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How Free Is Your Will?

A clock face, advanced neurosurgery--and startling philosophical questions about the decision to act

By Daniela Schiller and David Carmel | Tuesday, March 22, 2011 | 8 comments

Think about the last time you got bored with the TV channel you were watching and decided to change it with the remote control. Or a time you grabbed a magazine off a newsstand, or raised a hand to hail a taxi. As we go about our daily lives, we constantly make choices to act in certain ways. We all believe we exercise free will in such actions – we decide what to do and when to do it. Free will, however, becomes more complicated when you try to think how it can arise from brain activity.

Do we control our neurons or do they control us? If everything we do starts in the brain, what kind of neural activity would reflect free choice? And how would you feel about your free will if we were to tell you that neuroscientists can look at your brain activity, and tell that you are about to make a decision to move – and that they could do this a whole second and a half before you yourself became aware of your own choice?

Scientists from UCLA and Harvard -- Itzhak Fried, Roy Mukamel and Gabriel Kreiman -- have taken an audacious step in the search for free will, reported in a new article in the journal Neuron. They used a powerful tool – intracranial recording – to find neurons in the human brain whose activity predicts decisions to make a movement, challenging conventional notions of free will.

Fried is one of a handful of neurosurgeons in the world who perform the delicate procedure of inserting electrodes into a living human brain, and using them to record activity from individual neurons. He does this to pin down the source of debilitating seizures in the brains of epileptic patients. Once he locates the part of the patients' brains that sparks off the seizures, he can remove it, pulling the plug on their neuronal electrical storms.

Such epileptic seizures are random. No one knows when to expect them, so after the electrodes are implanted everybody sits around and waits. This gives researchers a unique opportunity to observe human neurons in action: During the wait, patients may volunteer to participate in experiments, allowing scientists to discover what functions the recorded neurons carry out. The invasive surgery required to implant electrodes (performed routinely in animals like rats and monkeys for research) cannot be done in humans unless a medical condition (such as epilepsy that does not respond to drugs) calls for it. Such investigations are, therefore, rare.

Fried and his colleagues implanted electrodes in twelve patients, recording from a total of 1019 neurons. They adopted an experimental procedure that Benjamin Libet, a pioneer of research on free will at the University of California, San Francisco, developed almost thirty years ago: They had their patients look at a hand sweeping around a clock-face, asked them to press a button whenever they wanted to, and then had them indicate where the hand had been pointing when they decided to press the button. This provides a precise time for an action (the push) as well as the decision to act. With these data the experimenters can then look for neurons whose activity correlated with the will to act.

Such neurons, they found, abound in a region of the frontal lobe called the supplementary motor area, which is involved in the planning of movements. But here is the interesting thing: about a quarter of these neurons began to change their activity *before* the time patients declared as the moment they felt the urge to press the button. The change began as long as a second and a half before the decision, and as early as seven tenths of a second before it, this activity was robust enough that the researchers could predict with over 80 percent accuracy not only whether a movement had occurred, but when the *decision* to make it happened.

So it turns out that there are neurons in your brain that know you are about to make a movement the better part of a second before you know it yourself. What does that mean?

It might be tempting to conclude that free will is an illusion. Some have believed this since the days of Libet, who recorded EEG and found it contained a specific pattern that predicted his subjects movements before they felt the conscious will to act. EEG measures electrical activity on the surface of the head, combining information from billions of neurons; Fried and his colleagues have gone further, by finding individual neurons that do this.

But before reaching any sweeping conclusions, it is important to remember that this study looked at a very rudimentary kind of action. The decision to move a finger hardly ranks as the same kind of free will we exercise when we make moral choices or major life decisions. To conclude that we aren't fully responsible for our actions, for example, would be extremely far-fetched.

And lets consider two more things. First, Fried and his colleagues used their patients' reports on decision-to-move times; it is possible that people are just very bad at accurately remembering or reporting when they made such decisions (although it is unlikely that they would be wrong to the tune of over a second). Second, the decision to move a finger – especially when that's the only thing you are supposed to do – might develop gradually rather than occurring at a single time. (Try it yourself: hold your finger against a surface, and wait till the urge to tap it causes you to. You may find that this urge isn't an all-or-none thing, and you wait till it is strong enough to actually go ahead.)

Even with the above caveats, though, these findings are mind-boggling. They indicate that some activity in our brains may significantly precede our awareness of wanting to move. Libet suggested that free will works by vetoing: volition (the will to act) arises in neurons before conscious experience does, but conscious will can override it and prevent unwanted movements.

Other interpretations might require that we reconstruct our idea of free will. Rather than a linear process in which decision leads to action, our behavior may be the bottom-line result of many simultaneous processes: We are constantly faced with a multitude of options for what to do right now – switch the channel? Take a sip from our drink? Get up and go to the bathroom? But our set of options is not unlimited (i.e., the set of options we just mentioned is unlikely to include "launch a ballistic missile"). Deciding what to do and when to do it may be the result of a process in which all the currently-available options are assessed and weighted. Rather than free will being the ability to do anything at all, it might be an act of selection from the present range of options. And the decision might be made before you are even aware of it. Think about that next time you reach for the remote.
