Smith (2002 [1759], pp. 214–15) said, "it is well that nature imposes upon us in this manner." The data on the happiest and unhappiest professions appear in Adams (2015). The addiction example is due to O'Donoghue and Rabin (2000, p. 240–1); Seneca (2007 [*c* 49], pp. 127–8) offered advice; Epicurus (2012 [*c* 300 BCE], p. 181) claims life is ruined by procrastination; and Sidgwick (2012 [1874], p. 121) discusses "man's forecast of pleasure."