CHAPTER

3 Decision-Making under Certainty

3.1 Introduction

The previous chapter showed how an extensive theory of choice under certainty can be built upon the foundation of a modest number of assumptions. Though the assumptions may seem weak, their implications can be challenged both on descriptive and normative grounds. In this chapter, we confront the theory with data. We explore some of the phenomena that behavioral economists argue are inconsistent with the theory of choice under certainty, as we know it. We focus on a couple of different phenomena, beginning with the failure to consider opportunity costs. Moreover, we will begin discussing what behavioral economists do when they discover phenomena that appear to be inconsistent with standard theory. In particular, we will discuss some of the building blocks of prominent behavioral alternatives, including prospect theory and the heuristics-and-biases program.

3.2 Opportunity costs

Imagine that you invest a small amount of money in real estate during a period when it strikes you as a safe and profitable investment. After you make the investment, the markets become unstable and you watch nervously as prices rise and fall. Finally, you sell your assets and realize that you have made a profit. "Wow," you say to yourself, "that turned out to be a great investment!" But when you boast to your friends, somebody points out that you could have earned even more money by investing in the stock market. At some level, you knew this. But you still feel that investing in real estate was a good choice: at least you did not lose any money. This is a case where you may have been acting irrationally because you failed to consider **opportunity costs**.

In order to analyze this kind of situation, let us stand back for a moment. An agent's decision problem can be represented using a **decision tree**: a graphical device showing what actions are available to some agent. Given that you only have two available actions – buying stocks and buying real estate – your decision problem can be represented as a decision tree (see Figure 3.1). Because this chapter is about choice under certainty, I will pretend that there is no uncertainty about the consequences that follow from each of these choices. (We will abandon this pretense in our discussion of choice under risk and uncertainty in Part 3.)

Suppose that you are tempted to buy real estate. What is the cost of doing so? There would be an out-of-pocket or **explicit cost**: the seller of the property

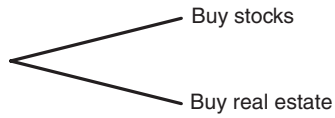


Figure 3.1 Simple decision tree

would want some money to give it up. The real cost, however, is what you forego when you buy the real estate. The opportunity cost – or **implicit cost** – of an alternative is the value of what you would have to forego if you choose it. In dollar terms, suppose that stocks will gain \$1000 over the next year and that real estate will gain \$900. If so, the opportunity costs of buying real estate is \$1000 and the opportunity cost of buying stocks is \$900. If you buy real estate, then, your economic profit will be \$900 − \$1000 = −\$100. If you buy stock, your economic profit would be \$1000 − \$900 = \$100. If there are more than two options, the opportunity cost is the value of the *most valuable* alternative option. Suppose that you can choose between stocks, real estate, and bonds, and that bonds will gain \$150 over the next year. The opportunity cost of buying stocks would remain \$900, and the economic profit would still be \$100.

Exercise 3.1 Investment problem

(**a**) Draw a decision tree illustrating this decision problem.
(**b**) What is the opportunity cost of buying real estate?
(**c**) What is the opportunity cost of buying bonds?

Decision trees make it clear that you cannot choose one alternative without foregoing another: whenever you choose to go down one branch of the tree, there is always another branch that you choose not to go down. When you vacation in Hawaii, you cannot at the same time vacation in Colorado; when you use your life savings to buy a Ferrari, you cannot at the same time use your life savings to buy a Porsche; when you spend an hour reading sociology, you cannot spend the same hour reading anthropology; when you are in a monogamous relationship with *this* person, you cannot at the same time be in a monogamous relationship with *that* person; and so on. Consequently, there is an opportunity cost associated with every available option in every decision problem.

For another example, imagine that you are considering going to the movies. On an ordinary evening, the decision that you are facing might look like Figure 3.2. Remember that the opportunity cost of going to the movies is the value of the most valuable option that you would forego if you went to the movies; that is, the opportunity cost of going to the movies is the greatest utility you could get by going down one of the other branches of the decision tree, which is the utility of the most valuable alternative use for some \$10 and two hours of your time.

As a matter of notation, we write $a_1, a_2, \ldots, a_n$ to denote the n different acts available to you; $u(a_1), u(a_2), \ldots, u(a_n)$ to denote the utilities of those acts; and

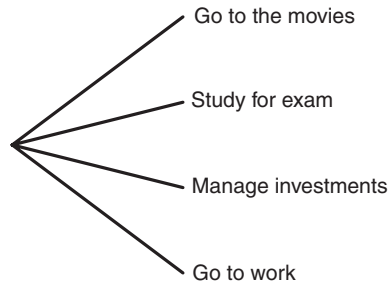


Figure 3.2 Everyday decision tree

$c(a_1), c(a_2), \ldots, c(a_n)$ to denote the opportunity costs of those acts. The opportunity cost $c(a_i)$ of act a_i can then be defined as follows:

Definition 3.2 Opportunity cost

$$c(a_i) = \max \{u(a_1), u(a_2), \ldots, u(a_{i-1}), u(a_{i+1}), \ldots, u(a_n)\}.$$

This is just to say that the opportunity cost of act a_i equals the maximum utility of the other acts.

Figure 3.3 represents a decision problem in which utilities and opportunity costs of four acts have been identified. The number on the left is the utility; the number in parentheses is the opportunity cost. You can compute the profit (in utility terms) by subtracting the latter from the former.

Exercise 3.3 Opportunity costs This exercise refers to Figure 3.3. Suppose that a fifth act (call it a_5) becomes available. Assume that a_5 has a utility of 9.
(**a**) What would the tree look like now?
(**b**) What would happen to the opportunity costs of the different alternatives?

There is a tight connection between opportunity costs, utilities, and the rational thing to do. As it happens, you are rational – that is, you maximize utility – just in case you take opportunity costs properly into account.

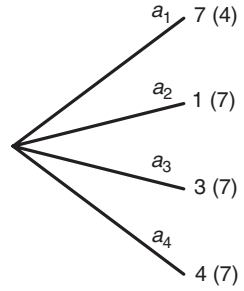


Figure 3.3 Decision tree with utilities and opportunity costs (in parentheses)

Proposition 3.4 *a_i is a rational choice $\Leftrightarrow u(a_i) \geq c(a_i)$*

Proof. We need to prove the claim both ways. The first part goes as follows: assume that a_i is the rational choice. Given our definition of rationality, this means that $u(a_i) \geq u(a_j)$ for all $j \neq i$. If so,

$$u(a_i) \geq \max \{u(a_1), u(a_2), \ldots, u(a_{i-1}), u(a_{i+1}), \ldots, u(a_n)\}$$

But because of the way we defined opportunity costs in Definition 3.2, this means that $u(a_i) \geq c(a_i)$. The second part is the same thing over again, except reversed. □

This proposition establishes formally what we already knew to be the case, namely, that it is irrational to invest in real estate whenever there is a more valuable alternative available, even if investing in real estate would generate a profit. Notice that the condition holds even if there is more than one optimal element. Whenever this happens, the utility of the optimal alternative will equal its opportunity cost.

Example 3.5 Gangnam Style By mid-2014, the goofy music video 'Gangnam Style' became the most watched YouTube clip of all time. According to a review by *The Economist*, in the amount of time people spent watching the clip, they could instead have built three of the largest type of aircraft carrier, four Great Pyramids of Giza, six Burj Khalifas (the world's tallest building in Dubai), or 20 Empire State Buildings. As this example shows, opportunity costs can be huge.

Exercise 3.6 Opportunity costs What is the opportunity cost of (**a**) staying in an unfulfilling relationship, (**b**) pursuing a course of study that does not excite you, and (**c**) sleeping until noon?

The concept of opportunity cost has considerable explanatory power.

Exercise 3.7 Opportunity costs, cont. Using the language of opportunity cost, explain why highly paid people are less likely than poor people to mow their own lawns, clean their own houses, maintain their own cars, and so on.

In practice, however, people frequently overlook or underestimate opportunity costs. In the context of investment decisions, many people are pleased with their performance if their investments increase in value over time, whether or not there is another investment that would have generated a larger profit. Overlooking opportunity costs can make you behave in self-destructive or otherwise suboptimal ways, as Exercise 3.6 shows. A person who ignores the opportunity cost of a bad relationship, for example, could miss out on a lot. If you were surprised by the opportunity costs of watching the 'Gangnam Style' video, chances are you underestimated them. Here is another example.

Example 3.8 Ignoring opportunity costs Imagine that after visiting your parents in Kansas a few times, you earn a voucher that can be exchanged for a

free airplane ticket anywhere in the country. You decide to go to Las Vegas. You would not actually have bought a ticket to Vegas, but because it was free you figured you might as well. Now you would like to visit your parents in Kansas, and wish you did not have to pay so much money for the ticket.

In this case, you may be acting irrationally because you did not consider the opportunity cost of using the ticket to go to Vegas. Insofar as you would have preferred to use the voucher to visit your parents in Kansas, you failed to consider what you could have used it for instead. Though the ticket was purchased using a voucher rather than cash, the decision to use it to go to Vegas is associated with a substantial opportunity cost. As this example illustrates, people are particularly likely to ignore the opportunity cost of spending a **windfall**, that is, an unexpectedly large or unforeseen profit. Yet the best way to spend a dollar is not a function of how it ended up in your pocket.

What follows is a classic example. There are two different versions of this question, one with the original numbers and one with the numbers in square brackets.

Example 3.9 Jacket/calculator problem Imagine that you are about to purchase a jacket for $125 [$15], and a calculator for $15 [$125]. The calculator salesman informs you that the calculator you wish to buy is on sale for $10 [$120] at the other branch of the store, located 20 minutes drive away. Would you make the trip to the other store?

In the original study, 68 percent of respondents were willing to make the drive to save $5 on the $15 calculator. Yet only 29 percent were willing to make the drive to save $5 on the $125 calculator.

Here, many respondents seem to have failed to take opportunity costs properly into account. Standard theory requires you to make your decision based on the opportunity cost of the 20-minute drive. The opportunity cost does not depend on how you saved the $5. If people took the opportunity cost properly into account, therefore, they would drive in the one scenario just in case they would drive in the other. But that is not what we observe.

Exercise 3.10 Room service Suppose that you are staying at an expensive hotel that offers in-room dining for $60. Ordinarily you would not pay that kind of money for a meal, but you say to ourself: "I already paid $220 for this room, so what's $60 more?" Explain in what way your decision to pay $60 for dinner ignores the opportunity cost of doing so.

In general, thinking about outcomes in terms of ratios is a good way to go wrong. Asking questions such as "What's another $10,000 when I'm already spending $100,000 on a new house?" is one way to ignore the opportunity costs of spending $10,000 that way. (We will return to the topic in Section 7.2.)

Exercise 3.11 Whatever it takes Politicians sometimes promise to do "whatever it takes" to eliminate poverty, defeat terrorism, etc. Use the concept of opportunity cost to explain why that is not be the best idea.

There are systematic data on how much money is lost by people who ignore opportunity costs. Here is one example.

Example 3.12 One day at a time The field study mentioned in Section 1.3 found that New York City cab drivers who set their own hours ignore opportunity costs in a big way. The study found that cab drivers operate with a daily income target, meaning that they will work until they have earned that amount and then quit. The result is that they will work fewer hours on more profitable (e.g., rainy) days, and more hours on less profitable (e.g., sunny) days. This is exactly the opposite of what they ought to be doing, since the opportunity cost of taking time off is *higher* on profitable days. The authors of the study estimate that holding the total number of hours constant, drivers could increase their earnings by as much as 5 percent by working the same number of hours every day, and as much as 10 percent by working more on more profitable days.

It is easy to think of other scenarios where people might ignore opportunity costs. Think about unpaid work. Even if you can save money by mowing your own lawn, this does not mean that it is rational to do so: if your hourly wage exceeds the hourly charge to have a lawn care company mow your lawn, and you have no particular desire to mow the lawn rather than spending another hour in the office, then the rational choice is to stay in the office and pay somebody to mow your lawn. Or think about investments in public safety. Even if recruiting more police officers might save lives, this does not necessarily mean that it is rational to do so. If there is an alternative investment that would save even more lives – street lights, for example – or in other ways generate more value, it would be irrational to recruit more police officers. In general, even if some business move, political reform, or any other initiative can be shown to have hugely beneficial consequences, this does not automatically make it rational: everything hinges on what the opportunity cost is.

Exercise 3.13 Advertising campaigns Your latest efforts to boost revenue led to an advertising campaign that turned out to be hugely successful: an investment of $1000 led to a $5000 boost in revenue. Does this mean that the investment in the advertising campaign was rational?

Exercise 3.14 War or terror Imagine that a new terrorist group is threatening the lives of innocent civilians, and that all things equal, it would be a good thing if the group vanished. Does this necessarily make it a good idea to launch military action to destroy it?

Why do people ignore opportunity costs? The first thing to note is how very difficult it would be to live up to the requirement to take opportunity costs into proper account. The requirement does not say that you have to consciously consider all the different alternatives available to you. But it does say that you must never choose an alternative whose opportunity cost is higher than its utility. This is an extremely demanding condition. Consider what would be

required in order to rationally choose whom to marry. You must have complete and transitive preferences over all alternatives and you must make sure that your choice of spouse is not inferior to any other choice. And the set of alternatives in this case might include half of humankind or more, though for many of us the budget set would be rather smaller. Hence, we should not be surprised that people sometimes overlook opportunity costs. (Section 3.5 discusses another reason why people may fail to take opportunity costs properly into account.)

Notice that it is irrational to fail to take opportunity costs properly into account, given the account of rationality that we developed in the previous chapter and use in this one. Certainly, in many cases this is right: if you fail to consider the opportunity cost of using your free ticket to go to Vegas, for example, it might be acceptable to call you irrational. But the fact that considering all possible alternatives is so very demanding – when getting married, for instance – means that there can be legitimate disagreement about whether failing to consider opportunity costs under those conditions is irrational or not. And if it can be rational to ignore opportunity costs, the theory that we have studied here is normatively incorrect. Still, an awareness of opportunity costs can be helpful, as Exercise 3.6 shows. Articulating what the opportunity costs of a given action are can help you see other and better opportunities open to you.

It is important not to exaggerate people's inability to take opportunity costs properly into account. Although the opportunity cost of going to college can be huge, since it includes the amount that can be gained from working instead of studying, people still do go to college. Does this mean they are irrational? Not necessarily. The opportunity cost of *not* going to college can be even greater, since the foregone alternative in this case includes the higher lifetime earnings that a college degree can confer. If so, going to college can be perfectly rational in spite of the sizeable opportunity cost of doing so. (The decision problem here – as in the case of investments in real estate and the stock market – is complicated by the fact that it involves choice over time, which is discussed further in Part 4 of this book.)

Problem 3.15 The opportunity cost of an economics education *What is (or would be) the opportunity cost, for you, of taking a course in behavioral economics? Upon reflection, is it (or would it be) worth it?*

The notion of opportunity cost has other applications. According to psychologist Barry Schwartz, the fact that we face opportunity costs helps explain why many of us are so unhappy in spite of the extraordinary freedom that we enjoy. In this analysis, it is the very fact that we are free, in the sense of having many options available to us, that prevents us from being happy:

> [The] more alternatives there are from which to choose, the greater our experience of the opportunity costs will be. And the greater our experience of the opportunity costs, the less satisfaction we will derive from our chosen alternative… [A] greater variety of choices actually makes us feel worse.

Schwartz calls it "the paradox of choice." Notice, though, that this would be a case where we pay too much, rather than too little, attention to opportunity costs.

Notice that there are behaviors that need not result from a lack of attention to opportunity costs, although it may look that way. When a person stays in a bad relationship because he or she would rather deal with "the devil you know than the devil you don't," the person is facing not just opportunity costs but also risk or uncertainty – which is something we will return to in Part 3.

3.3 Sunk costs

Suppose that you are the manager of the research and development (R&D) department of a big corporation and that you have to decide whether to spend $1M to complete a project that, you are aware, is going to fail. In one scenario, your corporation has already invested $9M in the project, and you have to decide whether to invest the additional $1M required to complete it. In another scenario, you have not yet invested anything in the project, and you have to decide whether to invest the $1M required to complete it. What would you do? You might be willing to invest in the first scenario but unwilling to do so in the second. Assuming that the two decision problems are otherwise identical, this would be irrational. And it would be irrational because you would be **honoring sunk costs**; you would, as people say, be "throwing good money after bad." One way to see this is to think of it in terms of opportunity costs: when you make a decision based on sunk costs, you in effect ignore or underweight opportunity costs – which is irrational (see the previous section).

Most decisions are not as simple as the decision trees we saw in Section 3.2. Some decision problems have several stages. Assuming that you want a soft drink, for example, you may first have to decide where to get one. Thus, you may have to choose, first, whether to go to Piggly Wiggly or Publix, and second, whether to get Coke or Pepsi. While the fact that this decision problem has two stages complicates matters somewhat, decision trees allow you to represent problems of this type too, as Figure 3.4 shows.

As always, the theory does not say whether you should choose Coke or Pepsi. However, it does say a few things about how your choices in one part of the tree should relate to your choices in other parts of the tree. Let us assume, for simplicity, that your universe consists of these two alternatives only, and that you are not indifferent between them. If you choose Coke rather than

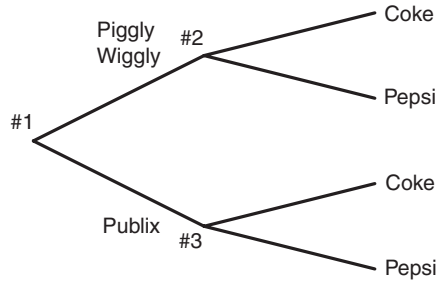


Figure 3.4 Multi-stage drinking problem

Pepsi at node #2, you also have to choose Coke rather than Pepsi at node #3; if you choose Pepsi rather than Coke at node #2, you also have to choose Pepsi rather than Coke at node #3. As we established in Exercise 2.21(b) on page 22, if you strictly prefer x to y, you must not also prefer y to x. And at #2 you are indeed facing the exact same options as you are at #3. (If you are indifferent between Coke and Pepsi, you can rationally choose either.)

Would anybody fail to act in the same way at nodes #2 and #3? There is a wide class of cases where people do. These are cases in which there are **sunk costs**: costs beyond recovery at the time when the decision is made. Consider the R&D scenario outlined earlier in this section. It can be represented as in Figure 3.5. Faced with these two problems, many people say they would invest at node #2 but not invest at node #3. Yet, at node #2, the $9M is a sunk cost: it cannot be recovered. Whether or not making the further $1M investment is worth it should not depend on whether you find yourself at node #2 or #3. Failing to ignore sunk costs is referred to as **honoring sunk costs**, or as committing the **sunk-cost fallacy**. The sunk-cost fallacy is sometimes called the **Concorde fallacy**, since French and British governments continued to fund the supersonic passenger jet long after it became clear that it would not be commercially viable, supposedly because they had already invested so much money and prestige in the project. As these examples illustrate, the sunk-cost fallacy can be costly.

Example 3.16 The basketball game Imagine that you paid $80 for a ticket for a college basketball game to be played about an hour's drive away. The ticket cannot be sold. On the day of the game, there is a freak snowstorm that makes driving hazardous. Would you go to the game?

Now, imagine that the ticket instead was given to you for free. Would you be more or less likely to go to the game?

Many people would be more likely to go to the game if they paid actual money for the ticket. Yet the cost of the ticket is a sunk cost at the time when the decision is made. Whether or not you paid for the ticket should not affect whether you go to the game or not.

The sunk-cost fallacy is evident in a wide range of everyday decisions. For one thing, it can make people hold on to failed investments. If you refuse to

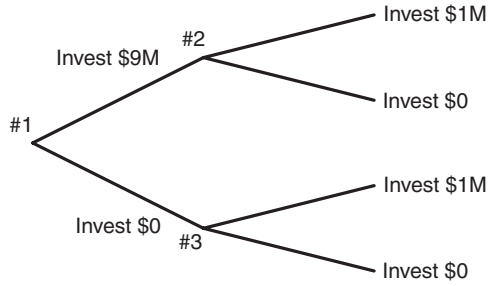


Figure 3.5 Multi-stage investment problem

sell an underperforming asset on the basis that you would lose the difference between what you paid for it and what you would get for it if you sold it now, you are honoring the sunk cost of the original investment; the rational thing to do is to hold on to the asset if you think it is the best investment available to you right now and to sell if it is not. The sunk-cost fallacy can also make people stay in failed relationships. If a friend refuses to ditch her current boyfriend, even though she realizes that he is an utter loser, on the basis that leaving him would mean that she would have wasted some of the best years of her life, she would be honoring the sunk cost of the time and effort that she has already committed to him. As these examples show, honoring sunk costs can be expensive not just in terms of money, but also in terms of time, effort, and heartache.

Exercise 3.17 Sunk costs Draw decision trees for people who (**a**) hold on to failed investments and (**b**) stay in bad relationships, in such a way that it becomes clear that the people in question are committing the sunk-cost fallacy.

Note that the rational decision is determined by what is going on only to the right of the node where you find yourself. What happens in other parts of the tree – in particular, to the left of your node – is completely irrelevant. In this sense, rational choices are completely forward-looking. For as the ancient Greek philosopher Aristotle noted some years back: "We do not decide to do what is already past; no one decides, for instance, to have sacked Troy." Things that happened in the past matter only insofar as they affect future outcomes.

Example 3.18 Reading habits According to a survey administered by Goodreads.com, 38.1 percent of readers say they will finish a book they started reading no matter what – even if they hate it. This behavior can be understood as an effort to honor the sunk cost involved in buying and starting to read the book.

Exercise 3.19 The fridge When cleaning out your fridge, you find some food obviously rotting in the back. You have no trouble throwing away the cheap mass-produced cheese somebody gave you, but you just cannot bring yourself to toss the amazing cheese you brought back from Paris. So you put it back in the back of the fridge, where it will sit for another couple of months before it smells so badly you have no choice to get rid of it. How do sunk costs figure in these decisions?

Exercise 3.20 Course selection Students at an expensive liberal arts college may take courses at a nearby public university at no additional charge. One of their professors tells them that it would make no sense to do so, since they would be losing the money they paid for tuition at the more pricey college. Given that a student has already paid tuition at the liberal arts college, but judges that the course offerings at the public university are better for her, where should she sign up? Explain.

The sunk-cost fallacy can start a vicious circle sometimes referred to as an **escalation situation**. Once a project – whether an R&D effort, a marriage, a

financial investment, or whatever – is beginning to go downhill, the sunk-cost fallacy encourages people irrationally to make additional investments in the project. Once the additional investment has been made, unless it turns the project around, people find themselves with an even greater sunk cost, which is even harder to ignore, thereby encouraging even greater investments.

Example 3.21 The F-35 The F-35 is the US military's next-generation fighter jet. Plagued with technical difficulties, the project was $160 billion over budget already by early 2014. Critics argue that the project needs to be cancelled. But the US Department of Defense (DOD) still wants its planes. "I don't see any scenario where we are walking back away from this program. We're going to buy a lot of these airplanes," the officer in charge of the program said to the *Fiscal Times*. Why? "DOD is so far down the F-35 rabbit hole, both in terms of technology and cost – $400 billion for 2,400 planes – that it has no choice but to continue with the program." You are unlikely to ever find a cleaner example of the sunk-cost fallacy.

The sunk-cost fallacy and escalation behavior are often invoked when explaining why the US spent so many years fighting a losing war in Vietnam. According to this analysis, once soldiers were committed and started dying, it became impossible to withdraw for fear that the dead would have "died in vain"; thus, more soldiers were committed, more soldiers died, and it became even harder to withdraw. Interestingly, the scenario was outlined as early as 1965 by George Ball, then Undersecretary of State. In a memo to President Johnson, Ball wrote:

> The decision you face now is crucial. Once large numbers of US troops are committed to direct combat, they will begin to take heavy casualties in a war they are ill-equipped to fight in a noncooperative if not downright hostile countryside. Once we suffer large casualties, we will have started a well-nigh irreversible process. Our involvement will be so great that we cannot – without national humiliation – stop short of achieving our complete objectives. Of the two possibilities I think humiliation will be more likely than the achievement of our objectives – even after we have paid terrible costs.

Some wars are justified and some wars are not. But the justification can never take the form of simply pointing out how much money and how many lives have already been sacrificed; if the war is justified, it must be for other, forward-looking reasons. One important insight is this: before you embark on a risky project, you may want to ask yourself whether it will be possible for you to call it off in case it starts going downhill. If not, this is a reason not to embark on the project in the first place.

An awareness of our tendency to honor sunk costs can be useful. The loser boyfriend from earlier in this section can appeal to sunk costs when trying to keep his girlfriend. Less obnoxiously, you can use knowledge of the sunk-cost fallacy to market your products. One of the reasons why outlet malls are located so far away from where people live is that executives want shoppers to think of the sunk cost of a long drive to the mall as an investment that will be lost if they do not shop enough. More upliftingly, it turns out that you can make money by teaching people about rational-choice theory.

Example 3.22 How to sell tires The following story was related by Cory, a former student of behavioral economics:

> I co-manage a local tire/automotive service retailer. Today, one of my good customers came into my store. He had purchased a set of tires from a separate online tire seller and came to get them installed. Before we started working on his car, he asked what other options would have been available to him. I proceeded to tell him about a brand new tire that I stocked that was overall much better than the one he bought – better traction features, better mileage, etc. I politely asked if he would like to buy them and have me send the others back. His response was: "No, that's okay, I've already bought these. I better just stick with them." I told him how easy the return process would be, how much longer the new tire would last, how it would save him money in the long run, etc., but his response remained the same: "Already paid for these; better stick with them." Finally, I told him that he was honoring sunk costs.
>
> So of course he asked what I meant, and I explained the concept at length. He was simply fascinated by this random lecture that he was receiving from somebody he thought to be just a "tire guy." I concluded the conversation by humorously declaring: "If you decide to stick with your original purchase, you are violating the theory of rational decision-making."
>
> He then looked at me with a ponderous stare. "You know what? I learned a lot from you. I think I *will* buy your tires and send the others back. Thanks for helping me!" So he bought the tires from me, had them installed, and I made a nice commission. I thought to myself: "Wow, I have been finished with behavioral economics for only one day, and already it is paying dividends!"

Knowledge of a tendency to honor sunk costs can also help us resist other people's manipulative behavior. If you are the loser's girlfriend, it might help to remind yourself that the wasted years in your past are no reason to stay with him, and if you are the shopper at the outlet mall, you can remind yourself that the long drive out there is no reason to buy stuff you do not want.

Example 3.23 Bullet trains In 2011, California Governor Jerry Brown pushed an effort to build a 520-mile high-speed railroad between the cities of Los Angeles and San Francisco. However, since it is very expensive to build railroads where people live, he hoped to start construction in a relatively remote and unpopulated part of the state. Why would he do this? According to critics, the *New York Times* reported at the time, Brown calculated "that future legislatures would not be able to abandon the project before it reached major population centers. 'What they are hoping is that this will be to high-speed rail what Vietnam was to foreign policy: that once you're in there, you have to get in deeper,' said Richard White, a professor of history at Stanford University." There is a good chance politicians hoped that the sunk cost of the initial investment would start an escalation situation that future administrations could not escape.

Notice that there are cases that may superficially look like the sunk-cost fallacy, but that really are not. In order for you to commit the sunk-cost fallacy in a decision problem like that in Figure 3.5, the options available to you at nodes #2 and #3 need to be identical. If they are not, you could rationally choose any combination of options. For example, your boss might demote you for failing

to invest at node #2 but not do so at node #3. If that is the case, it may well be rational for you to invest at #2 but not at #3, even if the investment would lead to large losses for the company. Similarly, if calling off a misguided military adventure would have unfortunate consequences – perhaps because the national humiliation would be unbearable, the military would look weak, the administration would look unmanly, and/or the next election would be lost – a president could rationally continue to fight the war. (Notice that we are concerned with rationality here, not morality.)

Either way, it is important not to accuse people of committing the sunk-cost fallacy if their behavior is better captured by standard theory.

Problem 3.24 Revenge *When wronged, many people feel a strong urge to take revenge. Assuming revenge is costly, would not a revenge simply be a matter of honoring the sunk cost of whatever injury they have already sustained? Or are there conditions under which taking revenge can be rational?*

3.4 Menu dependence and the decoy effect

Spend a moment considering which of the subscription offers in Table 3.1 you would prefer. You will notice that there is something strange about the three options. Why would anybody choose the print subscription, given that you can get an online and a print subscription for the very same price? Given that nobody in their right mind would choose option 2, why was it included? It turns out that there is a good reason for *The Economist* to present potential customers with all three options. When researchers presented MBA students with options 1 and 3 only, 68 percent chose option 1 and 32 percent chose option 3. When the authors presented MBA students with options 1, 2, and 3, 0 percent chose option 2. But only 16 percent chose option 1 whereas 84 percent chose option 3. Thus, it appears that the inclusion of an option that nobody in their right mind would choose can affect people's preferences over the remaining options.

Recall from Section 2.6 that the rational choice depends on your budget set, that is, your menu. When your menu expands, more options become available to you, and one of them may turn out to be more preferred than the one you would have chosen from the smaller menu. However, the theory from the previous chapter does impose constraints on what happens when your menu expands. Suppose you go to a burger restaurant and are told that you can choose between a hamburger and a cheeseburger. Imagine that you strictly prefer a hamburger and say so. Suppose, furthermore, that the server corrects herself and points out

Table 3.1 *The Economist* subscription offers

	Economist.com offers	**Price**
Option 1	Web subscription	$59
Option 2	Print subscription	$125
Option 3	Print + web subscription	$125

that there are snails on the menu as well. In this case, you can legitimately say that you will stick with the hamburger, in case hamburgers rank higher than snails in your preference ordering (as in columns (A) and (B) in Figure 3.6). Or you can switch to snails, in case snails rank higher than hamburgers (as in column (C) in the figure). It would be odd, however, if you said: "Oh, I see. In that case I'll have the cheeseburger." Why? No rational preference ordering permits you to change your mind in this way. Either you prefer cheeseburgers to hamburgers, in which case you should have ordered the cheeseburger from the start, or you do not, in which case you should not choose it whether or not there are snails on the menu. (This chain of reasoning assumes that we are talking about strict preference; if you are indifferent, you can choose anything.)

Formally speaking, the theory implies something we call the **expansion condition**.

Proposition 3.25 Expansion condition *If x is chosen from the menu $\{x, y\}$, assuming that you are not indifferent between x and y, you must not choose y from the menu $\{x, y, z\}$.*

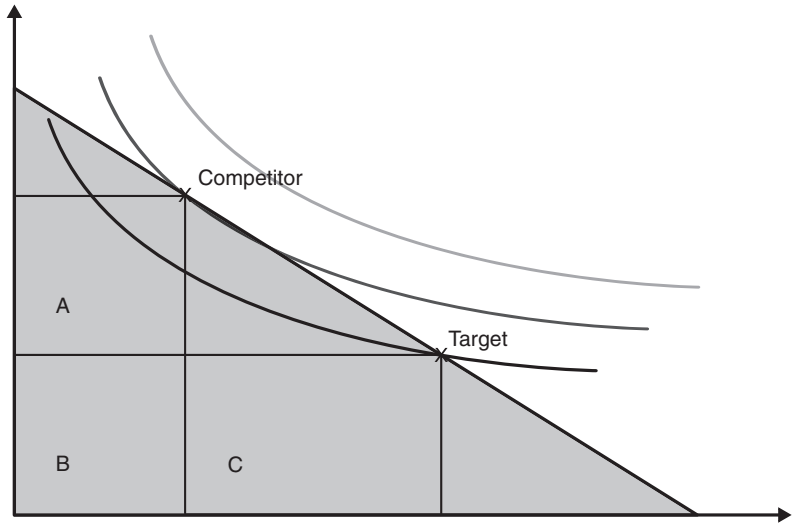
Proof. If you choose x when y is available, given that you are not indifferent between the two, you must strictly prefer x to y. If you choose y when x is available, given that you are not indifferent between the two, you must strictly prefer y to x. But we know from Proposition 2.16(ii) on page 21 that the strict preference relation is anti-symmetric; so this is impossible. □

Plainly put, Proposition 3.25 simply says that the introduction of an inferior product should not change your choice. The choice of y from the expanded menu would signal that you changed your preferences between the first and second decision. The theory, however, does not permit you to change your preferences as a result of an expanding menu or for any other reason. As we know from Section 2.8, the theory assumes that preferences are stable and do not change over time. The plausibility of the expansion condition can also be seen by reflecting on the nature of indifference curves and budget sets. If some option is optimal, given a set of indifference curves and a budget line, this fact cannot be changed by adding another (clearly inferior) option to the budget set. Thus, the introduction of another alternative inside the shaded area of Figure 2.6 on page 27 would not make the alternative marked X suboptimal.

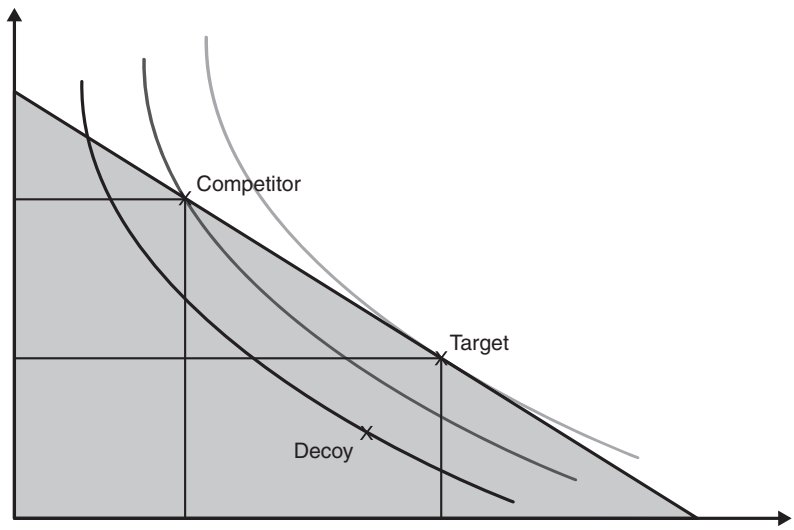
(A)	(B)	(C)
Hamburger	Hamburger	Snails
≻	≻	≻
Cheeseburger	Snails	Hamburger
≻	≻	≻
Snails	Cheeseburger	Cheeseburger

Figure 3.6 Preference orderings over food

Yet there is evidence that people's preferences do change when the menu expands. We talk about this as a case of **menu dependence**. Suppose that you market a product, which we call the **target**. The problem is that another company markets a similar product, which we call the **competitor**. The consumer can afford each of these; both the target and the competitor are on the budget line. The problem is that the consumer prefers the competitor. Thus, the decision problem facing the consumer looks like Figure 3.7(a). The two products here (the target and the competitor) can be understood as before, as commodity



(a) Before the introduction of the decoy



(b) After the introduction of the decoy

Figure 3.7 Decoy effect

bundles consisting of so many units of apples and so many units of bananas. They can also be understood as goods that differ along two dimensions: say, as cars that differ along the dimensions of speed and safety. Either way, it should be clear that the consumer in this figure will choose the competitor.

It turns out, however, that you can manipulate the consumer's choices by introducing a product that is in every respect inferior to the target. We say that one product x **dominates** another y just in case x is better than y in every possible respect. In terms of Figure 3.7(a), the target dominates every product in the boxes marked B and C. The competitor dominates every product in boxes A and B. Given a menu and a good x, we say that a product y is **asymmetrically dominated** by x just in case y is dominated by x but not by any other member of the menu. Suppose, now, that the menu includes a third item, which we call the **decoy**, and which is asymmetrically dominated by the target. This means that the decoy is located in the box marked C in Figure 3.7(a). In spite of the fact that few consumers would bother buying such a good – since it is in every respect worse than the target – its introduction can change people's choices. There is evidence that the introduction of the decoy changes people's indifference curves in the manner illustrated by Figure 3.7(b).

Notice that the indifference curves appear to have rotated clockwise around the competitor, as it were, toward the decoy. As a result, the target is now on a higher indifference curve than the competitor. Thus, in spite of the fact that the rational consumer would not dream of buying the decoy, the introduction of it still succeeds in changing people's indifference curves and therefore their choices. Because the presence of the dominated option appears to increase the attractiveness to the consumer of the dominating alternative, the decoy effect is sometimes referred to as the **attraction effect**. Notice that such shifts violate the expansion condition (Proposition 3.25) and consequently are irrational.

Example 3.26 Speed vs. safety Imagine that you are in charge of selling a car that is very fast but not very safe. Let us call it a "Bugatti." (When people complained about the poorly designed brakes of his cars, Mr Bugatti himself is alleged to have said: "My cars are for driving, not for braking.") The problem is that your customers too often choose a car that is less fast but more safe. Let us call it a "Volvo." To increase sales of your car, you decide to start selling a decoy. What features should it have?

If you put speed on the x-axis and safety on the y-axis, you get a graph exactly like Figure 3.7, in which the Bugatti is the target and the Volvo the competitor. The decoy must go in the box marked C. The fact that the decoy is below both target and competitor means that it is less safe than both the Bugatti and the Volvo. The fact that the decoy is left of the target but right of the competitor means that it needs to be less fast than the Bugatti but faster than the Volvo. Notice that a vehicle that is inferior to both cars in both respects – let us call it a "golf cart" – would not do the trick.

Exercise 3.27 Decoy effect For this question, refer to Figure 3.8.

(**a**) If you are in charge of marketing the target product, in what area would you want to put the decoy?

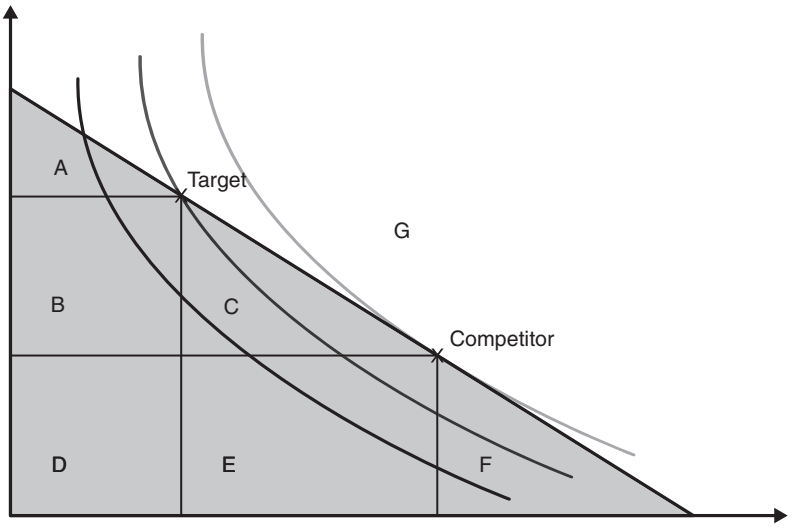


Figure 3.8 Decoy effect exercise

(**b**) Assuming the decoy works as anticipated, does the figure show the indifference curves the way they look *before* or *after* the introduction of the decoy?

Exercise 3.28 Real-estate sales Suppose that you are a real-estate agent showing two properties to potential customers. The one is in good shape but far from the clients' office; the other is only in decent shape but close to the office.

(**a**) If you want the customers to choose the former, what third property should you show?

(**b**) If you want the customers to choose the latter, what third property should you show?

Exercise 3.29 Third-party candidate Politician A has decided to run for political office on a platform promising lower taxes and cuts in public services. His opponent B promises higher taxes and more funding for public services. All things equal, the voters prefer low taxes and generous public services. Now, Politician B is in the lead. Politician A decides to channel some of his campaign funds to a third-party candidate, C, who will act as a decoy. What sort of platform must the third-party politician endorse to act as a decoy for A?

The following example is designed to show just how useful the study of behavioral economics can be. Remember that with great power comes great responsibility.

Exercise 3.30 Wingmen and wingwomen To improve your chances on the dating scene, you have decided to recruit a wingman or wingwoman.

(**a**) How, in general terms, should you choose your wingman or wingwoman?

(**b**) Imagine that your attractiveness and intelligence are both rated 9 on a 10-point scale. You have two competitors: one whose attractiveness is

10 and intelligence 8; and another whose attractiveness is 8 and intelligence 10. In what range would you want your wingman or wingwoman's attractiveness and intelligence to fall?

(**c**) If somebody asks you to be his or her wingman or wingwoman, what does this analysis suggest he or she thinks about your attractiveness and intelligence?

How does this help us explain the subscription offers in Table 3.1? Each option can be represented as a bundle of three different goods: online access, paper subscription, and a low price. Thus, option 1 can be represented as $\langle 1, 0, 1 \rangle$ because it includes online access, does not include a paper subscription, but has a low price. Similarly, option 2 can be represented as $\langle 0, 1, 0 \rangle$ and option 3 as $\langle 1, 1, 0 \rangle$. From this way of representing the options, it is quite clear that option 2 is (weakly) asymmetrically dominated by option 3. If the analysis offered in this section is correct, the introduction of the (inferior) option 2 might still drive customers to option 3, which is what *The Economist* wanted and expected.

The decoy effect is only one form of menu dependence. Another effect that has received a great deal of attention, especially in marketing literature, is the **compromise effect**: people's tendency to choose an alternative that represents a compromise or middle option in the menu. The phenomenon is sometimes described as resulting from **extremeness aversion**: a tendency to avoid options at the extremes of the relevant dimension. A high-end brand might try to drive business to their expensive products by introducing a super-expensive product; although the super-expensive product might never sell, it could make the expensive product stand out as an attractive compromise between the cheap and the super-expensive one. Low-end brands might try to do the same by introducing super-cheap products. This may be how we got diamond-studded swimsuits on the one end of the spectrum, and swimsuits made out of materials that degrade in the presence of sunlight, salt, and chlorine on the other. Various forms of menu-dependence are sometimes described as **context effects**, because people's decisions appear to be responsive to the context in which the decisions are made.

Exercise 3.31 Speed vs. safety, cont. Suppose that you want to harness the power of the compromise effect to sell more Bugattis (see Exercise 3.26). What sort of vehicle would you need to introduce to do so?

Exercise 3.32 Third-party candidates, cont. Suppose that politician A in Exercise 3.29 above wanted to win elections instead by harnessing the power of the compromise effect. What sort of platform must the third-party politician endorse to have this effect?

How do we best explain the decoy effect and other cases of menu dependence? Perhaps consumers look for a *reason* to pick one option over another, or to reject one of the options, in order to feel better about their decision. The introduction of a decoy gives the consumer a reason to reject the competitor and to choose the target, in that the target no longer scores lowest along either one of the two dimensions. The introduction of an extreme option gives

people a reason to choose the option in the middle. Such considerations would suggest that the search for reasons for action – or **reason-based choice** – may actually be responsible for making us behave irrationally. This is interesting, because having reasons for actions is otherwise frequently seen as the hallmark of rationality.

Either way, menu dependence can explain a wide variety of marketing practices, including why the number of options available to customers keeps increasing (see the discussion of the paradox of choice in Section 3.2). And it is obviously relevant to anybody who wants to sell things. Given the decoy and compromise effects, it might make sense to introduce a product you do not expect anyone to buy. For that reason, you cannot assess a product's contribution to corporate profits by simply looking at the sales of that product.

Notice that there are cases that look like menu dependence but which may be better described as something different. Suppose you enter a restaurant in a part of town you do not know very well and are offered the choice between fish, veal, and nothing at all. You choose the fish. Suppose, next, that the waiter returns to tell you that the menu also includes crack-cocaine. It would be perfectly possible, at this point, to decide you would rather not have anything at all without violating rational-choice theory. Why? When the waiter comes back, he does not just expand your menu, he also tells you something about the establishment – and also that you do not want to eat any of their food. Notice that this is not even a case of choice under certainty. The decoy scenarios are different: in this analysis, it is not the case that you learn something about the target by learning that the decoy is also on the menu.

3.5 Loss aversion and the endowment effect

The theory that we studied in the previous chapter makes preferences independent of your endowment, meaning what you have at the time when you make the decision. Consider your preferences for coffee mugs (Figure 3.9). Obviously, the theory does not tell you how much you should value the mug. However, it does say a few things about how you must order mugs and other things. Assuming you prefer more money to less, you prefer \$1 to \$0, \$2 to \$1, and so on. Because of completeness, if you are rational, there must be a dollar amount p (not necessarily in whole dollars and cents) such that you are indifferent between p and the mug. If p is \$1, your preference ordering can be represented as Figure 3.10. If you have the mug, and somebody asks you what it would take to give it up, your answer would be "No less than \$1," which is to say that your willingness-to-accept (WTA) equals \$1. If you do not have a mug, and somebody asks you what you would pay in order to get one, your answer would be "No more than \$1," which is to say that your willingness-to-pay (WTP) equals \$1 too; that is, your preference between the mug and the dollar bill does not depend on whether or not you already have a mug, and your WTA equals your WTP. (Your preference for a second mug might depend, however, on whether you already have a mug, as Figure 3.11 shows.)

Figure 3.9 The value of a coffee mug. Illustration by Cody Taylor

The independence of your preferences from your endowment is reflected in a fact about utility functions. Suppose your utility function over mugs looks like Figure 3.11. The numbers on the x-axis represent how many mugs you own, and the numbers on the y-axis represent how much utility they give you. Thus, owning one mug gives you $u(1)$ units of utility. When you move from zero to one mug (rightwards along the x-axis), your utility increases from $u(0) = 0$ to $u(1)$. Similarly, when you move from one to zero mugs (leftwards along the x-axis) your utility decreases from $u(1)$ to zero. Because the increase in utility resulting from receiving the mug equals the decrease in utility resulting from losing it, the utility of the first mug is independent of your endowment, that is, whether or not you have the mug. We can show this numerically. Suppose $u(x) = 3\sqrt{x}$, so that $u(1) = 3$ and $u(0) = 0$. If so, the amount of utility received from acquiring your first mug (3) equals the amount of utility lost when giving it up (3). Again, a second mug would increase your utility by a smaller amount: $u(2) - u(1) = 3\sqrt{2} - 3\sqrt{1} \approx 1.24$.

$$\$3$$
$$\succ$$
$$\$2$$
$$\succ$$
$$\$1 \sim \text{mug}$$
$$\succ$$
$$\$0$$

Figure 3.10 Preference ordering with mug

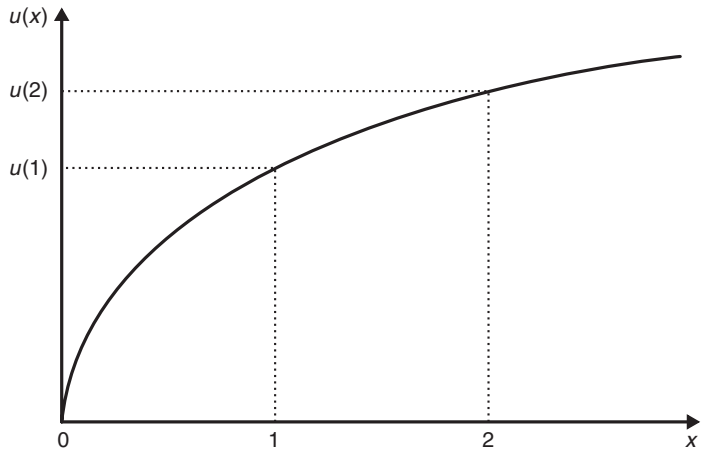


Figure 3.11 Utility over mugs

However, people do not in general behave this way. Frequently, people require a lot more to give up a cup when they already have one than they would be willing to pay when they do not. In one study using Cornell University coffee mugs, the median owner asked for $5.25 when selling a mug, while the median buyer was only willing to pay $2.25 to $2.75 to purchase one. This phenomenon is referred to as the **endowment effect**, because people's preferences appear to depend on their endowment, or what they already possess. Since the manner in which people assess various options might depend on a reference point – in this case, their current endowment – phenomena like these are sometimes referred to as **reference-point phenomena**.

The endowment effect and reference point phenomena are instances of **framing effects**, which occur when people's preferences depend on how the options are *framed*. There are many kinds of framing effects. In 2007, the Associated Press reported that Irishman David Clarke was likely to lose his license after being caught driving 180 km/h (112 mph) in a 100 km/h (62 mph) zone. However, the judge reduced the charge, "saying the speed [in km/h] seemed 'very excessive,' but did not look 'as bad' when converted into miles per hour." The judge's assessment appears to depend on whether Clarke's speeding was described in terms of km/h or mph. Similarly, people traveling to countries with a different currency sometimes fall prey to what is called **money illusion**. Even if you know that one British pound equals about one and a half US dollars, paying two pounds for a drink might strike you as better than paying three dollars.

The endowment effect and other reference-point phenomena are typically explained as the result of **loss aversion**: the apparent fact that people dislike losses more than they like commensurate gains. When the Brad Pitt character in *Moneyball* says "I hate losing more than I even wanna win," that is loss aversion. It is reflected in the fact that many people are more upset when they lose something than pleased when they find the same thing. Consider, for example, how upset you would be if you realized that you had lost a $10 bill, as

compared to how pleased you would be if you found one. Adam Smith noted this very phenomenon when he wrote "Pain … is, in almost all cases, a more pungent sensation than the opposite and correspondent pleasure." Using the language of framing, we will say that how much you value a $10 bill depends on whether it is framed as a (potential) loss, as in the first case, or as a (potential) gain, as in the second case, and that *losses loom larger than gains*.

Example 3.33 WTA vs. WTP In the presence of loss aversion, your willingness-to-accept (WTA) does not in general equal your willingness-to-pay (WTP). When eliciting your WTA, you are asked to imagine that you have some good and to state what dollar amount you would be willing to accept in order to give the good up, meaning that the good will be evaluated in the loss frame. When eliciting your WTP, you are asked to imagine that you do not have some good and to state what dollar amount you would be willing to pay in order to acquire the good, meaning that the good will be evaluated in the gain frame. Given that losses loom larger than gains, we should expect your WTA to exceed your WTP.

As the example shows, loss aversion has radical implications for the practice of cost–benefit analysis (to which we will return in Section 6.3). It is quite common to assess the value of goods by eliciting people's willingness-to-accept (WTA) or willingness-to-pay (WTP). The elicitation of WTAs and WTPs is particularly common in the case of public goods, like nature preserves, and other goods that are not traded on an open market. As we saw earlier in this section, standard theory entails that WTAs and WTPs should be more or less the same. Loss aversion entails that people value something that they have more than something that they do not have, meaning that we should expect their WTA to exceed their WTP and such analyses to generate distorted results.

Behavioral economists capture loss aversion by means of a **value function** $v(\cdot)$, which represents how an agent evaluates a change. The value function is an essential part of **prospect theory**, which is one of the most prominent theories to emerge from behavioral economics and to which we will return frequently below (e.g., in Sections 7.2–7.3 and 7.6). The value function has two critical features. First, unlike the utility function, which ranges over *total* endowments, the value function ranges over *changes* in the endowment. Second, the value function has a kink at the reference point – in this case, the current endowment – in such a way that the curve is steeper to the left of the origin: see Figure 3.12 for an illustration of a typical value function. Notice that in this picture the vertical distance between the origin and $v(-1)$ is much greater than the vertical distance between the origin and $v(+1)$. Mathematically, $|v(-1)| > |v(+1)|$. Again, this captures the fact that losses loom larger than gains, that is, that people dislike losses more than they like the commensurate gains.

Another implication of loss aversion is that if you gain something and then lose it, you may feel worse off even though you find yourself where you started, which makes little sense from a traditional economic perspective. Suppose your parents promise to buy you a car if you graduate with honors, but after you do they reveal that they were lying. Figure 3.13 shows how you might represent this change. By just looking at the picture, it is evident that the gain of a car, $v(+1)$, is smaller than the (absolute value of the) loss of a car,

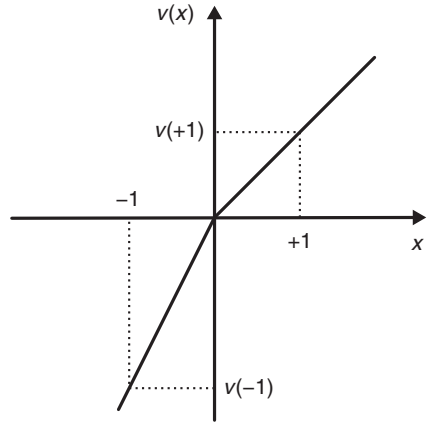


Figure 3.12 Value function

$v(-1)$. Thus, the net effect is negative: you will be worse off (in terms of value) after you find out that your parents tricked you into thinking that you would get a new car, than you would have been if they had not, even though you find yourself with the same number of cars (zero).

Example 3.34 Toy Yoda In 2001, a Florida waitress working for an establishment that proudly describes itself as "tacky" and "unrefined" sued her employer for breach of contract, alleging that she had been promised a new car for winning a beer sales contest. The manager, the waitress said, had promised her a "new Toyota" but when she claimed her prize, she found out that she had won a "new Toy Yoda" – meaning a Star Wars figure. She was understandably upset. Loss aversion explains why: being subjected to that kind of prank leaves a person worse off than she was before, even if her total endowment remains unchanged.

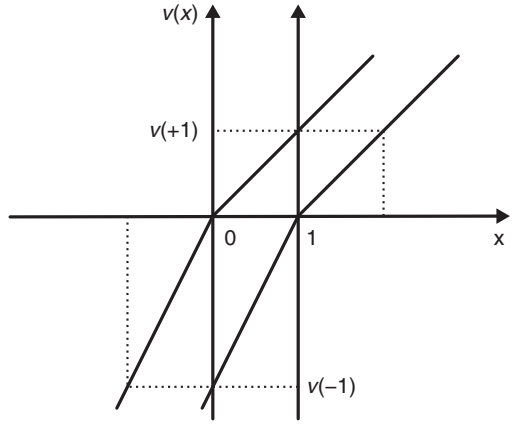


Figure 3.13 Value function and the car problem

It is possible to analyze loss aversion formally, by defining a value function $v(\cdot)$ that is steeper for losses than for gains. For example, we can define a value function along the following lines:

$$v(x) = \begin{cases} x/2 & \text{for gains} (x \geq 0) \\ 2x & \text{for losses} (x < 0) \end{cases}$$

It is easy to confirm that such a specification will generate graphs like Figure 3.12. The next examples and exercises illustrate how the value function can be used in practice.

Example 3.35 Losses and gains Use the value function above to answer the following two questions.

(**a**) What is the increase in value you would experience if you found \$10?
(**b**) What is the decrease in value you would experience if you lost \$10?
(**c**) In absolute terms, which is the greater number?

Here are the answers:

(**a**) When you go from your current endowment to your current endowment plus \$10, in terms of deviations from the existing endowment, you go from 0 to +10. In terms of value, this amounts to going from $v(\pm 0) = 0$ to $v(+10) = 10/2 = 5$. The change is $v(+10) - v(0) = +5 - 0 = +5$, meaning a gain of 5.
(**b**) When you go from your current endowment to your current endowment minus \$10, in terms of deviations from the existing endowment, you go from ± 0 to $-\$10$. In terms of value, this amounts to going from $v(\pm 0) = 0$ to $v(-10) = -20$. The change is $v(-10) - v(\pm 0) = -20 - 0 = -20$, meaning a loss of 20.
(**c**) The absolute value of the loss (20) is greater than the absolute value of the gain (5).

Notice two things about these calculations. First, to compute the change in value, you want to compute the value of your endowment *after* the change and subtract the value of your endowment *before* the change. And second, to compute the value of an endowment, you must first express the endowment as a *deviation* from your reference point and not in terms of absolute wealth or anything of the sort.

Exercise 3.36 Toy Yoda, cont. Suppose that the same value function captures the waitress's value function over cars in Example 3.34. What is the total change in value she experiences after she gains a car and then loses it? Assume that she incorporates it into her endowment and therefore adjusts her reference point immediately upon receiving the promise of a car.

Exercise 3.37 Having and losing In fact, it is possible to be worse off in value terms even if you are better off in dollar terms. Working with the same value function, compute the net effect in value terms of gaining \$6 and subsequently losing \$4. Assume that you incorporate the \$6 into your endowment immediately.

If you do *not* incorporate the \$6 gain into your endowment, and therefore do not change your reference point before losing the \$4, the net effect in value

terms would be $v(+6 - 4) = v(+2) = 1$. This phenomenon illustrates that it matters how complex outcomes are **bundled** – a topic to which we will return in Section 7.3

How you frame various outcomes and what reference point you choose, whether you do so consciously or not, can have a huge effect on how you feel about the outcome. The next example and exercises illustrate various applications of this idea.

Exercise 3.38 The bond market An ill-fated investment of yours in the junk bond market just decreased from \$1 to \$0. Your value function is $v(x) = x/2$ for gains and $v(x) = 2x$ for losses.

(**a**) Suppose, first, that your reference point is \$0. In value terms, how large is the loss you just experienced?

(**b**) Suppose, instead, that your reference point is \$1. In value terms, how large is the loss you just experienced?

(**c**) Which framing makes you feel worse?

Exercise 3.39 The stock market Alicia, Benice, and Charlie own stock in the same company. When they bought the stock, it was worth \$10. It later rose to \$17, but then dropped to \$12 before they sold it. The three are loss averse and have the same value function: $v(x) = x/2$ for gains and $v(x) = 2x$ for losses.

(**a**) Alicia uses the selling price (\$12) as her reference point. If you ask her, how much would she say that she lost in terms of value when the price dropped from \$17 to \$12?

(**b**) Benice uses the peak price (\$17) as her reference point. If you ask her, how much would she say that she lost in terms of value when the price dropped from \$17 to \$12?

(**c**) Charlie uses the buying price (\$10) as her reference point. If you ask her, how much would she say that she lost in terms of value when the price dropped from \$17 to \$12?

(**d**) Who was more disappointed when the price dropped?

The key is to see that Alicia and Charlie evaluate the change as a foregone gain, whereas Benice evaluates the change as an actual loss. Given that losses loom larger than gains, Benice suffers more.

Exercise 3.40 Thievery A thief steals \$100 from a victim. Let us suppose that the thief and victim have the same value function over money: $v(x) = x/2$ for gains and $v(x) = 2x$ for losses.

(**a**) How much, in value terms, does the thief gain as a result of his robbery?

(**b**) How much, in value terms, does the victim lose as a result of the robbery?

(**c**) Assuming that it makes sense to compare the thief's gain and the victim's loss, and ignoring any other consequences of the crime, what is the total effect of the robbery in value terms?

(**d**) Does this suggest that crime is a force for good or bad?

Exercise 3.41 The tax cut Suppose Alex and Bob are loss averse, so that their value function is $v(x) = x/2$ for gains and $v(x) = 2x$ for losses. Because

of an upcoming election, politician R promises a tax cut which would give each citizen an additional two dollars in his or her pocket every day. Politician D opposes the tax cut. Ultimately D wins the election. Neither Alex nor Bob receives the additional two dollars per day.

(**a**) Alex thought D would win the election and never thought of the additional two dollars as part of his endowment. He thinks of the two dollars as a foregone gain. What would he say D's election cost him in terms of value?

(**b**) Bob was sure that R would win the election, and started thinking of the two dollars as part of his endowment. He thinks of the two dollars as an actual loss. What would he say D's election cost him in terms of value?

(**c**) Who is likely to be more disappointed, Alex or Bob?

Loss aversion can explain a wide range of phenomena. For example, it can explain why many companies have 30-day-no-questions-asked return policies. Although costly in other ways, such policies may serve to convince a customer who otherwise would not make the purchase to take the product home and try it out. Once taken home, however, the product becomes part of the customer's endowment and loss aversion kicks in, meaning that the customer is unlikely to return the product. Loss aversion serves to explain why credit-card companies permit merchants to offer "cash bonuses" but prevent them from imposing "credit-card surcharges." Clients find it easier to forego a cash bonus than to suffer the loss of a surcharge, so they are more likely to use a credit card in the presence of the former than of the latter. Loss aversion helps explain why politicians argue about whether cancelling tax cuts amounts to raising taxes. Voters find the foregone gain associated with a cancelled tax cut easier to stomach than they do the loss associated with a tax increase. Consequently, politicians favoring higher taxes will talk about "cancelled tax cuts" whereas politicians opposing higher taxes will talk about "tax increases." Loss aversion can also explain why so many negotiations end in stalemate, even in the presence of potential, mutually beneficial agreements. Suppose two partners are negotiating the division of a pie and that both partners think they are owed two-thirds of the pie. Any division that strikes an outside observer as fair (including a 50–50 split) will feel like a loss to both partners, and an agreement might be hard to come by. Loss aversion can also explain why the volume of real-estate sales decreases in an economic downturn. Sellers may find it so hard to sell their house at a loss, relative to the price at which the property was purchased, that they would rather not sell it at all. This kind of behavior even prevents people from upgrading from a smaller to a larger property, which is economically rational to do during a downturn.

Exercise 3.42 Latte discounts Many coffee shops give customers a small discount if they bring their own reusable mug. The coffee shops could equivalently lower all prices and add a small penalty to the bill of customers who do not bring their own mugs. Yet, few coffee shops go for the latter solution. Why?

In addition, loss aversion helps account for some of the phenomena studied earlier in this book, including the fact that people fail to take opportunity costs properly into account. If people treat out-of-pocket costs as losses and

opportunity costs as foregone gains, loss aversion entails that out-of-pocket costs will loom larger than opportunity costs. Loss aversion may also help explain why people are so prone to honoring sunk costs. Since a sunk cost is often experienced as a loss, loss aversion entails that such costs will loom large, which in turn might drive people to honor sunk costs.

So far, we have largely assumed that the reference point is determined by a person's current endowment. This is not always the case. A person's reference point can be determined by her aspirations and expectations, among other things. The fact that reference points can be fixed by aspirations and expectations explains how people who get a five percent raise can feel cheated if they expected a ten percent raise, but be absolutely elated if they did not expect a raise at all.

Exercise 3.43 Bonuses Draw a graph that illustrates how a person who gets a five percent raise can be elated if she did not expect a raise at all, but feel cheated if she expected a ten percent raise.

Exercise 3.44 Exam scores Assume that Alysha and Billy have the following value function over exam scores: $v(x) = x/2$ for gains and $v(x) = 2x$ for losses. Both of them use the expected exam score as their reference point.

(**a**) Alysha expects to score 75 out of 100 on her upcoming midterm exam. She does better than expected. What is her gain, in terms of value, if her final score is 93?

(**b**) Billy also expects to score 75 out of 100 on his upcoming midterm exam. He does worse than expected. What is his loss, in terms of value, if his final score is 67?

(**c**) Insofar as you use your expectation as a reference point, what does value theory seem to say about maximizing value in your life: should you perform well or poorly in exams? Should you set high or low expectations for yourself?

The most spectacular example of the outsize role that expectations can play is baseball player Barry Bonds:

> When Pittsburgh Pirate outfielder Barry Bonds's salary was raised from $850,000 in 1990 to $2.3 million in 1991, instead of the $3.25 million he had requested, Bonds sulked, "There is nothing Barry Bonds can do to satisfy Pittsburgh. I'm so sad all the time."

The Stoic philosopher Seneca diagnosed the problem about 2000 years ago. He wrote: "Excessive prosperity does indeed create greed in men, and never are desires so well controlled that they vanish once satisfied." Behavioral economists use the term **aspiration treadmill** to refer to a process where increasing endowments lead to rising aspirations. The result is that people like Barry Bonds are nowhere near as happy with their $2.3 million salary when they have it as they thought they would be before they started making that kind of money. Thus, the aspiration treadmill is often invoked to explain the fact that the marginal happiness of money is sharply diminishing.

The aspiration treadmill also has consequences for how we experience losses. A model like that represented in Figure 3.11 suggests that a rich person who loses money would experience a much smaller loss in utility than a poor person would.

And yet, casual observation suggests many affluent people dislike, e.g., paying taxes no less than poor people do. Seneca had a comment on this too:

> For you are in error if you suppose that rich men put up with losses more cheerfully: the largest bodies feel the pain of a wound no less than the smallest … You may be sure that rich and poor men are in the same position, that their suffering is no different; for money sticks fast to both groups, and cannot be torn away without their feeling it.

Some people succeed in jumping off the aspiration treadmill. A 2006 story in the *New York Times* described an internet entrepreneur who had just traded his Porsche Boxster for a Toyota Prius: "'I don't want to live the life of a Boxster, because when you get a Boxster you wish you had a 911,' he said, referring to a much more expensive Porsche. 'And you know what people who have 911s wish they had? They wish they had a Ferrari.'"

A person's reference point can also be determined by other people's achievements or endowments. Such **social comparisons** help explain the fact that whether a person is happy with his or her salary will depend in part on the salaries of neighbors, friends, and relatives. In this respect, income is similar to speed. Is 70 mph (110 km/h) fast or slow? If everybody else on the highway is driving 50 mph, 70 mph feels fast. But if everybody else is driving 80 mph, 70 mph feels slow. Thus, your sense for how fast you are traveling depends not just on your absolute speed, but on your relative speed. Similarly, your sense for how much money you earn depends not just on your absolute income, but on your relative income.

Exercise 3.45 Salary comparisons Insofar as you use other people's salaries as a reference point, what does value theory seem to say about maximizing value in your life?

Example 3.46 Salary comparisons, cont. At one university library, there is a single book that is so popular that it is chained to the checkout counter. You would hope that it is some important medical reference work. But it is the book that lists the salaries of all university employees. Presumably, no one would use the book to look up one's own salary: that information is more easily accessible on one's monthly pay stub. In all likelihood, the book is so popular because people like to look up their colleagues' salaries.

As the last example illustrates, it is hard to deny that people engage in social comparisons. Social comparisons can also explain why bronze-medal winners can be more satisfied with their performance than silver-medal winners. Assuming that a bronze-medal winner compares himself or herself with the athletes who did not win a medal, the bronze medal represents achievement. But assuming that the silver-medal winner compares his or her performance with the gold-medal winner's, the silver medal represents defeat.

Loss aversion has other, and perhaps even more radical, implications for microeconomics. Because standard theory presupposes that preferences are independent of endowments, it implies that indifference curves are independent of endowments. Thus, if your indifference curves look like those

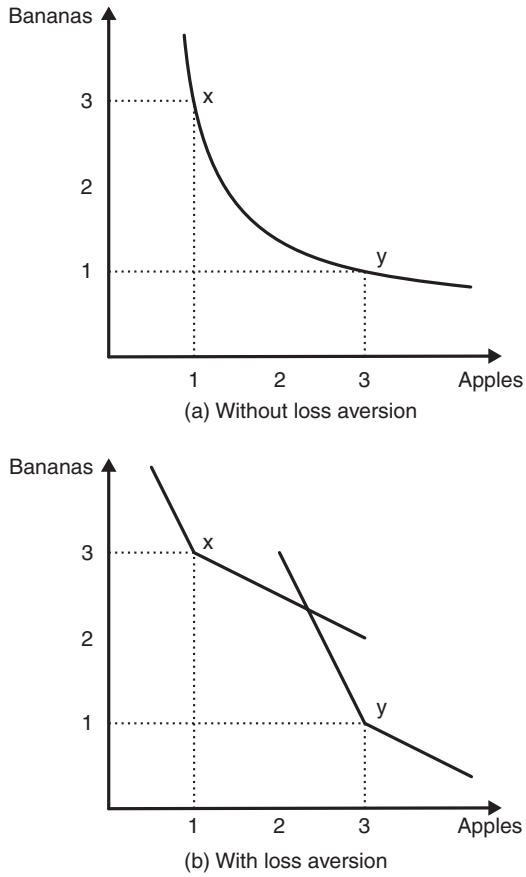


Figure 3.14 Indifference curves and loss aversion

in Figure 3.14(a), they do so independently of whether you happen to possess bundle x or y. This indifference curve is **reversible**, in the sense that it describes your preference over (actually, indifference between) x and y independently of your endowment.

By contrast, loss aversion entails that your indifference curves will not be independent of your current endowment. Suppose, for instance, that your value function is $v(x) = x$ for gains and $v(x) = 2x$ for losses, and that this is true for both apples and bananas. If you begin with bundle $y = \langle 3, 1\rangle$ and lose an apple, you will require two additional bananas to make up for that loss. Hence, the indifference curve going through y will also go through $\langle 2, 3\rangle$. If you start out with bundle y and lose a banana, you will require two additional apples to make up for that loss. Hence, the very same indifference curve will also go through $\langle 5, 0\rangle$. The result is similar if you begin with bundle $x = \langle 1, 3\rangle$. If you are loss averse, then, your indifference curves will look like those in Figure 3.14(b). Notice that there are two indifference curves here – really, two sets of indifference curves – one for initial endowment x and one for initial endowment y.

Exercise 3.47 Value functions Suppose that you are loss averse, and that your value function is $v(x) = x$ for gains and $v(x) = 3x$ for losses.

(**a**) Represent the value function graphically, in the manner of Figure 3.12.

(**b**) Represent your indifference curves graphically, in the manner of Figure 3.14(b), assuming that your initial endowment is $\langle 3, 4 \rangle$.

A feature of having kinks in your indifference curves – as in Figure 3.14(b) – is that if you begin with x and are offered to trade it for y, you will reject the offer. At the same time, if you begin with y and are offered to trade it for x, you will reject this offer too. This phenomenon is sometimes referred to as **status quo bias**, because you exhibit a tendency to prefer the existing state of affairs under any circumstances. In the study of Cornell coffee mugs, a median number of 2 out of 22 mugs changed hands when participants were allowed to trade mugs for money; in the absence of status quo bias, one would expect the number of trades to equal about 11. This result is important among other things because it appears at odds with what has come to be known as the **Coase Theorem.** Loosely speaking, the theorem says that in the absence of transaction costs, bargaining will lead to an efficient allocation. But to the extent that people exhibit status quo bias, they may fail to reach an efficient bargaining solution even when transactions costs are zero.

Exercise 3.48 Health care Broadly speaking, in Europe, health care is provided by the government and paid for by taxes. That is, individuals are taxed by the government, which then uses the tax money to provide health care services for the citizens. In the US, again broadly speaking, health care is largely purchased privately. That is, individuals pay lower taxes, and (if they so choose) use their money to purchase health care services.

(**a**) Use the notion of status quo bias to provide a detailed explanation of the following paradox: most Americans prefer their system to a European-style one, whereas most Europeans prefer their system to an American-style one.

(**b**) Illustrate your answer with a graph showing the indifference curves of a typical American and a typical European.

(**c**) Imagine that the US were to adopt a European-style health-care system. How should we expect Americans to feel about their new health-care system then, and how easy would it be for the opposition party to switch back?

Exercise 3.49 Affordable Care Act Writing in the *Washington Examiner* in July of 2013, Byron York explained why Democrats were so eager to implement the Affordable Care Act, a.k.a. Obamacare, which aims to provide health insurance for otherwise uninsured Americans:

> Obamacare is designed to increase the number of Americans who depend on the government to pay for health insurance … In all, the government will be transferring hundreds of billions of dollars to Americans for health coverage. The White House knows that once those payments begin, repealing Obamacare will no longer be an abstract question of removing legislation not yet in effect. Instead, it will be a very real matter of taking money away from people. It's very, very hard to do that.

What principle does this insight embody?

Exercise 3.50 Milton and Rose Friedman Nobel laureate Milton Friedman and Rose Friedman famously wrote: "Nothing is so permanent as a temporary government program."

(**a**) Use the concept of loss aversion to explain why supposedly temporary government programs have a tendency to last longer than originally intended.

(**b**) Some government programs now come with a sunset provision, which states that the law will be cancelled after a specific date. Explain how such provisions aim to solve the problem you identified under (a).

For better or worse, loss aversion and status quo bias make it rational for those who want to see expanded government programs to push ahead even with imperfect proposals, since it is easier to fix a flawed program later than it is to enact it in the first place. Loss aversion and status quo bias also make it rational for people who oppose them to aggressively resist *any* expansion, since it is very difficult to go back once a program is in place.

Status quo bias can be a real obstacle not only to sensible policies, but also to personal growth.

Example 3.51 Clutter While many people across the world continue to struggle to meet fundamental needs, more and more people in the developed world have the opposite problem: too much stuff. Although American homes have grown dramatically over the last 50 years or so, the amount of stuff people own has increased even faster. Consequently, the self-storage industry brags that it is one of the fastest-growing sectors of commercial real estate, bringing in more than $24 billion annually in the US alone. There is an entire body of self-help literature advising people to get rid of clutter in exchange for simplicity, happiness, and peace of mind, signifying both that people want to do so and that they are unable to. Why is decluttering so hard?

Loss aversion makes the gain of simplicity, happiness, and peace of mind seem small relative to the loss of all that stuff – prompting people to forgo the former in order to avoid the latter. The result is that people are biased in favor of the status quo, even when they acknowledge that it is inferior. The good news is that it may be possible to hack your mind by framing the decisions differently. If it is hard to get rid of that collection of VHS tapes you inherited, do not ask yourself, "Can I throw this away?" Instead, ask yourself, "If I didn't already own this, would I buy it?" If the answer is no, you know what to do. Or, if it is hard to get rid of half of your CD collection, do not ask yourself, "Which CDs should I throw away?" Instead, tell yourself that you are going to get rid of the entire collection and then ask yourself, "Which CDs should I keep?" Chances are it will be an easier process when the decision to declutter is not framed as a loss.

Status quo bias can explain why many people oppose human genetic enhancement. Many of us would be unwilling to give up our natural, pristine "unenhanced" state in exchange for an increase in intelligence quotient (IQ); yet, if we were the beneficiaries of genetic enhancement, it is hard to imagine that we would willingly accept a decrease in IQ in exchange for the natural, pristine "unenhanced" state. Also, status quo bias explains why many people

oppose free trade when they do not have it but are in favor of it when they do. Many people who hesitate to support free-trade agreements with other countries (with which they do not already trade freely) would protest loudly if somebody proposed eliminating free-trade agreements already in existence, for example, with adjoining states and regions. In all these cases, people are unmoved by the prospect of gaining a benefit that they do not already have, but deeply averse to losing some benefit that they already have.

Loss aversion must not be confused with diminishing marginal utility. If people would be willing to pay less for a mug that they do not own than they would accept in return for the mug that they do own, this may reflect diminishing marginal utility for mugs. Going back to Figure 3.11, notice that the utility derived from the second mug (that is, the marginal utility of the second mug) is much lower than the utility derived from the first mug. It is important not to attribute loss aversion to agents whose behavior is better explained in terms of diminishing marginal utility.

3.6 Anchoring and adjustment

Imagine that you subject people to the following two experiments. If your research participants protest that they do not know the answers to the questions, tell them to offer their best guesses.

Example 3.52 Africa and the UN Spin a wheel of fortune to come up with a number between 0 and 100, and invite your participants to answer the following two questions:

(**a**) Is the percentage of African nations in the United Nations (UN) greater than or less than the number?

(**b**) What is the actual percentage of African nations in the UN?

You probably would not expect the answer to (b) to reflect the random number generated by the wheel of fortune. Yet evidence suggests that you would find a correlation between the two. In one study, when the starting point was 10, the median answer to (b) was 25; when the starting point was 65, the median answer was 45.

Example 3.53 Multiplication Give people 5 seconds to come up with an answer to either one of the following multiplication problems:

(**a**) Compute: $1 * 2 * 3 * 4 * 5 * 6 * 7 * 8$

(**b**) Compute: $8 * 7 * 6 * 5 * 4 * 3 * 2 * 1$

Given that (a) and (b) are mathematically equivalent, you might expect your research participants to come up with more or less the same answer independently of which question they were asked. Yet, when a group of high school students were asked the first question, the median answer was 512; when they were asked the second question, the median answer was 2250. (The correct answer is 40,320.)

These phenomena are frequently explained by reference to **anchoring and adjustment,** which is a cognitive process that can be used when forming judgments. As the name suggests, anchoring and adjustment is a two-stage process:

first, you pick an initial estimate called an **anchor**, and second, you adjust the initial estimate up or down (as you see fit) in order to come up with a final answer. When deciding what a used car with a $15k price tag is worth, for example, you might start by asking yourself whether it is worth $15k and then adjust your estimate as required. If you think $15k is too much, you adjust your estimate of its worth downward; if you think $15k is too little, you adjust it upward.

According to one prominent account of human judgment and decision-making – the **heuristics-and-biases program** – we make judgments not by actually computing probabilities and utilities but by following **heuristics**. Thus, a heuristic is a rule of thumb or mental shortcut that can be used when forming judgments. Heuristics are thought to be functional, in the sense that they reduce the time and effort required to solve everyday problems and produce approximately correct answers under a wide range of conditions. But they are not assumed to be perfect: under certain circumstances, they are thought to fail in predictable fashion. Because the consistent application of a heuristic can lead to answers that are systematically and predictably wrong, we say that it can lead to **bias**. Thus, an account according to which we follow heuristics can help explain both why we oftentimes are able to make quick and perfectly appropriate judgments, and why we sometimes go wrong.

Anchoring and adjustment is one of the heuristics identified by the heuristics-and-biases program. Like all heuristics, anchoring and adjustment is thought to be functional but at the same time lead to bias under certain conditions. Evidence suggests that the adjustment is often insufficient. This means that the final judgment will to some extent be a function of the anchor, which may be perfectly arbitrary. If the anchor is very different from the true answer, anchoring and insufficient adjustment can generate highly inaccurate answers.

Consider Example 3.52. People's answer to the question about the percentage of African nations in the UN can be explained by saying that they take the random number as an anchor and adjust the answer up or down as they see fit. If the random number is 65, they begin with 65, then (assuming this number strikes them as too high) adjust downward. If, instead, the random number is 10, then (assuming this strikes them as too low) they adjust upward. Insofar as the adjustment is insufficient, we should expect the final estimate to be higher if the random number is 65 than if it is 10.

Consider Example 3.53. Under time pressure, students presumably perform a few steps of the multiplication problem (as time allows) and adjust upward to compensate for the missing steps. Insofar as the adjustment is insufficient, you would expect the answers to be too low. Moreover, because people who answer (a) will get a lower number after a few steps than people who answer (b), you would expect the former to offer a lower estimate than the latter. As you can tell, this is exactly what happened.

Anchoring and adjustment might affect a wide range of judgments. Consider the following famous story.

Exercise 3.54 Invention of chess According to legend, the inventor of chess was asked by the emperor what he (the inventor) wanted in return for his invention. The inventor responded: "One grain of rice for the first square on the chess-board, two grains for the second square, four grains for the third square, and so on."

The emperor was happy to oblige. There are 64 squares on the chess board, so on the 64th day, the inventor could demand $2^{64-1} \approx 10^{19} = 10{,}000{,}000{,}000{,}000{,}000{,}000$ grains of rice, a figure much greater than what the emperor had expected and could afford. Use the idea of anchoring and adjustment to explain how the emperor could underestimate the number so dramatically.

So far we have talked about anchoring and adjustment as something that affects belief, but there is evidence that it also affects preferences. In one study, experimenters showed MBA students various products, and asked them, first, whether they would be willing to buy the product for a price equal to the last two digits of their social security number, and second, to state their WTP. When people in the lowest quintile (the lowest 20 percent of the distribution with respect to social security numbers) were willing to pay $8.64 on the mean for a cordless trackball, people in the highest quintile were willing to pay $26.18. When people in the lowest quintile were willing to pay $11.73 for a bottle of fine wine, people in the highest quintile were willing to pay $37.55. Thus, people in the highest quintile were sometimes willing to pay more than three times as much as people in the lowest quintile. These results are easily explained by anchoring and (insufficient) adjustment, if we assume that the study participants used the last two digits of their social security number as an anchor.

From the discussion at the beginning of Section 3.5, it should be clear why this behavior pattern is irrational. The behavior pattern can be said to violate **procedure invariance**: the proposition that a stated preference should not differ depending on the method used to elicit it.

Anchoring and adjustment can explain a whole range of phenomena. It can explain, for instance, why it is so common to lure customers by lines such as these: "Used to be $50! Now only $24.99!" or "A $500 value for only $399" or "Suggested retail price: $14.99. Now, only $9.99." Sellers might hope that potential customers will form a judgment about the dollar value of the product by using the first amount as an anchor. The seller might realize that the customer would not be willing to pay $24.99 for the product if asked a direct question; however, the seller may be hoping that the customer will use the $50 figure as an anchor and insufficiently adjust downward, and therefore end up with a final WTP exceeding $24.99. That is, the seller hopes that people will use the greater number as an anchor. Anchoring and adjustment might also explain why realtors often publish an asking price that is higher than what they expect to receive for the property: by publishing a higher number, they might hope to influence what potential buyers would be willing to pay.

Exercise 3.55 Toasters Suppose that you wanted to sell toasters for $160, which will strike customers like a lot. How does research on anchoring and adjustment suggest that you do it?

You can also use anchoring and adjustment to increase the quantity that customers buy. Promotions of the form "3 for $2," "Limit of 6 per person," and "Buy 10 get 2 for free" work this way. To the extent that customers use the suggested quantity as an anchor and adjust insufficiently downward when deciding what quantity to purchase, such promotions can dramatically increase sales.

Anchoring and adjustment might also play a role in other kinds of decision. A German study of experienced judges and prosecutors found that sentencing decisions reflected irrelevant information provided to them by the researchers. Before handing down their decisions in a realistic but fictional case of sexual assault, the legal professionals were asked to imagine that a journalist called to ask if the sentence would be higher or lower than x years. The call should have no influence on the decision, but the researchers found that it did: when x was 1, the recommended sentence was 25 months; when x was 3, the recommended sentence was 33 months. Most amazingly, the difference between conditions remained significant even when the participants in the study were told that the anchor was generated randomly — *and when it was generated randomly right before their eyes by the rolling of dice*.

It is important not to exaggerate people's susceptibility to anchoring-and-adjustment-related bias. It may be that people respond to suggested retail prices (and the like) because they take a high suggested retail price to signal high quality. If so, their behavior may not be due to anchoring and adjustment at all. They would not even be making a choice under certainty. That said, this line of argument cannot explain how roulette wheels and social security numbers can affect behavior, on the assumption that no one would take such numbers as a mark of quality.

Either way, the heuristics-and-biases program has been enormously influential, and we will continue to discuss it below (for example in Sections 5.2 and 5.6). Because it carries so much explanatory power, we will return to anchoring and adjustment repeatedly (see, for example, Exercise 4.30 on page 85).

3.7 Discussion

This chapter has reviewed a number of different phenomena that appear to pose a problem for the theory that we learned in Chapter 2. Most of these phenomena are presented as challenges to the descriptive adequacy of rational-choice theory. Thus, behavioral economists think of the manner in which people ignore opportunity costs but honor sunk costs, exhibit menu dependence, overweight losses relative to gains, and permit arbitrary anchors to unduly affect their behavior as inconsistent with the view that people actually behave in accordance with rational-choice theory. Though far from universal, the deviations appear to be substantial, systematic, and predictable. Examples have illustrated that these phenomena can be costly indeed, not just in terms of time, effort, and money, but also in terms of human lives. Some of the phenomena that we have studied can also be construed as challenges to the normative adequacy of the theory. When it comes to opportunity costs, for example, we noted how extraordinarily demanding the theory can be. It has been argued that this makes the theory unsuitable as a normative theory. Obviously, this chapter does not pretend to have presented a complete list of phenomena that are at odds with standard theory of choice under certainty.

We have also reviewed some basic building blocks of theories that behavioral economists have proposed to account for phenomena that cannot be