The Mind and the Brain: Neuroplasticity and the Power of Mental Force - Jeffrey M. Schwartz, Sharon Begley (2003)

Chapter 9. FREE WILL, AND FREE WON'T

If the atoms never swerve so as to originate some new movement that will snap the bonds of fate, the everlasting sequence of cause and effect—what is the source of the free will possessed by living things throughout the earth?

—*Lucretius*, On the Nature of the Universe, Book 2

The question is whether such a technique can really make a man good. Greatness comes from within, 6655321. Goodness is something chosen. When a man cannot choose he ceases to be a man.

—*Anthony Burgess*, A Clockwork Orange

Attending the Tucson III conference, "Toward a Science of Consciousness," in April 1998 was both a great learning experience and a lot of fun. Dave Chalmers had encouraged me to present a talk on how my OCD work provided evidence for the power of the mind over the physical stuff of the brain. That alone would have made the meeting worthwhile, but the gathering also turned out to be a great place to make friends and (at least to some degree) influence people. At the very first session, I attended a presentation that immediately made me realize I wasn't alone in denying that the mind is a mere appendage of the brain. The paper was by someone who was about to have a significant impact on my life: Jonathan Shear. A professor of philosophy at Virginia Commonwealth University and managing editor of the *Journal of Consciousness Studies*, Shear is also a serious student (and practitioner) of Transcendental Meditation. He was an early adopter, as they say in the world of technology: by 1963 he was already deeply involved in the study of where meditation meets science, and he knew about the maharishi before he was The Maharishi (that is, before the Beatles worked with him in India). Fittingly, Shear's talk was on Eastern philosophies and their views of consciousness—and he attracted quite a crowd.

The next day Shear and I ran into each other outside one of the meeting rooms and started talking. We quickly realized we had important interests in common, especially the use of meditation to investigate consciousness. After about fifteen minutes, we slipped out for a long lunch at the hotel restaurant. There, over the buffet (he seemed relieved that I wasn't one of those "tofu-and-veggies-ordie" meditators), Shear peppered me with questions about Buddhism. My answers were long and technical, and so were his replies. We vowed to keep in touch, and after returning to Virginia, Shear asked whether I might contribute a long theoretical article to a single-topic issue being planned by the *Journal of Consciousness Studies* (*JCS*) to be called "The Volitional Brain." The guest editor would be the renowned neurophysiologist Benjamin Libet of the University of California, San Francisco. I was eager to take it on, since it offered a chance to develop further my ideas on the philosophical implications of the OCD work.

On May 31, 1998, I sent Shear the abstract of the paper I had presented the month before in Tucson. In it, as I've mentioned, I first used the term *mental force* in a scientific sense, as I explored the importance of volition to my OCD patients in changing their neural activity. As my title posed the question, "A Causal Role for Consciousness in the Brain?" I described how PET studies of patients with obsessive-compulsive disorder had demonstrated systematic alterations in cerebral activity in those who were successfully treated with a drug-free cognitive-behavioral therapy. I outlined the Four Step method and explained how it teaches patients to regard the intrusion of OCD symptoms into consciousness as the manifestation of a "false brain message," training them to willfully select alternative actions when experiencing obsessions and compulsions. Although such willful behavioral change is difficult, I went on, it both relieves OCD symptoms and brings about systematic changes in metabolic activity in the OCD circuit. It turns out that the key predictor of whether the Four Steps will help an OCD patient is whether he learns to recognize that a pathological urge to perform a compulsive behavior reflects a faulty brain message—in other words, to Revalue it.

This work seemed appropriate for an issue on the volitional brain because it flew in the face of the widespread notion, dating back to at least the time of Descartes, that mind is incapable of acting on and changing matter. As noted in Chapter 1, this philosophical position, known nowadays as *epiphenomenalism*, views conscious experience as nothing more special than the result of physical activity in the brain, as rain is the result of air pressure, wind, and cloud conditions in the atmosphere. Epiphenomenalism is a perfectly respectable, mainstream neurobiological stance. But it denies that the awareness of a conscious experience can alter the physical brain activity that gives rise to it. As a result, it seemed to me, epiphenomenalism fails woefully to account for the results I was getting: namely, that a change in the valuation a person ascribes to a bunch of those electrochemical signals can not only alter them in the moment but lead to such enduring changes in cerebral metabolic activity that the brain's circuits are essentially remodeled. That, of course, is what PET scans of OCD patients showed.

On June 3, Shear responded to the abstract I had sent him. Two of the *JCS* editors he had shown it to, he said, had reacted "quite positively." One of them, Keith Sutherland, answered Shear's query about whether to include something along those lines in the *JCS* volume with a succinct "Yes—go for it!" Sutherland remembered an article on my work that appeared in *New Scientist*, a popular British science weekly, the previous summer, and asked, "Does he touch on any similarities between cognitive therapy and Buddhist practice?" This was the first time a fellow scientist had independently suggested tying the OCD results, and implicitly my Four Step therapy, to Buddhist philosophy and meditation. Another editor, Bob Forman, called it "a counter punch, long overdue, to the meaning-ignoring epiphenomenalist types."

Working that summer to refine my theory of mental force, I spent many long nights sweating bullets over the paper. I also spent hours discussing the details with

Stapp, who, as it happened, had also been invited to contribute a paper to the *JCS* issue. As soon as I learned this, it struck me that this would be a great opportunity to integrate the OCD work with Stapp's interpretation of quantum mechanics to create something like a grand synthesis. He and I discussed the possibility of writing back-to-back papers and decided to give it a shot. So one Sunday in late July, when I had to be in Berkeley for the opening of a film a friend had just produced, I drove up early that morning and took the opportunity to visit Stapp at home. Sitting beside the pool in his backyard, with its breathtaking view of San Francisco Bay, we started talking about quantum physics, and how the philosophy that it supports seems quite Jamesian in implying that the willful expression of consciousness has causal efficacy in the material realm. What struck us both was how close William James had come to formulating a persuasive, scientifically based theory of how attention reifies intention. He lacked only a mechanism, but that was because only quantum physics, and not the classical physics of his day, provided one. We talked, too, about how both quantum physics and classical Buddhism give volition and choice a central role in the workings of the cosmos. For quantum physics, until and unless a choice is made about what aspect of nature to investigate, nothing definite occurs; the superposition of possibilities described by the Schrödinger wave equation never collapses into a single actuality, as discussed in the previous chapter. As Stapp puts it, "For the quantum process to operate, a question must be addressed to Nature." Formulating that question requires a choice about which aspect of nature is to be probed, about what sort of information one wishes to know. Critically, in quantum physics, this choice is free: in other words, no physical law prescribes which facet of nature is to be observed. The situation in Buddhist philosophy is quite analogous. Volition, or Karma, is the force that provides the causal efficacy that keeps the cosmos running. According to the Buddha's timeless law of Dependent Origination, it is because of volition that consciousness keeps arising throughout endless world cycles. And it is certainly true that in Buddhist philosophy one's choice is not determined by anything in the physical, material world. Volition is, instead, determined by such ineffable qualia as the state of one's mind and the quality of one's attention: wise or unwise, mindful or unmindful. So in both quantum physics and Buddhist philosophy, volition plays a special, unique role.

In neuroscience, on the other hand, to take an interest in the role of volition and the mental effort behind it, and further to wonder whether volition plays a critical role in brain function, is virtually unheard of. Piles of brain imaging studies have shown that volitional processes are associated with increases in energy use in the frontal lobes: "right here," you can say while pointing to the bright spots on the PET scan, volition originates. But the research is mute on the chicken-and-egg question of what's causing what. Does activity in the frontal lobes cause volition, or does volition trigger activity in the frontal lobes? If the former, does the activity occur unbidden, as a mere mechanical resultant, or is it in any sense free? Generally, neuroscientists assume that the brain causes everything in the mind, period—further inquiry into causality is most unwelcome.

In the final version of my “Volitional Brain” paper, I was trying to do better than this glib dismissal. The feel of OCD symptoms and the feeling of mental effort that accompanies the Four Steps make this disease and its treatment a perfect fit for a volume examining phenomena at the nexus of mind and brain, I argued to Stapp on that summer morning. The intrusive thoughts that plague patients feel like extraneous intrusions into consciousness, as if they were invaders from another brain. Experiencing OCD symptoms is a purely passive process. In contrast, Relabeling the OCD symptoms and Refocusing attention on healthy circuitry are wholly active processes. The difference between the two “feels” makes genuine choice and the causal efficacy of that choice possible. Going further, I argued that the undeniable role of effort and the possibility of an associated mental force to explain the observed changes in the OCD circuit suggest a mechanism by which the mind might affect—indeed, in a very real sense, reclaim—the brain. That mechanism would allow volition to be real and causally efficacious, not the “user illusion” that determinists call it; it would allow volition to act on the material brain by means of an active and purposeful choice about how to react to the conscious experience of OCD symptoms. As I laid all this out, Stapp expressed confidence that it was all consistent with quantum physics.

The mechanism that allows volition to be physically efficacious is the one I called mental force. Similarly to what has been called “mind as a force field,” mental force also echoes what Ben Libet, a pioneer in the study of the neurobiology of volition, has named the “conscious mental field.” I proposed in the final version of my *JCS* paper that mental force is a physical force generated by mental effort. It is the physical expression of will. And it is physically efficacious. At the moment an OCD patient actively changes how he responds to the obsessive thoughts and compulsions that besiege him, the volitional effort and refocusing of attention away from the passively experienced symptoms of OCD and toward alternative thoughts and behaviors generate mental force. Mental force acts on the physical brain by amplifying the newly emerging brain circuitry responsible for healthy behavior and quieting the OCD circuit. We know that directed mental effort causes measurable changes in brain function, the self-directed neuroplasticity discussed earlier. And we know that mental effort is not reducible to brain action: hence the need for a new actor—mental force.

This notion of mental force fit an idea about free will that Libet had long propounded, one known as the “free won’t” version of volition. In a nutshell, “free won’t” refers to the mind’s veto power over brain-generated urges—exactly what happens when OCD patients follow the Four Steps. Since Libet served as a guest editor for the *JCS* volume, it didn’t hurt that I was able to acknowledge my intellectual debt to him. But it was hardly a stretch to make the connection to his work: OCD symptoms can be viewed as high-powered, painfully persistent versions of the desultory mental events that pop into consciousness countless times each day. Most of these thoughts do not insist on action, or demand attention, because the will can ignore them rather easily, Libet had argued. But in OCD patients the thoughts aren't nearly this well mannered: they are as insistent and intrusive as a nagging toddler. The discomfort they cause demands attention. Making that attention mindful and wise requires effort of the highest degree. That effort, I suspected, becomes causally efficacious on brain action through the mechanism of mental force. At the 1999 Quantum Brain conference in Flagstaff, I had discussed this possibility with Libet, and now it became part of my argument.

The fact that willful refocusing of attention caused brain changes in patients with OCD had exciting implications for the physics of mind-brain. "Ideas that I had long been working on, but which seemed to have no practical application, tied in very well with Jeff's discovery of the power of mental effort to keep attention focused," Stapp recalled. "That gave me the impetus to pursue this." In his own *JCS* paper, Stapp argued that neither scientists nor philosophers who adhered to the ideas of classical Newtonian physics would ever resolve the mind-brain mystery until they acknowledged that their underlying model of the physical world was fundamentally flawed. For three centuries classical physics has proved incapable of resolving the mind-body problem, Stapp noted. And although quantum physics supplanted classical physics a century ago, the implications of the quantum revolution have yet to penetrate biology and, in particular, neuroscience. And that's a problem, for the key difference between classical and quantum physics is the connection they make between physical states and consciousness. Quantum theory "allows for mind—pure conscious experience—to interact with the 'physical' aspect of nature…. [I]t is [therefore] completely in line with contemporary science to hold our thoughts to be causally efficacious," Stapp argued. He ended his *JCS* paper with a discussion of my OCD therapy, calling it "in line with the quantum-mechanical understanding of mind-brain dynamics." According to that understanding, mental events influence brain activity through effort and intentions that in turn affect attention. "The presumption about the mind-brain that is the basis of Schwartz's successful clinical treatment," Stapp concluded, "is that willful redirection of attention is efficacious. His success constitute[s] prima facie evidence" that "will is efficacious."

This statement was tremendously gratifying because it stated, from a physicist's perspective, what seemed to me the essential core of all my OCD work: that effort itself is the key to altering one's brain function. Stapp's insight was that quantum theory naturally allows for the direct influence of mental effort on the function of the brain. It thus makes mental effort and its effect on attention a primary causal agent.

In addition to our individual papers for the *JCS* issue, Stapp and I wrote an "appendix" that appeared between them. It became our strongest argument yet of the power of quantum physics to support the causal efficacy of mental force: "The basic principles of physics, as they are now understood, are not the deterministic laws of classical physics," we wrote. The basic physical laws are, rather, those of quantum physics, which allow mental effort to "keep in focus a stream of consciousness that would otherwise become quickly defocused as a consequence of the Heisenberg uncertainty principle, and keep it focused in a way that tends to actualize potentialities that are in accord with consciously selected ends. Mental effort can, within contemporary physical theory, have, via the effects of willful focus of attention, large dynamical consequences that are not automatic consequences of physically describable brain mechanisms acting alone."

Stapp's and my contributions stood apart from the rest of the "Volitional Brain" papers in arguing that modern physics provides a basis for volition and mental effort to alter brain function. Other contributions, taken together, constituted a grand tour of what neuroscience at the end of the twentieth century knew about volition. Better known as free will, volition has had a tough time of it lately. The very notion of "willpower" now carries a whiff of the Victorian, like the smell rising from a musty old hatbox. Invoking "a failure of willpower" to explain someone's succumbing to the temptations of alcohol or illegal drugs or shopping until the credit card maxes out seems—at least to science sophisticates—as outdated and discredited as applying leeches to the sick. "There is no magical stuff inside you called willpower that should somehow override nature," James Rosen, a professor of psychology at the University of Vermont, told a reporter. "It's a metaphor." "Willpower as an independent cause of behavior is a myth," said Michael Lowe, professor of clinical psychology at M. C.P. Hahnemann University in Philadelphia.

How did we arrive at this pass? The confusion is nothing new. No less an eminence than Kant threw up his hands in the face of the problem, identifying "freedom of the will" as one of three metaphysical mysteries beyond the reach of the human intellect (the other two are immortality and the existence of God). Kant, in fact, succumbed to the same temptation as others who have grappled with free will: in order to reconcile the discoveries of a universe governed by natural law and the felt experience of freedom of action, he concluded that the world simply must have room (albeit a hidden room) for free moral choices—even if physical determinism rules the world of which we have sensory knowledge. For Kant, the fact that he could not disprove this notion sufficed to sustain it; the fact that he could not prove it did not deter him from believing it. This leitmotif recurs throughout modern attempts to come to grips with free will: free will seems to violate all we know of how the world works, but as long as we cannot construct a logical proof of its nonexistence we cling to it tenaciously, even desperately.

With attempts to find scientific support for free will failing badly, it is no surprise that the twentieth century saw the slow decline of free will as a scientifically tenable concept. In 1931, Einstein had declared it "man's illusion that he [is] acting according to his own free will." In 1964 the great humanist Carl Rogers wrote that "modern psychological science, and many other forces in modern life as well, hold the view that man is unfree, that he is controlled, that words such as purpose, choice and commitment have no significant meaning." In 1971, B. F. Skinner offered what may be the definitive statement of this view, arguing in *Beyond Freedom and Dignity* that our behavior reflects nothing more noble than conditioned responses to stimuli.

The scientific and philosophic basis for this perspective, of course, goes back to Descartes's clockwork universe and is a primary feature of all radical materialist perspectives. But materialist determinism truly gained ascendancy in biology and psychology more recently. It is hard to date precisely the moment when biological determinism turned free will into a "myth" or a mere "metaphor." Perhaps it was in 1996, with the discovery of the first gene associated with a common behavior—risk taking. Perhaps it was in 1995, with the discovery of leptin, the hormone associated with a loss of appetite control. Or perhaps it was even earlier, with the avalanche of discoveries in neuroscience linking a serotonin deficit with depression, and dopamine imbalances with addiction. Each connection that neuroscientists forged between a neurochemical and a behavior, or at least a propensity toward a behavior, seemed to deal another blow to the notion of an efficacious will.

Even if historians will never agree on the precise turning point, what is clear is that the cascade of discoveries in neuroscience and genetics has created an image of individuals as automata, slaves to their genes or their neurotransmitters, with no more free will than a child's windup toy. As Stapp has observed, "The chief philosophies of our time proclaim, in the name of science, that we are mechanical systems governed, fundamentally, entirely by impersonal laws that operate at the level of our microscopic constituents." This scientific determinism holds that every happenstance has a causally sufficient antecedent in the physical world. Given those antecedents, only the happenstance in question could have occurred. Determinism professes, as James put it, that "the future has no ambiguous possibilities hidden in its womb…. Any other future complement than the one fixed from eternity is impossible." That which is not necessary is impossible; though we may conceive of an alternate future as possible, that is an illusion. That which fails to come about was never a real possibility at all. In ancient times, determinism rested on a belief in an omniscient God. Today, it is not old-time religion but, rather, our culture's newfound faith—science—that challenges the belief in free will. "The self…is not imagined to be ultimately responsible for itself, or its ends and purposes. Rather, the self is entirely a function of environment and genetics," as one explanation of this view states it. Or, more bluntly, "My genes (or my neurotransmitters) made me do it." In this view it is never the "I" who acts, but always the neurochemicals, or the genes, or the neuronal circuits that determine our choices and our course of action. Behavior, in this view, "is solely the consequence of the past history of the system, that has brought it to a state where various neuronal populations form an excitatory consortium that organizes and ineluctably triggers the correlated synaptic volleys needed for a particular movement," as the neuroscientist Robert Doty described it. The sense that one is exercising free will when one orders the cheesecake or moves the cursor on the computer screen to another game of hearts rather than to the spreadsheet program with your overdue taxes—is an illusion, an artifact of a prescientific era, says the prevailing paradigm. The idea that we might choose cantaloupe over cheesecake is as illusory as the apparent underwater "bending" of an oar dipped into a river.

Before we explore the reality of will, it's worth noting that, for a quality whose reality most people wish dearly to believe in, will is hardly something most of us go around exercising every waking minute. For instance, most of our movements are nonmindful and occur without direct conscious control; we generally don't need to will the right foot to lift off the ground and swing forward when the left foot has finished its step. Rather, habitual patterns of action such as those controlled by the basal ganglia and cerebellum, and stimulus-response pairings explain more of our behavior than we perhaps care to admit. The only time volition enters into that walk may be in inspiring us to set out in the first place. But when you reach the last word on the right-hand page of a book, you probably do not (unless reading a mindfulness meditation tract) pause in profound deliberation over turning the page. James called these "effortless volitions," which "are mechanically determined by the structure of that physical mass, [the] brain." But it is effort*ful* volitions that concern us here. It is no exaggeration to call the question of the causal efficacy of will the most critical issue that any mature science of human beings must confront.

In contrast to determinism, indeterminism holds that there exist some actions whose antecedents in the material world are causally insufficient to produce them; given those same antecedents, the agent could have acted differently. It holds that the world of possibilities exceeds the number of actualities, in that the existence (or the coming into existence) of one thing does not strictly determine what other things shall be. When we conceive of alternative futures, more than one is indeed truly possible. "Actualities"—James again—"seem to float in a wider sea of possibilities from out of which they are chosen; and somewhere, indeterminism says, such possibilities exist, and form part of truth." It is obvious from this why the question of free will excites our passions: it seems to be the quality of mental life that, more than any other, holds the key to who we are and why we act. To believe in free will, or to deny it, is to imply a position, too, on such profound questions as the reality of fate and the relation of mind to matter, as well as on such practical ones as the locus and source of moral responsibility and the power all of us hold to shape our destiny. To assert a belief in free will is to accept responsibility for our actions and to recognize the mind as "more or less a first cause, an unmoved mover," as the theorist Thomas Clark says: it is to hold the view that "we could have willed otherwise in the radical sense that the will is not the explicable or predictable result of any set of conditions that held at the moment of choice."

More often than not, to believe that we have such freedom is also to believe that, without it, the moral order is in danger of collapse. If the human mind is not in some sense an unmoved mover, one cannot reasonably assign personal responsibility, or ground a system of true justice. In this sort of world, the person who kills or robs or steals is in the grip of an inexorable mechanical process, and there is no rational basis for belief in taking responsibility for one's actions and choices. If consciousness and its handmaiden, will, are "a benign user illusion," as the philosopher Daniel Dennett argued in 1991 in *Consciousness Explained*, then we come face to face with what he calls "the Spectre of Creeping Exculpation." This is a world most people find abhorrent, in a way the American justice system reflects. Although the law allows for an insanity defense, "insanity" is understood as an inability to understand that one's actions were wrong. Insanity, to the courts, is not an inability to choose to act otherwise. True, occasionally a defendant walks on the basis of the so-called Twinkie defense ("The sugary food I ate made me crazy"). But in the vast majority of cases a defense based on a brain abnormality, or a genetic one, fails. Carried to its logical limits, a system in which no one has a choice about what action to take is unworkable. Despite the messages from genetics and neuroscience, most Americans greatly prefer to believe that we can choose freely—that Adam truly had a choice about whether to eat from the Tree of Knowledge. A Buddhist way of putting this is that you alone are responsible for the motives you choose to act on. In Gotama's words, you are "the owner" of the state of your will and "heir" to the results of your actions. The essence of the Buddhist perspective is that you are free to choose the way in which you exert effort and strive.

In this atmosphere of skepticism about the existence of free will, the *Journal of Consciousness Studies* brought out its 298-page volume, "The Volitional Brain: Towards a Neuroscience of Free Will," in the summer of 1999. The *towards* in the title signaled that we were not there yet. But the pairing of *neuroscience* and *free will* signaled a sea change in attitude about whether free will is even a valid subject for scientific, as distinct from philosophical, inquiry. The scientist who, more than any other, put free will on the neurobiology radar screen was Ben Libet. His experiments have incited as much controversy and as many battling interpretations as any in the field of neuroscience.

Libet was inspired by work reported in 1964 by the German neurophysiologists Hans Kornhuber and Luder Deecke. Using an electroencephalograph (EEG), these researchers discovered that the pattern of electrical activity in the cerebral cortex shifts just before you consciously initiate a movement. It's sort of like the whine of an idling jet engine shifting in pitch just before the plane takes off. The scientists also used a then-new technique that allowed them to analyze stored EEG data and thereby explore the chronological relationship between a voluntary movement (of the hand or foot) and brain activity. What they found was that, between 0.4 and 4 seconds before the initiation of a voluntary movement, there appears a slow, electrically negative brain wave termed the *Bereitschaftpotential*, or "readiness potential." Detectable at the surface of the scalp, the electrical activity was interpreted as being related to the process of preparing to make a movement. But no scientist was prepared to take the next step, investigating whether that electrical activity might have anything to do with the will to make a movement. "Their work just sat there for almost twenty years," Libet said over lunch at a Japanese restaurant in New York in late 2000. "John Eccles, with whom I studied, said to me one day that Kornhuber and Deecke's experiment made the case that conscious will starts almost a second before you act to express that will. I myself thought that was quite unlikely, and in any case I thought it would be hopeless to try to time things accurately enough to fix the moment when conscious will arose. But finally I got this idea."

That idea was to find a way to pinpoint the moment when a person became aware of the conscious desire to act. In experiments he reported in 1982 and 1985, Libet asked volunteers to decide to flick or flex their wrist whenever they chose. These movements were to be performed, as Libet put it, "capriciously, free of any external limitations or restrictions." Devices on the subjects' scalps detected the readiness potential that marks neuronal events associated with preparation for movement. Libet found that this readiness potential began, on average, 550 milliseconds before the activation of the muscles moving the wrist. But not all readiness potentials were followed by movements. "The brain was evidently beginning the volitional process in this voluntary act well before the activation of the muscle that produced the movement," Libet noted in 1999. That is, the readiness potential he was detecting appeared too long before muscle activation to correspond directly with a motor command to the muscle.

What, then, was this odd cerebral signal, which seemed to be acting as a sort of advance scout blazing a trail for the motor command? Libet had instructed his subjects to move the wrist any time they had an urge to do so. His next—and key—question became, When does the conscious intention to execute some movement arise? According to the traditional view of will as something that initiates action, this sense of volition would have to appear before the onset of the readiness potential, or at worst coincidently with it; otherwise the neuronal train would have left the station, as it were, before the will could get into the act. In that case, will would be pretty wimpish, merely assenting to an action that was already under way. But 550 milliseconds is, neuronally speaking, an eternity: "An appearance of conscious will 550 msec or more before the act seemed intuitively unlikely," Libet thought, preceding the act by way too long an interval to make sense. Was it possible, instead, that conscious will *followed* the onset of the readiness potential? If so, "that would have a fundamental impact on how we could view free will."

In his next experiments, Libet therefore tried to establish when will showed up. At first, measuring the onset of will "seemed to me an impossible goal," he recalls. But after giving the matter some thought, he decided to ask subjects, sitting in chairs, to note the position of the second hand on a clock at precisely the moment when they first became aware of the intention to move. Because he was dealing in intervals of less than a second, Libet knew that an ordinary sweep second hand would not suffice. He needed something faster. He came up with the idea of using a spot of light on the face of an oscilloscope. The spot swept around like a second hand, but twenty-five times faster. Each marked-off "second" on the oscilloscope's face therefore amounted to 40 milliseconds. Although this might seem to present a stiff challenge to anyone trying to pinpoint the position of the spot of light, in a dry run Libet found that subjects (including him) were pretty accurate in their readings: when he gave them a weak electrical jolt to the skin and asked them what time the spotlight indicated, the subjects got it right to within 50 milliseconds. “We were ready to go,” he says.

Following Libet’s instructions, all of the five subjects flicked their wrist whenever the spirit (or something) moved them. They also reported where the oscilloscope spot was when they first became aware of the will to move. Libet compared that self-report with concurrent measurements of the onset of the readiness potential. The results of forty trials—which have since been replicated by other researchers—are straightforward to relate, if difficult to interpret. The readiness potential again appeared roughly 550 milliseconds before the muscle moved. Awareness of the decision to act occurred about 100 to 200 milliseconds before the muscle moved. Simple subtraction gives a fascinating result: the slowly building readiness potential appears some 350 milliseconds before the subject becomes consciously aware of his decision to move. This observation, which held for all of the five subjects in each of the six sessions of forty trials, made it seem for all the world as if the initial cerebral activity (the readiness potential) associated with a willed act was unconscious. The readiness potential precedes a voluntary act by some 550 milliseconds. Consciousness of the intention to move appears some 100 to 200 milliseconds before the muscle is activated—and about 350 milliseconds after the onset of the readiness potential.

Libet thus produced the first experimental support for the version of free will that Richard Gregory famously called “free won’t.” At first glance, the detection of a readiness potential before consciousness of the wish to act appears to bury free will: after all, cortical activity leading to a movement is well under way before the subject makes what he thinks is a conscious decision to act. The neuronal train has indeed left the station. If free will exists, it seems to be like a late passenger running beside the tracks and ineffectually calling, “Wait! Wait!” Yet Libet does not interpret his work as proving free will a convenient fiction. For one thing, the 150 or so milliseconds between the conscious appearance of will and the muscle movement “allow[s] enough time in which the conscious function might affect the final outcome of the volitional process,” he notes. Although his results have been widely and vigorously debated, one interpretation with significant experimental support is this: there exists conscious cerebral activity whose role may be “blocking or vetoing the volitional process so that no actual motor action occurs,” as Libet wrote in 1998. “Veto of an urge to act is a common experience for individuals generally.” It is also, of course, the essence of mindfulness-based OCD treatment and reaffirms Sherrington’s insight that “to refrain from an act is no less an act than to commit one”: thus, “free won’t.”

Experiments published in 1983 clearly showed that subjects could choose not to perform a movement that was on the cusp of occurring (that is, that their brain was preparing to make) and that was preceded by a large readiness potential. In this view, although the physical sensation of an urge to move is initiated unconsciously, will can still control the outcome by vetoing the action. Later researchers, in fact, reported readiness potentials that precede a planned foot movement not by mere milliseconds but by almost two full seconds, leaving free won't an even larger window of opportunity. "Conscious will could thus affect the outcome of the volitional process even though the latter was initiated by unconscious cerebral processes," Libet says. "Conscious will might block or veto the process, so that no act occurs." Everyone, Libet continues, has had the experience of "vetoing a spontaneous urge to perform some act. This often occurs when the urge to act involves some socially unacceptable consequence, like an urge to shout some obscenity at the professor." Volunteers report something quite consistent with this view of the will as wielding veto power. Sometimes, they told Libet, a conscious urge to move seemed to bubble up from somewhere, but they suppressed it. Although the possibility of moving gets under way some 350 milliseconds before the subject experiences the will to move, that sense of will nevertheless kicks in 150 to 200 milliseconds before the muscle moves—and with it the power to call a halt to the proceedings. Libet's findings suggest that free will operates not to initiate a voluntary act but to allow or suppress it. "We may view the unconscious initiatives for voluntary actions as 'bubbling up' in the brain," he explains. "The conscious will then selects which of these initiatives may go forward to an action or which ones to veto and abort…. This kind of role for free will is actually in accord with religious and ethical strictures. These commonly advocate that you 'control yourself.' Most of the Ten Commandments are 'do not' orders." And all five of the basic moral precepts of Buddhism are restraints: refraining from killing, from lying, from stealing, from sexual misconduct, from intoxicants. In the Buddha's famous dictum, "Restraint everywhere is excellent."

The evolution of Libet's thoughts about his own experiments mirrors that of neuroscience as a whole about the reality of volition. Libet had long shied from associating his findings with free will. For years he refused even to include the words in his papers and resisted drawing any deeper conclusions from his results. At the 1994 "Toward a Scientific Basis of Consciousness" conference (Tucson I), Libet was asked whether his results could be used to support the existence of free will. "I've always been able to avoid that question," he demurred. But in later years he embraced the notion that free will serves as the gatekeeper for thoughts bubbling up from the brain and did not duck the moral implications of that. "Our experimental work in voluntary action led to inferences about responsibility and free will," he explained in late 2000. "Since the volitional process is initiated in the brain unconsciously, one cannot be held to feel guilty or sinful for simply having an urge or wish to do something asocial. But conscious control over the possible act is available, making people responsible for their actions. The unconscious initiation of a voluntary act provides direct evidence for the brain's role in unconscious mental processes. I, as an experimental scientist, am led to suggest that true free will is a [more accurate scientific description] than determinism."

This may seem an enfeebled sort of free will, if it does not initiate actions but only censors them. And yet the common notion of free will assumes the possibility of acting otherwise in the same circumstances, of choosing not to perform actions that tempt us each and every day. By "the possibility of acting otherwise," I mean not that possibility as judged by an outside observer, one who might sneer that, well, you didn't have to scream at me. I mean, instead, that the possibility of an alternative action is one that you feel as more than theoretical. It must be one that you consider, even if only briefly, before acting. As a matter of fact, William James believed that will seized the moment after the first thought about an intended action, but before the actual action. Consistent with his feeling that "volition is nothing but attention," James argued that the ability to "emphasize, reinforce or protract" certain thoughts at the expense of others percolating into consciousness—an ability he identified with attention—manifests itself as will. So for James, too, will derives not from the freedom to initiate thoughts, but to focus on and select some while stifling, blocking—or vetoing—others. For Buddhist mindfulness practice, it is the moment of restraint that allows mindful awareness to take hold and deepen. The essence of directed mental force is first to stop the grinding machine-like automaticity of the urge to act. Only then can the wisdom of the prefrontal cortex be actively engaged.

Free will as gatekeeper raises a deeper question: how does the gatekeeper decide which thoughts to let pass and which to turn back, which to allow to be expressed and which to veto unceremoniously? Libet himself concedes that although his discovery of the 550-millisecond gap offers a hint of how free will operates, it does not address whether our willed actions are strictly determined by the prior history and state of the neurons in our brain, or whether the will to action is truly free—by which I mean not reducible to and predictable from material processes. The initiatives that bubble up in the brain are, he suspects, based on the person's past—memories, experiences, the values transmitted by the larger society—as well as on present circumstances. If willed actions are strictly determined, and if the brain's veto of possible actions is strictly determined by neural antecedents, then we are right back where we started, with (presumably) unconscious neural states' calling all the shots. Such "free" will seems hardly worth having, and we find ourselves once again in a purgatory where our brains or our genes control our actions as a puppeteer controls a marionette. But Libet insists that such is not the case. "I propose…that our conscious veto may not require or be the direct result of preceding unconscious processes," he declared. "There is no logical imperative in any mind-brain theory, even identity theory, that requires specific neural activity to precede and determine the nature of a conscious control function. And there is no experimental evidence against the possibility that the control process may appear without development by prior unconscious processes."

Libet turned eighty-five in 2001, and he had lost none of his fire. He seemed resigned, though, to remain a voice in the wilderness. "Most neuroscientists shy away from my argument invoking free will and a mental field that are not encompassed by existing physical law," he says with a hint of a grin.

It violates determinism, which makes them very uncomfortable. But physical laws were discovered as a result of the study of physical objects, not of subjective *experience. Even if we had perfect knowledge of all the trillions of synaptic connections in a brain, of all the circuits that comprise it—even with all this, as we have learned from the Heisenberg Uncertainty Principle as well as chaos theory, you cannot predict what that brain will do*.

Both Buddhist and William James's philosophy are quite consistent with this interpretation of volition. In Buddhism, the quality of awareness or attention determines the nature of the consciousness that arises, and thus the action (karma) that takes place. The only willful choice one has is the quality of attention one gives to a thought at any moment. Similarly, James believed that "th[e] strain of attention is the fundamental act of will." And in the Four Steps, of course, to Refocus mindfully away from a destructive obsession or compulsive urge and onto a benign object of attention is the core volitional act, as I will describe further in the next chapter.

Libet's discovery of the 550-millisecond gap in the mid-1980s launched a thousand symposia and inspired a neuroscience of volition. Typically, considering how enamored brain scientists are of mapping the regions that correspond to mental events, they have had a field day (or decades) recording cerebral activity during willed acts. As early as 1977, for instance, researchers led by the Swedish physiologist David Ingvar had volunteers first automatically and rhythmically clench their hand, and then imagine doing the same act without moving their hand. Measuring cerebral blood flow, which serves as a proxy of neuronal activity, they found activation of motor cortex during automatic hand clenching. In addition, and quite markedly, the prefrontal cortex was activated during the willful mental activity. Many subsequent studies have similarly found that willed mental effort results in prefrontal cortex activation. In schizophrenics who show symptoms of a "sick will," which is marked by autistic behavior and inactivity, the dorsolateral prefrontal cortex shows lower-than-normal activity. In depression, one symptom of which is a lack of initiative (will?), three decades of brain mapping have shown consistently low activity in the prefrontal cortex. This has led to the suspicion that the prefrontal cortex houses, at minimum, what Ingvar calls "action programs for willed acts."

Study after study has indeed found a primary role for the prefrontal cortex in freely performed volitional activity. "That aspect of free will which is concerned with the voluntary selection of one action rather than another critically depends upon the normal functioning of the dorsolateral prefrontal cortex and associated brain regions," Sean Spence and Chris Frith concluded in "The Volitional Brain." Damage to this region, which lies just behind the forehead and temples and is the most evolutionarily advanced brain area, seems to diminish one's ability to initiate spontaneous activity and to remain focused on one task rather than be distracted by something else. These symptoms are what one would predict in someone unable to choose a particular course of action. Large lesions of this region turn people into virtual automatons whose actions are reflexive responses to environmental cues: such patients typically don spectacles simply because they are laid before them, or eat food presented to them, mindlessly and automatically. (This is what those who have had prefrontal lobotomy do.) And studies in the 1990s found that when subjects are told they are free to make a particular movement at the time of their own choosing—in an experimental protocol much like Libet's—the decision to act is accompanied by activity in the dorsolateral prefrontal cortex. Without inflating the philosophical implications of this and similar findings, it seems safe to conclude that the prefrontal cortex plays a central role in the seemingly free selection of behaviors, choosing from a number of possible actions by inhibiting all but one and focusing attention on the chosen one. It makes sense, then, that when this region is damaged patients become unable to stifle inappropriate responses to their environment: a slew of possible responses bubbles up, as it does in all of us, but brain damage robs patients of the cerebral equipment required to choose the appropriate one.

Typical of the new breed of neuroscientists intrepid enough to investigate the existence and efficacy of will is Dr. David Silbersweig. As a philosophy major at Dartmouth College, in 1980 he wrote his senior thesis on the philosophy of mind. A slight man with an intense manner (perhaps a side effect of the caffeine he was substituting for sleep, thanks to his newborn, on the summer day in 2000 when we met), Silbersweig chose not to hole up in a garret and think deep thoughts about Mind. Instead, he enrolled in medical school. But after training at Cornell Medical Center and working at the Medical Research Council in London, Silbersweig returned to the passion of his youth. At the functional neuroimaging lab at Cornell that he runs with his wife, Emily Stern, he looks for the neural footprints that volition leaves as it darts through the brain. As he puts it, "We are now in an era where you can address questions of volition through neuroscience."

Silbersweig and Stern do that with PET scans, testing how volition affects conscious perception. Sensory input, of course, does not necessarily produce conscious sensory awareness: if it did, people would be aware of every sight that their visual system takes in, and we plainly aren't. (To test this, ask yourself what lies at the extreme right of your peripheral vision this very second, but without concentrating on it.) In such a case, sensory information is clearly being processed—one can trace the sequence of activation along the visual pathway—yet conscious perception of it is absent. To investigate the role of volition in sensory disturbances, Silbersweig and Stern study, among other conditions, schizophrenia. When schizophrenics hear voices, the brain is constructing a simulacrum of reality. The patient is conscious of sounds that are not there, suggesting that a brain state underlying the mental state ("I hear voices!") is sufficient for conscious awareness. But no volition is involved; the patient does not wish to hear voices. So here we have conscious sensory perception in the absence of both sensory stimuli and volition.

Volition can coexist with conscious perception, but in the absence of sensory stimuli. This is the well-known case of mental imagery. One can voluntarily (volitionally) evoke a sensory experience, calling up the image of a giraffe or the voice of Dr. Martin Luther King, Jr., delivering his "I Have a Dream" speech. If you just did either of these, then your visual association cortex almost certainly became active in the first case, your auditory association cortex in the second. Imagery thus presents a neat comparison to schizophrenic hallucinations: the same lack of sensory input, a similar albeit internally experienced conscious percept—but with volition.

For another example of how volition can affect sensation, fortune sent Stern and Silbersweig a young man known as S. B., who was eighteen when they began studying him in 1992. S. B. had suffered two strokes of the middle cerebral artery, in 1990 and 1991. The strokes had produced lesions that left him cortically deaf: although his ear and the rest of the peripheral components of his auditory system are fine, S. B. fails to hear environmental sounds—a door closing, a car backfiring. But cortical deafness is more nuanced than this. When S. B. concentrates hard, he can make out simple sounds—when they begin and when they cease, as well as their volume. So in experiments with S. B., volition alone is responsible for conscious perception.

PET scans pick out striking differences in brains receiving or not receiving external auditory stimuli, with or without awareness, with or without volition. In one unmedicated schizophrenic's brain, Stern and Silbersweig found, auditory-language association cortices in the temporal lobe became more active at the very moment he reported hearing voices. There was, as expected, no activity in the primary auditory cortex, the region that processes input from the ear. Among five schizophrenic patients who were on medication but still heard voices, the active regions included those generally believed to retrieve contextual information (the hippocampus), integrate emotional experience with perception (ventral striatum), and help maintain conscious awareness (thalamus). These regions, together, probably generate complex, emotionally charged hallucinations. But just as Sherlock Holmes solved a mystery by noting that a dog had failed to bark, it was the brain region that remained dark that offered the tantalizing clue to volition, which is absent during schizophrenic hallucinations. The frontal cortex remained quiet.

Silbersweig and Stern compared this pattern to that in healthy patients who were asked to imagine sounds. "There was a preponderance of activity in the frontal lobes," Silbersweig said. When S. B. became aware of sounds to which he was otherwise deaf—sounds that he could hear only if he willed himself to do so—the same frontal regions lit up. What they were seeing, Silbersweig believes, "was an effect of volition and attention on perceptual function, a top-down modulation of activity." The PET results support the hypothesis that these prefrontal systems play a role in "volitional control of conscious sensory experience," Silbersweig and Stern conclude.

One of the more striking hints of the reality, and power, of will came from experiments in the late 1990s on patients with "locked-in syndrome." In this terrifying condition, a patient's cognitive and emotional capacities are wholly intact, but he is completely paralyzed. He cannot point, nod, whisper, smile, or perform any other voluntary motor function. (Occasionally some muscles around the eye are spared, allowing the patient to blink voluntarily and so achieve a rudimentary form of communication.) Such a patient's muscles are deaf to the wishes of his mind. Locked-in syndrome is generally caused by stroke or other brain injury; it can also result from Lou Gehrig's disease, amyotrophic lateral sclerosis (ALS). The damage blocks the pathways by which the brain initiates voluntary movement. For decades scientists despaired of ever helping these patients. But then a few groups began investigating a long shot: might they somehow bypass the muscles and enable the patients to communicate through computers controlled by the brain alone?

Johnny Ray had been locked-in ever since a brainstem stroke in December 1997. His powers of reason, cognition, emotion all remained intact. But his brain could no longer communicate with his body, for those messages run through the brainstem, where the neuronal wires were no more functional than electric utility lines after Hurricane Andrew. He could no longer move or talk. So in a twelve-hour operation the following March, Johnny, a Vietnam veteran, had electrodes implanted into the region of his motor cortex that controlled the movement of his left hand. The electrodes, encased in glass cones, contained growth-promoting substances that caused some of the patient's functioning brain cells to grow into the cones. When they did, an electric signal passing along an axon in the part of the cortex controlling the left hand excited the minuscule gold contacts in the electrodes, which amplified and transmitted the signal through a gold wire to a receiver in Johnny's pillow at the Veterans Affairs Medical Center in Decatur, Georgia, and from there to a computer. Soon, Johnny was imagining moving his left hand, causing a wave of action potentials to sweep through his motor cortex. By altering the frequency of the signals, he managed to move a cursor to various icons ("help," "pain"). He stared at the computer monitor, focusing on the imagined movement of his paralyzed hand, willing the cursor to move. He eventually learned to control the cursor well enough to spell, choosing letters from the screen one at a time. In a few months, he got up to three characters per minute. And then he skipped the middle step: rather than imagine moving his hand, he simply concentrated on moving the cursor. And it moved. He had willed the cursor to move.

The herculean mental effort required to operate the cursor system provides strong evidence that what is involved here is real, volitional effort. As such, it mirrors the tremendous mental effort that OCD patients must make to veto the urge to execute some compulsion. In the absence of effort the OCD pathology drives the brain's circuitry, and compulsive behaviors result. But mental effort, I believe, generates a directed mental force that produces real physical effects: the brain changes that follow cognitive-behavioral therapy for OCD. The heroic mental effort required underlines the power of active mental processes like attention and will to redirect thoughts and actions in a way that is detectable on brain scans. Let me be clear about where mental effort enters the picture. The OCD patient is faced with two competing systems of brain circuitry. One underlies the passively experienced, pathological intrusions into consciousness. The other encodes information like the fact that the intrusions originate in faulty basal ganglia circuits. At first the pathological circuitry dominates, so the OCD patient succumbs to the insistent obsessions and carries out the compulsions. With practice, however, the conscious choice to exert effort to resist the pathological messages, and attend instead to the healthy ones, activates functional circuitry. Over the course of several weeks, that regular activation produces systematic changes in the very neural systems that generate those pathological messages—namely, a quieting of the OCD circuit. Again quoting James, "*Volitional effort is effort of attention*…. *Effort of attention is thus the essential phenomenon of will*."

I propose, then, that "mental force" is a force of nature generated by volitional effort, such as the effort required to refocus attention away from the obsessions of OCD and onto an actively chosen healthy behavior. Directed mental force, I suggest, accounts for the observed changes in brain function that accompany clinical improvement among OCD patients who have been successfully treated with the Four Steps. The volitional effort required for Refocusing can, through the generation of mental force, amplify and strengthen alternative circuitry that is just beginning to develop in the patient's brain. The results are a quieting of the OCD circuit and an activation of healthy circuits. Through directed mental force, what begin as fragile, undependable processes—shifting attention away from the OCD obsessions and onto less pathological behaviors—gradually become stronger. This is precisely the goal of the therapy: to make the once-frail circuits prevail in the struggle against the OCD intruder. The goal is to become, as Gotama Buddha termed it, "a master of the course of thought." Volitional effort and attentional Refocusing generate a mental force that changes brain circuitry, thus resulting in a lessening of OCD symptoms—and, over time, produces a willfully induced change in the very circuitry of the brain.

One should not, needless to say, posit the existence of a new force of nature lightly. The known forces—gravity, electromagnetism, and the strong and weak forces that, respectively, hold atomic nuclei together and cause radioactive decay—do a pretty good job of explaining a dizzying range of natural phenomena, from the explosion of a supernova to the photosynthesis of a leaf, from the flight of a falling autumn leaf to the detonation of the Hiroshima bomb. But mental force, its name notwithstanding, is not strictly analogous to the four known forces. Instead, I am using *force* to imply the ability to affect matter. The matter in question is the brain. Mental force affects the brain by altering the wave functions of the atoms that make up the brain's ions, neurotransmitters, and synaptic vesicles. By a direct action of mind, the brain is thus made to behave differently. It is in this sense of a direct action of mind on brain that I use the term *mental force*. It remains, for now, a hypothetical entity. But explaining phenomena like the self-directed neuroplasticity observed in OCD patients undergoing Four Steps therapy, like the brain changes detected in those of Alvaro Pascual-Leone's piano players who only imagined practicing a keyboard exercise, like the brain changes in Michael

Merzenich's monkeys who paid attention to incoming sensory stimuli—explaining all of these phenomena and more requires a natural force of this kind. Mental force is the causal bridge between conscious effort and the observed metabolic and neuronal changes.

Let me anticipate an objection. Materialists may argue that although the experience of effort is caused by the brain's activity (as are all mental experiences, in this view), it has no effect on the brain. If the brain changes, according to this argument, it is because the same brain events that generate the feeling of mental effort also act back on (other parts of) the brain; this intervening thing called "the feeling of mental effort," they might argue, is a mere side effect with no causal power of its own. But this sort of reasoning is inconsistent with evolutionary theory. The felt experience of willful effort would have no survival value if it didn't actually *do something*. Therefore, positing that the feeling is the mere empty residue of neuronal action is antibiological reasoning and an unnecessary concession to the once-unquestioned but now outdated tenet that all causation must reside in the material realm. Moreover, the "brain changes itself" hypothesis fails to account for the observed clinical data, in which OCD patients describe making a concerted mental effort to master the task that changes their brain. Denying the causal efficacy of mental effort, then, means ignoring the testimony of individuals who describe the enormous exertion of will required to wrestle their obsessions into submission. (Of course, psychology has a long history of dismissing such verbal reports as a misleading source of data. But as James pointed out in 1890, that dismissal reflects the "strange arrogance with which the wildest materialist speculations persist in calling themselves 'science.'") To those of us without a constitutional aversion to the idea of an active role for the mind in the real world, the facts speak loud and clear: there are no rational grounds for denying that conscious mental effort plays a *causal role* in the cerebral changes observed in these OCD patients.

In contrast to classical physics, with its exclusive focus on material causation, quantum physics offers a mechanism that validates the intuitive sense that our conscious thoughts have the power to affect our actions. Quantum theory, in the von Neumann-Wigner formulation as developed by Henry Stapp, offers a mathematically rigorous alternative to the impotence of conscious states: it allows conscious experience to act back on the physical brain by influencing its activities. It describes a way in which our conscious thoughts and volitions enter into the causal structure of nature and focus our thoughts, choose from among competing possible courses of action, and even override the mechanical aspects of cerebral processes. The quantum laws allow mental effort to influence the course of cerebral processes in just the way our subjective feeling tells us it does. How? By keeping in focus a stream of consciousness that would otherwise diffuse like mist at daybreak. Quantum theory demonstrates how mental effort can have, through the process of willfully focusing attention, dynamical consequences that cannot be deduced or predicted from, and that are not the automatic results of, cerebral mechanisms acting alone. In a world described by quantum physics, an insistence on causal closure of the physical world amounts to a quasi-religious faith in the absolute powers of matter, a belief that is no more than a commitment to brute, and outmoded, materialism.

An obvious question is how far one can extend the reach of the hypothesized mental force. As the Decade of the Brain ended, neuroscientists had mapped out the neural circuits that underlie myriad states and behaviors, from depression to aggression to suicidal impulses. Does the existence of mental force imply that with enough attention and volition the violent teen can will himself the brain circuits that make a civilized adult of him? That the suicidal widow can will herself the neural circuits correlated with a love of life, or at least spiritual acceptance? That the schizophrenic can will his voices to be silent, and his visions to disappear? The power of cognitive-behavioral therapy to alter brain circuits in people with either depression or OCD implies that similar therapy, drawing on mental force, should be able to change other circuitry that underlies an aspect of personality, behavior, even thought. And that, of course, encompasses approximately everything, from the mundane to the profound: addiction or temperance, a bad temper or a forgiving nature, impatience or patience, love of learning or antipathy to it, generosity or niggardliness, prejudice or tolerance.

There is a danger to this way of thinking: it treads close to the position that anyone with a mental illness remains sick because of a failure of will, anyone with an undesirable personality trait retains it because she has failed to exert sufficient mental effort. Even those of us who distrust the "My genes (or my neurochemicals) made me do it" school of human behavior back away from the implication that will alone can bring into being the neural circuitry capable of supporting any temperament or behavioral tendency—indeed, any state of mental health. But to frame the issue in this all-or-nothing way is to create a simplistic, and false, choice. The distinction between active and passive mental events offers us some flexibility as we search for where free will and mental force might exhaust their powers. That the passive side of the picture is largely determined, no one can deny. That the intensity of that passive conscious content can at times be overwhelming, no one with an ounce of empathy can fail to realize. Sometimes the power of those passive, unbidden, and unwanted brain processes—the voices the schizophrenic hears, the despair a depressive feels—is simply too great for mental force to overcome. And although directed mental force allows will to change the brain in both the stroke patients Edward Taub has treated and my own OCD patients, of course it is not will alone. It is knowledge, training, support from the community and loved ones, and appropriate medical input.

Twenty-five hundred years ago, a culture very distant from our own in both time and place produced an astonishing prescient insight. In the Pali texts, Gotama says, "It is volition, monks, that I declare to be Karma (Action). Having willed, one perfoms an action by body, speech or mind." By these words the Buddha meant that it is the state of one's will that determines the nature of one's actions (karma), and so profoundly influences one's future states of consciousness. This is the Law of Karma. As the Buddhist scholar Ledi Sayadaw explains, "Volition becomes the chief and supreme leader in the sense that it informs all the rest. Volition, as such, brings other psychical activities to tend in one direction." In addition, Gotama vividly described how the quality of attention that one places on a mental or physical object determines the type of conscious state that arises in response to that object. As the next few months of my collaboration with Henry Stapp were to show, Gotama wasn't a bad neuroscientist—or physicist either, for that matter. By the time Stapp wrote his paper for "Volitional Brain," we were well on the way toward identifying a quantum-based mechanism by which the mental effort that generates "willful focus of attention" would bring about brain changes like those detailed in the OCD brain imaging work. Attention was key.

The implication of the preceding chapters—particularly the power of mental effort and mindfulness to alter neuronal connections—is that will is neither myth nor metaphor. It is, or at least exerts, a real physical force. The research on OCD makes clear that will involves different levels of consciousness, with high-order mental functions potentially presiding over lower-level ones. As 1999 passed, with fireworks and laser shows, into 2000, Stapp and I worked to connect the seemingly disparate threads of a nascent theory: William James's observations about will and attention, my work showing the power of mental effort to change the brain patterns of OCD patients, and quantum physics. James foreshadowed the mechanism by which, according to Stapp, volition acts through quantum processes: "At various points," James wrote, "ambiguous possibilities shall be left open, either of which, at a given instant, may become actual. [One] branch of these bifurcations become[s] real."