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The Fat Trap

By TARA PARKER-POPE
Published: December 28, 2011

For 15 years, Joseph Proietto has been helping people lose weight. When these obese patients arrive at his weight-loss clinic in Australia, they are determined to slim down. And most of the time, he says, they do just that, sticking to the clinic’s program and dropping excess pounds. But then, almost without exception, the weight begins to creep back. In a matter of months or years, the entire effort has come undone, and the patient is fat again. “It has always seemed strange to me,” says Proietto, who is a physician at the University of Melbourne. “These are people who are very motivated to lose weight, who achieve weight loss most of the time without too much trouble and yet, inevitably, gradually, they regain the weight.”

Anyone who has ever dieted knows that lost pounds often return, and most of us assume the reason is a lack of discipline or a failure of willpower. But Proietto suspected that there was more to it, and he decided to take a closer look at the biological state of the body after weight loss.

Beginning in 2009, he and his team recruited 50 obese men and women. The men weighed an average of 233 pounds; the women weighed about 200 pounds. Although some people dropped out of the study, most of the patients stuck with the extreme low-calorie diet, which consisted of special shakes called Optifast and two cups of low-starch vegetables, totaling just 500 to 550 calories a day for eight weeks. Ten weeks in, the dieters lost an average of 30 pounds.

Jen Davis for The New York Times
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While researchers have known for decades that the body undergoes various metabolic and hormonal changes while it’s losing weight, the Australian team detected something new. A full year after significant

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By RACHEL NOLAN

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weight loss, these men and women remained in what could be described as a biologically altered state. Their still-plump bodies were acting as if they were starving and were working overtime to regain the pounds they lost. For instance, a gastric hormone called ghrelin, often dubbed the “hunger hormone,” was about 20 percent higher than at the start of the study. Another hormone associated with suppressing hunger, peptide YY, was also abnormally low. Levels of leptin, a hormone that suppresses hunger and increases metabolism, also remained lower than expected. A cocktail of other hormones associated with hunger and metabolism all remained significantly changed compared to pre-dieting levels. It was almost as if weight loss had put their bodies into a unique metabolic state, a sort of post-dieting syndrome that set them apart from people who hadn't tried to lose weight in the first place.

“What we see here is a coordinated defense mechanism with multiple components all directed toward making us put on weight,” Proietto says. “This, I think, explains the high failure rate in obesity treatment.”

While the findings from Proietto and colleagues, published this fall in [The New England Journal of Medicine](#), are not conclusive — the study was small and the findings need to be replicated — the research has nonetheless caused a stir in the weight-loss community, adding to a growing body of evidence that challenges conventional thinking about obesity, weight loss and willpower. For years, the advice to the overweight and obese has been that we simply need to eat less and exercise more. While there is truth to this guidance, it fails to take into account that the human body continues to fight against weight loss long after dieting has stopped. This translates into a sobering reality: once we become fat, most of us, despite our best efforts, will probably stay fat.

I have always felt perplexed about my inability to keep weight off. I know the medical benefits of weight loss, and I don't drink sugary sodas or eat fast food. I exercise regularly — a few years ago, I even completed a marathon. Yet during the 23 years since graduating from college, I've lost 10 or 20 pounds at a time, maintained it for a little while and then gained it all back and more, to the point where I am now easily 60 pounds overweight.

I wasn't overweight as a child, but I can't remember a time when my mother, whose weight probably fluctuated between 150 and 250 pounds, wasn't either on a diet or, in her words, cheating on her diet. Sometimes we ate healthful, balanced meals; on other days dinner consisted of a bucket of Kentucky Fried Chicken. As a high-school cross-country runner, I never worried about weight, but in college, when my regular training runs were squeezed out by studying and socializing, the numbers on the scale slowly began to move up. As adults, my three sisters and I all struggle with weight, as do many members of my extended family. My mother died of esophageal cancer six years ago. It was her great regret that in the days before she died, the closest medical school turned down her offer to donate her body because she was obese.

It's possible that the biological cards were stacked against me from the start. Researchers know that obesity tends to run in families, and recent science suggests that even the desire to eat higher-calorie foods may be influenced by heredity. But untangling how much is genetic and how much is learned through family eating habits is difficult. What is clear is that some people appear to be prone to accumulating extra fat while others seem to be protected against it.

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In [a seminal series of experiments](#) published in the 1990s, the Canadian researchers Claude Bouchard and Angelo Tremblay studied 31 pairs of male twins ranging in age from 17 to 29, who were sometimes overfed and sometimes put on diets. (None of the twin pairs were at risk for obesity based on their body mass or their family history.) In one study, 12 sets of the twins were put under 24-hour supervision in a college dormitory. Six days a week they ate 1,000 extra calories a day, and one day they were allowed to eat normally. They could read, play video games, play cards and watch television, but exercise was limited to one 30-minute daily walk. Over the course of the 120-day study, the twins consumed 84,000 extra calories beyond their basic needs.

That experimental binge should have translated into a weight gain of roughly 24 pounds (based on 3,500 calories to a pound). But some gained less than 10 pounds, while others gained as much as 29 pounds. The amount of weight gained and how the fat was distributed around the body closely matched among brothers, but varied considerably among the different sets of twins. Some brothers gained three times as much fat around their abdomens as others, for instance. When the researchers conducted similar exercise studies with the twins, they saw the patterns in reverse, with some twin sets losing more pounds than others on the same exercise regimen. The findings, the researchers wrote, suggest a form of “biological determinism” that can make a person susceptible to weight gain or loss.

But while there is widespread agreement that at least some risk for obesity is inherited, identifying a specific genetic cause has been a challenge. In October 2010, [the journal Nature Genetics reported](#) that researchers have so far confirmed 32 distinct genetic variations associated with obesity or body-mass index. One of the most common of these variations was identified in April 2007 by a British team studying the genetics of Type 2 diabetes. [According to Timothy Frayling](#) at the Institute of Biomedical and Clinical Science at the University of Exeter, people who carried a variant known as FTO faced a much higher risk of obesity — 30 percent higher if they had one copy of the variant; 60 percent if they had two.

This FTO variant is surprisingly common; about 65 percent of people of European or African descent and an estimated 27 to 44 percent of Asians are believed to carry at least one copy of it. Scientists don’t understand how the FTO variation influences weight gain, but studies in children suggest the trait plays a role in eating habits. In one 2008 study led by Colin Palmer of the University of Dundee in Scotland, Scottish schoolchildren were given snacks of orange drinks and muffins and then allowed to graze on a buffet of grapes, celery, potato chips and chocolate buttons. All the food was carefully monitored so the researchers knew exactly what was consumed. Although all the children ate about the same amount of food, as weighed in grams, children with the FTO variant were more likely to eat foods with higher fat and calorie content. They weren’t gorging themselves, but they consumed, on average, about 100 calories more than children who didn’t carry the gene. Those who had the gene variant had about four pounds more body fat than noncarriers.

I have been tempted to send in my own saliva sample for a DNA test to find out if my family carries a genetic predisposition for obesity. But even if the test came back negative, it would only mean that my family doesn’t carry a known, testable genetic risk for obesity. Recently the British television show “[Embarrassing Fat Bodies](#)” asked Frayling’s lab to test for fat-promoting genes, and the results showed one very overweight family had a lower-than-average risk for obesity.

A positive result, telling people they are genetically inclined to stay fat, might be self-fulfilling. In February, [The New England Journal of Medicine published a report](#) on how genetic testing for a variety of diseases affected a person’s mood and health habits. Over

all, the researchers found no effect from disease-risk testing, but there was a suggestion, though it didn't reach statistical significance, that after testing positive for fat-promoting genes, some people were more likely to eat fatty foods, presumably because they thought being fat was their genetic destiny and saw no sense in fighting it.

While knowing my genetic risk might satisfy my curiosity, I also know that heredity, at best, would explain only part of why I became overweight. I'm much more interested in figuring out what I can do about it now.

The National Weight Control Registry tracks 10,000 people who have lost weight and have kept it off. "We set it up in response to comments that nobody ever succeeds at weight loss," says Rena Wing, a professor of psychiatry and human behavior at Brown University's Alpert Medical School, who helped create the registry with James O. Hill, director of the Center for Human Nutrition at the University of Colorado at Denver. "We had two goals: to prove there were people who did, and to try to learn from them about what they do to achieve this long-term weight loss." Anyone who has lost 30 pounds and kept it off for at least a year is eligible to join the study, though the average member has lost 70 pounds and remained at that weight for six years.

Wing says that she agrees that physiological changes probably do occur that make permanent weight loss difficult, but she says the larger problem is environmental, and that people struggle to keep weight off because they are surrounded by food, inundated with food messages and constantly presented with opportunities to eat. "We live in an environment with food cues all the time," Wing says. "We've taught ourselves over the years that one of the ways to reward yourself is with food. It's hard to change the environment and the behavior."

There is no consistent pattern to how people in the registry lost weight — some did it on Weight Watchers, others with Jenny Craig, some by cutting carbs on the Atkins diet and a very small number lost weight through surgery. But their eating and exercise habits appear to reflect what researchers find in the lab: to lose weight and keep it off, a person must eat fewer calories and exercise far more than a person who maintains the same weight naturally. Registry members exercise about an hour or more each day — the average weight-loser puts in the equivalent of a four-mile daily walk, seven days a week. They get on a scale every day in order to keep their weight within a narrow range. They eat breakfast regularly. Most watch less than half as much television as the overall population. They eat the same foods and in the same patterns consistently each day and don't "cheat" on weekends or holidays. They also appear to eat less than most people, with estimates ranging from 50 to 300 fewer daily calories.

Kelly Brownell, director of the Rudd Center for Food Policy and Obesity at Yale University, says that while the 10,000 people tracked in the registry are a useful resource, they also represent a tiny percentage of the tens of millions of people who have tried unsuccessfully to lose weight. "All it means is that there are rare individuals who do manage to keep it off," Brownell says. "You find these people are incredibly vigilant about maintaining their weight. Years later they are paying attention to every calorie, spending an hour a day on exercise. They never don't think about their weight."

Janice Bridge, a registry member who has successfully maintained a 135-pound weight loss for about five years, is a perfect example. "It's one of the hardest things there is," she says. "It's something that has to be focused on every minute. I'm not always thinking about food, but I am always aware of food."

Bridge, who is 66 and lives in Davis, Calif., was overweight as a child and remembers going on her first diet of 1,400 calories a day at 14. At the time, her slow pace of weight loss

prompted her doctor to accuse her of cheating. Friends told her she must not be paying attention to what she was eating. “No one would believe me that I was doing everything I was told,” she says. “You can imagine how tremendously depressing it was and what a feeling of rebellion and anger was building up.”

After peaking at 330 pounds in 2004, she tried again to lose weight. She managed to drop 30 pounds, but then her weight loss stalled. In 2006, at age 60, she joined a medically supervised weight-loss program with her husband, Adam, who weighed 310 pounds. After nine months on an 800-calorie diet, she slimmed down to 165 pounds. Adam lost about 110 pounds and now weighs about 200.

During the first years after her weight loss, Bridge tried to test the limits of how much she could eat. She used exercise to justify eating more. The death of her mother in 2009 consumed her attention; she lost focus and slowly regained 30 pounds. She has decided to try to maintain this higher weight of 195, which is still 135 pounds fewer than her heaviest weight.

“It doesn’t take a lot of variance from my current maintenance for me to pop on another two or three pounds,” she says. “It’s been a real struggle to stay at this weight, but it’s worth it, it’s good for me, it makes me feel better. But my body would put on weight almost instantaneously if I ever let up.”

So she never lets up. Since October 2006 she has weighed herself every morning and recorded the result in a weight diary. She even carries a scale with her when she travels. In the past six years, she made only one exception to this routine: a two-week, no-weigh vacation in Hawaii.

She also weighs everything in the kitchen. She knows that lettuce is about 5 calories a cup, while flour is about 400. If she goes out to dinner, she conducts a Web search first to look at the menu and calculate calories to help her decide what to order. She avoids anything with sugar or white flour, which she calls her “gateway drugs” for cravings and overeating. She has also found that drinking copious amounts of water seems to help; she carries a 20-ounce water bottle and fills it five times a day. She writes down everything she eats. At night, she transfers all the information to an electronic record. Adam also keeps track but prefers to keep his record with pencil and paper.

“That transfer process is really important; it’s my accountability,” she says. “It comes up with the total number of calories I’ve eaten today and the amount of protein. I do a little bit of self-analysis every night.”

Bridge and her husband each sought the help of therapists, and in her sessions, Janice learned that she had a tendency to eat when she was bored or stressed. “We are very much aware of how our culture taught us to use food for all kinds of reasons that aren’t related to its nutritive value,” Bridge says.

Bridge supports her careful diet with an equally rigorous regimen of physical activity. She exercises from 100 to 120 minutes a day, six or seven days a week, often by riding her bicycle to the gym, where she takes a water-aerobics class. She also works out on an elliptical trainer at home and uses a recumbent bike to “walk” the dog, who loves to run alongside the low, three-wheeled machine. She enjoys gardening as a hobby but allows herself to count it as exercise on only those occasions when she needs to “garden vigorously.” Adam is also a committed exerciser, riding his bike at least two hours a day, five days a week.

Janice Bridge has used years of her exercise and diet data to calculate her own personal

fuel efficiency. She knows that her body burns about three calories a minute during gardening, about four calories a minute on the recumbent bike and during water aerobics and about five a minute when she zips around town on her regular bike.

“Practically anyone will tell you someone biking is going to burn 11 calories a minute,” she says. “That’s not my body. I know it because of the statistics I’ve kept.”

Based on metabolism data she collected from the weight-loss clinic and her own calculations, she has discovered that to keep her current weight of 195 pounds, she can eat 2,000 calories a day as long as she burns 500 calories in exercise. She avoids junk food, bread and pasta and many dairy products and tries to make sure nearly a third of her calories come from protein. The Bridges will occasionally share a dessert, or eat an individual portion of Ben and Jerry’s ice cream, so they know exactly how many calories they are ingesting. Because she knows errors can creep in, either because a rainy day cuts exercise short or a mismeasured snack portion adds hidden calories, she allows herself only 1,800 daily calories of food. (The average estimate for a similarly active woman of her age and size is about 2,300 calories.)

Just talking to Bridge about the effort required to maintain her weight is exhausting. I find her story inspiring, but it also makes me wonder whether I have what it takes to be thin. I have tried on several occasions (and as recently as a couple weeks ago) to keep a daily diary of my eating and exercise habits, but it’s easy to let it slide. I can’t quite imagine how I would ever make time to weigh and measure food when some days it’s all I can do to get dinner on the table between finishing my work and carting my daughter to dance class or volleyball practice. And while I enjoy exercising for 30- or 40-minute stretches, I also learned from six months of marathon training that devoting one to two hours a day to exercise takes an impossible toll on my family life.

Bridge concedes that having grown children and being retired make it easier to focus on her weight. “I don’t know if I could have done this when I had three kids living at home,” she says. “We know how unusual we are. It’s pretty easy to get angry with the amount of work and dedication it takes to keep this weight off. But the alternative is to not keep the weight off.”

“I think many people who are anxious to lose weight don’t fully understand what the consequences are going to be, nor does the medical community fully explain this to people,” Rudolph Leibel, an obesity researcher at Columbia University in New York, says. “We don’t want to make them feel hopeless, but we do want to make them understand that they are trying to buck a biological system that is going to try to make it hard for them.”

Leibel and his colleague Michael Rosenbaum have pioneered much of what we know about the body’s response to weight loss. For 25 years, they have meticulously tracked about 130 individuals for six months or longer at a stretch. The subjects reside at their research clinic where every aspect of their bodies is measured. Body fat is determined by bone-scan machines. A special hood monitors oxygen consumption and carbon-dioxide output to precisely measure metabolism. Calories burned during digestion are tracked. Exercise tests measure maximum heart rate, while blood tests measure hormones and brain chemicals. Muscle biopsies are taken to analyze their metabolic efficiency. (Early in the research, even stool samples were collected and tested to make sure no calories went unaccounted for.) For their trouble, participants are paid \$5,000 to \$8,000.

Eventually, the Columbia subjects are placed on liquid diets of 800 calories a day until they lose 10 percent of their body weight. Once they reach the goal, they are subjected to another round of intensive testing as they try to maintain the new weight. The data generated by these experiments suggest that once a person loses about 10 percent of body

weight, he or she is metabolically different than a similar-size person who is naturally the same weight.

The research shows that the changes that occur after weight loss translate to a huge caloric disadvantage of about 250 to 400 calories. For instance, one woman who entered the Columbia studies at 230 pounds was eating about 3,000 calories to maintain that weight. Once she dropped to 190 pounds, losing 17 percent of her body weight, metabolic studies determined that she needed about 2,300 daily calories to maintain the new lower weight. That may sound like plenty, but the typical 30-year-old 190-pound woman can consume about 2,600 calories to maintain her weight — 300 more calories than the woman who dieted to get there.

Scientists are still learning why a weight-reduced body behaves so differently from a similar-size body that has not dieted. Muscle biopsies taken before, during and after weight loss show that once a person drops weight, their muscle fibers undergo a transformation, making them more like highly efficient “slow twitch” muscle fibers. A result is that after losing weight, your muscles burn 20 to 25 percent fewer calories during everyday activity and moderate aerobic exercise than those of a person who is naturally at the same weight. That means a dieter who thinks she is burning 200 calories during a brisk half-hour walk is probably using closer to 150 to 160 calories.

Another way that the body seems to fight weight loss is by altering the way the brain responds to food. Rosenbaum and his colleague Joy Hirsch, a neuroscientist also at Columbia, used functional magnetic resonance imaging to track the brain patterns of people before and after weight loss while they looked at objects like grapes, Gummi Bears, chocolate, broccoli, cellphones and yo-yos. After weight loss, when the dieter looked at food, the scans showed a bigger response in the parts of the brain associated with reward and a lower response in the areas associated with control. This suggests that the body, in order to get back to its pre-diet weight, induces cravings by making the person feel more excited about food and giving him or her less willpower to resist a high-calorie treat.

“After you’ve lost weight, your brain has a greater emotional response to food,” Rosenbaum says. “You want it more, but the areas of the brain involved in restraint are less active.” Combine that with a body that is now burning fewer calories than expected, he says, “and you’ve created the perfect storm for weight regain.” How long this state lasts isn’t known, but preliminary research at Columbia suggests that for as many as six years after weight loss, the body continues to defend the old, higher weight by burning off far fewer calories than would be expected. The problem could persist indefinitely. (The same phenomenon occurs when a thin person tries to drop about 10 percent of his or her body weight — the body defends the higher weight.) This doesn’t mean it’s impossible to lose weight and keep it off; it just means it’s really, really difficult.

Lynn Haraldson, a 48-year-old woman who lives in Pittsburgh, reached 300 pounds in 2000. She joined Weight Watchers and managed to take her 5-foot-5 body down to 125 pounds for a brief time. Today, she’s a member of the National Weight Control Registry and maintains about 140 pounds by devoting her life to weight maintenance. She became a vegetarian, writes down what she eats every day, exercises at least five days a week and blogs about the challenges of weight maintenance. A former journalist and antiques dealer, she returned to school for a two-year program on nutrition and health; she plans to become a dietary counselor. She has also come to accept that she can never stop being “hypervigilant” about what she eats. “Everything has to change,” she says. “I’ve been up and down the scale so many times, always thinking I can go back to ‘normal,’ but I had to establish a new normal. People don’t like hearing that it’s not easy.”

What's not clear from the research is whether there is a window during which we can gain weight and then lose it without creating biological backlash. Many people experience transient weight gain, putting on a few extra pounds during the holidays or gaining 10 or 20 pounds during the first years of college that they lose again. The actor Robert De Niro lost weight after bulking up for his performance in "Raging Bull." The filmmaker Morgan Spurlock also lost the weight he gained during the making of "Super Size Me." Leibel says that whether these temporary pounds became permanent probably depends on a person's genetic risk for obesity and, perhaps, the length of time a person carried the extra weight before trying to lose it. But researchers don't know how long it takes for the body to reset itself permanently to a higher weight. The good news is that it doesn't seem to happen overnight.

"For a mouse, I know the time period is somewhere around eight months," Leibel says. "Before that time, a fat mouse can come back to being a skinny mouse again without too much adjustment. For a human we don't know, but I'm pretty sure it's not measured in months, but in years."

Nobody wants to be fat. In most modern cultures, even if you are healthy — in my case, my cholesterol and blood pressure are low and I have an extraordinarily healthy heart — to be fat is to be perceived as weak-willed and lazy. It's also just embarrassing. Once, at a party, I met a well-respected writer who knew my work as a health writer. "You're not at all what I expected," she said, eyes widening. The man I was dating, perhaps trying to help, finished the thought. "You thought she'd be thinner, right?" he said. I wanted to disappear, but the woman was gracious. "No," she said, casting a glare at the man and reaching to warmly shake my hand. "I thought you'd be older."

If anything, the emerging science of weight loss teaches us that perhaps we should rethink our biases about people who are overweight. It is true that people who are overweight, including myself, get that way because they eat too many calories relative to what their bodies need. But a number of biological and genetic factors can play a role in determining exactly how much food is too much for any given individual. Clearly, weight loss is an intense struggle, one in which we are not fighting simply hunger or cravings for sweets, but our own bodies.

While the public discussion about weight loss tends to come down to which diet works best (Atkins? Jenny Craig? Plant-based? Mediterranean?), those who have tried and failed at all of these diets know there is no simple answer. Fat, sugar and carbohydrates in processed foods may very well be culprits in the nation's obesity problem. But there is tremendous variation in an individual's response.

The view of obesity as primarily a biological, rather than psychological, disease could also lead to changes in the way we approach its treatment. Scientists at Columbia have conducted several small studies looking at whether injecting people with leptin, the hormone made by body fat, can override the body's resistance to weight loss and help maintain a lower weight. In a few small studies, leptin injections appear to trick the body into thinking it's still fat. After leptin replacement, study subjects burned more calories during activity. And in brain-scan studies, leptin injections appeared to change how the brain responded to food, making it seem less enticing. But such treatments are still years away from commercial development. For now, those of us who want to lose weight and keep it off are on our own.

One question many researchers think about is whether losing weight more slowly would make it more sustainable than the fast weight loss often used in scientific studies. Leibel says the pace of weight loss is unlikely to make a difference, because the body's warning

system is based solely on how much fat a person loses, not how quickly he or she loses it. Even so, Proietto is now conducting a study using a slower weight-loss method and following dieters for three years instead of one.

Given how hard it is to lose weight, it's clear, from a public-health standpoint, that resources would best be focused on preventing weight gain. The research underscores the urgency of national efforts to get children to exercise and eat healthful foods.

But with a third of the U.S. adult population classified as obese, nobody is saying people who already are very overweight should give up on weight loss. Instead, the solution may be to preach a more realistic goal. Studies suggest that even a 5 percent weight loss can lower a person's risk for diabetes, heart disease and other health problems associated with obesity. There is also speculation that the body is more willing to accept small amounts of weight loss.

But an obese person who loses just 5 percent of her body weight will still very likely be obese. For a 250-pound woman, a 5 percent weight loss of about 12 pounds probably won't even change her clothing size. Losing a few pounds may be good for the body, but it does very little for the spirit and is unlikely to change how fat people feel about themselves or how others perceive them.

So where does that leave a person who wants to lose a sizable amount of weight? Weight-loss scientists say they believe that once more people understand the genetic and biological challenges of keeping weight off, doctors and patients will approach weight loss more realistically and more compassionately. At the very least, the science may compel people who are already overweight to work harder to make sure they don't put on additional pounds. Some people, upon learning how hard permanent weight loss can be, may give up entirely and return to overeating. Others may decide to accept themselves at their current weight and try to boost their fitness and overall health rather than changing the number on the scale.

For me, understanding the science of weight loss has helped make sense of my own struggles to lose weight, as well as my mother's endless cycle of dieting, weight gain and despair. I wish she were still here so I could persuade her to finally forgive herself for her dieting failures. While I do, ultimately, blame myself for allowing my weight to get out of control, it has been somewhat liberating to learn that there are factors other than my character at work when it comes to gaining and losing weight. And even though all the evidence suggests that it's going to be very, very difficult for me to reduce my weight permanently, I'm surprisingly optimistic. I may not be ready to fight this battle this month or even this year. But at least I know what I'm up against.

Tara Parker-Pope is the editor of the [Well blog](#) at The Times.

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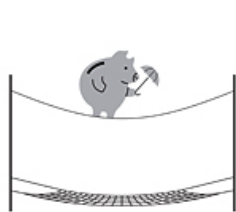
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