

GOD SOUL MIND BRAIN

A Neuroscientist's Reflections on the Spirit World

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Chapter 1

The intention behind the event

Questions of the spirit world are usually considered to be scientifically unapproachable. We humans are somehow, for reasons unknown, aware of ourselves and of the world around us. We perceive soul and consciousness and awareness in each other. Ghosts, spirits, protecting angels, gods—most people claim to have sensed at one time or another the presence or warmth or intent of these disembodied minds. Science is now widely accepted to be a useful tool for studying the physical domain, but the spiritual domain is almost universally assumed to be outside the limits of physicality, of science, of any mechanistic understanding.

Of all branches of science, neuroscience is the only one that has seriously challenged the dualistic view that the universe is divisible into matter and spirit. For at least a century neuroscientists have suspected that the machinery of the brain is somehow physically responsible for consciousness—for the soul itself. To understand how the brain results in the mind would rank among the great achievements of science. Darwin's theory of natural selection answered the question of how we got here. Einstein's special and general theories of relativity described the structure of space and time. Would it be possible to uncover the biological basis of the spirit world?

It is my belief that neuroscience has already effectively answered this question, and has done so mainly in the last twenty years with the advent of what is called social neuroscience. Not all neuroscientists are entirely aware of the tiger whose tail they have grabbed. There are still many conflicting views of the brain basis of consciousness and, as of yet, little work on the brain basis of spiritual beliefs. Yet in synthesizing the literature, one can see a relatively simple theory that has already emerged from the work of many people. Special-purpose machinery in the human brain, that evolved over millions of years to make us socially intelligent animals, results in our perception of other people's minds, in our perception of our own consciousness, and in the perceptual illusion that disembodied minds fill up the spaces around us. The general structure of the theory is in place, it is conceptually sound, it seems increasingly likely to be correct, but the neuroscientific details are far from known. The purpose of my book is to describe to the public my own understanding of this remarkable,

burgeoning scientific advance—nothing less than the mechanistic understanding of the spirit world.

Before I go any further I need to address a particular point. I know that in writing this book I will be accused by some people of trying to kill the spiritual world. People who are suspicious of science or openly hostile to it commonly argue that it kills mystery and reduces beauty to gears and numbers. But science does exactly the opposite. Good science doesn't "explain away" in the sense of dismissing. To come to some deeper understanding of the natural world is a type of homage and makes the universe immeasurably more interesting, compelling, and yes, even quite beautiful to contemplate. My goal here is not to denigrate the human experience of gods and spirits. Quite the opposite. Most science, unable to make head or tail of human spirituality, has ignored or dismissed it. I propose to pay it the ultimate respect of a scientist: taking this crucial piece of human nature seriously and examining it scientifically.

A second point that I would like to make at the outset concerns the audience for this book. The book is not a scientific report. It is not meant to propose a theory in full technical detail to my colleagues. It is written for the most general, nonscientific audience. The examples that I give throughout are not the contrived or complicated examples of experimental protocol. They are anecdotes from everyday life. In the first half of the book I lay out fundamental principles of perception, illusion, awareness, and consciousness. The second half of the book focuses more on the underlying brain science, and the writing necessarily becomes more technical and detailed but hopefully still clear to a nonscientific audience.

If you are a neuroscientist or psychologist who wants to get right to the heart of the story, I urge you to read Chapter 4 (Explaining consciousness) and Chapter 7 (The machinery for the perception of mind). Together they present the essential concepts. If you would like to have the concepts placed in a larger perspective, then I urge you to read the entire book. It is, after all, short. I told the story as succinctly as I could.

My interest in human consciousness comes from two directions. I am a neuroscientist and also a novelist. The novelist in me believes it is possible to give the general public a complete account of human consciousness, as far as it can be understood at the moment, without unduly complicated terminology, medical lists of brain nuclei, or equations. It should be possible to get right to business in plain English.

Two modes of perception

In fifth grade some friends of mine played a joke on me.

Just as I sat down at my school desk, the drawer slid open an inch. The explanation was obviously gravity acting on a loose slider mechanism. I pushed it closed and turned to my assignment, but a moment later the drawer pulled open again. That was odd. It was clearly broken. I would need to ask the teacher to look at it. Then I noticed a quivering blur in the corner of my eye. Glancing down, I saw a pale, cadaverous human hand emerging from the corner of the drawer.

A decidedly impolite word escaped my lips, and the entire class turned to stare at me. The teacher was shocked. I began to realize the truth only when I heard suppressed giggles behind me. Two of my ever-helpful friends, it turned out, were playing with a length of fishing line and a rubber hand left over from Halloween.

The experience is indelibly impressed in my memory. In the span of ten seconds my mind went through several distinct phases. First I perceived the movement to be a result of physical, mechanical forces. Nothing threatening. Then I had the sudden, spine-tingling perception that the movement was the result of intentionality. Zombie intentionality (if that is not an oxymoron). Finally I realized the true source of the intentionality, which turned out to be much more malevolent than any zombie.

I out myself as a nerd—but even at that time, in fifth grade, and despite the casual cruelty of classroom humor, I was mostly astounded by a sudden scientific realization. The brain evidently came equipped with two totally different, complementary modes for explaining events in the world. The first mode was to find the physical cause of an event. Gravity, vibration, loose bolts, whatever. The second mode was to attribute intention to the event. Here were two fundamentally different styles of explanation. What struck me was the suddenness of the change from one to the other, as if a switch in my brain had turned to a new setting, from “that thing is inanimate” to “that thing is moving by choice.” A different circuit seemed to have turned on. I think everybody has had a similar if not quite so dramatic experience—the sudden, spine-tingling realization that something you thought was inanimate is actually alive, sentient, and acting under its own volition.

That realization about a special mode of perception turns out to be essentially correct. The brain does contain special-purpose machinery whose job is to attribute volition, intentions, agendas, goals, emotions, and other mentalistic events.

The ability to construct models of other minds is probably present in many species of animal, and probably varies with social complexity. Primates of all kinds have enormously complex social structures and therefore well-developed circuits for understanding other brains. Marine mammals have complex social interactions. Cat and dog species also depend on social interaction, although arguably the social structure in a lion pride is less rich and less gigantically complex than the social structure in monkey or human society. Even rats, mice, and many species of birds have social structures that may require some limited degree of perception of each other's minds. The perception of intentionality need not be limited to within-species interactions. An antelope must look at a lion and perceive at a glance whether the cat is hunting or just passing by.

Humans are particular experts. Our circuitry for social perception is so well developed that we find it second nature to guess at the inner goals and emotions of others. The skill is so natural that some readers may wonder why I am bothering to point out the obvious. Of course we intuit each other's mental experiences.

The importance of these brain circuits comes into rather horrible focus in cases when the circuits fail. In at least some cases of autism, the social circuits do not function correctly. Autistic people and people with Asperger's syndrome, a less severe form of autism, have a notoriously difficult time intuiting the mental states of other people. They can try to figure out what someone is thinking and feeling by using propositional logic and sheer cleverness—and many autistic people are extremely intelligent. But the specialized hardware that is tuned to social perception is weakened in these people's brains, and therefore they lack the immediate intuition into other minds that comes so easily to the rest of us. Cases like these help to make the point that our talent for reading other people's minds is not a function of general intelligence, but instead depends on highly specialized hardware in our brains that we normally take for granted.

This book explores three basic propositions. First, when we perceive intentions, emotions, mind, *soul*, in another person, it is the specialized social hardware in the brain that is responsible for constructing those perceptions. Second, when we sense presences and spirits, ghosts and gods, it is the same hardware again, creating perceptions of mind and intent to explain the events around us. Third, when we perceive the same things in ourselves—our own consciousness, our own soul—again, it is the same specialized social hardware constructing those perceptions. This last proposition is perhaps the most difficult to nail down. How can awareness itself be explained as the processing of information in the brain? It turns out, however, that even this

long-sought philosophical—one might say alchemical—understanding of mind falls into place rather neatly when considering the brain hardware that is tuned to social perception.

The goal of any branch of science is to explain a large range of phenomena in terms of a simple, unifying mechanism. The central thesis of this book is that the experience of self, soul, consciousness, spirit, ghost, god, everything that populates the spiritual world, is a *perception of mind* and is created by the social machinery of the brain.

Spirits of the weather

Imagine a lightning bolt hits the ground a few feet away from you in your back yard. In the modern world you are likely to accept it as a meteorological phenomenon. Scary, but physically explainable. Due to moisture and wind, an electric charge accumulates in a cloud. As a result, a glowing plasma of electrons streams down to the ground, super heating the air directly along its path. The superheated air produces a clap of sound.

In Chapter 1, I noted that the human brain is equipped with two different built-in methods to explain the world. The first method is to find the physical cause of an event. The second is to find an intention behind the event. Many people will see intentionality in the lightning strike. Maybe a malevolent spirit was trying to kill you. More optimistically, a protective spirit might have nudged the lightning aside a few feet to save you. Or maybe it was a warning. A spirit wants you to re-think some aspect of your life or it will kill you next time.

In a prescientific culture, in which there is no physical explanation for lightning and certainly no physical way to predict it, the only available explanation is an intentional one. A storm or a flood might also be an act of an angry agent. If a tree falls and crushes your hut, maybe a spirit was angry at your family. If a steady rain waters the crops, maybe a spirit is expressing generosity. Anything like the weather or an earthquake or a volcano, that is physically unpredictable, and therefore not easily explained by simple rules of cause and effect, lends itself to an intentional explanation. From a modern scientific perspective we view these beliefs as superstitious and primitive. But to dismiss them misses a deep truth. These spirit explanations are social perceptions. They are the same kinds of perceptions that we experience every day and that the human brain is built to compute. Given a gesture, a motion, an action that has no obvious external cause, the brain computes a possible inner cause—an intention.

Let me be clear. I am not suggesting that the people of ancient Troy sat down to think and said, "I don't know physically why the Scamander River flooded and killed a bunch of people. One possible but unlikely explanation is that the river is under the control of, or is itself, an intentional agent that was expressing anger. Lacking any better explanatory theory, we had better appease the agent by burning ox hair. But if a scientist comes along and explains the phenomenon differently, we'll accept the newer theory." I am not suggesting such a cognitive process of deductive and in-

ductive inference (although some cognition may be involved). When viewed from the perspective of logical inference, the whole proposition seems ridiculous and feeds our false sense of modern-day superiority. I am suggesting that the perceptual machinery in the human brain *automatically* constructs models about the mental states and intentions that underlie events. We are built to do it. We do it all the time. We can't help it. It is our heritage as social animals. Lacking any other competing explanation, and sometimes even in the face of competing explanations, those models of intentionality prevail. As a result the Trojans wouldn't have *theorized* about a river spirit. They would have *perceived* the presence of the spirit and its anger, and felt that it was real.

Ghosts

There is currently an extensive industry for the exorcism of ghosts. Within a few seconds I was able to find eight sites on the Internet advertising exorcist services. If someone feels the presence of a spirit haunting his house, he can hire one of these many professionals. Rationalists may scoff at this superstitious belief; but the rationalists have failed to realize that it is not just a belief. It is a creeping feeling that another mind is present. It is a *perception*. It is the social machinery in the brain constructing a model of a mind. What is the ghost but a model of a human mind, complete with emotions and perhaps even an agenda, constructed inside the brain of the person who lives in the house? The model is constructed by putting together information: a creaking here, a blurry shadow there, noticing a drawer open when it should be closed, the cognitive expectation of a ghost. The result is a potent feeling of mind, even though there is no corresponding body for the perceived mind to inhabit. In a sense, from the perspective of the person who lives in the house and calls the exorcist, the ghost is as real as the soul of any living, breathing neighbor down the street, because it is constructed out of the same stuff. In both cases, the perceived soul is a model constructed by the social circuitry in the brain.

My aunt once told me that when she wakes up in the middle of the night and looks at the digital clock, if the numbers are symmetric (for example 11:11, or 12:21), it means that one of her dead relatives is in the room. Here is her reasoning, as far as I understand it. The symmetric number display is so unlikely that, to her, it eliminates a purely physical or coincidental explanation. Therefore she resorts to an intentional explanation. A spirit or intentional agent must have woken her up at that moment

with the goal of communicating its presence to her. At those times, she actually feels the ghost in the room with her. Sometimes it has a friendly feel (Grandma Margaret) and sometimes it has a dreadful, angry feel (Great Aunt Beth complaining about her bunions).

As long as we are on the subject of hauntings—my sister Lisa told me a bizarre ghost story. Her pet rat died of old age one day. Later that night when Lisa was in bed, she heard the rat rustling about his cage in the dark and chewing seeds. The sound evoked in her a full-blown percept, a physical certainty that her rat's spirit was haunting its erstwhile cage. She could feel it to be true. Yet at the same time she did not believe in ghosts of any kind, human or rodent, and hoped that a rational explanation would present itself in the morning. (It did. Some mice had gotten into the cage to eat the left-over food.)

In a sense, the world as we perceive it truly is divisible into the physical world and the spirit world. Both worlds are constructs in the mind. Both are populated by models: models of objects, models of apples, models of chairs, models of people, models of dogs and cats and computers and rats and coffee cups. We experience the models, not the real things. But one class of model, computed by one set of brain circuits, is based on physical objects that obey simple cause and effect, whereas the other class of model, computed by social brain circuits, includes intentionality, awareness, agenda, emotion, and other mental properties. The duality of the human world—mind and brain, soul and clay—is directly traceable to a basic truth of the natural environment. The world contains both simple objects and other brains. We are therefore equipped with computational machinery to model both kinds of items. The duality of the experiential world reflects the duality of the natural environment to which the brain is adapted.

God

Atheistic scientists tend to take a hostile view of God. Among those in the public eye at the moment are Richard Dawkins, who published the extremely well-written book *The God Delusion*, and Bill Maher, who made the insightful comic movie *Religulous*. Their view, and the view of many atheists, is that God is an anachronistic and benighted belief, a silly fable, both ignorant and dangerous. My view, the view expressed

in this book, is utterly different. Here I am suggesting that a belief in God is a natural extension of the way the human brain is wired.

What is God but the perception of intentionality on a global scale? It is the perception of a single, unified mind behind every otherwise inexplicable event.

Indeed, calling God a belief is a misnomer. It is more than a belief; it is more than a theory; it is more than imagination; it is a perception. That is precisely why it feels real to people. It is one of the reasons why atheists and religious people talk at cross purposes. To the religious, God is not really about theories and deductions, reasons for and reasons against. It is not really a cognitive proposition. To those who have the perception, the pervasive universal consciousness feels like external reality. One experiences the love and the anger and the awareness of God. Is God real? In the view described here, God is as real as the color red, also a perceptual construct of the brain.

The difference between the monotheistic Christian god and a ghost who bangs a drawer shut is only one of scale. The ubergod controls more, does more, decides more. They both fall into the same category—they are perceptions of mind. When unaccountable events occur—babies are born, people die unexpectedly, planes crash, someone survives an accident that ought to have killed him, a lucky number wins the lottery—these events are grist for the social machinery in the brain. Because the events are unlikely or unpredictable, they do not lend themselves to a physical mode of explanation. Instead they inspire social perception—the perception of a mind that must have intended those events.

A standard and, I think, unnecessarily dismissive scientific explanation is that God is a faulty deduction, an incorrect theory, or the result of wishful imagination. Perhaps so for some people, but I personally doubt that a god that was purely imagined would have so many people fervently convinced, or would have so much cultural universality. The absolute certainty expressed by worshippers suggests to me that underlying the imagination and the speculation and the theorizing and the desire is a genuine percept. I don't suppose that all monotheistic people have had this perceptual experience, but enough of them have had it to form a critical mass at the core of the religion. Such people at certain moments perceive the presence of God as a tangible emotional and mental warmth—as a consciousness that is physically present.

Consider the following list of perceived minds. Perceiving—sometimes misperceiving—the intentions of another person. Perceiving a soul in a favorite stuffed animal. Mourning the death of a favorite glass knickknack that used to sit on the mantle shelf. Feeling that a tree has a spirit. Feeling that a ghost is in the room behind you, watch-

ing you. The Greek gods who were in control of lightning and the sea and the wind and the fortunes of war. A monotheistic god who orchestrates the world. Obviously not everybody has all of these experiences, and yet they are all examples of the same ubiquitous process. They are perceptions of mind. My central scientific point is that you never do experience another person's mind. You experience a model that your brain constructs. The spirit world, from God on down, is the product of the machinery for social perception.

A philosopher might say that if we live in an experiential world made up entirely of simulation, of simulated objects and simulated actions, of simulated minds and simulated intentions, then within the only universe that matters, the universe of our own personal experience, the universe that we walk through and live in and interact with, the soul exists, minds exist, spirits exist, ghosts exist, God exists, as real or unreal as anything else, as real as a table, as real as the color of the sky. Perception supplies our reality. This point of view belongs to the general approach called solipsism. The mind creates the world that we experience. Can a belief in God ever be consistent with science? Arguably I am proposing a way in which the science of the mind can breathe some solipsistic existence into God. God is not imaginary, not a theory, not a wishful fantasy, but a part of the perceptual world. As a scientist, however, I would also like to know about the universe beyond the simulated world of perception. The spirit world, by its very nature, by its dependence on social perceptual construct, is a creation of the brain. It is perceptual illusion.

Chapter 4

Explaining consciousness

The previous chapters describe in some detail how we humans perceive the world around us as though it were painted with mental attributes. A specialized system in the brain for social perception does that painting. We perceive the properties of mind in other people, in animals, sometimes in inanimate objects, and even in empty space. A central point of this book is that we perceive our own minds using the same neuronal machinery and essentially the same processes that we use to perceive other minds. Consciousness is social perception applied inwardly. At first glance this proposal sounds straightforward. It is easy to let it pass as obvious, nod once or twice, and read on. But consider how strange the proposition really is.

A common view of consciousness is that I know I'm conscious because I feel it inside me. It is a direct experience of my own mind. A corollary to this view is that consciousness is by nature a private phenomenon. I can know my own mind only, and I am forced to guess about other people's minds. I can never really know for certain if you are conscious or what your thoughts may be, though I can suspect based on your behavior.

This view may have led Turing to his famous test for computer consciousness. How will we know whether a computer has achieved consciousness? The same way that we judge each other's consciousness. If we talk to that computer and cannot figure out from the conversation whether it is a real conscious human or a machine, then the machine has for all practical purposes achieved consciousness. The Turing test therefore acknowledges a fundamental assumption of human consciousness—that it is private, that I can directly experience only my own consciousness, and that I must rely on observation and deduction to understand any other consciousness.

I am proposing that this common, seemingly indisputable assumption about human consciousness is wrong. There is no fundamental difference between my perception of someone else's mind and my perception of my own mind. I do not directly experience my own mind. I *perceive* it through the same intermediary, the machinery for social perception, that I use to perceive anyone else's consciousness. That neur-

onal machinery is able to collect more data on my own brain and therefore construct a better quality of model for it, but fundamentally my perception of my own mind is in the same class of phenomenon as my perception of someone else's mind. They are both models. They are both proxies for the real thing. They are both useful and also profoundly inaccurate. I do not actually know my own mind, any more than I know anyone else's mind—I know only the model that my social machinery has constructed of it.

Some of the most intriguing evidence in support of this formulation of consciousness comes from damage to the brain. I will discuss this evidence in greater detail in the second half of the book, especially in Chapter 7. To summarize briefly here, there is a brain region thought to be particularly involved in social perception—in reconstructing the contents of another person's mind. Yet when this brain region becomes damaged, such as by stroke, a strange set of symptoms develops that at first glance seems to have nothing to do with social perception. When this brain region is damaged on the right side of the brain, where it has its largest presence, the person loses conscious awareness of everything to the left side of his body. When that brain area is damaged on the left side of the brain, the right side seems to be able to take over pretty well, and the awareness deficit is not apparent. When that brain area is damaged on both sides of the brain. . . . I am not sure that condition has been studied thoroughly. By hypothesis, the patient becomes a zombie, bereft of conscious awareness, at least until some compensatory re-wiring of the brain occurs. The strange overlap between the brain areas involved in social perception and the brain areas that, when damaged, lead to a loss of awareness—a seeming riddle of clinical neuroscience—is actually easily explainable by the principle that consciousness is a specific, self-application of social perception.

Each of the following sections in this chapter addresses the same underlying principle—the essential equivalence between social perception and consciousness—but from a different perspective. Through that means I can draw a more complete picture of the concept.

Only a brain system expert at perceiving mind would understand the concept of consciousness and therefore would be able to answer questions about consciousness

Imagine the following Kafkaesque situation. A large room is divided into a hundred cubicles. In each cubicle a person is sitting with a telephone. Each person speaks a different language.

You are standing outside the building, in contact with it through your cell phone.

“Is anyone in there?” you say.

“Yes,” the phone says. “I’m here.”

“What’s it like in there?” you say. “Is it light? Is it dark? Is it comfortable?”

Because you are speaking English, only one person inside the building answers. The answers that you get are limited, filtered through the perspective of the particular speaker. If you ask enough questions, you may build up a detailed account of the inside of the building, but of course that account will not be complete and may even be flat-out wrong in some ways. It will be the inside of the building as seen by the English speaker.

This building with its one English speaker is analogous to the human mind. Imagine that you ask a person, “Are you conscious? Are you aware? Do you have intentionality?” I am suggesting that there is only one set of brain circuits that evolved to compute these concepts of consciousness, awareness, and intentionality. They are the circuits that model the same states in others, the circuits for social perception and social cognition. By default, therefore, this is the only brain system that understands the question and that can report being conscious.

The brain system proceeds to give you a limited account from its own perspective, within the bounds of its own processing capacity. It has access to some information but not all information in the brain. Some of what it reports is accurate and some is invented. It perceives the brain (in which it is embedded) in the same way that it is built to perceive all things: as an intentional agent, a unified entity moving through life, observing and deciding, choosing to act. Whatever action is performed by the brain, this system constructs an intentional explanation for the action. That intentional explanation is sometimes correct—the system is an expert at finding explanations—but sometimes that explanation is mistaken. No matter. It can’t tell the difference. The report it gives you, the running narrative, is an incomplete, approximate, and sometimes flat-out wrong interpretation of the functioning of that brain. But it is the only stream-of-consciousness narrative you are going to get, because you are talking to the only brain system that understands your questions.

our own minds, the model includes a spatial location assigned to it, and the model is as simplified, and as subject to error, as any other perceptual model.

We talk about the inner me, the inner self, our private experience, and we contrast that with the world that we perceive outside of us. We think of these worlds as being fundamentally different in nature. Wasn't that Descartes' point when he famously said, "I think, therefore I am"? He didn't trust his perceptions of the outside world, but he thought he could trust his access to his own mind. What I am suggesting is that this distinction is an artificial one. Inner self or outer world, it is all perception. The difference lies mainly in the spatial coordinates assigned to the perceptual model. In some cases, attributes are assigned to locations inside our bodies. In other cases, attributes are painted onto people or animals or objects in the world around us.

The central philosophical question of consciousness is often put this way: Why does thinking *feel* like anything at all? When I solve a math problem in my head, why don't I merely process the information without feeling it? Why does it come with the added property that it feels like something to me? First consider the interesting format of the question—the analogy between thinking and body sensation. Why *feel*? The similarity, I am suggesting, is that in both cases your perceptual machinery creates a model as a proxy for the real thing, in both cases the model has a location assigned to it, and in both cases that location is referenced to the body. You perceive your own thoughts to be inside your own head, just as (to be prosaic about it) you perceive a stomach ache to be inside your own gut. In both cases the perceptual model is assigned a location inside the personal boundaries of the body. Hence the natural tendency to label the perception of one's own thinking as a type of *feeling*. Both belong to the category of perceiving the internal environment.

Confabulation

If you are thoughtful or observant, you probably long ago noticed that some of your behavior is shaped by unknown processes outside your awareness. Maybe you accidentally poured orange juice in your coffee—picked up the carton and did it without even noticing until it was too late. Or maybe someone asked you an innocent question and you found yourself snarling back, surprised at your own anger and unsure where the emotion came from. If you are human at all, then some time in the past you acted in a way that you couldn't entirely explain. But these rare moments are only the tip

of the iceberg. They are the obvious cases in which your behavior was so nonsensical, so surprising to you, that you couldn't invent an easy explanation, and so you were forced to recognize that something unconscious in your brain caused it to happen. But less obvious cases occur constantly. You may act in a way that seems quite natural—you think your conscious mind has decided to act this or that way, and you think you know the reason—but the real reason might not be consciously known to you.

Psychologists call it confabulation, and there are many experimental examples of it. The most telling examples come from the famous split-brain experiments of the 1960s. Although conducted nearly fifty years ago, these experiments are just as remarkable and revealing today as they were then. In those experiments, one half of a person's cerebral cortex was surgically disconnected from the other half. The reason was to prevent the spread of epilepsy from one side of the brain to the other. Medically, the experiments were an astonishing success. People who used to have frequent Grand Mal seizures would instead suffer only occasional, brief, Petite Mal seizures. They were almost cured. As a side benefit, the surgery allowed scientists to study the two halves of the brain separately. (These days epilepsy is better controlled by drugs.)

The split-brain experiments are especially interesting because of a peculiar feature of the human brain. In most people, the left side of the brain is capable of speaking fluently, whereas the right side has very little if any speech ability. This asymmetry between the two hemispheres varies somewhat from person to person, but the pattern holds for most people. It is one of the more remarkable properties of the human brain, though the value of it, if there is any, is still debated.

The neuroscientist Roger Sperry, who pioneered the study of split-brain people, realized that when he spoke to these patients and they spoke back, he was talking only to the left hemisphere. It was the only hemisphere that could talk back. When he spoke to the patients after their surgery, the left hemisphere didn't seem to notice anything unusual. It knew that it had undergone an operation, but it didn't feel any differently afterward. It didn't report that it missed the right side in any manner.

The right hemisphere still functioned. It still computed, decided, and acted. It was mainly responsible for controlling the left side of the body. The two sides of the body had to function like dance partners making expert and practiced moves together without any direct thought-connection. Why didn't the left hemisphere notice that it had been split off from direct contact with its other half, that it was now sitting side by side with a separate intelligence making independent decisions? The left hemisphere's delusion that it was in conscious control of the entire body was the most bizarre symptom of the surgery.

To trace down the reason, Sperry and his colleagues did experiments to put the two hemispheres at odds with each other. For example, suppose a picture of a shoe is flashed on the left side of a projection screen. The patient, looking at the screen, would see this picture with the right (non-speaking) hemisphere of the brain. At the same time, a picture of a kite is flashed on the right side of the screen. The kite would be seen by the patient's left (speaking) hemisphere.

If you ask the person, "What did you see?" his left, speaking hemisphere might answer: "A kite."

If you tell the person, "Point with your left hand and show me what you saw," now the person might point to the shoe on his foot. Why? Because although the non-speaking hemisphere cannot verbalize its answer, it can understand language well enough to follow simple instructions, and it controls the left hand.

Now you ask the person, "Why did you point to your shoe?" The speaking hemisphere might say, "I was pointing to the shoelace, which is a little like the string on a kite."

The answer is confident. The left hemisphere asserts it as if it were a simple truth and not a wild fabrication invented after the fact. The experimenter and the right hemisphere of the patient both know the real reason, but the left hemisphere has made up its own reason and is content with it. The reason why the left hemisphere thinks it is in control of the entire body is evidently because, whatever action the body performs, the left hemisphere makes up a plausible reason to account for the action. It thinks it chose to perform that action. One presumes the right hemisphere is doing the same thing on its side, confabulating explanations for the body's actions, but because the right hemisphere doesn't speak, it can't easily explain its thoughts to the experimenter.

Experiments of this type reveal the incredible extent of confabulation. Our comfortable, stream-of-consciousness explanation of our actions is not particularly accurate. It is partly an invention. The machinery for social perception is wired to confabulate about other people, to take in someone else's behavior and construct and update a useful if simplified model about that person's intentions. That machinery is simply doing to ourselves what it normally does to others.

When we say we are conscious, aware, self-aware, in conscious control of our actions, have a stream-of-consciousness understanding of ourselves, what we really mean, apparently, is this: there is a system in the brain whose job is to construct models of intentionality of other people or of ourselves; and right or wrong, confabu-