while driving is not worth the increased accident risk? It is always a challenge to decide whether a particular choice was wrong. If by focusing on a deadline you neglect your kids, was that a bad choice? Who is to say? It depends on the consequences of performing poorly at work, the impact of your absence on your children, and even what you want out of life. An outside observer would need to struggle to untangle these considerations. But by exposing *how* tunneling operates, how some considerations are often ignored, the scarcity mindset can shed light on the issue even without settling these debates.

It tells us, for example, that we should be cautious about inferring preferences from behavior. We might see the busy person neglect his children and conclude that he does not care as much about his kids as he does about his work. But that may be wrong, much as it would be wrong to conclude that the uninsured farmer does not particularly care about the loss of his crop to the rains. The busy person may be tunneling. He may value his time with his children greatly, but the project he is rushing to finish pushes all that outside the tunnel. He may look back later in life and report a great deal of anguish about not having spent more time with his children. This is genuine anguish and not merely compliance with a social norm. It is the predictable disappointment of anyone who tunnels. Projects must be finished now; the children will be there tomorrow. Looking back at how our time or money was spent during moments of scarcity, we are bound to be disappointed. Immediate scarcity looms large, and important things unrelated to it will be neglected. When we experience scarcity again and again, these omissions can add up. This should not be confused with a lack of interest; after all, the person himself regrets it.

We started this chapter by showing how scarcity captures our attention. We see now that this primitive mechanism compounds into something much larger. Scarcity alters how we look at things; it makes us choose differently. This creates benefits: we are more effective in the moment. But it also comes at a cost: our single-mindedness leads us to neglect things we actually value.

2

THE BANDWIDTH TAX

Here are three vignettes about scarcity that illustrate a different consequence of focusing:

One of your biggest clients has informed you that it will be taking its business elsewhere. You convince the account manager to listen to one last pitch. She agrees but says it must take place tomorrow. You cancel all your meetings and put off all your other tasks. You pour all your time into the pitch. One appointment, though, cannot be avoided. Your daughter has her city championship softball game tonight. For a moment you even consider skipping that, but your better side (barely) wins out: surely her pitches feel as important to her as your sales pitch feels to you. On the way to the game, your daughter realizes she forgot her lucky charm. You snap at her before turning around to pick it up. By the time you have regained your composure, it's too late. She was already nervous for the game and now you've made her more nervous. Something fun has become tension filled. At the game, you can't enjoy yourself. Your mind keeps

turning to that presentation. Not that you can work on it now—you just can't focus on the game. You're distracted, and when your daughter occasionally catches a glimpse of you, you know she knows it. Lucky for you, her team wins and the jubilation helps cover your mistakes. But certainly your performance that evening would not put you in any parenting Hall of Fame.

John has an exam tomorrow. He is putting himself through college. Though his parents saved for all their kids' education, they did not save enough. They never dreamed that tuition would rise so much. John is the youngest of four kids, and by the time his turn came around, the college fund was meager and tuition was even higher. Still, he chose to go to a more prestigious but more expensive college. If he was going to invest in a college degree, he reasoned, he might as well invest in the one that would be worth the most. He patched together student loans, the college's financial aid, and scholarships. It was messy, but somehow he made it work. It always seemed like a good choice. Until now. Two scholarships that were to be automatically renewed have suddenly evaporated; the foundations that award them were hit hard by the recession and were forced to cut back. How would he make tuition for next semester? The payment was due in less than a month. Would the bank give him another student loan? Could he afford it? He could borrow from his aunt and uncle; his father would hate it but did he have a choice? Should he just transfer to the local college? John just can't focus. He keeps thinking about what to do. Preoccupied, he misses a study group meeting that he wanted—needed—to attend. This is no time to take the exam, but he has no choice. When the day arrives, he tries to focus, but his mind keeps going elsewhere. He misses some easy questions and is doubly upset at the end of the day. Not only is he struggling with tuition; he is annoyed at his abysmal performance on the exam.

A manager of a fast-food burger shop laments his trouble with his (low-wage) employees. "They are just so unreliable," he says. He complains that most of his time is spent cajoling them into behaving better with the customers. "Customer service means just that," he tells them. "Put on a smile. Be friendly. When the customer talks to you, make small talk. When the customer is a jerk, don't get snippy. It's your job to be polite." The rest of his time is spent dealing with careless mistakes. "When someone says they want medium fries, how hard is it to press the button that says 'fries'?" he asks incredulously. He is clearly frustrated with his workers. "Maybe it's that they just don't care. Maybe it's the education in this country. Maybe it's the way they were raised," he says.

These vignettes illustrate different consequences of scarcity capturing attention. In the previous chapter, we saw how tunneling distorts the trade-offs we make. Trying to focus on making ends meet right now, we fail to consider the impact in the future of raising the insurance deductible. In the vignettes above, in contrast, we catch people as they are trying to focus on something unrelated to their immediate scarcity. We catch the harried executive not when she is putting together her sales pitch but when she is a parent. We catch the student not when he is dealing with making ends meet but when he is trying to focus on his exam. We catch the low-income worker not when she is at home managing her finances but when she is at work serving food.

These anecdotes illustrate a central hypothesis: because the focus on scarcity is involuntary, and because it captures our attention, it impedes our ability to focus on other things. The executive is trying to focus on her daughter's baseball game, but scarcity keeps pulling her mind away. Even when we try to do something else, the tunnel of scarcity keeps drawing us in. Scarcity in one walk of life means we have less attention, less mind, in the rest of life.

The concept of *less mind* is well studied by psychologists. Though careful research in psychology employs several fine distinctions to capture this idea, we will use the single umbrella term *bandwidth* to cover them all. Bandwidth measures our computational capacity,

our ability to pay attention, to make good decisions, to stick with our plans, and to resist temptations. Bandwidth correlates with everything from intelligence and SAT performance to impulse control and success on diets. This chapter makes a bold claim. By constantly drawing us back into the tunnel, scarcity taxes our bandwidth and, as a result, inhibits our most fundamental capacities.

IT'S LOUD IN HERE

Imagine sitting in an office located near the railroad tracks. Trains rattle by several times an hour. They are not deafening. They do not disrupt conversation. In principle they are not loud enough to prevent you from working. But, of course, they do. As you try to concentrate, the rattle of each train pulls you away from what you were doing. The interruption itself is brief, but its effect lasts longer. You need time to refocus, to collect your thoughts. Worse, just when you have settled back in, another train rattles by.

This description mirrors the conditions of a school in New Haven that was located next to a noisy railroad line. To measure the impact of this noise on academic performance, two researchers noted that only one side of the school faced the tracks, so the students in classrooms on that side were particularly exposed to the noise but were otherwise similar to their fellow students. They found a striking difference between the two sides of the school. Sixth graders on the train side were a full year behind their counterparts on the quieter side. Further evidence came when the city, prompted by this study, installed noise pads. The researchers found that this erased the difference: now students on both sides of the building performed at the same level. A whole host of subsequent studies have shown that noise can hurt concentration and performance. Even if the impact of noise does not surprise you, the size of the impact (a full school year level at sixth grade) should. In fact, these results mirror many laboratory studies that have documented the powerful effects of even slight distraction.

Now picture yourself working in a pleasant, quiet office: no disruptions, no trains. Instead, you are struggling with your mortgage and the fact that freelance work is hard to come by. Your spouse and you are living a two-earner life with only one and a quarter earners. You sit down to focus on your work. Soon your mind is wandering. *Should we sell the second car? Should we take another loan?* Suddenly, that quiet office is not so quiet anymore. These noisy trains of thought are every bit as hard to ignore. They arrive at even greater regularity and are every bit as uninvited. But these trains pull you on board. *Should we sell the second car?* leads to *That would raise some money, but it would make the logistics so much harder, just when I need to be working as hard as I can. We don't want to risk the one steady job we do have.* You can ride these trains of thought for some time before you break free and return to focusing on your task. Though this room seems quiet, it is full of disruptions—disruptions that come from within.

This is how scarcity taxes bandwidth. The things that distract us, that occupy our mind, need not come from outside us. We often generate them for ourselves, and these distractions can disrupt our attention more than a physical train. These trains of thought rumble with personal relevance. The mortgage distraction lingers because it matters. It is not a passing nuisance but an intensely personal concern. It is a distraction precisely because it causes us to tunnel. The persistent concern pulls at the mind, drawing us in. Just like an external noise that distracts us from thinking clearly, scarcity generates *internal* disruption.

The notion of an "internal disruption" is commonplace in the cognitive sciences and in neuroscience. A great many studies have documented the profound impact of internal thoughts—even something as trivial as rehearsing a sequence of numbers in your head—on general cognitive function. And years of lab studies compounded by fMRI evidence have taught us about the way the brain focuses and is disrupted. One common distinction is between "top-down" processing, where the mind is directed by our conscious choice of what to focus on, and "bottom-up" processing, where attention is captured by one stimulus or another in ways that we find hard to control.

We saw this in the introduction, when food-related words captured the attention of the hungry. You know the feeling well, from any time a quick movement or sound captured your attention away from what you were doing. A particularly noteworthy form of distraction, one that requires no external distractors at all, is mind wandering. Without our realizing it, the brain's resting state—the default network—tends to pull us away from what we are doing. True to its name, this happens without our conscious input, when our mind "wanders." So while we are often able to direct our brain's activity, at other times we lose that control. For the kids in the school near the trains, the ability to remain focused in the presence of bottom-up distractors depends also on how much work the brain is doing, on how "loaded" it is. Behavioral and neuroimaging studies have shown that distraction along with brain activity related to the presence of distractors increase when the load is high. Top-down attention cannot prevent bottom-up intrusions. When someone says your name across the room at a party, your attention shifts no matter how intently you are trying to focus on something else.

Scarcity itself also captures attention via a bottom-up process. This is what we mean when we say it is involuntary, happening below conscious control. As a result, scarcity, too—like trains or sudden noises—can pull us away even when we are trying to focus elsewhere.

An early study tested this idea by giving subjects a simple enough task: push a button when you see a red dot on the screen. Sometimes, just before the dot appeared, another picture would flash on the screen. For nondieters, this picture had no effect on whether people saw the dot. For dieters, in contrast, something interesting happened. They were less likely to see the red dot if they had just seen a picture of food. Flashing a picture of a cake, for example, reduced dieters' chance of seeing the red dot immediately afterward: it was as if the cake had blinded them. This happened only with pictures of food; nonfood pictures had no effect. Of course the dieters were not physically blinded; they were just mentally distracted. Psychologists call this an *attentional blink*. The food picture, now gone,

had made them mentally blink. When the dot appeared, their minds were elsewhere, still thinking about the food. All of this happened in a fraction of a second, too quick to control. Too quick to even be aware of. The title of the study says it best: "All I Saw Was the Cake."

The attentional blink occurs briefly. The distracting effects of scarcity, we conjectured, would last significantly longer. To test this, we ran a study with the psychologist Chris Bryan, in which we gave subjects word searches such as this one:

WORD SEARCH

D	N	O	V	I	G	Z
I	T	J	M	S	F	U
Q	L	E	W	O	X	N
K	W	C	E	P	B	X
H	R	E	B	R	X	J
W	P	D	S	W	T	A
N	U	X	K	R	Z	S

STREET
TREE
PICTURE
CLOUD
CARPET
LAMP
DAYTIME
RAIN
VACUUM
DOOR

Subjects searched for the highlighted word (*STREET* in this case). When they found and clicked it, a new grid appeared and they would look for the next word. A second group of subjects was given the same task but with slightly different words. For example:

WORD SEARCH

O	Q	M	V	T	W	A
J	O	R	G	T	M	G
R	M	X	H	T	D	K
N	A	R	E	E	E	C
T	O	E	K	F	P	Z
Q	X	G	T	P	I	V
J	C	A	K	E	Q	P

CAKE
TREE
DONUT
CLOUD
SWEETS
LAMP
INDULGE
RAIN
DESSERT
DOOR

The even-numbered words were the same for both groups. The odd-numbered words were neutral words for the first group but tempting ones for the second: *STREET* became *CAKE*, *PICTURE* became *DONUT*, and so on. We then looked at how long it took participants to find the same words, those they had in common, the even-numbered neutral ones.

For most subjects, changing the odd-numbered words had no effect. Not so for dieters. Dieters took 30 percent longer to find *CLOUD* after they had just searched for *DONUT*. Dieters were not slow overall—they found *CLOUD* just as quickly as nondieters when it was preceded by *PICTURE*. The *DONUT* was the problem. What is happening here is clear. It is a version of what psychologists call *proactive interference*. The mention of a donut brings it top of mind. The nondieter searches for it, finds it, and moves on. The dieter, in contrast, finds it hard to move on. Even while searching for the next word, for *CLOUD*, that donut, every bit as disruptive as a passing train, is still there, drawing attention. And it is hard to find *CLOUD* when your mind is elsewhere.

Surely you've experienced something similar. If not with food, then perhaps with time. You are against a tight project deadline but must attend an unrelated meeting. How much of this meeting will you process? Sitting at the meeting you try to focus, but despite your best efforts, your mind keeps wandering back to that deadline. Your body is at the meeting, but your mind is elsewhere. Like the word *DONUT* for the dieter, the deadline keeps pulling you away.

Imagine that you are surfing the web on your laptop. On a reasonably fast computer, you easily go from page to page. But imagine now that there are many other programs open in the background. You have some music playing, files downloading, and a bunch of browser windows open. Suddenly, you are crawling, not surfing, the web. These background programs are eating up processor cycles. Your browser is limping along because it has less computing power to work with.

Scarcity does something similar to our mental processor. By constantly loading the mind with other processes, it leaves less "mind"

for the task at hand. This leads us to the central hypothesis of this chapter: *scarcity directly reduces bandwidth*—not a person's inherent capacity but how much of that capacity is currently available for use.

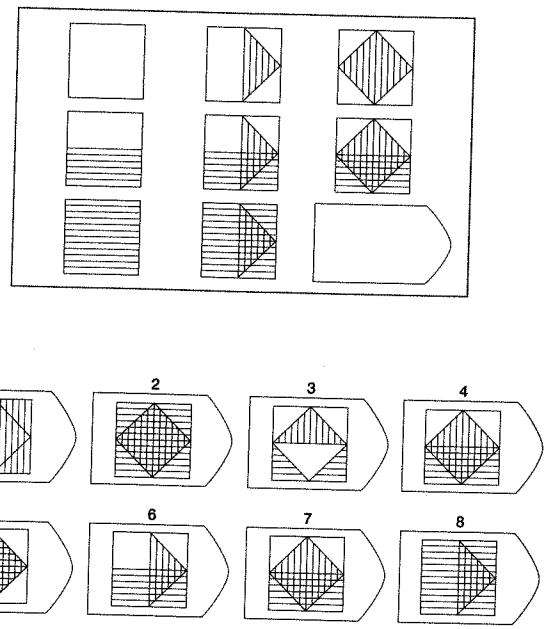
To test this hypothesis, we need to refine our definition of *bandwidth*. We are using the term as a placeholder for several more nuanced and carefully researched psychological constructs. In effect, we are walking a fine line. As psychologists, we care about the distinctions, functional and otherwise, between the various constructs and their corresponding brain function. And *bandwidth* is a generic term that obscures those distinctions. But as social scientists interested in the effects of scarcity, we are willing to leave the fine distinctions alone, much as one might refer to *democracy* or *subatomic particles* while avoiding the many finer distinctions that these afford. By way of compromise, we will continue to use the blanket term *bandwidth* to refer to two broad and related components of mental function, which we will now explain in greater depth.

The first might be broadly referred to as *cognitive capacity*, the psychological mechanisms that underlie our ability to solve problems, retain information, engage in logical reasoning, and so on. Perhaps the most prominent in this category is fluid intelligence, the ability to think and reason abstractly and solve problems independent of any specific learning or experience. The second is *executive control,* which underlies our ability to manage our cognitive activities, including planning, attention, initiating and inhibiting actions, and controlling impulses. Much like a central processor, executive control is essential to our ability to function well. It determines our ability to focus, to shift attention, to retain things in memory, to multitask, to self-monitor. Cognitive capacity and executive control are multifaceted and rich in nuance. And scarcity affects both.

COGNITIVE CAPACITY

A central feature of cognitive capacity is fluid intelligence. To test for the impact of scarcity on people's cognitive capacity, we use the most

prominent and universally accepted measure of fluid intelligence, the Raven's Progressive Matrices test, named after the British psychologist John Raven, who developed the test in the 1930s. For an example, look at the following, which is similar to a typical Raven's test item, and ask yourself which of options 1–8 fits in the missing space:



You may recognize this test from your school days. It is a common component of IQ tests. While IQ tests are complex and variegated, most agree that the Raven's Progressive Matrices test is one of the most important and reliable components. Raven's requires no knowledge of world events and little formal study. It is the most common way that psychologists, educators, the military, and others measure what is called fluid intelligence, the capacity to think logically, analyze and solve novel problems, independent of background knowledge. A mechanic reasoning about why an engine won't start uses both background automotive knowledge and reasoning skills. The same mechanic looking at a Raven's Matrix is applying his reasoning skills in a context in which he has no expertise—he's on par

with a farmer in India. This has made Raven's particularly useful as a measure of general intelligence, one that supposedly transcends specific culture. Still, there are skeptics. Those who have familiarity with tests and test taking will surely perform better. Those who have taken geometry might do better. In fact, it is known that there are benefits to schooling—children with more years of school do better than those of equal age with fewer years. The debates about what IQ really measures persist even for fluid intelligence. Fortunately, these debates do not matter for our purposes. We will not be comparing fluid intelligence between one person and another or from one culture to the next. We are interested in how scarcity affects the same person's cognitive capacity. It may strike you as odd that a person's "capacity" can be so easily affected, but that is precisely the point—we are used to thinking of cognitive capacity as fixed, when in fact it might change with circumstances.

To see the effect of scarcity on fluid intelligence, we ran some studies with our graduate student, Jiaying Zhao, in which we gave people in a New Jersey mall the Raven's Progressive Matrices test. First, half the subjects were presented with simple hypothetical scenarios, such as this one:

> *Imagine that your car has some trouble, which requires a $300 service. Your auto insurance will cover half the cost. You need to decide whether to go ahead and get the car fixed, or take a chance and hope that it lasts for a while longer. How would you go about making such a decision? Financially, would it be an easy or a difficult decision for you to make?*

We then followed this question with a series of Raven's Matrices problems. Using self-reported household income, we divided subjects, by median split, into rich and poor. In this setup we found no statistically significant difference between the rich and poor mall-goers. Of course, there may have been some difference, but it was not big enough for us to detect in this sample. The rich and the poor looked equally smart.

For the remaining subjects, we ran the same study but with a

slight twist. They were given this question instead (with the change shown in bold):

> *Imagine that your car has some trouble, which requires an* ***expensive $3,000 service.*** *Your auto insurance will cover half the cost. You need to decide whether to go ahead and get the car fixed, or take a chance and hope that it lasts for a while longer. How would you go about making such a decision? Financially, would it be an easy or a difficult decision for you to make?*

All we have done here is replace the $300 with $3,000. Remarkably, this change affected the two groups differently. Coming up with half of $300 or $3,000 was easy for those who were well off. They could just pay out of savings or put it on a credit card. For the less well off, finding $150 for an important need was not too hard either. Not enough to make them think too much about scarcity and their own finances.

Not so for the $3,000 car expense: finding $1,500 was going to be hard for those with low incomes. A 2011 study found that close to half of all Americans reported that they would be unable to come up with $2,000 in thirty days even if they really needed it. Of course the question we gave the mall respondents was hypothetical. But it was realistic, and it likely got them thinking about their own money concerns. They may not have a broken car, but experiencing money scarcity would mean they had monetary issues close to top of mind. Once we tickled that part of the brain, the all-too-real nonhypothetical thinking about scarcity would come spilling out. *Coming up with $1,500 would be hard. My credit cards are maxed out. Already the minimum payment due is so large. How will I make the minimum payment this month? Can I afford to miss another payment? Should I take a payday loan this time instead?* A little tickle could raise a racket in the brain.

And this racket affected performance. The well-off subjects, with no racket, did just as well here as if they had seen the easy scenario.

The poorer subjects, on the other hand, did significantly worse. A small tickle of scarcity and all of a sudden they looked significantly less intelligent. Preoccupied by scarcity, they had lower fluid intelligence scores.

We have run these studies numerous times, always with the same results. This is not merely an artifact of the $3,000 being *mathematically* more challenging. When we ran nonfinancial problems, we found absolutely no effect of giving similarly small versus large numbers. The effect is specific to hard problems that are financial in nature (for those who are short on money). It is also not the result of a lack of motivation. In one replication of the study, we paid people for every correct answer on the Raven's test. Presumably the low-income participants have a *greater* incentive to do better: after all, the money matters to them more. But they did not do any better; in fact, they did just a tiny bit worse than before. Low-income participants who presumably could have used the extra pay left the mall with less money after having contemplated the harder scenarios, an effect that was absent for those financially more comfortable.

In all the replications, the effects were equally big. To understand how big these effects are, here is a benchmark from a study on sleep. In this study, one group of subjects was put in bed at a normal time. Another group was forced to stay awake all night. Pulling an all-nighter like this is terribly debilitating. Imagine yourself after one night without any sleep. The next morning, the sleeping group was awakened, and both groups were given a Raven's test. Not surprisingly, the sleep deprived did much worse.

In comparison, how big was our effect at the mall? It was even bigger. How smart do you feel after a night of no sleep? How sharp would you be the next morning? Our study revealed that simply raising monetary concerns for the poor erodes cognitive performance even more than being seriously sleep deprived.

There is another way to understand the size of our findings. Because the Raven's test is used to measure fluid intelligence, it has a direct analogue with IQ. Typical studies of IQ assume a normal distribution of IQ scores, with a mean of 100 and a standard deviation

of 15. (Standard deviation is a measure of the dispersion of scores around their mean. In a normal distribution, almost 70 percent of scores fall within one standard deviation of the mean.) One can calibrate the impact of an intervention by looking at how its effect compares to the standard deviation. For example, if an intervention has an effect equivalent to one-third of a standard deviation, then that effect corresponds to about five IQ points.

By that measure our effects correspond to between 13 and 14 IQ points. By most commonly used descriptive classifications of IQ, 13 points can move you from the category of "average" to one labeled "superior" intelligence. Or, if you move in the other direction, losing 13 points can take you from "average" to a category labeled "borderline deficient." Remember: these differences are not between poor people and rich people. Rather, we are comparing how the same person performs under different circumstances. The same person has fewer IQ points when she is preoccupied by scarcity than when she is not. This is key to our story. The poor responded just like the rich when the car cost little to fix, when scarcity had not been rendered salient. Clearly, this is not about inherent cognitive capacity. Just like the processor that is slowed down by too many applications, the poor here *appear* worse because some of their bandwidth is being used elsewhere.

EXECUTIVE CONTROL

The second component of bandwidth is executive control. As discussed above, executive control is multifaceted, so we begin by considering one of the many important functions to which it contributes, namely, self-control. In the late 1960s Walter Mischel and his colleagues performed one of the most interesting (at the very least, the cutest) psychology experiments on impulsivity. Mischel's research staff would seat a four- or five-year-old in a room and put a marshmallow in front of him. Some children would stare entranced

at it, some would fidget with excitement; all of them wanted it. And the child could have it. But, before he could eat it, he was told there was a catch. More of an opportunity, really. The researcher was going to leave the room. If the child hadn't eaten the marshmallow before the researcher returned, he would get a second marshmallow. The children were faced with one of the oldest problems known to man, what the social scientist Thomas Schelling calls "the intimate contest for self-command," the problem of self-control.

Self-control remains one of the more difficult parts of the study of psychology. We know many ingredients go into the manufacturing of self-control. It depends on how we weigh the future. And we appear to do it inconsistently. Immediate rewards (a marshmallow now) are salient and receive a heavy weight. Rewards in the distant future (two marshmallows later) are less salient and thus receive lower weight. So when we think about one versus two marshmallows in the abstract future, two is better than one. But when one marshmallow is right in front of us now, it suddenly beats two. Self-control also depends on willpower, a resource whose functioning we do not fully understand, but which is affected, among other things, by personality, fatigue, and attention.

Self-control relies heavily on executive control. We use executive control to direct attention, initiate an action, inhibit an intuitive response, or resist an impulse. In fact, a less publicized but often replicated part of Mischel's study is highly instructive here. The children who were most successful in resisting the marshmallow temptation did so by focusing their attention elsewhere. Instead of looking at and thinking about the marshmallow, they thought about other things. Instead of having to resist the desire, they simply arranged not to notice it. As Mischel put it, "Once you realize that willpower is just a matter of learning how to control your attention and thoughts, you can really begin to increase it."

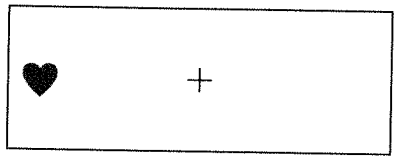
This provides a telling link between executive control and self-control. Since executive control helps direct attention and control impulses, reduced executive function will hamper self-control. A

number of experiments have vividly illustrated this connection. One experiment gave subjects a memory task. Some were asked to remember a two-digit number; some were given a seven-digit number. The subjects were then led to a lobby where they would await further testing. In front of them in the waiting area were slices of cake and fruit. The real test was what they would choose while they waited, while rehearsing those numbers in their heads. Those whose minds were not terribly occupied by the two-digit number chose the fruit most of the time. Those whose minds were busy rehearsing the seven-digit number chose the cake 50 percent more often. The cake is the impulsive choice. It requires conscious action to prevent the automatic choice. When our mental bandwidth is used on something else, like rehearsing digits, we have less capacity to prevent ourselves from eating cake.

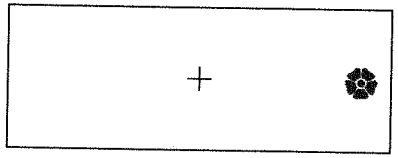
In another study, white Australian students were served food, but in this case it was something they found revolting: a chicken foot cooked in a Chinese style that preserved the entire foot intact, claws included. The challenge for the subjects was that this was served by a Chinese experimenter, creating some pressure to act civilized. As in the cake study, some subjects' minds were loaded: they were asked to remember an eight-digit number. Those whose minds were not loaded managed to maintain composure, keeping their thoughts to themselves. Not so with the cognitively loaded subjects. They would blurt out rude comments, such as "This is bloody revolting," despite their best intentions.

Whether it is eating cake we would rather resist or saying things we do not mean to say, a tax on bandwidth makes it harder for us to control our impulses. And because scarcity taxes bandwidth, this suggests that scarcity not only can lower fluid intelligence but can also reduce self-control. Hence, the Australian student snaps at the Chinese experimenter, the executive consumed by the impending presentation snaps at her daughter, and the employee thinking about his unpaid bills snaps at a rude customer.

To explore whether scarcity reduces executive control, we gave subjects at the New Jersey mall a test that is frequently used to measure executive control, one that directly tested their ability to inhibit automatic responses. First, the subjects were presented with the hypothetical financial scenarios, either easy or hard, as before. They would then see pictures such as these:



or



in rapid succession on a computer screen. They placed the fingers of both hands on the keyboard, and their task was to press the same side as the heart and the *opposite* side of the flower. So if the heart appears on the right, you press right. And if the flower appears on the right, you press left.

The flower creates an automatic impulse that needs to be resisted: hitting the same side as the heart comes easy; hitting the opposite side of the flower is hard. Doing well requires overriding your impulse to quickly hit the same side. The more executive control you have, the better you will do. This test measures how capable you are at inhibiting your first impulse in favor of a different response, be it resisting a cake, biting your tongue, or, in this case, resisting the flower.

Though this task tests executive control, quite different from fluid intelligence, the results were the same. After the financially easy questions, the poor and the well off looked similar. They were able to control their impulses to the same degree, and they made about the same number of errors. But the financially hard questions

changed things dramatically for the poor. The well-off subjects continued to do just as well as if they had seen the easy scenario. They exhibited the same level of executive control. The poorer subjects, on the other hand, now did significantly worse. They were more impulsive, mistakenly hitting the same side as the flower more often. While they had hit the correct key 83 percent of the time in the context of the financially easy scenarios, correct key presses went down to 63 percent in the context of scenarios that were financially more challenging. A small tickle of scarcity and they were suddenly more impulsive. Beyond fluid intelligence, scarcity appears to reduce executive control.

HARVESTS

These experiments at the mall test our hypothesis. But in a way, they are artificial. They show how people respond when we trigger in them thoughts about scarcity, which we induce through hypothetical questions about financial hardship. Our interest, though, is in people's everyday lives outside the confines of an experiment. Does scarcity tax people's cognitive resources even when there are no experimenters lurking at the mall to get them to think about it?

Showing this is essential to our argument. But it is hard. We cannot simply look at how poor people compare to rich people in cognitive capacity or self-control. Too many other things—health, friends, education—differ between the rich and the poor for us to be able to attribute any observed differences to scarcity. Such comparisons have been attempted endlessly with no obvious solution to the statistical problems that are inherent to such comparisons. How could we see the effect of scarcity free from all these intricacies?

It was around this time that we were doing fieldwork on farming in India with the economist Anandi Mani, when we noticed something interesting. Farmers get their income in a big lump, all at once at harvest time. This means the farmer has a very different financial

life from most workers, who get paid regularly (daily, weekly, or monthly). Instead, a farmer might get paid twice a year or sometimes even once a year. Now picture a farmer who gets paid in June. The next few months are quite good: he's got cash. But even if he's prudent and tries hard to smooth his spending over this period, by the time next April or May rolls around, he will be tight on cash. So the *same farmer* is rich in the months after harvest and poor in the months before harvest.

This was quite close to what we needed: we could examine the same farmer's bandwidth in the months before harvest and in the months after harvest. Instead of comparing rich and poor people, we'd be seeing how the same person behaves differently when tight for cash and when flush with cash. But there was one wrinkle. Might not harvest months impose different obligations from ordinary months? For example, festivals and weddings are common during harvest months—exactly because people are cash rich. So instead of seeing the effects of scarcity, we might just see the effects of celebrations.

To get around this, we used sugar cane farming, which has a peculiar feature. Sugar cane requires an enormous factory to crush the cane and extract the juice (which, once evaporated, forms sugar). The factories can only process so much and the crop can't sit after harvesting for long. So sugar cane is harvested during a four-to-five-month window. In some areas it is harvested throughout the year. Neighboring plots are often on very different harvest cycles. One farmer may be harvesting while his neighbor to one side harvested several months ago and his other neighbor has months to go before harvesting. This rather obscure fact gave us the break we needed. We could now study the same farmers when they're poor and rich *and* know that there's nothing specific about the preharvest and postharvest calendar months. After all, the same month was preharvest for one farmer and postharvest for his neighbor.

As we expected, the data showed that the farmers were more strapped for cash preharvest. Seventy-eight percent of them had pawned something in the month before harvest (and 99 percent took

some sort of loan), but only 4 percent pawned something in the month after harvest (and only 13 percent took any kind of loan). Before harvest, they were also more likely to report having trouble coping with ordinary bills.

As at the mall, we again measured executive control and fluid intelligence. We gave the farmers a Raven's Matrices task, but we could not do the heart–flower task because it was difficult to administer it in the field. So for an executive control task, we chose a close cousin, something called the Stroop task. In this task, subjects see strings of items, such as *F F F F*, and have to quickly say how many items are in the string. (In this case, the answer is four.) When you see *2 2 2 2*, quickly saying "four" is quite hard. It is hard for the same reason that it is hard to quickly hit the opposite side each time you see the flower.

Using these tasks, we found that farmers performed much worse before harvest than after harvest. The same farmer fared worse on fluid intelligence and executive control when he was poor (preharvest) than when he was rich (postharvest). Much like the subjects at the mall, the same person looked less intelligent and more impulsive when he was poor. Yet in this case it was not us who triggered scarcity-related thoughts or even tried to bring them to the surface. These thoughts were there naturally when the farmers were poor (the harvest money dissipated to a small amount) but not when they were rich (still flush with cash from the harvest).

And again the magnitudes were large. The postharvest farmers got about 25 percent more items correct on Raven's. Put in IQ terms, as in the earlier mall study, this would correspond to about 9 or 10 IQ points. Not as big a gap as at the mall, but that is to be expected. After all, here we hadn't induced them to think about money. We simply measured their mental state at an arbitrarily selected point in time, their *latent* tendency to have their bandwidth taxed by scarcity. On the executive control task, they were 11 percent slower in responding and made 15 percent more errors while poor, quite comparable to the mall study. Had we met a farmer when he was poor, we would have been tempted to attribute his limited capacity to a personal trait. But we know from our study that his limitation has

little to do with his genuine capacity as a person. The very state of having less money in the months before harvest had made him perform less intelligently and show less cognitive control.

Before notching this as a victory for our theory, however, a few doors must be shut. We know that scarcity (poverty) changes before and after harvest. But are there other things that change with it? And if so, might these be the drivers of the psychic changes? Three alternatives stand out.

First, if the farmers are poorer preharvest, might they also be eating less? If so, would it be such a surprise then to find that their cognitive function was also lower? Worse nutrition and simple hunger could leave anyone's brain in a weakened state. For our farmers, though, this was not the case. These farmers are not so poor when they are short on cash that they are forced to cut back on food. If anything, they spent slightly less money on food postharvest. Although we find that they spend less preharvest, they do not spend less on food. Instead, they spend less on other things that matter. For example, they might give a cousin a smaller gift for his wedding. In a culture like India's, where gift giving is not simply a bonus but an obligation (a repayment of past gifts), such cutbacks can be painful.

Second, might they not be working harder preharvest? Preparing for harvest is hard work and might leave farmers tired. Physical exhaustion could easily bring mental exhaustion. In fact, our surveys sufficiently preceded the actual harvest date (four weeks is a long time in agriculture) that preparation for harvest had not started in any serious way. Farmers were not working any more or harder in the preharvest week than in the postharvest week.

Finally, harvest time is not only when you get your money; it's also when you find out how much you got. Farming is notoriously variable. Some harvests are bountiful, others meager. Could the simple anxiety of not knowing what he will earn affect the farmer's mental state? For some crops, such as rice, this is a serious concern. But not so with sugar cane. By surveying his land, a farmer can readily estimate his income. Almost all the crop growth has happened several months before harvest. The last months are just to increase the sugar

content of the crop, not its volume. But this is the mill's problem: the farmers get paid solely on volume, not on sugar content. The only reason farmers do not harvest earlier is that the sugar mill does not allow it. In short, several months ahead of time farmers have an accurate understanding of how much they will get paid. They know as much before as they do after the harvest.

There are other minor quibbles we could discuss. But the bottom line is clear. Poverty *itself* taxes the mind. Even without an experimenter around to remind us of scarcity, poverty reduces fluid intelligence and executive control. Returning to where we started, this suggests a major twist in the debate over the cognitive capacity of the poor. We would argue that the poor do have lower *effective* capacity than those who are well off. This is not because they are less capable, but rather because part of their mind is captured by scarcity.

OTHER FORMS OF SCARCITY

> *About that time, it occurred to me that I was succeeding in the world with only part of my brain engaged. While a tenth of it was devoted to school, a tenth devoted to my daughter, and perhaps another tenth devoted to family crises and illnesses, the other 70 percent of my mind was constantly focused on food—the calorie count of a grape, the filling bulk of popcorn, the clever use of water as a placebo. "How much farther," I thought, "can I go in the world if I use that 70 percent more wisely?"*
>
> —NATALIE KUSZ, "THE FAT LADY SINGS"

We all understand that dieting can be hard: resisting tasty foods can be difficult for all of us. The bandwidth tax, however, suggests that dieting is more than hard. It is mentally taxing. Dieters, when doing anything, should find they have fewer mental resources because they are partly preoccupied with food. In fact, this is what a few studies

have shown. They have compared dieters to nondieters on various cognitive measures, the kind that psychologists use to gauge effective cognitive capacity. Sometimes they compare restrained eaters to nonrestrained eaters. Sometimes they compare the same person over time, during periods when he is dieting compared to periods when he is not. However they do it, they find the same effect. Across a variety of cognitive tests, they find that people simply perform worse when they are dieting. And when psychologists interview the respondents, they find a common pattern: concerns related to dieting are top of mind for these dieters and interfere with their performance.

These results do not appear to come from a simple lack of calories. Not surprisingly (since many of those who attempt to diet fail), the effects appear even in cases where there is no weight loss. Furthermore, direct physiological measures show that nutritional deficiencies do not cause these cognitive impairments. Think of it this way—while losing weight you are preoccupied and face a bandwidth tax. But if you are able to settle into a new equilibrium and find yourself no longer needing to restrain eating, then the bandwidth tax disappears. Of course, one can poke holes in these data: dieters and nondieters may differ for other reasons. More research will be needed to quantify the size of the bandwidth tax for dieters, but it is striking that the results around calorie scarcity mirror what we have found in studying income scarcity.

Something similar happens with the lonely. One study gave lonely and nonlonely subjects a different kind of bandwidth measure, a rather elegant procedure called a *dichotic listening task*. Subjects are asked to listen to two different sounds, one in each ear. They might hear a woman's voice in one ear and a man's voice in the other. The test measures how well people can track one ear and shut out the distraction coming in from the other. This test relies on an interesting fact about the brain: brain lateralization. Most people are right-ear dominant for language, which means that verbal information presented to the right ear is easier for them to attend to. When given no

instructions, they tend to focus on the voice presented to the right ear. In fact, when asked to track what was said in the right ear, the lonely and the nonlonely did equally well. In contrast, focusing on the nondominant ear—the left ear—requires bandwidth. It requires executive control to override the natural proclivity to focus on the right and instead to attend to the left. And now the lonely did significantly less well. They were less effective at overriding their natural urge, less effective at tuning out the right ear and listening to the left. The lonely in other words showed impaired bandwidth—in this case, lesser executive control.

In other studies, researchers did something similar to what we did at the mall. They had subjects fill out what they thought were personality tests, and then, by random assignment, they gave these subjects feedback leading them to believe the tests clearly indicated they were going to be either socially well adjusted or else very lonely. They randomly, and instantaneously, created perceived scarcity by leading their subjects to anticipate loneliness. After the information had sunk in, they gave the subjects a Raven's test and found that those who anticipated being lonely did much worse. In fact, when they placed subjects in the scanner, they saw that making people think they would be lonely reduced activation of the executive control areas of the brain. Finally, in a study looking at impulse control, when subjects who anticipated being lonely were given the opportunity to taste chocolate-chip cookies, they ate roughly twice as many. Consistent with this, research on the diets of older adults has found that those who feel lonely in their daily lives have a substantially higher consumption of fatty foods.

Finally, we see similar effects even for artificial scarcity. Recall the Angry Blueberries study from chapter 1. We have found in similar games that the "poor" subjects (those given fewer resources in the game) do worse on the heart–flower task after having played the game. Even though (being poor) they play far shorter games, they are so focused that they have less bandwidth at the end. Like the dieters, the money poor, and the lonely, these blueberry-poor subjects are taxed by scarcity.

SCARCITY AND WORRY

Of course, scarcity is not the only thing that can tax bandwidth. Imagine you had a fight with your spouse one morning. You might not be very productive at work. You might look and act "dumber" that day. You might not hold your tongue when you should. Part of your bandwidth is being used up fussing, fretting, and maybe fuming over the fight. You, too, would have less brain left for everything else. Under this view, everyone has concerns and needs that can tax the mind.

What, then, is so special about scarcity?

Scarcity, by its nature, is a clustering of several important concerns. Unlike a marital spat that can happen anywhere and to anyone, preoccupations with money and with time cluster around the poor and the busy, and they rarely let go. The poor must contend with persistent monetary concerns. The busy must contend with persistent time concerns. Scarcity predictably creates an additional load on top of all their other concerns. It consistently and predictably taxes bandwidth. Everyone can be preoccupied: rich and poor people fight with their spouses; rich and poor people can be flustered by their bosses. But whereas only some people who experience abundance will be preoccupied, everyone experiencing scarcity will be preoccupied.

This discussion raises another important question. In all this talk about scarcity, are we just referring to stress in a roundabout way? In everyday life, *stress* is used liberally, to mean many things. Scientifically, however, there has been considerable progress in the understanding of stress. We now have a firmer grasp of the biochemistry of the generalized stress response. We can even identify several of the molecules involved—glucocorticoids (such as cortisol), norepinephrine, and serotonin—as well as some of their function. This knowledge allows us to more carefully consider whether stress is the biological mechanism by which scarcity affects the mind.

There is, even in our data, some reason to think that stress plays some role. Predictably, experiencing scarcity can be stressful. In the

harvest study, for example, we found that postharvest farmers were less stressed than they were before harvest. We also found sizable reductions in heart rate variability, a frequently used measure of stress.

At the same time, stress is unlikely to be the primary driver of many of the effects we have observed. Some of the most important effects had to do with scarcity taxing what we have come to call bandwidth. Stress, in contrast, does not have these predictable effects. Some studies find that stress *heightens* working memory. Still other studies have found mixed evidence, including some indication that executive control might improve during periods of stress. Of course, the chronic effects of stress are still different, but the effects of scarcity that we have studied are immediate: in the mall study, simply reminding people about their money had an almost instantaneous effect on their mental capacity. In addition, we have shown a particular pattern of improved performance (the focus dividend) and diminished performance (the bandwidth tax), a pattern that anxiety and stress alone cannot explain.

Finally, to think of all of this as stress and worry misses a deeper point. The bandwidth tax is not a finding in isolation. It emerges from the same core mechanism as the focus dividend or the way tunneling shapes our choices. A focus on stress alone would miss these deeper connections and ultimately limit our understanding of the scarcity mindset.

WHAT THE BANDWIDTH TAX MEANS

The vignettes with which we opened this chapter may seem obvious in light of the bandwidth tax. You wouldn't be surprised if the cashier hadn't heard the order of fries just when a train passed by. So you (and her manager) shouldn't be surprised if, lost in thought about how to make rent this month, she overlooks the order of fries. She is not being careless. She is preoccupied. Thoughts such as, Should I risk being late again on my credit card? can be every bit as loud as

a passing train. The manager with the impending sales pitch tries to focus on her daughter's game. Yet before she knows it, she finds herself ruminating on the sales pitch. The student tries to focus on the exam at hand but is constantly interrupted by thoughts of the looming tuition bill. Even smiling and being pleasant is hard when your mind is taxed. The employee snaps at rude customers more often than she intends. The parent snaps at the child. A taxed bandwidth leads to carelessness. The student forgets his study group meeting. The server rings up the wrong item.

The bandwidth tax changes us in surprising and powerful ways. It is not merely its presence but also its magnitude that is surprising. Psychologists have spent decades documenting the impact of cognitive load on many aspects of behavior. Some of the most important are the behaviors captured in these vignettes: from distraction and forgetfulness to impulse control. The size of these effects suggests a substantial influence of the bandwidth tax on a full array of behaviors, even those like patience, tolerance, attention, and dedication that usually fall under the umbrella of "personality" or "talent." So much of what we attribute to talent or personality is predicated on cognitive capacity and executive control. The restaurant manager looks to all the usual places to explain his employees' behavior—lack of skill, no motivation, or insufficient education. And a taxed bandwidth can look like any of these. The harried sales manager, when she snaps at her daughter, looks like a bad parent. The financially strapped student who misses some easy questions looks incapable or lazy. But these people are not unskilled or uncaring, just heavily taxed. The problem is not the person but the context of scarcity.

Recall the metaphor of the computer slowed down by programs open in the background. Imagine you are sitting at that computer unaware of these other programs. As your browser crawls from page to page, you might draw the wrong conclusion. What a slow computer, you might think, confusing the processor loaded down by other tasks for one that is inherently slow. Similarly, it is easy to

confuse a mind loaded by scarcity for one that is inherently less capable. This, after all, is the attribution that the fast-food restaurant manager makes of his employees. Unlike the manager, we are emphatically not saying that poor people have less bandwidth. Quite the opposite. We are saying that all people, if they were poor, would have less effective bandwidth.

All this suggests that we ought to broaden our notion of scarcity. When we think of having very little (time, money, calories), we focus on the physical implications of scarcity: less time for fun, less money to spend. The bandwidth tax suggests there is another, perhaps more important, shortfall. We must now get by with fewer mental resources. Scarcity doesn't just lead us to overborrow or to fail to invest. It leaves us handicapped in other aspects of our lives. It makes us dumber. It makes us more impulsive. We must get by with less mind available, with less fluid intelligence and with diminished executive control—making life that much harder.

PART TWO

Scarcity Creates Scarcity