
A salon on choice, volition, and apathy

WHY DO SOME PEOPLE SEEM TO HAVE CONTROL OVER THEIR ACTIONS WHILE OTHERS DON'T?

BY JOE MIKSCH

FREE-WILL HUNTING

Okay, there was this fellow. He worked down at the lower tip of Manhattan, on Wall Street. Essentially, he was your run-of-the-mill office drone. His primary task was to copy documents for a boss who was both an understanding gent and someone who avoided muddying the waters, rocking the boat, what have you. It wasn't a thrilling job, but our man was adept, reliable, and quiet. In short, he was a model employee—for a while, at least.

His friends, if he'd had them, would have called him Bart. Thin, sallow, and apparently shy, Bart wasn't one to chat around the water cooler, a trait that earned him some mistrust from his colleagues but pleased the head man. He spoke only when spoken to, and even then rarely responded with more than a word or two. Once this limited communication was complete, Bart went back to his desk and his work.

ILLUSTRATION | CATHERINE LAZURE

Then things began to change. In the small, cramped office in the middle of the world's financial hub, Bart stopped doing his job. Most people would have fired the guy, but the boss was concerned and tried to light a little fire under his odd copyist. He'd say something like, "Hey, Bart, how about you go mail these letters?" or, "Hey, big fella, whadd'ya say you run out and get some lunch? I'm buying." Each time Bart responded simply, "I would prefer not to," and got back to being busy doing nothing.

He seemed lethargic, almost incapable of moving. Bart's colleagues began to wonder whether there was something terribly wrong in the young man's brain that prevented him from acting, from behaving in a manner that was appropriate. Did he want to do what was asked but somehow just couldn't?

Or was he, as he said, expressing a preference to, well, to not do anything, to not move an inch, to stare at the wall all day long, and then putting that preference into action—or, rather—lack of action? Was that preference self-generated? Was Bart in the awkward position of mentally wishing to act but being unable to do so because of some malfunction in brain chemistry or brain circuitry? Was he predisposed to respond as he did under the circumstances that faced him? Did he have free will?

What ailed Herman Melville's Bartleby the Scrivener remains a mystery, but implications of free will arise in our daily lives, not just in classic literature. Why can some of us ignore the siren song of the bacon double cheeseburger, whereas others, also fully aware of the artery-clogging dangers, can't move ourselves to opt for the salad?

From dining choices to compulsiveness, movement disorders to Tourette's, doctors bump up against issues of will all the time. So with the University of Pittsburgh being home to some of the world's most prominent brain-focused brainiacs—at the Center for the Neural Basis of Cognition (CNBC), the Department of History and Philosophy of Science, and the Western Psychiatric Institute and Clinic—we couldn't resist posing a few really hard questions about why some people seem to be able to control their actions better than others. *Pitt Med* sat down with a philosopher, a neurobiologist, a psychologist, a psychiatrist, and a Parkinson's disease patient and hashed it out. Although these commentators haven't even attempted to solve the jigsaw puzzle of free will, their work and lives shed light on a few key pieces. ■

The Neurobiologist
How Do You Manufacture Volition?

Peter Strick talks over his omelet at the Holiday Inn Select in Oakland. Amid the clatter of plates and chatter of patrons, the soft-spoken and unfailingly pleasant man says, "Let me see that." Snatching a legal pad from a breakfast companion, he begins to sketch out the basal ganglia.

This set of structures, as one early observer put it, is set deep in the "dark basement of the brain" and tied to motor function, though Strick has convinced the neuroscience community that it's responsible for much more.

Strick is a member of the American Academy of Arts and Sciences, a PhD, and a professor of neurobiology and psychiatry at the University of Pittsburgh; he also codirects the CNBC. The joint venture between Pitt and Carnegie Mellon University looks to tease out the brain's secrets regarding awareness and judgment. With loops and lines, Strick illustrates components of the basal ganglia: globus pallidus, striatum, substantia nigra, subthalamic nucleus, and thalamus. (See p. 23 for more on the basal ganglia and Strick's contributions to understanding their function.) Complex interactions take the form of arrows and doodles. When he's done, the page is a mess. Thankfully, Strick is a better explainer than artist.

In the lab, Strick uses viruses as tracers to map the intricate circuitry and architecture of the nervous system. He has found that the basal ganglia play a part in the realms of vision, affect, sensation, higher executive processing, and, as long understood, motor control. If the ganglia aren't functioning properly, the result can be Tourette's syndrome, attention deficit hyperactivity disorder, obsessive-compulsive disorder, Huntington's disease, or Parkinson's disease.

The basal ganglia, Strick has made clear, have something to do with our behavior and our ability to control our actions.

Imagine a man with Parkinson's disease. One of his symptoms is akinesia, a disinclination to move. He knows that in order to place a phone call, he's got to get up from the easy chair, walk across the room, pick up the receiver, and dial. Yet, despite knowing all this, he can't. Not that he doesn't understand the situation. Not that he doesn't want to make the call. He's just unable to manufacture the internal drive that would propel him to do so.

Yet, Strick says, if someone were to, say, tape dance studio–style cut-out footprints to the floor, the man would be able to get to the phone without a problem.

"They will walk nearly normally," Strick says. "The thought is that when you provide the visual input to guide movement, the external stimulus will allow them to overcome the lack of internal generation of movement."

In this case, a loop (identified by Strick in 1986) involving elements of the basal ganglia isn't functioning properly. This, he says, is where you get into issues of free will.

"We can see consequences of when [the loop] is functioning abnormally," Strick says, "as in Parkinson's disease.

"People have argued if Parkinson's disease represents a disinclination to move, maybe this loop has something to do with volition." Strick won't commit as to whether he buys into that argument. His domain is figuring out the brain's circuitry.

What happens when circuitry goes haywire? We now know that the motor symptoms associated with Parkinson's—resting tremors, disinclination to move, and rigidity—are measurable consequences of the die-off of dopamine-producing cells integral to sensory motor function of the basal ganglia. What's less obvious to Strick and other neuroscientists is the basal ganglia's normal function. Is this collection of gray matter the will's home in the brain? Is it simply intended to inhibit tremors or make us more flexible?

Strick can't tell us—yet. "We know a tremendous amount about what happens when the basal ganglia [aren't] functioning normally, but we don't know quite as much about what happens when [they are] functioning normally," he says. "I think we're really at the beginning of that."

One of Strick's colleagues designed a study that let monkeys choose between treats that were equally appealing. A different section of the brain lit up when a monkey made a 50/50 choice compared to, say, what was active when making a choice involving a favorite juice.

When the results were presented at a recent Society for Neuroscience meeting, Strick was intrigued.

Certain parts of the cerebral cortex, which Strick believes are intertwined with the urge to move, were active only when the monkey determined that neither treat was preferable and was engaged in making a choice free from outside influence.

"When the values were judged to be equal, the neurons in the medial cortical areas were active. The urge-to-move area. Choice."

Strick looks at his pointer finger, holds it out in front of himself, and bends it.

"I became really interested in studying the nervous system by just being fascinated that I could move my finger whenever I wanted," Strick says.

"That still just amazes me. When you talk about internally initiating movement, how do you manufacture that? Those things get to the nature of consciousness, the nature of internal representations, and free will."

The conversation turns to addiction: How does someone, with finality, quit using drugs, smoking, or gambling? They probably can't, says Strick. Not cold turkey. The urge would stay with them.

After he's prodded for a solution, Strick adds, "You need to replace, substitute, the behavior." Carrots for cigarettes. The coffee shop for the bar. A new crowd as opposed to the old gang. Perhaps the circuitry, the loops and pathways that modulate behavior, becomes too strong to be broken. This isn't self-control, Strick says, it's "white-knuckling it through."

Is free will, then, just a question for philosophers to argue over, or is it hidden somewhere in the invaginations of the brain?

"I don't know," Strick says. "[Neurobiologists] may have some insights, but it is rather like asking a horse trainer which horse to bet on in a race. You get informed information, but by no means do you get a winner every time or perhaps even most of the time."

Strick keeps busy instead finding out what's answers are hidden in those deep dark basements of gray matter—what some might call the physical reality of the brain. ■

Answers to how we're able to control our actions seem to lie in circuits that travel the deep "dark basement of the brain."

CIRCUITOUS CIRCUITRY

In 1986, Peter Strick, then a researcher at the Veterans Administration Medical Center in Syracuse, N.Y., along with Garrett Alexander and Mahlon DeLong at Johns Hopkins University, published a paper in the *Annual Review of Neuroscience*. In layperson's terms, the paper was a very big deal. It more or less redefined the function of a portion of the brain.

At that time, the function of the basal ganglia—a collection of nerve cells deep inside the brain—was thought to lie exclusively in the realm of motor control.

The scientists identified four previously unknown loops involving the basal ganglia. It turned out circuits of the basal ganglia are not only involved in the control of limb and eye movement, they also play a role in decision making, affect, working memory, and behavior.

Strick, whose lab is still supported in part by the Veterans Administration, is now a Pitt professor of neurobiology and psychiatry, as well as codirector of the Center for the Neural Basis of Cognition, a University of Pittsburgh–Carnegie Mellon University collaboration. He points to two basal ganglia disorders—Parkinson's disease and Huntington's disease—as examples of the multifaceted nature of these loops. Parkinson's, he says, starts off with movement disorders and, as it progresses to different circuits, instigates behavioral disorders. Huntington's starts with behavioral problems, such as depression, and then creates motor problems. Strick believes basal ganglia loops are also factors in attention deficit hyperactivity disorder and obsessive-compulsive disorder.

He recently showed that premotor areas of the frontal cortex—once thought to influence motor function only through connection to the primary motor cortex—link with spinal motor neurons and may be responsible for some direct generation and control of voluntary movement. And he found that the cerebellum—formerly thought to be the seat of movement, coordination, and balance—is also a player in the thinking process. To top it off, he demonstrated that the cerebellum may control aspects of basal ganglia function.

As for the 1986 paper being a big deal—it has been cited 1,200 times and still averages between 120 and 150 citations a year two decades after publication. After 300 citations, a paper is considered a classic. —*JM*

The Philosopher

Can Science Make Room for Intention and Other Fuzzy Ideas?

The physical reality of the brain is genetic, chemical, and electrical. The feeling of having agency, of being in control of ourselves and our fate, is none of those things. It's a much more amorphous state, the notion that we are independent actors navigating life by making choices and having moral responsibility.

Neuroscientists like Strick who toil in labs have measurements, charts, and graphs; volumes of earlier measurements, charts, and graphs; and the gravitas that comes with all that. At the end of the day, if all goes well, these practitioners of the hard sciences come up with a generally accepted explanation of a physical phenomenon that is called "fact." Maybe, if a scientist is really good (and/or lucky) her work leads to a cure for, or maybe a better understanding of, some scourge.

Philosophy doesn't translate to the clinic and probably hasn't cured anything—even ennui. But, as a discipline, it has one thing going for it in the free will debate: It actually asks the question, "Is there free will, and what is its nature?"

In the extreme, consider that if free will is a mere construct, why should we have laws and courts? How can an individual who is nothing but a product of genetics and experience, who is predisposed to act in a certain manner under a particular set of circumstances, be held culpable for anything from jaywalking to homicide? The feeling of choice may have been there, yet crossing against that light or shooting that man was an event dictated by how the brain, constituted as it is, processed each and every event that led to that point in time.

"That's the philosophical problem of free will," says Jackie Sullivan, a PhD candidate studying the history and philosophy of science. Sullivan has an MS in neurobiology and is a member of the CNBC.

"On one hand, the question is whether agents act according to their intentions, beliefs, and desires, whether or not they're in control of those actions, whether or not they can act autonomously. Or is everything determined in advance?" Sullivan adds.

Ah, determinism. On one hand, it's a philosophical position that eliminates all the warm and fuzzy stuff like intentions and beliefs—the unverifiable—but on the other hand, well, on the other hand, who wants to feel like a rat in a Skinner box?

Sullivan has an answer to that question—no one.

"I think that if we were to throw out free will, it would have serious moral consequences in our society," she says. "And so I think that most people who want to reconcile free will and determinism say, 'Look, we have to believe that agents act autonomously in some cases because if we're to say, if we're to use environmental and genetic factors as a justification for why someone acted, then we lose the whole idea of moral responsibility.'"

Despite this stance, the philosopher/neurobiologist is unwilling to chuck science of the brain out of the equation.

"I think the story is ultimately a lot more complex than any particular individual area of science can possibly comprehend," she says. "And I think that's why nowadays you see a lot of areas of science becoming more integrative to deal with how complex the phenomena are."

Look, she says, at the myriad approaches that exist under the aegis of science. Some areas focus on the cognitive, others on strictly biological phenomena. But regardless of the scientific approach, Sullivan contends, many doing benchwork involving the brain are unwilling or unable to consider beliefs and feelings, things she believes are integral to making us human and making sense of the mind and all that stems from it. Maybe, she says, what we find out about how neural systems operate—such as Strick's work with the basal ganglia—can be integrated into how philosophers understand concepts such as free will. Maybe there can be some sort of synthesis.

"I'm not interested in debunking neuroscience. I think there is an approach in philosophy that's a lot different [from] the approach you find in science to certain kinds of questions. And I think there should be room for all different kinds of analysis," she says.

"I think somebody does need to keep science in check. Should it be the philosophers? I don't know."

All of which leads us back to Peter Strick's wagging finger. Was his choice to gesture with his pointer finger an outcome dictated by genes and experience? If so, what choice remains?

"If you want to go about debunking the stimulus/response theory, you can say, 'Well it seems that there isn't anything around me that's causing me to raise one finger rather than another,'" Sullivan says. There's no reward ahead, no fear of punishment. Unless, of course, Strick had extended his middle finger. That could upset someone.

But Strick insists offensive gestures are simply not in his repertoire; nor were they ever. "My mother raised me right," he says.

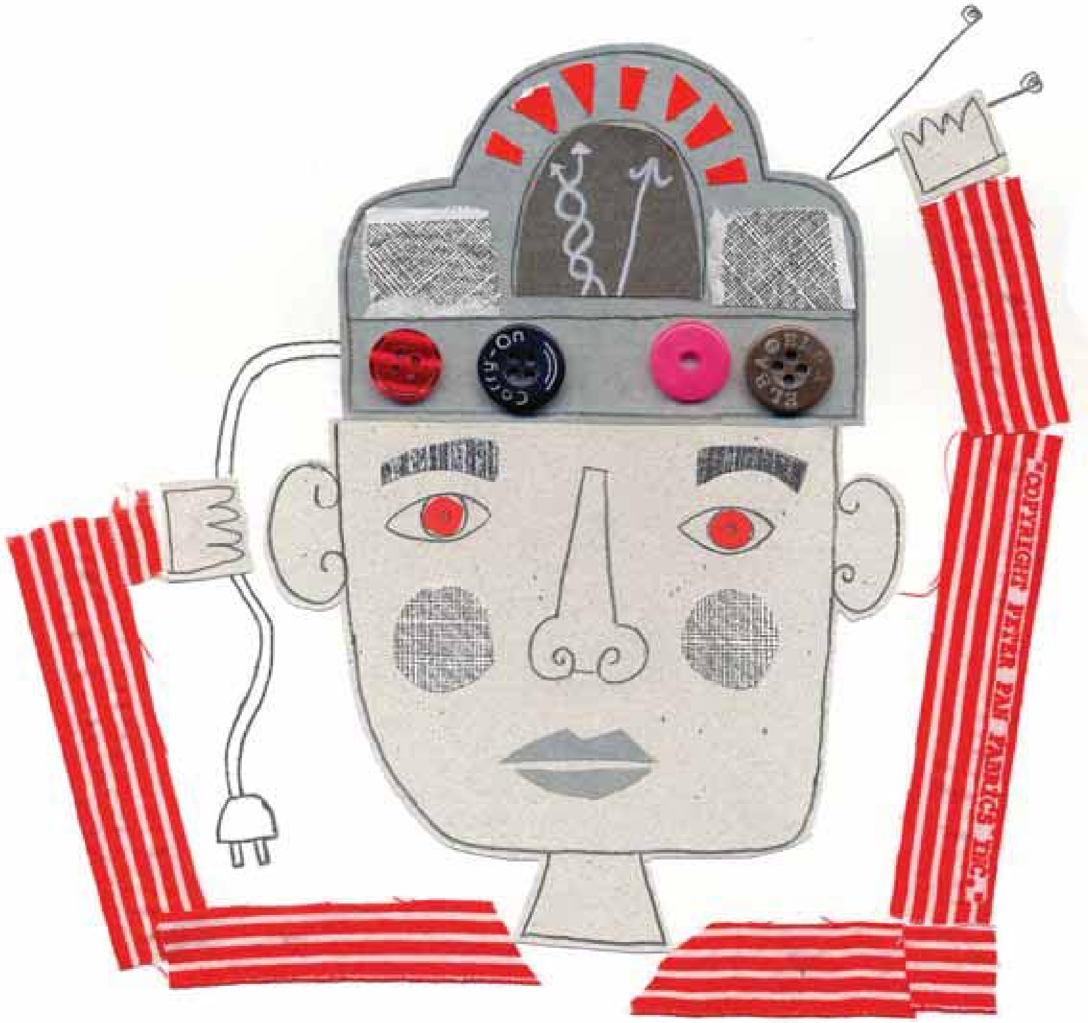
Is that the echo of determinism? ■

The Psychiatrist

Our Choices Are Real

Genetics and experience are important, of course, in molding the individuals we become. No reasonable person would argue that point. But when it comes to making conscious decisions, says Mary Phillips, they're certainly not the only determining factors.

Phillips, an MD, came to the University of Pittsburgh last year as a professor of psychiatry and member of the CNBC, having previously served as a visiting professor, on loan from the Institute of Psychiatry, Kings College London, where she maintains a research group. Phillips directs her department's functional imaging program; she uses the technology to sort out the neural mechanisms involved in normal emotion, a pursuit that's given her some insight into the nature of choice and will.



Our brains behave differently when we perceive that we have control over an outcome.

What we are genetically, and what we've experienced over the course of our lives, she says, do not constrict us to the degree that we should toss the concept of free will off the Cathedral of Learning.

"We still have some control," she asserts.

"We have decision-making control. Our genes and environment just limit our choices." Our choices may be limited, she says, but they are real.

The brain, she notes, behaves differently when it, consciously or unconsciously, perceives an element of control over a situation. Phillips recounts an experiment performed in London:

"It's called the 'tickling experiment.' They rigged up this machine and, basically, the person—the poor, unsuspecting person in the scanner—will pull a lever, and they either get a tickle in the direction they expected, or a tickle in the opposite direction, or no tickle at all."

Eventually, Phillips says, the subject figured out a pattern and had some ability to predict what would happen when she pulled the lever. At this point, activity was observed in different brain circuitry than when the subject wasn't wise to the pattern.

"It's just that when you become aware of self-control, there's something that kicks in as opposed to when things are done to you," Phillips explains. The brain, Phillips says, seems to know the difference between when it is acting and when it is being acted upon.

"Think about psychiatric symptoms such as delusions, hallucinations, imaginary voices," she says. "There's a free will issue here. People don't choose to have those experiences. It turns out that hallucinations and true sensory experiences involve different brain responses. Similar and overlapping, but different."

In such cases, Phillips says, "There's always an abnormality within the basal ganglia as well as the cortex. We always find some kind of functional abnormality in the basal ganglia."

Phillips thinks that Strick's circuits that pass through the basal ganglia all play a role in allowing us to consciously choose how we behave, which begs the question, "Are the basal ganglia involved with free will?" Answering the question, Phillips says, "What I can say is the basal ganglia are very important for helping us actually experience emotion consciously. The basal ganglia are a very crucial part of our cognitive, behavioral, and emotional circuits."

A few regions show increased activity when our brains are making decisions, Phillips says: Don't forget the prefrontal cortex—which communicates with the basal ganglia and is active when people attempt to coordinate thoughts and actions with internal goals. Or the cerebellum (also on the Strick basal ganglia circuit), which is involved with behaviors that border on the automatic, like driving a car or the motions of an experienced musician. Or the amygdala—a component of the basal ganglia that helps regulate emotion. So, then, in which neighborhood of the brain does free will reside—if it can be located?

No one knows, of course. Phillips' comments suggest less of a location and more of a perpetually forwarded address.

"Inevitably, free will is going to involve so many complex interactions between the cortical [outer portion of the brain] and the subcortical [nested inner regions]," she says.

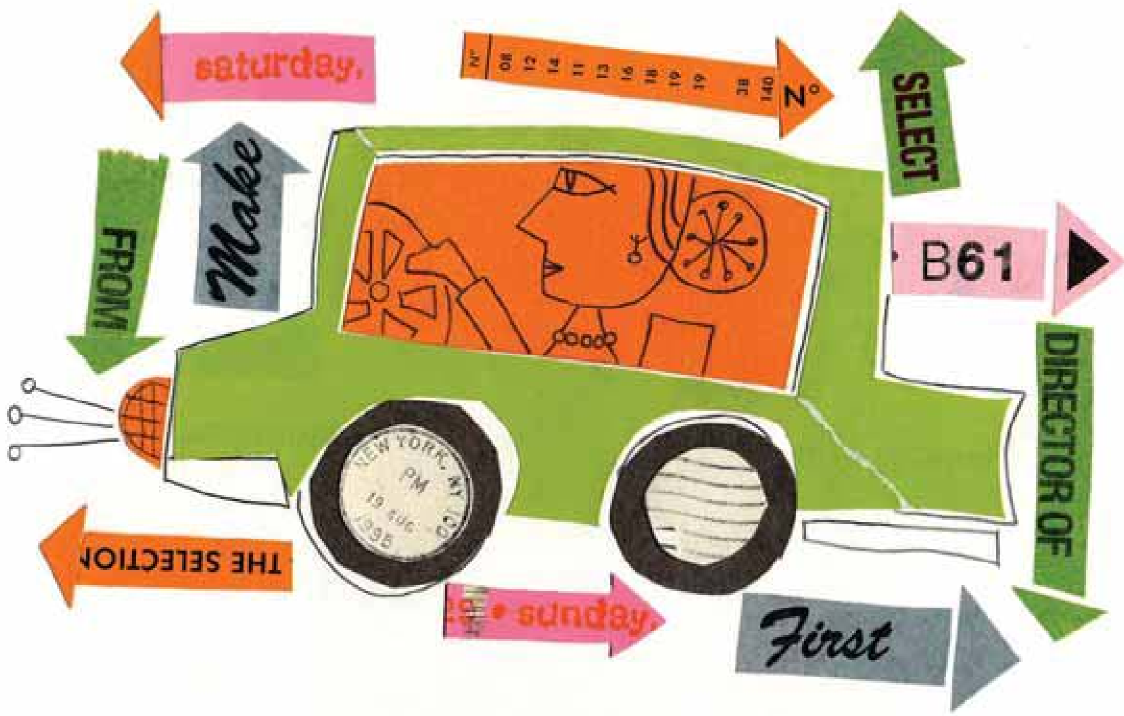
"But I'm sure we're going to get there eventually.

"What you'd have to do is design an experiment where you can single out the one component that's free will, as opposed to being forced to do something. And then you've got to design it so well that you can show that any differences you see in brain activity have to do with free will. That's a very difficult thing to do."

There are technological challenges to overcome, more refined and directed questions to ask about the brain—"Your question, that's a biggie," Phillips says. "It's metaphysical and nebulous"—and there are even seemingly simple matters, such as agreeing on definitions.

"People have different meanings for free will," she says. "How do you measure it?" ■

We seem to have a deep-seated impulse to behave as though we're independent actors.



PATHS TO OBSESSION

The symptoms of obsessive-compulsive disorder are easily observable. The man who washes his hands every time he touches something. The woman who repeatedly goes back to make sure she made the coffee for the next morning. The guy who has stashed away every *Pittsburgh Post-Gazette* he's ever bought. The "why" of such behaviors is much more mysterious.

University of Pittsburgh professor of psychiatry Mary Phillips uses functional magnetic resonance imaging (fMRI) to associate such behavior with specific neural pathways. Her research findings may one day help pharmaceutical companies make targeted drugs or help doctors make more informed decisions on therapy.

Phillips' team showed compulsive hand washers pictures of dirty objects and told them to imagine they'd come in contact with the objects but wouldn't be able to wash afterward. The hand washers exhibited greater activity in areas of the brain associated with processing emotions, specifically disgust, than their control counterparts.

Phillips' lab tied checking—think of someone repeatedly going back to make sure he turned off the oven—with regions of the basal ganglia important for motor and attention functions, particularly the inhibition of unwanted impulses.

Obsessive hoarders were a bit more difficult to figure out. They showed higher than usual activity in the motor cortex and right orbitofrontal cortex, which is involved in decision making. Other experiments show that heightened activity in the right orbitofrontal cortex indicates that such patients may be more responsive to antidepressant medication. —*JM*

The Psychologist

An Illusion of Control

Julie Fiez has also delved into what happens, in a hard-wired way, when we try to control outcomes.

Her lab showed volunteers, as part of a group of studies, a series of numbers, asking them to predict if each would be greater or less than five. If the guess was correct, a green arrow would appear, indicating that the subject won money. If incorrect, the subject saw a red arrow, denoting a loss. The volunteers were hooked to neuroimaging machines that revealed the striatum was active when they made these predictions. The striatum is a region of the basal ganglia that's part of the dopamine pathway and involved in circuits associated with volition.

In other situations, where the volunteers were not asked to predict an outcome, the striatum didn't light up.

"This suggests that [the striatum] really is only active when subjects perceive a contingency between their actions and the outcome," says Fiez.

In the first experiment, Fiez reports, there was no way for the subjects to improve the likelihood of winning money: The sequence of the numbers presented to them was random and volunteers were told so beforehand. Yet participants reported after the scan that they had developed a strategy or thought that they had detected a pattern.

They thought they were in control and their brains acted like they had control even though they didn't.

Fiez is a PhD associate professor in the Department of Neuroscience and Department of Psychology at the University of Pittsburgh, a member of the CNBC, and a research scientist in the University's Learning Research and Development Center. Her interests are the neuroscience behind language processing, as well as behind reward and motivation.

Her experiments tell her that we seem to have a deep-seated impulse to behave as though we're independent actors.

"It's surprising that people still seem to be going through a decision-making process," she says of the experiments.

"Even if I know the program's going to pick an outcome after I press a key to give me the predetermined reward or punishment," she adds, "the brain nevertheless wants to make a decision.

"There's something very powerful there."

She suggests it shows that there's a strong desire for agency embedded in our brains.

Fiez makes a leap into the theoretical. She thinks that our apparent desire to claim some kind of independent involvement in decision-making factors heavily in learning. We may be able to set a goal for ourselves at a specific moment in time, but whatever we choose as a goal is predicated upon what came before. Yet we think we have agency, control.

"I guess the argument [for this determinist line of thinking] would have to be something like—it's the set of prior experiences that caused you to engage the prefrontal cortex in a way that perceives this to be a goal and perceives you to have contingency upon others.

"You have this illusion of control," Fiez says.

So if that's the case, what accounts for so many of us being sure that we are independent actors hacking our way through the jungle to cut out a life of our own, on our own?

Fiez thinks it could be because so much happens to us over the course of our lives that we're unable to trace what appear to be choices back to the experiences that determined the outcomes.

"I keep emphasizing in my cognitive [psychology] class that every single moment of cognition leaves a trace somehow," she says.

"So when do you ever have a choice?" she asks.

"I don't know. You certainly feel like you have a choice, and you certainly feel like sometimes you do struggle with something.

"If you had a computer simulation that could keep track of every single thing that you experienced, that could somehow get us to that exact point [of decision] and show that every single time this is what the person does, that would prove the illusion of control.

"As a neuroscientist, there's a part of me that sort of thinks you are the sum total of what you started out with and all the experiences you've had.

"But at an individual level, a subjective level, it feels very powerfully like you have a choice, and it would seem kind of ludicrous that you don't."

The Patient
Eroded Freedom

Jim Cordy doesn't have a choice. At least he feels like he doesn't.

Like that day the Squirrel Hill resident was up near Pitt's Petersen Events Center. That afternoon, he spotted Chancellor Mark Nordenberg on the corner by the Pete. Now, Nordenberg's a pretty recognizable person, particularly on the University of Pittsburgh campus, but crowds of people were passing him by, no one stopping to engage him in conversation. Cordy had met Nordenberg a time or two at Pitt basketball games, but the two didn't really know each other, at least not well. Cordy considers himself the shy and retiring type, certainly not a guy who would just walk up to the Chancellor and start talking to him. He had no reason to chat up Nordenberg and no deep-seated desire to meet him again.

"But of all those people crossing the street, only one person had the chutzpah to go up to him and say, 'Hey, Mark, how are you doing?' and it was me."

Cordy says he never would have done something like that before Parkinson's set in.

The disease has changed him. To some degree, he feels that his freedom has been eroded, both by the ailment and the treatment. When he takes levodopa to replace the dopamine drained away by Parkinson's, he acts in ways that seem foreign to him, engages in compulsive behaviors that he finds embarrassing. If he takes too much, he develops dyskinesia—his limbs make wild, flailing movements. If he fails to take the drug, or doesn't take enough, commonplace tasks such as getting out of the car, tucking in his shirt, or putting on his socks are all but impossible, no matter how strongly he desires to do them.

Cordy, 58, was diagnosed with Parkinson's 18 years ago.

"It's progressed continually," he says. "Movement deteriorates. I have a hard time getting out of the tub; I tend to freeze. Fine motor skills are shot. Short-term memory is shot."

Conversation with Cordy is like playing Whack-a-Mole at an arcade. He jumps from topic to topic. What he wants and what he does, or can do, are distant from one another. Though Cordy clearly wishes his circumstances were otherwise, he lacks self-pity.

"Things range from the mildly annoying to the debilitating," Cordy says.

But, he adds, the disease and the treatment—which have rendered him unable to make his limbs do what he wants them to do and make him behave in ways he most assuredly would choose not to—have also allowed him some freedoms: the ability to take chances.

He does so as founder and president emeritus of the Parkinson Chapter of Greater Pittsburgh. In that capacity, he has spoken at Congressional hearings, lobbied for money for Parkinson's research, and promoted the pursuit of stem cell research. And he has done so relentlessly.

"I wouldn't have done anything like this before. [Levodopa] just makes you more compulsive; you just do things.

"I'm an empowered person with Parkinson's," he says.

The predispositions and decades of pre-Parkinson's experience that guided Cordy's behavior for the first 40 years of his life seem to have been rendered impotent by the disease.

Can this be construed as evidence that will amounts to no more than a function of biology, chemistry, and electrical impulses in the brain? On the other hand, can biology actually free some of us? Cordy says he has no idea.

What he does know is that he'd dearly like to be as he was.