Is there a neurobiology of the free will?

Can neurobiology help to resolve the age-old discussions about freedom, cause and chance?

Bertram Gerber

Free will—or rather the question of whether it exists—has been the topic of heated debate among philosophers for millennia. For many neuroscientists too, the idea of freedom poses a dilemma: if what we do is caused by brain processes—which follow the laws of nature—our behaviour is determined by those laws and is not free. Conversely, if behaviour is the result of chance events within the brain that as such have no identifiable cause, we are not free either, because our behaviour would not be caused by anything, let alone free will. What is wrong with these arguments? And can neuroscience help to resolve the dilemma?

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Science is an attempt to cope with the world. It grasps things as effects and searches for their cause. Accordingly, science has a materialistic framework in the sense that it is limited to what matters: to whatever can be investigated in terms of the effect it has. Despite popular clichés science is fundamentally practical, because the test of scientific knowledge is whether we can properly act on it: do we indeed find it easier to sail for the Indies assuming that the Earth is round than when we thought it was flat? Science does not strive for truth, in other words, but for probability, a kind of knowledge that can be, and arguably has to be, 'probed'. Therefore, the limits of science result from its core concept, from the notion that 'nothing comes from nothing'. Questions about what existed before

the beginning of everything or what might exist once it all ends—the loose ends of cause-and-effect relationships—are out of bounds for science.

How then does chance factor into the scientific framework? After all, chance events cannot be explained as an effect of anything: we cannot make any observation that would allow us to predict at which point in time the nucleus of an atom will decay. We therefore have to reckon with genuine chance; that is, an event without a cause. Indeed, the concept of 'reckoning' is key here: even though we cannot predict when a single nucleus will decay, we can nonetheless calculate how long it will take for a gram of plutonium to decay, allowing us to act accordingly. At the level of calculus, science has adopted chance as a stray cat: it accepts it but cannot ultimately tame it, for it is not able to deal with single, individual chance events. For science, therefore, there are just two sorts of event: events with causes, with which it is classically concerned, and events without causes, chance events. So how then might science help us to understand freedom? The answer, applying the scientific *modus operandi*, is by looking for the effects of freedom, by asking what behaviour would result from a 'free' decision. Such a research programme targets the organization of behaviour and thus the very core of neurobiology.

Neurobiology is concerned with the function of the brain, or the question: for what do we have a brain? It seems to me that we have a brain in order to do the right thing—the one word, the one step, the one signature that can give our life a new direction. To ask for the function of the brain, therefore, is to ask how behaviour comes about.

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Some neuroscientists have expanded their interest to include psychological processes, such as memory or perception, but arguably these approaches remain within the limits of behavioural analysis. For example, to investigate a psychological process such as memory, it is necessary first to ask what behaviour should be observable if such a thing as memory exists. Suppose that *Drosophila* maggots are repeatedly exposed to alternating cycles of training such that one particular scent is rewarded with food whereas a different scent is not. If the animals subsequently prefer the 'rewarded' over the 'non-rewarded' scent, we can conclude that they have memory. Equipped with such a test, neurobiologists can try to understand the details of the events that must take place in the brain to result in this kind of behaviour. In other words, what makes a neurobiological investigation possible is looking not at the psychological occurrence itself, but at its behavioural corollary. In this sense, psychological processes become appropriate subjects for scientific analysis. Thus, for a neurobiological investigation of free will, we would need a specific behavioural test to diagnose the effect of a 'free' decision.

No neurobiological observation could ever refute Socrates' claim that he wanted to drink the poison given to him

Figure credit: The Death of Socrates (oil on canvas) by Salvator Rosa (1615–1673). Private Collection/ Photo from Christie's Images/The Bridgeman Art Library [out of copyright].

Perhaps the criterion is perfectly simple. 'I am free if I can do, or not do, what I want'. But the word 'I' is suspiciously prominent in this sentence, and one wonders whether science is able to handle such personalized accounts. More importantly, as the criterion is that there is no contradiction between my will and my deed, could

neurobiology resolve any such contradiction? Does neurobiology have any access to will that is independent of deed; that is, can neurobiology prove that will does not match with behaviour? The answer is no. No neurobiological observation could ever refute Socrates' claim that he wanted to drink the poison given to him. Whether it

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was his free decision or not, neurobiology cannot tell because it lacks access to his will that is independent of what he does or what he says.

Neurobiology therefore cannot contribute to the debate about free will. Nevertheless, the relationship between freedom, cause and chance continues to spark controversy, also among neurobiologists. What are the issues?

Does 'doing what I want' mean that I need to be able to defy the laws of nature to be free? Does it mean we are only free if we can move mountains, make water flow upwards, or turn it into wine? Such a concept of freedom would be meaningless. Indeed we are only free to exercise our will if the laws of nature are valid and the consequences of our actions can be reliably assessed in advance. The laws of nature are therefore not detrimental to and do not constrain our freedom; on the contrary, they are a precondition for expressing it.

Does 'doing what I want' therefore mean that my actions can only be constrained by the laws of nature, and nothing else? Would I be truly free, for example, if I were able to perform a somersault in the middle of giving a lecture because I just felt like doing so? Ought I to be able to engage in any activity, at any time? Hardly so; in fact, I would be considered mad, and in a certain sense 'I' would not truly exist at all. It is only because of the continuous constraints imposed by my life story—the individual combination of inner necessities, experience and social interactions throughout my life—that it is possible to speak of my will in the first place. Otherwise, 'I' would be a mere generator of chance. Even if action is ultimately rooted in chance processes—and I think this might turn out to be so—these are individually tailor-made chance processes, within the bounds of my genetic constitution and my personal and social biography. These bounds establish individually unique probability fields for action selection, which enable us to take our own chances. In other words, a will without all these contingencies would never be my will, let alone my free will. I am free to the

extent that the reasons for my behaviour are my own reasons, to the extent that I ascribe to myself the authorship of my actions.

How does this ascribing of authorship work? We can decide whether or not to touch the hotplate. If we do, we suffer the painful consequence of our action and look for its cause within ourselves. That is, we blame ourselves for the pain, and in doing so establish ourselves as 'subject'. Significantly, this sense of oneself as the author of an action has a neurobiological counterpart: after touching the hotplate, heat-sensitive sensory cells in the skin send a message to the brain where they trigger changes in the brain's neural circuitry that restrain our future curiosity about hotplates. We are not only ascribing authorship to ourselves in the sense of 'my own fault!', but the consequences of action are also being inscribed on us in the form of a memory trace. Indeed, our ability to learn from the consequences of actions—so-called operant learning—is a phylogenetic *tour de force*: animals that are not capable

of such learning are unlikely to survive natural selection. This process is particularly important if the individual does not or cannot know the consequences of its actions, when it has to take its chances by trying something out. After doing so, the consequences are assessed for future behavioural organization, for personalizing the probability fields of action selection. Given the phylogenetically ancient aptitude for operant learning—the personalization of chance—maybe the self-ascription of behavioural authorship and the subjective experience this entails are rooted equally deeply in our evolutionary family tree?

The take-home message of these considerations, I believe, should be: there is no contradiction between the validity of the laws of nature and the freedom of our will. Nor is there a contradiction between the biological, biographical or social contingency of our will and our freedom. Moreover, our freedom is not in any form limited by the possible involvement of chance in generating action.

In simplified terms, I am free if there is no contradiction between what I want and what I do. However, as neurobiology has no access to will that is independent of deed, it is not able to characterize a particular behaviour or will as 'free'. Thus, neurobiology cannot define, prove or refute the

freedom of our will, and it certainly cannot explain it. What neurobiology can provide, however, is an analysis of the brain processes underlying the 'personalization' of the chances taken.

It seems that whatever freedom actually is, it is first and foremost your freedom—so good luck with it!

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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