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The Captain Kirk Principle

Intuition is the key to knowing without knowing how you know

Stardate: 1672.1. Earthdate: October 6, 1966. *Star Trek* episode 5, "The Enemy Within." Captain James T. Kirk has just beamed up from planet Alpha 177, where magnetic anomalies have caused the transporter to malfunction, splitting Kirk into two beings. One is cool and rational. The other is impulsive and irrational. Rational Kirk must make a command decision to save the crew, but he is paralyzed with indecision, bemoaning to Dr. McCoy: "I can't survive without him [irrational Kirk]. I don't want to take him back. He's like an animal—a thoughtless, brutal animal. And yet it's me."

This psychological battle between intellect and intuition was played out in nearly every episode of *Star Trek* in the characters of the ultrarational Mr. Spock and the hyperemotional Dr. McCoy, with Captain Kirk as the near-perfect embodiment of both. Thus I call this balance the *Captain Kirk Principle: intellect is driven by intuition, intuition is directed by intellect.*

For most scientists intuition is the bête noire of a rational life, the enemy within to beam away faster than a phaser on overload. Yet the Captain Kirk Principle is now finding support from a rich new field of scientific inquiry brilliantly summarized by Hope College psychologist David G. Myers in his new book *Intuition: Its Powers and Perils* (Yale University Press, 2002). I confess to being skeptical when I first picked up the book, but as Myers demonstrates through countless wellreplicated experiments, intuition—"our capacity for direct knowledge, for immediate insight without observation or reason"—is as much a part of our thinking as analytic logic.

Physical intuition, of course, is well known and accepted as part of an athlete's repertoire of talents—Michael Jordan and Tiger Woods come to mind. But there are social and psychological intuitions as well, which operate at levels so fast and subtle that they cannot be considered a function of rational thought. Harvard's Nalini Ambady and Robert Rosenthal, for example, discovered that the evaluation of teachers by students who saw a mere thirty-second video of the teacher were remarkably similar to those of students who had taken the course. Even three two-second video clips of the teacher yielded a striking 0.72 correlation with the course student evaluations.

Research consistently shows how unattended stimuli can subtly affect us. At USC, Moshe Bar and Irving Biederman flashed emotionally positive scenes (kitten, romantic couple) or negative scenes (werewolf, dead body) for forty-seven milliseconds before subjects viewed slides of people.

Although subjects reported seeing only a flash of light for the initial emotionally charged scenes, they gave more positive ratings to people whose photos had been associated with the positive scenes—i.e., something registered somewhere in the brain.

Intuition similarly plays a role in "knowing" other people. The best predictor of how well a psychotherapist will work out for you is your initial reaction in the first five minutes of the first session. People with dating experience know within minutes whether they will want to see a first date again. To the extent that lie detection through the observation of body language and facial expressions is accurate (overall not very), women are better at it than men because they are more intuitively sensitive to subtle cues. Women are also superior in discerning which of two people in a photo was the other's supervisor, whether a male-female couple is a genuine romantic relationship or a posed, phony one, and when shown a two-second silent video clip of an upset woman's face, women guess more accurately than men whether she is criticizing someone or discussing her divorce.

Intuition is not subliminal perception; it is subtle perception and learning—knowing without knowing that you know. Chess masters often "know" the right move to make even if they cannot articulate how they know it. People who are highly skilled in identifying "micromomentary" facial expressions are also more accurate in judging lying. (In testing college students, psychiatrists, polygraphists, court judges, police officers, and Secret Service agents on their ability to detect lies, only Secret Service agents, trained to look for subtle cues, scored above chance.)

Most of us are not good at lie detection because we rely too heavily on what people say rather than on what they do. Subjects with damage to the brain that renders them less attentive to speech are more accurate at detecting lies, such as aphasic stroke victims who were able to identify liars 73 percent of the time when focusing on facial expressions (nonaphasic subjects did no better than chance). We may even be hard-wired for intuitive thinking: a patient with damage to parts of his frontal lobe and amygdala (the fear center) is unable to understand social relations or detect cheating, particularly in social relations, even though cognitively he is otherwise normal.

Although in science we eschew intuition because of its many perils (also thoroughly documented by Myers), we would do well to remember the Captain Kirk Principle that intellect and intuition are complementary, not competitive. Without intellect our intuition may drive us unchecked into emotional chaos. Without intuition we risk failing to resolve complex social dynamics and moral dilemmas, as Dr. McCoy explained to the indecisive rational Kirk: "We all have our darker side—we need it! It's half of what we are. It's not really ugly—it's human. Without the negative side you couldn't be the captain, and you know it! Your strength of command lies mostly in him."

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None So Blind

Perceptual-blindness experiments challenge the validity of eyewitness testimony and the metaphor of memory as a video recording

Picture yourself watching a one-minute video of two teams of three players each, one team donning white shirts and the other black shirts, as they move about each other in a small room tossing two basketballs. Your task is to count the number of passes made by the white team. Unexpectedly, after thirty-five seconds a gorilla enters the room, walks directly through the farrago of bodies, thumps his chest, and nine seconds later exits (see figure). Would you see the gorilla?

Most of us, in our perceptual vainglory, believe we would—how could anyone miss a guy in an ape suit? In fact, 50 percent of subjects in this remarkable experiment by Daniel J. Simons and

Christopher F. Chabris do not see the gorilla, even when asked if they noticed anything unusual (see their paper "Gorillas in Our Midst" at http://bit.ly/Z3I3Es with links to ordering the DVD of this and other clips of related experiments). The effect is known as "inattentional blindness": when attending to one task—say, talking on a cell phone while driving—many of us become blind to dynamic events, such as a gorilla in the crosswalk.

I incorporated the gorilla DVD into my public lecture on science and skepticism given at universities around the country. I always ask for a show of hands of those who did not see the gorilla in the first viewing (I show the clip a second time with no counting, and nearly everyone sees it). Even under such public social pressure, out of more than ten thousand students I encountered last year (2003), approximately half confessed their perceptual blindness. Many were shocked, accusing me of showing two *different* clips. Simons had the same experience: "we actually rewound the videotape to make sure subjects knew we were showing them the same clip."

These experiments reveal a hubris in our powers of perception, as well as a fundamental misunderstanding of how the brain works. We think of our eyes as video cameras, and our brains as blank tapes to be filled with percepts. Memory, in this model, is simply rewinding the tape and playing it back in the theater of the mind, in which some cortical commander watches the show and reports to a higher homunculus what it saw.

Fortunately for criminal defense attorneys, this is not the case. The perceptual system, and the brain that analyzes its data, are far more complex. As a consequence, much of what passes before our eyes may be invisible to a brain focused on something else. "The mistaken belief that important events will automatically draw attention is exactly why these findings are surprising; it is also what gives them some practical implications," Simons told me. "By taking for granted that unexpected events will be seen, people often are not as vigilant as they could be in actively anticipating such events."

Driving is an example. "Many accident reports include claims like 'I looked right there and never saw them,'" Simons notes. "Motorcyclists and bicyclists are often the victims in such cases. One explanation is that car drivers expect other cars but not bikes, so even if they look right at the bike, they sometimes might not see it." Simons recounts a study by Richard Haines of pilots who were attempting to land a plane in a simulator with the critical flight information superimposed on the windshield. "Under these conditions, some pilots failed to notice that a plane on the ground was blocking their path."

Over the years in this column I have pounded paranormalists pretty hard, so they may rightly point to these studies and accuse me of inattentional blindness when it comes to ESP and other perceptual ephemera. Perhaps my attention to what is known in science blinds me to the unknown.

Maybe. But the power of science lies in open peer publication, which, with the emergence of the Internet, is no longer constrained by the affordances of paper. I may be perceptually blind, but not all scientists will be, and out of this fact arises the possibility of new percepts and paradigms. There may be none so blind as those who will not see, but in science there are always those whose vision is not so constrained. But first they must convince the skeptics, and we are trained to look for gorillas in our midst.

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Common Sense

Surprising new research shows that crowds are often smarter than individuals

In 2002 I was asked by an acquaintance to serve as his "phone a friend" on the popular television series *Who Wants to Be a Millionaire?* When he was stumped by a question he elected to "poll the audience" instead, which was wise not only because I did not know the answer, but also because the data show that the audience is right 91 percent of the time, compared to only 65 percent for experts.

Although this difference may in part be explained by the fact that the audience is usually queried for easier questions, there is something deeper at work here. For solving a surprisingly large and varied number of problems, crowds are smarter than individuals. This is contrary to what the nineteenth-century Scottish journalist Charles Mackay concluded in his 1841 book *Extraordinary Popular Delusions and the Madness of Crowds*, a staple of skeptical literature: "Men, it has been well said, think in herds. It will be seen that they go mad in herds, while they only recover their senses slowly, and one by one." This has been the dogma ever since, supported by sociologists such as Gustave Le Bon, in his classic work *The Crowd: A Study of the Popular Mind.* "In crowds it is stupidity and not mother wit that is accumulated."

Au contraire, Monsieur Le Bon. There is now overwhelming evidence, artfully accumulated and articulated by the *New Yorker* columnist James Surowiecki in his enthralling 2004 book *The Wisdom of Crowds* (Doubleday), that "the many are smarter than the few." In one experiment subjects were asked to estimate the number of jelly beans in a jar. The group average was 871, only 2.5 percent off the actual figure of 850. Only one of the fifty-six subjects was closer. The reason is that in a group individual errors on either side of the true figure cancel each other out.

A similar result was discovered in an example so counterintuitive that it startles. When the US submarine *Scorpion* disappeared in May 1968, a naval officer named John Craven assembled a diverse group of submarine experts, mathematicians, and salvage divers. Instead of putting them in a room to consult one another, he had each of them give a best guesstimate, based on the sub's last known speed and position (and nothing else), of the cause of its demise, its rate and steepness of descent, and other variables. Craven then computed a group average employing Bayes's theorem, a statistical method where a probability is assigned to each component of a problem (see chapter 71 on a Bayesian computation of the probability of God's

existence). The *Scorpion*'s location on the ocean floor was only 220 yards from the averaged prediction even though not one member of the group had selected that spot.

Stranger still was the stock market's reaction on January 28, 1986, the day of the space shuttle *Challenger* catastrophe. Of the four major shuttle contractors—Lockheed, Rockwell International, Martin Marietta, and Morton Thiokol—the latter (the builder of the solid rocket booster that exploded) was hit hardest, with a 12 percent loss, compared to only 3 percent for the others. A detailed study of the market (a sizable crowd indeed!) by economists Michael T. Maloney from Clemson University and J. Harold Mulherin from Claremont McKenna College could find no evidence of insider trading or media focus on the rocket booster or Morton Thiokol. Given four possibilities, the masses voted correctly.

Not all crowds are wise, of course—lynch mobs come to mind. And "herding" can be a problem when the members of a group think uniformly in the wrong direction. The stock market erred for the space shuttle *Columbia* disaster, for example, dumping Thiokol stock even though the boosters were not involved.

For a group to be smart it should be autonomous, decentralized, and cognitively diverse, which the committee who rejected the foam impact theory of the space shuttle *Columbia* while it was still in flight was not. Google is brilliant because it uses an algorithm that ranks web pages by the number of links to them, with those links themselves valued by the number of links to their page of origin. This works because the Internet is the largest autonomous, decentralized, and diverse crowd in history, IMHO.

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As Luck Would Have It

Are some people really luckier than others, or is it all in their heads? Both

Amyotrophic lateral sclerosis (ALS) is a neuromuscular disease that attacks motor neurons until muscle weakness, atrophy, and paralysis lead inexorably to death. Victims of this monstrous malady could be forgiven for thinking themselves unlucky.

How, then, can we explain the attitude of the disease's namesake, baseball great Lou Gehrig? He told a sellout crowd at Yankee Stadium: "For the past two weeks you have been reading about the bad break I got. Yet today I consider myself the luckiest man on the face of this earth." The Iron Horse went on to recount his many blessings and fortunes, a list twice punctuated with "I'm lucky" and "that's something." Choking back the emotional gravitas, Gehrig concluded that "I may have been given a bad break, but I have an awful lot to live for."

The physical meltdown caused by ALS was documented on ABC's *Nightline*, as Brandeis University sociologist Morrie Schwartz turned his plight into an opportunity to teach one final course on the lessons of life. "Through my dying I'm teaching people how to live," he told his old student Mitch Albom, whose book *Tuesdays with Morrie* records the life wisdom of a dying man. "I can't go shopping, I can't take out the garbage, I can't take care of the bank accounts," Schwartz admitted, "but I can take care and look at what I think is important in life, and I have both the leisure and the time and the impulse to do that."

Clearly luck is a state of mind. Is it more than that? To explore this question scientifically, the experimental psychologist Richard Wiseman created a "luck lab" at the University of Herfordshire in Britain. Wiseman began by testing whether lucky people are actually luckier in winning the lottery. He recruited seven hundred people who had already purchased lottery tickets to complete his luck questionnaire, which is a self-report scale that measures whether people consider themselves to be lucky or unlucky. Although lucky people were twice as confident as unlucky people that they would win the lottery, there was no difference in winnings. Wiseman then administered to another group of subjects a standardized IQ test and found no difference in intelligence between those who considered themselves to be lucky or unlucky.

Wiseman then gave subjects a standardized "life satisfaction" scale that asks people to rank themselves on how satisfied they are with their family life, personal life, financial situation, health, and career. The results were striking. "Lucky people are far more satisfied with all areas of their lives than unlucky or neutral people," Wiseman reveals in his charming and insightful book *The Luck Factor* (Miramax Books, 2003). Does this satisfied state of mind translate into actual life outcomes that someone might call "lucky"? It does. Here's how.

Wiseman gave subjects the "Big Five" personality scale, which measures *agreeableness*, *conscientiousness*, *extroversion*, *neuroticism*, and *openness*. Although there were no differences on *agreeableness* and *conscientiousness*, Wiseman found statistically significant differences between lucky and unlucky people on *extroversion*, *neuroticism*, and *openness.*

Lucky people score significantly higher than unlucky people on *extroversion*. "There are three ways in which lucky people's extroversion significantly increases the likelihood of their having a lucky chance encounter," Wiseman explains, "meeting a large number of people, being a 'social magnet,' and keeping in contact with people." Lucky people, for example, smile twice as much and engage in more eye contact than unlucky people, which leads to more social encounters, which generates more opportunities.

The personality dimension of *neuroticism* measures how anxious or relaxed someone is, and Wiseman found that lucky people were half as anxious as unlucky people; that is, "because lucky people tend to be more relaxed than most, they are more likely to notice chance opportunities, even when they are not expecting them." In one experiment, Wiseman had subjects count the number of photographs in a newspaper. Lucky people were more likely than unlucky people to notice on page two a half-page ad with this message in large, bold type: STOP COUNTING—THERE ARE 43 PHOTOGRAPHS IN THIS NEWSPAPER.

Wiseman discovered that lucky people also score significantly higher in *openness* than unlucky people. "Lucky people are open to new experiences in their lives. They don't tend to be bound by convention and they like the notion of unpredictability." As such, lucky people travel more, encounter novel prospects, and welcome unique opportunities.

Expectation also plays a role in luck. Lucky people expect good things to happen, and when they do, they embrace them. But even when misfortune falls, lucky people turn bad luck into good fortune. Consider the example set by the longest ALS sufferer in history, Stephen Hawking, who writes, "I was fortunate that my scientific reputation increased, at the same time that my disability got worse. This meant that people were prepared to offer me a sequence of positions in which I only had to do research, without having to lecture." That led to his cognitive style of thinking through problems visually and geometrically, instead of computationally on a chalkboard, which was no longer available to him. "I was lucky to have chosen to work in theoretical physics, because that was one of the few areas in which my condition would not be a serious handicap." Confined to an electric wheelchair and unable to move, Hawking capitalized on his ill fortune by using it as a chance to revolutionize science and transform the universe, which he did.

That's something.

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The Political Brain

A recent brain-imaging study shows that our political predilections are products of unconscious confirmation bias

> The human understanding when it has once adopted an opinion … draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises … in order that by this great and pernicious predetermination the authority of its former conclusions may remain inviolate.
>
> —Francis Bacon, *Novum Organum,* 1620

Pace Will Rogers, I am not a member of any organized political party. I am a libertarian. As a fiscal conservative and social liberal, I never met a Republican or Democrat in whom I could not find something to like. I have close friends in both camps in which I have observed the following: no matter the issue under discussion, both sides are equally convinced that the evidence overwhelmingly supports their position.

This surety is the confirmation bias, where we seek and find confirmatory evidence in support of already existing beliefs and ignore or reinterpret disconfirmatory evidence. According to Tufts University psychologist Raymond Nickerson, in a comprehensive literature review ("Confirmation Bias: A Ubiquitous Phenomenon in Many Guises," *Review of General Psychology* 2, no. 2 [1998]: 175–220), the confirmation bias "appears to be sufficiently strong and pervasive that one is led to wonder whether the bias, by itself, might account for a significant fraction of the disputes, altercations, and misunderstandings that occur among individuals, groups, and nations."

Now a functional magnetic resonance imaging (fMRI) study shows where in the brain the confirmation bias occurs, and how it is unconscious and driven by emotions. The study was conducted at Emory University under the direction of psychologist Drew Westen, and the results were presented at the January 28, 2006, Annual Conference of the Society for Personality and Social Psychology.

During the run-up to the 2004 presidential election, while undergoing an fMRI bran scan, thirty men—half self-described "strong" Republicans and half "strong" Democrats—were tasked with assessing statements by both George W. Bush and John Kerry in which the candidates clearly contradicted themselves. Not surprisingly, in their assessments Republican subjects were as critical of Kerry as Democratic subjects were of Bush, yet both let their own preferred candidate off the evaluative hook.

The neuroimaging results, however, revealed that the part of the brain most associated with reasoning—the dorsolateral prefrontal cortex—was quiescent. Most active were the orbital frontal cortex, which is involved in the processing of emotions; the anterior cingulated, which is associated with conflict resolution; the posterior cingulated, which is concerned with making

judgments about moral accountability; and—once subjects had arrived at a conclusion that made them emotionally comfortable—the ventral striatum, which is related to reward and pleasure.

"We did not see any increased activation of the parts of the brain normally engaged during reasoning," Westen explained. "What we saw instead was a network of emotion circuits lighting up, including circuits hypothesized to be involved in regulating emotion, and circuits known to be involved in resolving conflicts." Interestingly, neural circuits engaged in rewarding selective behaviors were activated. "Essentially, it appears as if partisans twirl the cognitive kaleidoscope until they get the conclusions they want, and then they get massively reinforced for it, with the elimination of negative emotional states and activation of positive ones."

These are the neural correlates of the confirmation bias, and the implications reach far beyond politics. A judge or jury assessing evidence against a defendant, a CEO evaluating information about a company, or a scientist weighing data in favor of a theory will undergo the same cognitive process. What can we do about it?

In science we have built-in self-correcting machinery. Strict double-blind controls are required in experiments, in which neither the subjects nor the experimenters know the experimental conditions during the data collection phase. Results are vetted at professional conferences and in peer-reviewed journals. Research must be replicated in other labs unaffiliated with the original researcher. Disconfirmatory evidence, as well as contradictory interpretations of the data, must be included in the paper. Colleagues are rewarded for being skeptical. Extraordinary claims require extraordinary evidence. As Westen notes, however, "Even with these safeguards in place, scientists are prone to confirmatory biases, particularly when reviewers and authors share similar beliefs, and studies have shown that they will judge the same methods as satisfactory or unsatisfactory depending on whether the results matched their prior beliefs."

We need similar controls for the confirmation bias in the law, business, and politics. Judges and lawyers should call each other out on the practice of mining data selectively to bolster an argument and warn juries about the confirmation bias. CEOs should assess skeptically the enthusiastic recommendations of their VPs and demand to see contradictory evidence and alternative evaluations of the same plan. Politicians need a stronger peer-review system that goes beyond the churlish opprobrium of the campaign trail, and I would love to see a political debate in which the candidates were required to make the opposite case.

Skepticism is the antidote for the confirmation bias.

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Folk Science

Why our intuitions about how the world works are often wrong

Thirteen years after the legendary confrontation over the theory of evolution between Bishop Samuel Wilberforce ("Soapy Sam") and Thomas Henry Huxley ("Darwin's bulldog"), Wilberforce died in an equestrian fall in 1873. Huxley quipped to the physicist John Tyndall, "For once, reality and his brain came into contact and the result was fatal."

When it comes to such basic forces as gravity and such fundamental phenomena as falling, our intuitive sense of how the physical world works—our folk physics—is reasonably sound. Thus we appreciate Huxley's wry comment and note that even children get the humor of cartoon physics where, for example, when a character runs off a cliff he does not fall until he realizes that he has left terra firma (also known as "coyotes interruptus," in honor of Wile E. Coyote, who frequently fell to his doom in this manner while chasing his road runner nemesis).

But much of physics is counterintuitive, as is the case in many other disciplines as well, and before the rise of modern science we had only our folk intuitions to guide us. Folk astronomy, for example, told us that the world is flat, celestial bodies revolve around the Earth, and the planets are wandering gods who determine our future. Folk biology intuited an élan vital flowing through all living things, which in their functional design were believed to have been created ex nihilo by an intelligent designer. Folk psychology compelled us to search for the homunculus in the brain—a ghost in the machine—a mind somehow disconnected from the brain. Folk economics caused us to disdain excessive wealth, label usury as a sin, and mistrust the invisible hand of the market.

The reason why folk science so often gets it wrong is that we evolved in an environment radically different from the one in which we live. Our senses are geared for perceiving objects of middling size—between, say, ants and mountains—not bacteria, molecules, and atoms on one end of the scale, and stars and galaxies on the other end. We live a scant three score and ten years, far too short a time to witness evolution, continental drift, or long-term environmental changes.

Causal inference in folk science is equally untrustworthy. We correctly surmise designed objects such as stone tools to be products of an intelligent designer, and thus naturally assume that all functional objects, such as eyes, must have been similarly intelligently designed. Lacking a cogent theory of how neural activity gives rise to consciousness, we imagine mental spirits floating within our heads. We lived in small bands of roaming hunter-gatherers who accumulated little wealth and had no experience of free markets and economic growth.

More generally, folk science leads us to trust anecdotes as data, such as illnesses being cured by assorted nostrums based solely on single-case examples. Equally powerful are anecdotes involving preternatural beings, compelling us to make causal inferences linking these nonmaterial entities to all manner of material events, illness being the most personal. Because people often recover from illness naturally, whatever was done just before recovery receives the credit, prayer being the most common.

In this latter case we have a recent real science analysis of this ancient folk science supposition. The April 2006 issue of *American Heart Journal* published a comprehensive study directed by Harvard University Medical School cardiologist Herbert Benson on the effects of intercessory prayer on the health and recovery of patients undergoing coronary bypass surgery. The 1,802 patients were divided into three groups, two of which were prayed for by members of three religious congregations. Prayers began the night before the surgery and continued daily for two weeks after. The prayers were allowed to pray in their own manner, but they were instructed to ask "for a successful surgery with a quick, healthy recovery and no complications." Half the prayer-recipient patients were told that they were being prayed for while the other half were told that they might or might not receive prayers. Results showed no statistically significant differences between any of the groups. Case closed.

Of course, people will continue praying for their ill loved ones, and by chance some of them will recover, and our folk science brains will find meaning in these random patterns. But to discriminate true causal inferences from false, real science trumps folk science.

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Free to Choose

The neuroscience of choice exposes the power of ideas

Have you ever watched a white rat choose between an 8 percent and a 32 percent sucrose solution by pressing two different bars on variable-interval schedules of reinforcement? No? Lucky you. I devoted two years of what would otherwise have been a misspent youth to running choice experiments with rats in Skinner boxes at California State University–Fullerton under the direction of Douglas J. Navarick for a master's thesis in 1978, "Choice in Rats as a Function of Reinforcer Intensity and Quality." Boys gone wild!

Since then, behaviorists' black box has been penetrated by neuroscientists, most recently by Read Montague from the Institute of Advanced Study in *Why Choose This Book?* (Dutton, 2006). Montague argues that our brains evolved computational programs to evaluate choices in terms of their value and efficiency: "Those that accurately estimate the costs and the longterm benefits of choice will be more efficient than those that don't—and in the long term these are the winners."

Life, like the economy, is about the efficient allocation of limited resources that have alternative uses (to paraphrase the economist Thomas Sowell). It all boils down to energy efficiency. To a predator, says Montague, prey are batteries of energy. "This doctrine mandates that evolution discover efficient computational systems that know how to capture, process, store, and reuse energy efficiently." Those that do, pass on their genetic programs for efficient computational neural processing to make efficient choices. Over the course of millions of years, says Montague, our brain has evolved to be so efficient that it consumes about a fifth of the energy of an average lightbulb, costing about a nickel a day to run.

Computational programs are designed by evolution to learn how to solve certain tasks. Rats, for example, inherit programs that are especially good at learning mazes and pressing bars because they evolved to forage in dark and spatially complex environments. There are no blank slates for mice or men. "Despite their differences," Montague explains, "all goals have one thing in common: They can all be used by our brains to direct decisions that lead to the satisfaction of the goal."

Unfortunately, these evolved computational programs can be hijacked. Addictive drugs, for example, rewire the brain's dopamine system—normally used to reward choices that are good for the organism, such as food, family, and friends—to reward choosing the next high instead. Ideas do something similar, in that they take over the role of reward signals that feed into the dopamine neurons. This includes *bad* ideas, such as the Heaven's Gate cult members who chose suicide to join the mother ship they believed was awaiting them near the comet

HaleBopp. The brains of suicide bombers have been similarly commandeered by religious and political bad ideas.

In *The Science of Good and Evil* (Times Books, 2004) I argued that we evolved moral emotions that operate similar to other emotions, such as hunger and sexual appetite. Thinking of these emotions as proxies for highly efficient computational programs deepens our understanding of the process. When we need energy we do not compute the relative caloric values of our food choices; we just feel hungry for certain food types, eat them, and are rewarded with a sense of satisfaction. Likewise, in choosing a sexual partner, the brain employs a computational program to make you feel attracted to people with good genes, as indicated by such proxies as a symmetrical face and body, clear complexion, and a 0.7 waistto-hip ratio in women and an inverted pyramid build in men. Similarly, in making moral choices about whether to be altruistic or selfish, we feel guilt or pride for having done the wrong or the right thing, but the moral calculation of what is best for the individual and the social group was made by our Paleolithic ancestors. Emotions such as hunger, lust, and pride are stand-ins for these computations.

How can we utilize this theory of choice to our advantage? Montague employed fMRI brain scans to discover that certain brands, such as Coke, "change dopamine delivery to various brain regions through their effect on reward prediction circuitry." The Coke brand has a "flavor" in the ventromedial prefrontal cortex, a region essential for decision making. Just as Coke is a proxy for flavor, hunger a proxy for caloric need, lust a proxy for reproductive necessity, and guilt and joy proxies for immoral and moral behavior, so too can we market moral brands to rewire brains to value and choose good ideas.

In honor of the late economist Milton Friedman, author of the radical book *Free to Choose*, I propose that we begin by marketing this brand—the Principle of Freedom: *All people are free to think, believe, and act as they choose, as long as they do not infringe on the equal freedom of others.*