Fear

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> Neither a man nor a crowd nor a nation can be trusted to act humanely or think sanely under the influence of a great fear. . . . To conquer fear is the beginning of wisdom.
>
> —Bertrand Russell[1]

What Are You Afraid Of?

Here are a few questions that might, at first, seem silly.

- Which is riskier: nuclear reactors or sunlight?
- Which animal is responsible for the greatest number of human deaths in the U.S.?
  - — Alligator
  - — Bear
  - — Deer
  - — Shark
  - — Snake
- Match the causes of death (on the left) with the number of annual fatalities worldwide (on the right):

1. War	a. 310,000
2. Suicide	b. 815,000
3. Homicide	c. 520,000

Now let's look at the answers.

The worst nuclear accident in history occurred when the reactor at Chernobyl, Ukraine, melted down in 1986. According to early estimates, tens of thousands of people might be killed by radiation poisoning. By 2006, however,

Putting It in Context

What triggered you to write this piece? And how do you think it should be helpful to professional investment practitioners?

Folk wisdom on Wall Street has long held that the two emotional extremes of investing are fear and greed. It just so happens that neuroscientists have made significant discoveries in recent years about how fear is generated in the human brain. They have also explored how it shapes memory, changes judgments about risk and time, and skews behavior.

As Benjamin Graham understood and Warren Buffett has also exemplified, investing is above all about self-control. You stand no chance of making sense out of the markets if you cannot govern your own emotions. One of the central lessons both of behavioral finance and of neuroeconomics is that we are often in the grip of emotions without even realizing it. I hope this article enables investment professionals to recognize the importance of thinking more deeply about the hidden forces that can drive our decisions.

[1] Bertrand Russell. "An Outline of Intellectual Rubbish" (1943): www.solstice.us/russell/intellectual_rubbish.html.

fewer than 100 had died. Meanwhile, nearly 8,000 Americans are killed every year by skin cancer, which is most commonly caused by overexposure to the sun.[2]

In the typical year, deer are responsible for roughly 130 human fatalities—seven times more than alligators, bears, sharks, and snakes combined. How could gentle Bambi cause such bloodshed? Unlike those other, much more fearsome animals, deer don't attack with teeth or claw. Instead, they step in front of speeding cars, causing deadly collisions.

Finally, most people think war takes more lives than homicide—which they believe kills more people than suicide. In fact, in most years, war kills fewer people than conventional homicides do, and the number of people who take their own lives is almost twice the number of those who are murdered. (In the list on the previous page, the causes and the number of deaths that result from them are already matched correctly.) Homicide seems more common than suicide because it's a lot easier to imagine someone else dying than it is to imagine killing yourself.

None of this means that nuclear radiation is good for you, that rattlesnakes are harmless, or that the evils of war are overblown. What it does mean is that we are often most afraid of the least likely dangers, and frequently not worried enough about the risks that have the greatest chances of coming home to roost. It also reminds us that much of the world's misfortune is caused not by the things we are afraid of, but by being afraid. The most terrible devastation wrought by Chernobyl, for example, did not come out of its nuclear reactors. Instead, it came from the human mind. As panicky business owners fled the area, unemployment and poverty soared. Anxiety, depression, alcoholism, and suicide ran rampant among the residents who could not afford to leave. Fearing that their unborn babies had been poisoned, expectant mothers had more than 100,000 unnecessary abortions. The

[2]Mark Peplow, "Counting the Dead," *Nature*, vol. 440, no. 7087 (20 April 2006):982–983; Dillwyn Williams and Keith Baverstock, "Chernobyl and the Future: Too Soon for a Final Diagnosis," *Nature*, vol. 440, no. 7087 (20 April 2006):993–994 (www.nature.com/news/2005/050905/full/437181b.html; www.who.int/mediacentre/news/releases/2005/pr38/en/index.html); seer.cancer.gov/statfacts.html/melan.html. Roughly 4,000 cases of thyroid cancer resulted from the Chernobyl accident: so far, 15 have been fatal. While the U.N.'s worst-case estimate is that more than 9,000 people may eventually die as a result of Chernobyl, nearly all the potential victims remain alive two decades after the accident.

damage from radiation was dwarfed by the damage from the fear of radiation, as imaginary terrors led to real tragedies on a massive scale.[3]

We're no different when it comes to money. Every investor's worst nightmare is a stock market collapse like the Crash of 1929 that ushered in the Great Depression. According to a recent survey of 1,000 investors, there's a 51 percent chance that in any given year, the U.S. stock market might drop by one-third. And yet, based on history, the odds that U.S. stocks will lose a third of their value in a given year are only around 2 percent. The real risk is not that the stock market will have a meltdown, but that inflation will raise your cost of living and erode your savings. Yet only 31 percent of the people surveyed were worried that they might run out of money during their first ten years of retirement. Riveted by the vivid fear of a market Chernobyl, they overlooked the more subtle but severe damage that can be dealt by the silent killer of inflation.[4]

If we were strictly logical, we would judge the odds of a risk by asking how often something bad has actually happened under similar circumstances in the past. Instead, explains psychologist Daniel Kahneman, "we tend to judge the probability of an event by the ease with which we can call it to mind." The more recently an event has occurred, or the more vivid our memory of something like it in the past, the more "available" an event will be in our minds—and the more probable it will seem to happen again. But that's not the right way to assess risk. An event does not become more likely to recur merely because its last occurrence was recent or memorable.[5]

Just say these words aloud: *airplane crash*. What do you see in your mind's eye? Chances are, you imagine a smoky cabin filling with screams, a bone-shattering crunch, a giant fireball pinwheeling down a runway. In principle, says Paul Slovic, a psychologist at the University of Oregon, "risk is brewed from an equal dose of two ingredients—probabilities and consequences." But

[3]*NYT* (12 November 2002):F4; www.flmnh.ufl.edu/fish/sharks/attacks/relariskanimal.htm; Ricky L. Langley, "Alligator Attacks on Humans in the United States," *Wilderness and Environment Medicine,* vol. 16, no. 3 (September 2005):119–124; www.natural-resources.wsu.edu/research/bear-center/bear-people.htm; www.cdc.gov/nasd; *World Report on Violence and Health,* U.N. World Health Organization (2002):10 (www.who.int/violence_injury_prevention/violence/world_report/en); UNDP and UNICEF, "The Human Consequences of the Chernobyl Nuclear Accident," United Nations Development Programme (25 January 2002): www.undp.org; Douglas Chapin et al., "Nuclear Safety: Nuclear Power Plants and Their Fuel as Terrorist Targets," *Science,* vol. 297, no. 5589 (20 September 2002):1997–1999. These data are for calendar year 2000, but even the war in Iraq has not changed the numbers enough to alter the order they are listed in.

[4]John Ameriks, Robert D. Nestor, and Stephen P. Utkus, "Expectations for Retirement," Vanguard Center for Retirement Research (November 2004):12–14.

[5]Jason Zweig and Malcolm Fitch, "When the Stock Market Plunges, Will You Be Brave or Will You Cave?" *Money Magazine*, vol. 26, no. 1 (January 1997):104.

in practice, when we perceive the risks around us, the doses of those two ingredients are not always equal. Since the consequences of a crash can be so horrific, while the probabilities of a crash evoke no imagery at all, we get zero comfort from the fact that the odds against dying in a U.S. plane crash are roughly 6,000,000 to one. Those images of death are scary, while "6,000,000 to one" is an abstraction that conveys no feeling at all. ("I don't have a fear of flying," the basketball player Toni Kukoc once said, "I have a fear of crashing.") Once again, the emotional force of the reflexive brain overwhelms the analytical powers of the reflective brain.

On the other hand, we feel perfectly safe—if not immortal—when we're behind the wheel of our own car. Many travelers think nothing of having a couple of beers, then climbing into their car and driving to the airport with a cell phone in one hand and a cigarette in the other. Many of them even worry about whether their plane might crash—and remain utterly blind to the ways their own behavior is riddled with risk. The numbers tell the story: Only 24 people died on commercial aircraft in the U.S. in 2003, while 42,643 people were killed in car accidents. Adjusting for the distance traveled, you're about 65 times more likely to die in your own car than in a plane. And yet it's air travel that frightens us. Over the twelve months after the terrorist attacks of September 11, 2001, the fear of flying put far more people onto U.S. roads, causing an estimated 1,500 extra deaths in car crashes.[6]

The more vivid and easily imaginable a risk is, the scarier it feels. People will pay twice as much for an insurance policy that covers hospitalization for "any disease" than one that covers hospitalization for "any reason." Of course, by definition, "any reason" includes all diseases. But "any reason" is vague, while "any disease" is vivid. That vividness fills us with a fear that makes no economic sense. However, it makes perfect emotional sense.[7]

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[6]Paul Slovic, "Informing and Educating the Public about Risk," *Risk Analysis*, vol. 6, no. 4 (December 1986):403–415; www.planecrashinnfo.com/cause.htm; Kukoc, *Sports Illustrated* (24 February 24):46; *National Transportation Statistics 2005,* U.S. Department of Transportation (December 2005):Table 2–1 (www.bts.gov/publications/national_transportation_statistics/2005/index.html); Michael Sivak and Michael J. Flannagan, "Flying and Driving after the September 11 Attacks," *American Scientist*, vol. 91, no. 1 (January–February 2003):1 (http://american.scientist.org/template/AssetDetail/assetid/16237); Gerd Gigerenzer, "Out of the Frying Pan into the Fire: Behavioral Reactions to Terrorist Attacks," *Risk Analysis,* vol. 26, no. 2 (April 2006):347–351.

[7]Eric J. Johnson, John Hershey, Jacqueline Meszaros, and Howard Kunreuther, "Framing, Probability Distortions, and Insurance Decisions," in *Choices, Values, and Frames*, edited by Daniel Kahneman and Amos Tversky (New York: Cambridge University Press, 2000):224–240.

The emotion generated in our reflexive system can shove our analytical abilities aside, so the presence of one risk can make other things seem riskier, too. In the wake of September 11, for example, the Conference Board's Consumer Confidence Index, a measure of how Americans feel about the economic outlook, slumped by 25 percent. And the number of people who said they planned to buy a car, a home, or a major appliance in the coming six months dropped by 10 percent.

When an intangible feeling of risk fills the air, you can catch other people's emotions as easily as you can catch a cold. Merely reading a brief newspaper story about crime or depression is enough to prompt people into more than doubling their estimates of the likelihood of unrelated risks like divorce, stroke, or exposure to toxic chemicals. Just as when you have a hangover the slightest sound can seem deafening, an upsetting bit of news can make you hypersensitive to anything else that reminds you of risk. As is so often the case with the reflexive brain, you may not realize that your decisions are driven by your feelings. Roughly 50 percent of people can recognize when they have been disturbed by a bit of negative news, but only 3 percent admit that being upset may influence how they react to other risks.[8]

Our intuitive sense of risk is driven up or down by what Paul Slovic calls "dread" and "knowability." Those two factors, he explains, "infuse risk with feelings."

- Dread is determined by how vivid, controllable, or potentially catastrophic a risk seems to be. Repeated surveys have found that people consider handguns a bigger risk than smoking. Because we can choose not to smoke (or choose to quit if we do), the hazards of smoking seem to be under our control. But there's not much you can do to prevent some thug from putting a bullet through your head at any moment, and TV cop shows pump your living room full of gunshots every night—so handguns seem scarier. Yet smoking kills hundreds more people than handguns do.
- The "knowability" of a risk depends on how immediate, specific, or certain the consequences appear to be. Fast and finite dangers (fireworks, skydiving, train crashes, etc.) feel more "knowable" (and less worrisome) than vague, open-ended risks like genetically modified foods or global warming. Americans rate tornadoes as a much more frequent killer than asthma. Because asthma moves slowly and many of its victims survive, it seems less dangerous, even though it kills many more people. If the consequences of

[8]Consumer confidence data courtesy of the Conference Board's Carol Courter, e-mail to JZ (14 March 2006). Eric J. Johnson and Amos Tversky, "Affect, Generalization, and the Perception of Risk," *Journal of Personality and Social Psychology*, vol. 45, no. 1 (1983):20–31; Eric Johnson, interview by JZ via e-mail (14 February 2006).

> a risk are highly uncertain and poorly understood, any perceived problem can trigger a frenzy of publicity. Thus hedge funds, those giant investment pools that operate in almost complete secrecy, become front-page news whenever they lose money.[9]

Dread and knowability come together to twist our perceptions of the world around us: We underestimate the likelihood and severity of common risks, and we overestimate the likelihood and severity of rare risks—especially if we have never personally experienced them. When we feel we are in charge and we understand the consequences, risks will seem lower than they truly are. When a risk feels out of our hands and less comprehensible, it will feel more dangerous than it actually is. It's as if we see the world through warped binoculars that not only magnify whatever is remote but shrink whatever is near.

That's why so many people buy flight insurance at the airport: The chance of dying in a plane crash is almost zero, and most passengers are already covered by life insurance anyway, but air travel still *feels* risky. Meanwhile, roughly three-quarters of all Americans living in vulnerable areas have no flood insurance. Because homeowners can readily see how high the water has risen in the past, and because they can easily invest in drainage systems and other techniques that seem to control the risk of flooding, they feel safer than they really are. Hurricane Katrina exposed how dangerous this feeling of safety can be.[10]

In the stock market, these quirks of risk perception can be a big distraction. On March 22, 2005, a woman named Anna Ayala was eating at a Wendy's restaurant in San Jose, California. She spooned a helping of chili into her mouth, started to chew, and then spat out a human finger. When the news broke, Wendy's stock fell 1 percent on heavy trading volume, and by April 15, 2.4 percent had been chopped off the market value of the stock. Customers turned away, costing the company an estimated $10 million in revenues. But investigators soon found that Ayala had planted the finger (which one of her husband's coworkers had lost in an industrial accident) in the bowl of chili

[9]Sarah Lichtenstein et al., "Judged Frequency of Lethal Events," *Journal of Experimental Psychology: Human Learning and Memory,* vol. 4, no. 6 (November 1978):551–578; Paul Slovic, "Perception of Risk," *Science,* vol. 236, no. 4799 (17 April 1987):280–285; Paul Slovic and Ellen Peters, interview by JZ via e-mail (29 June 2005). Besides dread and knowability, there is a third factor—how many people are exposed to the risk—but it appears to play a less significant role.

[10]www.floodsmart.gov; Mark J. Browne and Robert E. Hoyt, "The Demand for Flood Insurance: Empirical Evidence," *Journal of Risk and Uncertainty,* vol. 20, no. 3 (May 2000):291–306; Howard Kunreuther, "Has the Time Come for Comprehensive Natural Disaster Insurance?" in *On Risk and Disaster*, edited by Ronald J. Daniels, Donald F. Kettl, and Howard Kunreuther (Philadelphia: University of Pennsylvania Press, 2006):175–202.

herself. Wendy's business recovered steadily, and anyone who sold the stock in the initial panic was left feeling like somebody with ten thumbs, as it nearly doubled over the coming year.[11]

Much the same thing happened in June 1999, when eBay's website crashed and "went dark" for 22 hours. Trading in Beanie Babies and G.I. Joes ground to a halt, costing eBay about $4 million in lost fees and causing consternation among thousands of buyers and sellers. Over the next three trading days, eBay's shares fell 26 percent, a loss of more than $4 billion in market value. Because the internet was still relatively young, many investors had no idea when eBay could fix the problem—so the consequences seemed highly uncertain, arousing enormous fear. But eBay's site was soon running smoothly, and the stock almost tripled over the next five years.

In short, overreacting to raw feelings—"blinking" in the face of risk—is often one of the riskiest things an investor can do.

The Hot Button of the Brain

Deep in your brain, level with the top of your ears, lies a small, almond-shaped knob of tissue called the amygdala. When you confront a potential risk, this part of your reflexive brain acts as an alarm system—generating hot, fast emotions like fear and anger that it shoots up to the reflective brain like warning flares. (There are actually two amygdalae, one on the left side of your brain and one on the right, just as office elevators often have one panic button on either side of the door.)

The amygdala helps focus your attention, in a flash, on anything that's new, out of place, changing fast, or just plain scary. That helps explain why we overreact to rare but vivid risks. After all, in the presence of danger, he who hesitates is lost; a fraction of a second can make the difference between life and death. Step near a snake, spot a spider, see a sharp object flying toward your face, and your amygdala will jolt you into jumping, ducking, or taking whatever evasive action should get you out of trouble in the least amount of time. This same fear reaction is triggered by losing money—or believing that you might.

While other parts of your brain also generate fear, the amygdala's role is probably the best understood so far. While it can fire up around pleasant stimuli, too, it seems to be custom-fit for fear. The amygdala links directly to areas that manipulate your facial muscles, control your breathing, and regulate your heart rate. Fibers emanating from the amygdala also signal other parts of the brain to release norepinephrine, a kind of starter fluid that prepares the delivery of

[11] Wendy's, press release, Wendy's International Inc. (7 July 2005); Wendy's, 10–Q report (11 August 2005); www.cnn.com/2005/LAW/09/09/wendys.finger.ap; stock data from http://finance.yahoo.com; Patricia Sellers, "eBay's Secret," *Fortune,* vol. 150, no. 8 (18 October 2004):160–178 (www.forbes.com/forbes/1999/0726/6402238a.html).

energy to your muscles for instant action. And the amygdala helps infuse your bloodstream with corticosterone, a stress hormone that assists the body in responding to an emergency.

Remarkably, the amygdala can flood your body with fear signals before you are consciously aware of being afraid. If you smell smoke in your home or office, your heart will hammer and your feet will start flying well before any fire alarm goes off. In the presence of real or potential danger, the amygdala waits for nothing. "You don't need to fall off a ten-story building in order to be afraid of falling off it," says neuroscientist Antoine Bechara of the University of Southern California. "Your brain doesn't need actual experience."[12]

A rat born and bred in a laboratory, where it has never seen a cat, will nevertheless freeze instantly if it encounters one. The rat's amygdala senses danger and triggers an automatic fear response—even though the rat has no idea what a cat is. A rat with an injured amygdala, however, will not freeze; instead, it will scamper up to the cat, climb on its back, even nibble on its ear. (Fortunately for the rats, in these experiments the cat has been sedated.) When the amygdala is damaged, the sense of fear is broken.

"Emotion can be beneficial when it is triggered by a chain of prior experiences," explains Bechara. "Otherwise, you would take forever to decide." In speeches to investors, I sometimes reach into a sealed bag, pull out a rattlesnake, and throw it into the audience. In theory, "rational" people should sit there while the snake flies through the air. They should take a few moments to decide whether it's worth causing a ruckus by scrambling out of the way, and to calculate the odds that a writer would throw a live snake at them during a speech. Having weighed the potential costs against the possible benefits, "rational" people should conclude that there's no cause for alarm. Instead, they scream and bolt out of the chair. (Needless to say, the snake isn't real; it's a rubber toy.)

Does this lightning response of the amygdala make us "irrational"? Of course not. As it helped our remote ancestors survive, the fear reflex remains a vital survival tool in daily life today: It makes you look both ways before you cross the street and reminds you to hold the railing on high balconies. However,

[12]Antonio R. Damasio, *Descartes' Error: Emotion, Reason, and the Human Brain* (New York: Penguin, 1994); Joseph LeDoux, *The Emotional Brain: The Mysterious Underpinnings of Emotional Life* (New York: Simon & Schuster, 1996); Andrew J. Calder, Andrew D. Lawrence, and Andrew W. Young, "Neuropsychology of Fear and Loathing," *Nature Reviews Neuroscience,* vol. 2 (May 2001):352–363; K. Luan Phan et al., "Functional Neuroanatomy of Emotion," *NeuroImage,* vol. 16, no. 2 (June 2002):331–348; M. Davis and P. J. Whalen, "The Amygdala: Vigilance and Emotion," *Molecular Psychiatry,* vol. 6, no. 1 (January 2001):13–34; Nathan J. Emery and David G. Amaral, "The Role of the Amygdala in Primate Social Cognition," in *Cognitive Neuroscience of Emotion*, edited by Richard D. Lane and Lynn Nadel (New York: Oxford University Press, 2000):156–191; Antoine Bechara, interview by JZ (2 April 2002); D. Caroline Blanchard and Robert J. Blanchard, "Innate and Conditioned Reactions to Threat in Rats with Amygdaloid Lesions," *Journal of Comparative and Physiological Psychology,* vol. 81, no. 2 (1972):281–290.

when a potential threat is financial instead of physical, reflexive fear will put you in danger more often than it will get you out of it. Selling your investments every time they take a sudden drop will make your broker rich, but it will just make you poor and jittery.

Social signals can set off the hot button of your brain as easily as physical dangers can. When photographs of fearful faces are flashed for 33 one-thousandths of a second—and immediately followed by longer exposures of emotionally neutral faces—your reflective mind has no time to become aware that you saw anything scary. But your reflexive brain will "know" it with lightning speed. The exposure to a fearful face for just a thirtieth of a second is enough to spark intense activation in the amygdala, priming your body for action just in case this subliminal threat turns out to be real.[13]

The amygdala also enables us to spot fearful body language in a split second: The mere glimpse of someone standing hands-up makes us expect a mugging, and a hunched and cowering figure makes us anticipate a beating. If you were exposed for just a third of a second to images of anonymous actors making agitated gestures, your amygdala would instantly "catch" their fear, alerting the stress systems throughout your body in a flash.

Finally, the amygdala is sensitive to that uniquely human way of conveying threats—through language. Brain scans show that your amygdala will fire more intensely in response to words like *kill*, *danger*, *knife*, or *torture*, than to words like *towel*, *formation*, *number*, or *pen*. Researchers in France have recently shown that a frightening word can make you break out in a sweat even if it appears for only 12 one-thousandths of a second—roughly 25 times faster than the blink of a human eye! (No wonder you cringe when someone says, "I got killed on that fund" or "Buying that stock would be like trying to catch a falling knife.")[14]

An alarming word or two can even be powerful enough to transform your memories. In a classic experiment by psychologist Elizabeth Loftus, people viewed video footage of car accidents. Some of the viewers were asked how fast the cars were going when "they hit each other." Others were asked how fast the cars were going when "they smashed into each other." Even though both groups

[13]Paul J. Whalen et al., "Masked Presentation of Emotional Facial Expressions Modulate Amygdala Activity without Explicit Knowledge," *Journal of Neuroscience*, vol. 18, no. 1 (1 January 1998):411–418; Beatrice de Gelder, "Towards the Neurobiology of Emotional Body Language," *Nature Reviews Neuroscience*, vol. 7 (March 2006):242–249; Beatrice de Gelder et al., "Fear Fosters Flight," *PNAS*, vol. 101, no. 47 (23 November 2004):16701–16706.

[14]N. Isenberg et a1., "Linguistic Threat Activates the Human Amydala," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 96, no. 18 (31 August 1999):10456–10459; Laetitia Silvert et al., "Autonomic Responding to Aversive Words without Conscious Valence Discrimination," *International Journal of Psychophysiology*, vol. 53, no. 2 (July 2004):135–145; Elizabeth L. Loftus and John C. Palmer, "Reconstruction of Automobile Destruction: An Example of the Interaction between Language and Memory," *Journal of Verbal Learning and Verbal Behavior*, vol. 13, no. 5 (October 1974):585–589. A normal eyeblink lasts about 320 milliseconds (e-mail from SUNY Stony Brook neurobiologist Craig Evinger to JZ, 23 March 2006).

saw the same videos, the people who were prompted by the words "smashed into" estimated that the cars were going 19 percent faster. "Hit" may not sound very scary, but "smashed into" does. That evidently switches on the amygdala, splashing emotion back onto your memory and changing your perceptions of the past.

What does all this tell us about investing? Humans are reflexively afraid not just of physical dangers, but also of any social signal that transmits an alarm. A television broadcast from the floor of the stock exchange on a bad trading day, for example, combines a multitude of cues that can fire up the amygdala: flashing lights, clanging bells, hollering voices, alarming words, people gesturing wildly. In a split second, you break out in a sweat, your breathing picks up, your heart races. This primal part of your brain is bracing you for a "fight or flight" response before you can even figure out whether you have lost any money yourself.

Both actual and imagined losses can flip this switch. Using brain scans, one study found that the more frequently people were told they were losing money, the more active the amygdala became. Other scanning experiments have shown that even the expectation of financial losses can switch on this fear center. Traumatic experiences activate genes in the amygdala, stimulating the production of proteins that strengthen the cells where memories are stored in several areas of the brain. A surge of signals from the amygdala can also trigger the release of adrenaline and other stress hormones, which have been found to "fuse" memories, making them more indelible. And an upsetting event can shock neurons in the amygdala into firing in synch for hours—even during sleep. (It is literally true that we can relive our financial losses in our nightmares.) Brain scans have shown that when you are on a financial losing streak, each new loss heats up the hippocampus, the memory bank near the amygdala that helps store your experiences of fear and anxiety.[15]

[15]Tiziana Zalla et al., "Differential Amygdala Responses to Winning and Losing: A Functional Magnetic Resonance Imaging Study in Humans," *European Journal of Neuroscience,* vol. 12, no. 5 (May 2000):1764–1770; Grafman, interview by JZ (6 March 2002); Hans C. Breiter et al., "Functional Imaging of Neural Responses to Expectancy and Experience of Monetary Gains and Losses," *Neuron,* vol. 30, no. 2 (May 2001):619–639; Gleb P. Shumyatsky et al., "Stathmin, a Gene Enriched in the Amygdala, Controls Both Learned and Innate Fear," *Cell*, vol. 123, no. 4 (18 November 2005):697–709; R. Douglas Fields, "Making Memories Stick," *Scientific American*, vol. 292, no. 2 (February 2005):75–81; Karim Nader, Glenn E. Schafe, and Joseph E. Le Doux, "Fear Memories Require Protein Synthesis in the Amygdala for Reconsolidation after Retrieval," *Nature,* vol. 406 (17 August 2000):722–726; James L. McGaugh, "Memory—A Century of Consolidation," *Science,* vol. 287, no. 5451 (14 January 2000):248–251; B. A. Strange and R. J. Dolan, "β-Adrenergic Modulation of Emotional Memory-Evoked Human Amygdala and Hippocampal Responses," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 101, no. 31 (3 August 2004):11454–11458; James L. McGaugh et al., "Modulation of Memory Storage by Stress Hormones and the Amygdaloid Complex," in *Modulation of Memory Storage by Stress Hormones and the Amygdaloid Complex*, edited by Michael Gazzaniga (Cambridge, MA: MIT Press, 2000):1081–1098; Joe Guillaume Pelletier et al., "Lasting Increases in Basolateral Amygdala Activity after Emotional Arousal," *Learning and Memory*, vol. 12 (2005):96–102; Rebecca Elliott et al., "Dissociable Neural Responses in Human Reward Systems," *Journal of Neuroscience*, vol. 20, no. 16 (15 August 2000):6159–6165. "Adrenaline" is the common term for epinephrine.

What's so bad about that? A moment of panic can wreak havoc on your investing strategy. Because the amygdala is so attuned to big changes, a sudden drop in the market tends to be more upsetting than a longer, slower—or even a much bigger—decline. On October 19, 1987, the U.S. stock market plunged 23 percent—a deeper one-day drop than the Crash of 1929 that ushered in the Great Depression. Big, sudden, and inexplicable, the Crash of 1987 was exactly the kind of event that sparks the amygdala into flashing fear throughout every investor's brain and body. The memory was hard to erase: In 1988, U.S. investors sold $15 billion more shares in stock mutual funds than they bought, and their net purchases of stock funds did not recover to precrash levels until 1991. The "experts" were just as shell-shocked: The managers of stock funds kept at least 10 percent of their total assets in the safety of cash almost every month through the end of 1990, while the value of seats on the New York Stock Exchange did not regain their precrash level until 1994. A single drop in the stock market on one Monday in autumn disrupted the investing behavior of millions of people for at least the next three years.[16]

The philosopher William James wrote that "an impression may be so exciting emotionally as almost to leave a *scar* upon the cerebral tissues." The amygdala seems to act like a branding iron that burns the memory of financial loss into your brain. That may help explain why a market crash, which makes stocks cheaper, also makes investors less willing to buy them for a long time to come.

Fright Makes Right

I learned how my own amygdala reacts to risk when I participated in an experiment at the University of Iowa. First I was wired up with electrodes and other monitoring devices—on my chest, my palms, my face—to track my breathing, heartbeat, perspiration, and muscle activity. Then I played a computer game designed by neuroscientists Antoine Bechara and Antonio Damasio. Starting with $2,000 in play money, I clicked a mouse to select a card from one of four decks displayed on the computer monitor in front of me. Each "draw" of a card made me either "richer" or "poorer." I soon learned that the two left decks were more likely to produce big gains but even bigger losses, while the two right decks blended more frequent but smaller gains with a lower chance of big losses. (The left decks were the rough equivalent of an aggressive growth fund that invests in risky small stocks, while the right decks resembled

[16]ICI, *2005 Investment Company Fact Book* (Washington, DC: Investment Company Institute, 2005):77; ICI, *1996 Mutual Fund Fact Book* (Washington, DC: Investment Company Institute, 1996):125; Donald B. Keim and Ananth Madhavan, "The Relation between Stock Market Movements and NYSE Seat Prices," *Journal of Finance,* vol. 55, no. 6 (December 2000):2817–2840; William James, *The Principles of Psychology, volume 1* (New York: Henry Holt, 1890), reprinted (Mineola, NY: Dover Press, 1980):670. (Italics in original.)

a balanced fund that mixes stocks and bonds for a smoother return.) Gradually, I began picking most of my cards from the decks on the right; by the end of the experiment I had drawn 24 cards in a row from those safer decks.[17]

Afterward, I looked over the printout of my bodily responses with a profound sense of wonder. I could see that the paper was covered with jagged lines that traced my spiking heartbeat and panting breath as the red alert of risk swept through my body. But the reflective areas of my brain never had a clue that I was on edge. So far as I "knew," I was doing nothing more than calmly trying to make a few bucks by picking cards.

At first, the printout showed, my skin would sweat, my breath quicken, my heart race, and my facial muscles furrow immediately after I clicked on any card that cost me money. Early on, when I drew one card that lost me $1,140, my pulse rate shot from 75 to 145 in a split second. After three or four bad losses from the risky decks, my bodily responses began surging before I selected a card from either of those piles. Merely moving the cursor over the riskier decks, without even clicking on them, was enough to make my physiological functions go haywire—as if I had stepped toward a snarling lion. It took only a handful of losses for my amygdala to create an emotional memory that made my body tingle with apprehension at the very thought of losing money again.

My decisions, I now could see, had been driven by a subliminal fear that I sensed with my body even though the "thinking" part of my mind had no idea I was afraid. As anyone who has ever come upon a sudden danger knows, it's often only after the fact that you realize how keyed up you were in your moment of peril. My brain handled this danger the same way, even though it was a financial, not a physical, risk and even though it involved only play money, not real cash.

At least in the developed world, money has become an inherently desirable object. Current social pressures—plus centuries of tradition—lead us to equate money with safety and comfort. (Ironically, we even call stocks, bonds, and

[17]JZ participated in the Iowa Gambling Task (and interviewed Antoine Bechara and Antonio Damasio) at the University of Iowa, 2 April 2002. The experiment is also described in Antonio Damasio, *Descartes' Error: Emotion, Reasons, and the Human Brain* (New York: Penguin, 1994):212–222; Antonio R. Damasio, "The Somatic Marker Hypothesis and the Possible Functions of the Prefrontal Cortex," *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences,* vol. 351, no. 1346 (October 1996):1413–1420; Antoine Bechara et al., "Different Contributions of the Human Amygdala and Ventromedial Prefrontal Cortex to Decision-Making," *Journal of Neuroscience*, vol. 19, no. 13 (1 July 1999):5473–5481; Antoine Bechara, D. Tranel, and A.R. Damasio, "The Somatic Marker Hypothesis and Decision-Making," in *Handbook of Neuropsychology*, *volume 7: The Frontal Lobes*, 2nd edition, edited by Jordan Grafman (London: Elsevier, 2002):117–143. For a divergent view, see Alan G. Sanfey and Jonathan D. Cohen, "Is Knowing Always Feeling?" *Proceedings of the National Academy of Sciences in the United States of America*, vol. 101, no. 48 (30 November 2004):16709–16710, and Tiago V. Maia and James L. McClelland, "A Reexamination of the Evidence for the Somatic Marker Hypothesis," *Proceedings of the National Academy of Sciences in the United States of America*, vol. 101, no. 45 (9 November 2004):16075–16080.

other investments "securities"!) So a financial loss or shortfall is a painful punishment that arouses an almost primitive fear. "Money is a symbolic token of the problem of life," says neuroscientist Antonio Damasio. "Money represents the means of maintaining life and sustaining us as organisms in our world." Seen in this light, it's not surprising that losing money can ignite the same fundamental fears you would feel if you encountered a charging tiger, got caught in a burning forest, or stood on the crumbling edge of a cliff.

Ironically, this highly emotional part of our brain can sometimes help us act more rationally. When Bechara and Damasio run their card-picking game with people whose amygdalas have been injured, they find that these patients never learn to avoid choosing from the riskier decks. If amygdala patients are told that they have just lost money, their pulse, breathing, and other bodily responses show no change. With the amygdala knocked out, a financial loss no longer hurts.

The result is what Bechara calls "a disease of decision-making." With no emotional signal from the amygdala to alert the prefrontal cortex about how bad it will feel to lose money, these people sample cards from all the decks—good and bad—until they end up going broke. Normally, the amygdala plays a vital role as the alarm that signals "Don't go there!" But once the reflexive brain is impaired, then the reflective areas say, "Hmm, maybe I should try that one." Without the saving grace of fear, the analytical parts of the brain will keep trying to outsmart the odds, with disastrous results. "The process of deciding advantageously," says Damasio, "is not just logical but also emotional."

A team of researchers designed an even simpler game to test how fear affects our financial decisions. Starting off with $20, you could then risk $1 on a coin flip (or pass and risk nothing). If the coin came up heads, you would lose your $1; if it came up tails, you would win $2.50. The game ran for 20 rounds. The researchers tried the experiment on two groups: people with intact brains (or "normals") and people with injuries to emotional centers of the brain like the amygdala and the insula ("patients").[18]

The "normals" were reluctant to bet. They gambled in only 58 percent of all the rounds (even though, on average, they could have come out ahead just by betting on every flip). And they proved the proverb "Once burned, twice shy": Immediately after a loss, the normals would bet only 41 percent of the time. The pain of losing $1 discouraged the normals from trying to win $2.50.

The people with damaged emotional circuits behaved very differently. They bet their dollar, on average, in 84 percent of all the rounds—and, even when the previous flip had lost them $1, the patients took the next bet 85 percent of the time. That's not all. The longer they played, the more willing the patients became to flip the coin again—regardless of how much they had

[18] Baba Shiv et al., "Investment Behavior and the Negative Side of Emotion," *Psychological Science*, vol. 16, no. 6 (June 2005):435–439.

lost. In their case, it's as if the pain circuits in the brain had been anesthetized, making it impossible for the patients to feel the anguish of loss. Therefore, they bet with abandon: Damn the consequences, full speed ahead!

The result? The people with emotionally impaired brains earned 13 percent more money than those whose brains were undamaged. With their fear circuits knocked offline, these people take chances that the rest of us are too scared to touch.

The lesson? It's not that you could raise your investing returns by whacking yourself upside the head with a hammer. It's that the fear of financial loss *always* lurks within the normal investing brain. When the market is flat or rising, your sense of fear may go into deep hibernation. But believing that you are fearless is very different from being fearless. During the peak of the bull market, investors bragged that they didn't mind taking big risks in the pursuit of bigger gains. But most of these people had never suffered a major financial loss—and the meltdown in the amygdala that goes along with it. That led all too many investors to the mistaken conclusion that big losses wouldn't bother them.

But you can't change the biological facts. Imagining that you can shrug off setbacks before you've ever suffered any is a disastrous delusion, since it leads you to take such high risks that huge losses become inevitable. When the bull market of the 1990s died, people lost trillions of dollars on stocks they never should have owned in the first place. These people paid a terrible price for their poor self-knowledge.

Is There Safety in Numbers?

Nowadays, investment herds often form in online chat rooms where intense peer pressure pulls each visitor toward the views of the most vocal and charismatic members. You look around and find a large support group all expressing similar views—so you feel "there's safety in numbers."[19]

But groups of animals, points out University of California, Los Angeles, ecologist Daniel Blumstein, "have more eyes, ears, and noses with which to detect predators." In general, animals in groups are *more* sensitive to risk than

[19] Luc-Alain Giraldeau, "The Ecology of Information Use," in *Behavioural Ecology: An Evolutionary Approach*, 4th edition, edited by John R. Krebs and Nicholas B. Davies (Oxford: Blackwell, 1997):42–68; Isabelle Coolen et al., "Species Difference in Adaptive Use of Public Information in Sticklebacks," *Proceedings: Biological Sciences,* vol. 270, no. 1531 (22 November 2003):2413–2419; Theodore Stankowich and Daniel T. Blumstein, "Fear in Animals: A Meta-Analysis and Review of Risk Assessment," *Proceedings of the Royal Society of London, Series B, Biological Sciences,* vol. 272, no. 1581 (22 December 2005):2627–2634; Blumstein, interview by JZ via e-mail (6 March 2006). The science and mathematical laws of herding are explored in depth in Luc-Alain Giraldeau and Thomas Caraco, *Social Foraging Theory* (Princeton, NJ: Princeton University Press, 2000).

they are in isolation. The larger the group in which animals gather together, the sooner and faster they will tend to flee from danger. So there's safety in numbers only when there's nothing to be afraid of. The comfort of being part of the crowd can disappear in a heartbeat.

Of course, anyone who has ever been a teenager knows that peer pressure can make you do things as part of a group that you might never do on your own. But do you make a conscious choice to conform, or does the herd exert an automatic, almost magnetic, force? People were recently asked to judge whether three-dimensional objects were the same or different. Sometimes the folks being tested made these choices in isolation. Other times, they first saw the responses of either four "peers" or four computers. (The "peers" were, in fact, colluding with the researchers conducting the study.) When people made their own choices, they were right 84 percent of the time. When all four computers gave the wrong answer, people's accuracy dropped to 68 percent. But when the peer group all made the wrong choice, the individuals being tested chose correctly just 59 percent of the time. Brain scans showed that when people followed along with the peer group, activation in parts of their frontal cortex decreased, as if social pressure was somehow overpowering the reflective brain.[20]

When people did take an independent view and guessed against the consensus of their peers, brain scans found intense firing in the amygdala. (There was no such pattern when they guessed independently of the computers, showing that it is human peer pressure that makes it so hard for us to think for ourselves.) Neuroeconomist Gregory Berns, who led the study, calls this flare-up in the amygdala a sign of "the emotional load associated with standing up for one's belief." Social isolation activates some of the same areas in the brain that are triggered by physical pain. In short, you go along with the herd not because you consciously choose to do so, but because it hurts not to.

Once you join the crowd, your feelings are no longer unique. A team of neuroscientists scanned the brains of people watching the classic spaghetti western *The Good, the Bad and the Ugly*, leaving the viewers free to daydream, get caught up in Ennio Morricone's eerie music, or wonder why Clint Eastwood can't stop squinting. Even so, a third of the surface of each viewer's cerebral cortex lit up in lockstep with the other viewers' brains—a striking phenomenon that the researchers call "ticking together." People's brains were especially prone to tick together at the most obvious turning points in the movie, like gunshots,

[20]Gregory S. Berns et al., "Neurobiological Correlates of Social Conformity and Independence during Mental Rotation," *Biological Psychiatry,* vol. 58, no. 3 (1 August 2005):245–253; Jaak Panksepp, "Feeling the Pain of Social Loss," *Science,* vol. 302, no. 5643 (10 October 2003):237–239; Naomi I. Eisenberger, Matthew D. Lieberman, and Kipling D. Williams, "Does Rejection Hurt?" *Science,* vol. 302, no. 5643 (10 October 2003):290–292.

explosions, or sudden plot twists. When emotions run high, individual brains converge to think almost as one. (If you have a DVD of *The Good, the Bad and the Ugly*, you can follow along on your computer, matching the footage of the movie with other people's brain activation patterns, at www.weizmann.ac.il/neurobiology/labs/malach/brainshow/.)[21]

"Ticking together" suggests that our own emotions tend to peak in synch with other people's reactions to the same stimuli. We move in herds partly because, although we are all individuals, our brains respond in common to common circumstances. When we face the same conditions, "ticking together" leads many of us to share the same emotions. If the financial news makes you feel anxious or afraid, surprised or elated, the chances are high that many other investors feel the same way.

Being part of a larger group of investors can make you feel safer when everything is going great. But once risk rears its ugly head, there is no safety in numbers: You may find that everyone in the herd is dumping your favorite stock and, in effect, running for their lives. One burst of bad news, and the support group can become a stampede. You will suddenly be all alone, just when nothing feels safe anymore.

When Nobody Knows the Odds

Military-intelligence scholar Daniel Ellsberg helped to bring down the presidency of Richard Nixon when, in 1971, he leaked the Pentagon Papers to the *New York Times*. That top-secret report documented systematic flaws of decision-making in the Vietnam War. Ellsberg was no stranger to the notion that people don't always have good judgment. A decade earlier, as an experimental psychologist at Harvard, he had published the results of a mind-bending little discovery that became known as the Ellsberg Paradox. Here's how it works. Imagine that you have two urns in front of you. They are open at the top so you can reach in, but you cannot see what is inside. The first—call it Urn A—contains exactly 50 red balls and 50 black balls. Urn B also contains exactly 100 balls; some are red and some are black, but you do not know how many there are of each. You will win $100 if you draw a red ball from either urn.[22]

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[21] Uri Hasson et al., "Intersubject Synchronization of Cortical Activity during Natural Vision," *Science,* vol. 303, no. 5664 (12 March 2004):1634–1640; Luiz Pessoa, "Seeing the World in the Same Way," *Science,* vol. 303, no. 5664 (12 March 2004):1617–1618.

[22] Ellsberg's biography and his classic article "Risk, Ambiguity, and the Savage Axioms" (*Quarterly Journal of Economics,* vol. 75, no. 4 [November 1961]:643–669) are available at www.ellsberg.net. The Ellsberg Paradox has been replicated in many subsequent experiments; see Colin Camerer and Martin Weber, "Recent Developments in Modeling Preferences: Uncertainty and Ambiguity," *Journal of Risk and Uncertainty,* vol. 5, no. 4 (October 1992):325–370, and Catrin Rode et al., "When and Why Do People Avoid Unknown Probabilities in Decisions Under Uncertainty?" *Cognition,* vol. 72, no. 3 (26 October 1999):269–304. Rumsfeld, remarks at news briefing, Department of Defense (12 February 2002).

Which urn would you pick from? If you're like most people, you prefer Urn A.

Now let's repeat the game, but change the rules: This time, you win $100 if you draw a *black* ball from either urn. Which urn would you pick from now? Most people stick with Urn A. But that makes no logical sense! If you went with Urn A the first time, you obviously acted as if it contained more red balls than Urn B. Since you know Urn A has 50 red balls, your first choice implies that Urn B contains fewer than 50 red balls. Therefore, you should conclude that more than 50 balls in Urn B are black. Now that you are trying to draw a black ball, you should pick from Urn B.

Why, then, do people prefer Urn A in both the first and second rounds? In a press conference in 2002, U.S. Secretary of Defense Donald Rumsfeld made a widely mocked distinction between what he called "known knowns," "known unknowns," and "unknown unknowns." But—although he has less in common with Ellsberg than almost anyone else alive—Rumsfeld was right. "Known knowns," Rumsfeld explained, "are things we know that we know." In the case of known unknowns, he continued, "we know there are some things we do not know."

In those terms, Ellsberg's Urn A is a known known: You can be sure it has a 50/50 mix of red and black balls. Urn B, on the other hand, is a known unknown: You can be sure it contains both red and black balls, but you have no idea how many of each. Urn B is brimming with what Ellsberg called "ambiguity," and that feels scary. After all, what if 99 of the balls in Urn B somehow turn out to be red? Then you will stand a very high chance of winning nothing on the draw for black balls. The less sure we can be about the probabilities, the more we worry about the consequences. So we avoid Urn B, regardless of basic logic.

Ellsberg found that people persisted in choosing Urn A even after they realized it made no sense, and even if he asked them to bet money on whether they had picked the right urn. When Ellsberg tried his experiment on the leading economists and decision theorists of his time, many of them made the same mistake as the man in the street.

That's no surprise, since Ellsberg's Paradox is rooted in the same tension between thinking and feeling that drives so many of our investing decisions. A team of researchers recently scanned the brains of people who were asked to pick from a deck of 20 cards. Sometimes the players knew that the deck contained 10 red and 10 blue cards; at other times, all they knew was that the deck contained both red and blue cards. (They would miss out on a $3 gain if they picked the wrong card.) The first deck, like Ellsberg's Urn A, was a known known; the second, like Urn B, was a known unknown. When people considered picking from the ambiguous deck, the fear center in the amygdala went into overdrive. What's more, thinking about an ambiguous bet dampened activity in the caudate, one of the brain's reward centers that, as we saw in

Chapter Five, helps us trust someone and feel the pleasure of being in control of a situation. Not knowing the odds not only inflames our fears, but also strips us of the feeling that we are in charge.[23]

Ellsberg's Paradox often shows up in the stock market. Even though the growth rate of every company is uncertain, some rates seem more predictable than others. When a company's growth seems reliable, Wall Street says it has "high visibility." Ellsberg might say it has "low ambiguity." Whatever you call it, investors pay a premium for this illusion of predictability:

- Stocks that are followed by more security analysts on Wall Street have higher trading volume, suggesting that investors prefer betting on companies that are eyeballed by more "experts."
- The more closely analysts agree about how much a company will earn over the coming year, the more investors will pay for the stock. (As we saw in Chapter Four, analysts are lousy at predicting corporate earnings; yet investors prefer a precise but wrong forecast over a vague but accurate one.)
- Among security analysts, 78 percent agree that ambiguity about future earnings "tends to make me less confident" investing in small stocks than large stocks.
- On average, the earnings of so-called "value" companies are more than twice as volatile as those of "growth" companies.[24]

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[23] Aldo Rustichini, "Neuroscience: Emotion and Reason in Making Decisions," *Science*, vol. 310, no. 5754 (9 December 2005):1624–1625; Ming Hsu et al., "Neural Systems Responding to Degrees of Uncertainty in Human Decision-Making," *Science*, vol. 310 (9 December 2005):1680–1683. (The frontal lobe is also involved: Scott A. Huettel et al., "Neural Signatures of Economic Preferences for Risk and Ambiguity," *Nature,* vol. 49, no. 5 [2 March 2006]:765–775.) Not knowing what the odds are is very different from knowing that the odds are low; as we saw in Chapter Three, nothing is quite as thrilling as a long-shot gamble on a big jackpot. When the probabilities of winning are remote, many people prefer an ambiguous over a certain gamble; see Hillel J. Einhorn and Robin M. Hogarth, "Decision Making Under Ambiguity," *Journal of Business*, vol. 59, no. 4, pt. 2 (October 1986):S225–S250.

[24] Michael J. Brennan, "The Individual Investor," *Journal of Financial Research,* vol. 18, no. 1 (1995):59–74; Robert A. Olsen and George H. Troughton, "Are Risk Premium Anomalies Caused by Ambiguity?," *Financial Analysts Journal,* vol. 56, no. 2 (March/April 2000):24–31; Thomas K. Philips, "The Source of Value," *Journal of Portfolio Management*, vol. 28, no. 4 (Summer 2002):36–44; Brad Barber et al., "Reassessing the Returns to Analysts' Stock Recommendations," *Financial Analysts Journal*, vol. 59, no. 2 (March/April 2003):88–96; John A. Doukas, Chansog (Francis) Kim, and Christos Pantzalis, "Divergent Opinions and the Performance of Value Stocks," *Financial Analysts Journal*, vol. 60, no. 6 (Nov/Dec 2004):55–64; Eugene F. Fama and Kenneth R. French, "The Anatomy of Value and Growth Stock Returns," CRSP Working Papers (September 2005): http://ssrn.com/abstract=806664.

All this makes investing in value stocks or small stocks the equivalent of trying to pick a black ball from Urn B: The higher ambiguity makes your odds of success feel less certain. Picking from the "predictable" growth stocks in Urn A simply feels safer. So most investors steer clear of value companies and small stocks, driving their share prices down, and pile into big growth companies, sending their stocks soaring—at least in the short run. Over longer periods, however, growth stocks and the stocks most popular with analysts tend to earn lower returns than value stocks and underanalyzed companies. By avoiding stocks that are high in ambiguity, the investing public makes them underperform in the short run—creating bargains that go on to outperform over the long run.

Fighting Your Fears

When you confront risk, your reflexive brain, led by the amygdala, functions much like a gas pedal, revving up your emotions. Fortunately, your reflective brain, with the prefrontal cortex in charge, can act like a brake pedal, slowing you down until you are calm enough to make a more objective decision. The best investors make a habit of putting procedures in place, in advance, that help inhibit the hot reactions of the emotional brain. Here are some techniques that can help you keep your investing cool in the face of fear:

Get It Off Your Mind. You'll never find the presence of mind to figure out what to do about a risk gone bad unless you step back and relax. Joe Montana, the great quarterback for the San Francisco 49ers, understood this perfectly. In the 1989 Super Bowl, the 49ers trailed the Cincinnati Bengals by three points with only three minutes left and 92 yards—almost the whole length of the field—to go. Offensive tackle Harris Barton felt "wild" with worry. But then Montana said to Barton, "Hey, check it out—there in the stands, standing near the exit ramp, there's John Candy." The players all turned to look at the comedian, a distraction that allowed their minds to tune out the stress and win the game in the nick of time. When you feel overwhelmed by a risk, create a John Candy moment. To break your anxiety, go for a walk, hit the gym, call a friend, play with your kids.[25]

Use Your Words. While vivid sights and sounds fire up the emotions in your reflexive brain, the more complex cues of language activate the prefrontal cortex and other areas of your reflective brain. By using words to counteract the stream of images the markets throw at you, you can put the hottest risks in cooler perspective.[26]

[25] Paul Zimmerman, "The Ultimate Winner," *Sports Illustrated* (13 August 1990):72–83; Larry Schwartz, "No Ordinary Joe" (www.espn.go.com/classic/biography/s/Montana_Joe.html).

[26] James J. Gross, "Antecedent- and Response-Focused Emotion Regulation: Divergent Consequences for Experience, Expression, and Physiology," *Journal of Personality and Social Psychology*, vol. 74, no. 1 (January 1998):224–237.

In the 1960s, Berkeley psychologist Richard Lazarus found that showing a film of a ritual circumcision triggered instant revulsion in most viewers, but that this disgust could be "short-circuited" by introducing the footage with an announcement that the procedure was not as painful as it looked. Viewers exposed to the verbal commentary had lower heart rates, sweated less, and reported less anxiety than those who watched the film without a soundtrack. (The commentary wasn't true, by the way—but it worked.)

More recent, disgusting film clips—featuring burn victims being treated and closeups of an arm being amputated—have been shown to viewers by the aptly named psychologist James Gross. (Although I do not recommend watching it on a full stomach, you can view the amputation clip at http://psych.stanford.edu/~psyphy/movs/surgery.mov.) He has found that viewers feel much less disgusted if they are given written instructions, in advance, to adopt a "detached and unemotional" attitude.

As we've learned, if you view a photograph of a scary face your amygdala will flare up, setting your heart racing, your breath quickening, your palms sweating. But if you view the same photo of a scary face accompanied by words like *angry* or *afraid*, activation in the amygdala is stifled and your body's alarm responses are reined in. As the prefrontal cortex goes to work trying to decide how accurately the word describes the situation, it overrides your original reflex of fear.[27]

Taken together, these discoveries show that verbal information can act as a wet blanket flung over the amygdala's fiery reactions to sensory input. That's why using words to think about an investing decision becomes so important whenever bad news hits. To be sure, formerly great investments can go to zero in no time; once Enron and WorldCom started to drop, it didn't pay to think analytically about them. But for every stock that goes into a total meltdown, there are thousands of other investments that suffer only temporary setbacks—and selling too soon is often the worst thing you can do. To prevent your feelings from overwhelming the facts, use your words and ask questions like these:

Other than the price, what else has changed?

Are my original reasons to invest still valid?

[27] Ahmad Hariri, interview by JZ via e-mail (14 April 2005); Ahmad R. Hariri, S.Y. Bookheimer, and J.C. Mazziotta, "Modulating Emotional Responses: Effects of a Neocortical Network on the Limbic System," *NeuroReport*, vol. 11, no. 1 (17 January 2000):43–48; Ahmad R. Hariri et al., "Neocortical Modulation of the Amygdala Response to Fearful Stimuli," *Biological Psychiatry*, vol. 53, no. 6 (15 March 2003):494–501; Kezia Lange et al., "Task Instructions Modulate Neural Responses to Fearful Facial Expressions," *Biological Psychiatry*, vol. 53, no. 3 (2003):226–232; Florin Dolcos and Gregory McCarthy, "Brain Systems Mediating Cognitive Interference by Emotional Distraction," *Journal of Neuroscience*, vol. 26, no. 7 (15 February 2006):2072–2079.

If I liked this investment enough to buy it at a much higher price, shouldn't I like it even more now that the price is lower?

What other evidence do I need to evaluate in order to tell whether this is really bad news?

Has this investment ever gone down this much before? If so, would I have done better if I had sold out—or if I had bought more?

Track Your Feelings. In Chapter Five, we learned the importance of keeping an investing diary. You should include what neuroscientist Antoine Bechara calls an "emotional registry," tracking the ups and downs of your moods alongside the ups and downs of your money. During the market's biggest peaks and valleys, go back and read your old entries from similar periods in the past. Chances are, your own emotional record will show you that you tend to become overenthusiastic when prices (and risk) are rising, and to sink into despair when prices (and risk) go down. So you need to train yourself to turn your investing emotions upside down. Many of the world's best investors have mastered the art of treating their own feelings as reverse indicators: Excitement becomes a cue that it's time to consider selling, while fear tells them that it may be time to buy. I once asked Brian Posner, a renowned fund manager at Fidelity and Legg Mason, how he sensed whether a stock would be a moneymaker. "If it makes me feel like I want to throw up," he answered, "I can be pretty sure it's a great investment." Likewise, Christopher Davis of the Davis Funds has learned to invest when he feels "scared to death." He explains, "A higher perception of risk can lower the actual risk by driving prices down. We like the prices that pessimism produces."[28]

Get Away from the Herd. In the 1960s, psychologist Stanley Milgram carried out a series of astounding experiments. Let's imagine you are in his lab. You are offered $4 (about $27 in today's money) per hour to act as a "teacher" who will help guide a "learner" by penalizing him for wrong answers on a simple memory test. You sit in front of a machine with 30 toggle switches that are marked with escalating labels from "slight shock" at 15 volts, up to "DANGER: SEVERE SHOCK" at 375 volts, and beyond to 450 volts (marked ominously with "XXX"). The learner sits where you can hear but not see him. Each time the learner gets an answer wrong, the lab supervisor instructs you to flip the next switch, giving a higher shock. If you hesitate to increase the voltage, the lab supervisor politely but firmly instructs you to continue. The first few shocks are

[28]Antoine Bechara, interview by JZ (2 April 2002); Jason Zweig, "What's Eating You," *Money Magazine*, vol. 30, no. 13 (December 2001):63–64; Beverly Goodman, "Family Tradition," *SmartMoney,* vol. 15, no. 3 (March 2006):64–67; Davis, interview by JZ via e-mail (27 June 2006).

harmless. But at 75 volts, the learner grunts. "At 120 volts," Milgram wrote, "he complains verbally; at 150 he demands to be released from the experiment. His protests continue as the shocks escalate, growing increasingly vehement and emotional. . . . At 180 volts the victim cries out, 'I can't stand the pain'. . . At 285 volts his response can only be described as an agonized scream."[29]

What would you do if you were one of Milgram's "teachers"? He surveyed more than 100 people outside his lab, describing the experiment and asking them at what point they thought they would stop administering the shocks. On average, they said they would quit between 120 and 135 volts. Not one predicted continuing beyond 300 volts.

However, inside Milgram's lab, 100 percent of the "teachers" willingly delivered shocks of up to 135 volts, regardless of the grunts of the learner; 80 percent administered shocks as high as 285 volts, despite the learner's agonized screams; and 62 percent went all the way up to the maximum ("XXX") shock of 450 volts. With money at stake, fearful of bucking the authority figure in the room, people did as they were told "with numbing regularity," wrote Milgram sadly. (By the way, the "learner" was a trained actor who was only pretending to be shocked by electric current; Milgram's machine was a harmless fake.)

Milgram found two ways to shatter the chains of conformity. One is "peer rebellion." Milgram paid two people to join the experiment as extra "teachers"—and to refuse to give any shocks beyond 210 volts. Seeing these peers stop, most people were emboldened to quit, too. Milgram's other solution was "disagreement between authorities." When he added a second supervisor who told the first that escalating the voltage was no longer necessary, nearly everyone stopped administering the shocks immediately.

Milgram's discoveries suggest how you can resist the pull of the herd:

- Before entering an internet chat room or a meeting with your colleagues, write down your views about the investment you are considering: why it is good or bad, what it is worth, and your reasons for those views. Be as specific as possible—and share your conclusions with someone you respect who is not part of the group. (That way, you know someone else will keep track of whether you change your opinions to conform with the crowd.)
- Run the consensus of the herd past the person you respect the most who is not part of the group. Ask at least three questions: Do these people sound reasonable? Do their arguments seem sensible? If you were in my shoes, what else would you want to know before making this kind of decision?

[29] Stanley Milgram, *Obedience to Authority* (New York: Harper & Row, 1974):4, 23, 107, 117–119, 123.

- If you are part of an investment organization, appoint an internal sniper. Base your analysts' bonus pay partly on how many times they can shoot down an idea that everyone else likes. (Rotate this role from meeting to meeting to prevent any single sniper from becoming universally disliked.)
- Alfred P. Sloan, Jr., the legendary chairman of General Motors, once abruptly adjourned a meeting this way: "Gentlemen, I take it we are all in complete agreement on the decision here. . . . Then I propose we postpone further discussion of this matter until our next meeting to give ourselves time to develop disagreement and perhaps gain some understanding of what the decision is all about." Peer pressure can leave you with what psychologist Irving Janis called "vague forebodings" that you are afraid to express. Meeting with the same group over drinks in everyone's favorite bar may loosen some of your inhibitions and enable you to dissent more confidently. Appoint one person as the "designated thinker," whose role is to track the flow of opinions set free as other people drink. According to the Roman historian Tacitus, the ancient Germans believed that drinking wine helped them "to disclose the most secret motions and purposes of their hearts," so they evaluated their important decisions twice: first when they were drunk and again when they were sober.[30]

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[30]Irving L. Janis, *Groupthink*, 2nd edition (Boston: Houghton Mifflin, 1982):271; Tacitus, *Germania.*