

# FREEING UP

# INTELLIGENCE

A preoccupation with scarcity diminishes IQ and self-control.  
Simple measures can help us counteract this cognitive tax

**By Sendhil Mullainathan and Eldar Shafir**

ILLUSTRATION BY STUART BRIERS

Imagine sitting in an office located near the railroad tracks. Trains rattle by several times an hour. As you try to concentrate, the rumble of every train pulls you away from what you are doing. You need time to refocus, to collect your thoughts. Worse, just when you have settled back in, another train hurtles by.

This description mirrors the conditions of a school in New Haven located next to a noisy railroad line. In the early 1970s two researchers decided to measure the impact of this noise on students. They 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.

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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. Prompted by this study, the city installed noise padding. This intervention erased the difference, the researchers found: students on both sides of the building now performed at the same level. These results mirror many laboratory studies that have documented the powerful effects of even slight distraction.

**NOISY TRAINS OF THOUGHT ARE HARD TO IGNORE. ALTHOUGH THE ROOM SEEMS QUIET, IT IS FULL OF DISRUPTIONS—ONES THAT COME FROM WITHIN.**

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 out another loan? These noisy trains of thought are every bit as hard to ignore. Although the room seems quiet, it is full of disruptions—ones that come from within.

Such internal disruptions stem from scarcity. An unrealized need can capture our attention and impede our ability to focus on other things. 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. Although careful research in psychology employs several fine distinctions to capture this idea, we use the single umbrella term “bandwidth” to cover them all. Bandwidth refers to our cognitive capacity and our ability to pay attention, make good decisions, stick with our plans and resist temptations. It correlates

#### FAST FACTS

##### A SCARCITY MIND-SET

- 1 An involuntary preoccupation with an unmet need, such as a shortage of money or time, can capture our attention and impede our ability to focus on other things.
- 2 A fixation on scarcity taxes our cognitive capacity and executive control, thus diminishing intelligence and impulse control, among other things.
- 3 We can free up cognitive bandwidth by converting recurring demands into one-time actions.

with intelligence and SAT performance, impulse control and success on diets. Scarcity creates a powerful goal—dealing with pressing needs—that inhibits other considerations. We argue that by constantly drawing us back to that urgent unmet goal, scarcity taxes our bandwidth and our most fundamental capacities.

#### Bandwidth Blues

We use the term “bandwidth” to refer to two broad, related components of mental function. The first might be 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. The second is executive control, which underlies our ability to manage our cognitive activities, including planning, attention, and initiating and inhibiting actions. Cognitive capacity and executive control are multifaceted. And scarcity affects both.

A prominent and universally accepted measure of fluid intelligence is the Raven’s Progressive Matrices test, named after British psychologist John Raven, who developed it in the 1930s. With our graduate student Jiaying Zhao, we used this test to observe the effect of scarcity on the fluid intelligence of people in a New Jersey mall. 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 to 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 gave them a series of Raven’s matrices problems. Using self-reported household income, we divided subjects into rich and poor.

For the remaining subjects, we ran the same study with a slight twist—we made the service cost \$3,000 rather than \$300. 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 so for the \$3,000 car expense: finding \$1,500 would be harder for those with low in-

comes. A 2011 study found that close to half of all Americans reported that they would be unable to come up with \$2,000 in 30 days even if they really needed it. Of course, the question we gave the mall respondents was hypothetical. But it was realistic, and it very likely got them thinking about their own financial concerns. They may not have a broken car, but experiencing money scarcity would mean they had monetary issues close to the top of mind. Once we tickled that part of the brain, the all too real nonhypothetical thinking about scarcity would come spilling out.

And this mental racket affected performance. The better-off subjects, with no distractions, did just as well here as if they had seen the easy scenario. The poorer subjects, on the other hand, did significantly worse. Preoccupied by scarcity, they had lower fluid intelligence scores.

In our numerous replications of this study, the effects have been consistent and big. To understand the size of these effects, consider the impact of sleep deprivation on performance on Raven's matrices. In one study, a group of subjects went to bed at a normal time. Another group was forced to stay awake all night. The next morning all the subjects were given a Raven's test. Not surprisingly, those deprived of sleep did much worse. By comparison, our effect at the mall was even bigger.

Another way to understand the size of our findings is in terms of IQ. Because the Raven's test is used to measure fluid intelligence, it has a direct analogue with IQ. Our effects correspond to between 13 and 14 IQ points. A gain of that many points can lift you from the category of "average" to "superior" intelligence. Or, if you move in the other direction, losing 13 points can take you from "average" to a category labeled "borderline-deficient." In our studies, the same person has fewer IQ points when he or she is preoccupied by scarcity than when not. This cognitive penalty is the key to our story.

The second component of bandwidth is executive control, a kind of central processor for the brain. One of the many important functions to which it contributes is self-control. Because executive control helps to direct attention and modulate impulses, reduced executive function will hamper self-control.

A number of experiments have vividly illustrated this connection. One such study gave subjects a memory task. Some people were asked to remember a two-digit number; others were given a seven-digit figure. The subjects were then led to a lobby to wait for further testing. In front of them in the waiting area were slices of cake and fruit. The real test was which food they would select while rehearsing



those numbers in their head. The subjects with the two-digit number chose the fruit most of the time. Those whose mind was busy rehearsing the seven-digit number chose the cake 50 percent more often. The cake is the impulsive choice. When our mental bandwidth is used on something else, such as 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 disgusting: a chicken foot cooked in a Chinese style that preserved the entire foot intact, claws included. The dish 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 mind was not taxed managed to maintain composure, keeping their thoughts to themselves. The cognitively loaded subjects did not. They were more likely to 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.

To explore whether scarcity reduces executive control, we returned to the mall in New Jersey. We

**Recurring distractions can substantially diminish intelligence, thereby affecting performance at school and on the job.**

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repeated our earlier design—with the hypothetical financial scenarios—but then tested our participants on their impulse control rather than fluid intelligence. The results were the same. After the financially easy questions, the poor and the well-off looked similar. Yet the financially hard questions made our poorer subjects significantly more impulsive, whereas the well-off subjects were unaffected.

### Scarcity in the Field

These experiments tested our hypothesis. Our interest, though, is in people's everyday lives outside the confines of an experiment. Around this time, we were doing fieldwork on farming in India with economist Anandi Mani of the University of Warwick in England, and we noticed something interesting. Farmers get their income in a big lump, all at once at harvest time. This system means the farmer has a very different financial life from most workers, who get paid regularly.

Now picture a farmer who gets paid in June. The next few months are quite good. Yet even if he is prudent and tries hard to smooth his spending during this period, by the time the following 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 farmers' bandwidth in the months before harvest and after harvest. Instead of comparing rich and poor people, we would see how the same person's behavior might vary when tight on money and when flush with cash. But there was one wrinkle. Might not harvest months impose different obligations than ordinary months did? For example, festivals and weddings are common during harvest months—exactly because people are

A parent preoccupied with work may appear to be an unskilled caregiver, yet that person's cognitive bandwidth may simply be heavily taxed.



**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.**

cash-rich. So instead of seeing the effects of scarcity, we might just see the effects of celebrations.

To get around this, we used sugarcane farming, which has a peculiar feature. Sugarcane requires an enormous factory to crush the cane and extract the juice (which, once evaporated, forms sugar). The factories can process only so much, and the crop cannot sit for long after harvesting. So sugarcane is harvested during a four- to five-month window. Neighboring plots are often on very different harvest cycles. One farmer may be in the process of harvesting, whereas a neighbor might have sold his crop several months earlier. This rather obscure fact gave us the break we needed. We could now study the same farmers when they are poor and rich and know that there is nothing specific about the preharvest and postharvest months.

As we expected, the data showed that the farmers were more financially strapped preharvest. In the month before harvest, 78 percent of them had pawned something (and 99 percent took some kind of loan), but in the month after harvest only 4 percent pawned something (and only 13 percent took any kind of loan). Before harvest, they were also 11 percent more likely to report having trouble coping with ordinary bills.

We again measured fluid intelligence and executive control. We gave the farmers a Raven's matrices task, and for executive control we chose the Stroop task. In this task, subjects see strings of items, such as A F F F, and must quickly say how many items are in the string. When you see 2 2 2 2, quickly saying "four" is quite hard. We found that farmers performed much worse on both these tests before harvest than after harvest. Much like our subjects in 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—those thoughts were there naturally.

Again the magnitudes were large. The postharvest farmers got about 25 percent more items correct on a Raven's test. Put in IQ terms, this percent-

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age corresponds with about nine or 10 IQ points. It is not as big a gap as in the mall, but that is to be expected. After all, here we had not induced them to think about money. We simply measured their mental state at an arbitrary point. 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.

Returning to where we started, we see that the results suggest 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. Not because they are less capable but rather because part of their mind is captured by scarcity.

### Give Yourself a Break

Tight finances are just one kind of scarcity; dieting is another. Across a variety of cognitive tests, psychologists find that people simply perform worse when they are dieting. And when they interview the respondents, they find a common pattern: concerns related to dieting are top of the mind for these dieters and interfere with their performance. Other research has identified a similar effect from loneliness—a social form of scarcity.

What, then, is so special about scarcity? Scarcity is a clustering of several important concerns. Unlike a marital spat that can happen anywhere and to anyone, preoccupations with money and time cluster around the poor and the busy, and they persist. Whereas only some people who experience abundance will be preoccupied, everyone experiencing scarcity will fixate on their state.

The size of these effects suggests the bandwidth tax has a substantial influence on a full array of behaviors, even those such as patience, tolerance, attention and dedication, that usually fall under the umbrella of personality or talent. When she snaps at her daughter, the harried sales manager looks like a bad parent. The financially strapped student who misses some easy questions on a test looks incapable or lazy. Yet these people are not unskilled or uncaring, just heavily taxed. The problem is not the person but the context of scarcity.

The deeper lesson is the need to focus on managing and cultivating bandwidth, despite pressures to the contrary brought on by scarcity. Increasing work hours, working people harder, forgoing vacations, and so on are all tunneling responses, as is borrowing at high interest. They ignore the long-term consequences. Psychiatrists report an increasing numbers of patients who show symptoms of acute stress: “stretched to their limits and beyond,

## TIPS FOR MANAGING SCARCITY

Convert tasks that demand constant vigilance into one-time actions.



**Finances:** Enroll in an employer’s 401(k) plan so that saving for the future becomes automatic. Sign up for automatic bill payment.



**Exercise:** Set up appointments with a personal trainer or friend to work out together or make a bet with a friend. These measures raise the stakes of sticking with your exercise plan.



**Work:** Schedule breaks for walks and stick to a regular bedtime. Sacrificing health to put in longer hours takes a toll on us mentally, physically and emotionally, which diminishes performance.



**Family time:** Sign up for a weekly activity together, to ensure that even at your busiest you have quality time once a week.



**Food:** Knowing that stress compels us to make unhealthy choices, plan ahead for tough times by stocking your pantry with nutritious items. Being health-conscious while shopping rather than at every meal frees up cognitive bandwidth.

with no margin, no room in their lives for rest, relaxation and reflection.”

There is nothing magical about working 40 or 50 or 60 hours a week. But there is something important about letting your mind out for a jog—to maximize bandwidth rather than hours worked. **M**

### FURTHER READING

- **Distracted and Confused?: Selective Attention under Load.** Nilli Lavie in *Trends in Cognitive Sciences*, Vol. 9, No. 2, pages 75–82; February 1, 2005.
- **“That Is Bloody Revolting!”: Inhibitory Control of Thoughts Better Left Unsaid.** W. von Hippel and K. Gonsalkorale in *Psychological Science*, Vol. 16, No. 7, pages 497–500; July 2005.
- **Some Consequences of Having Too Little.** A. K. Shah, S. Mullainathan and E. Shafir in *Science*, Vol. 338, pages 682–685; November 2, 2012.
- **Poverty Impedes Cognitive Function.** A. Mani, S. Mullainathan, E. Shafir and J. Zhao in *Science*, Vol. 341, pages 976–980; August 30, 2013.

*From Our Archives*

- **Building Better Brains.** John Jonides et al.; September/October 2012.
- **Treating a Toxin to Learning.** Clancy Blair; September/October 2012.