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Column

Do flies have free will?

Neuroscience can't show us the source of free will, says Philip Ball, because it's not a scientific concept.

Philip Ball

Gluing a fly's head to a wire and watching it trying to fly sounds more like the sort of experiment a naughty schoolboy would conduct than one that turns out to have philosophical and legal implications.

But that's the way it is for the work reported this week by a team of neurobiologists in the online journal PLoS One[1]. They say their study of the 'flight' of a tethered fly reveals that the fly's brain has the ability to be spontaneous — to make decisions that aren't predictable responses to environmental stimuli.

The researchers think this might be what underpins the notorious cussedness of laboratory animals, wryly satirized in the so-called Harvard Law of Animal Behavior: "Under carefully controlled experimental circumstances, an animal will behave as it damned well pleases."

In humans, this apparently volitional behaviour is traditionally ascribed to our free will. Björn Brembs of the Free University of Berlin, Germany, and his colleagues make the somewhat radical claim that their experiment shows that even flies, although not making conscious decisions, have a kind of primitive 'free will' circuit wired into their brains.

That's an intriguing idea, not least because it forces us to confront the question of what on earth 'free will' could mean in a neuroscientific context. My suspicion is that such a meaning doesn't exist.

Hardwired spontaneity

In Brembs' experiment, a fly is tethered inside a blank white cylinder devoid of any environmental triggers that might make it change direction. If the fly is nothing but an automaton impelled hither and thither by external inputs, then this lack of clues will leave it choosing directions at random. But measuring the tugs that the fly gives the tether reveals that it isn't trying to flit about randomly, but instead attempting to alternate localized buzzing about with occasional big hops.

This kind of behaviour has been seen in other animals (including humans), where it has been interpreted as a good foraging strategy: if a close search of one place doesn't bring a result, you're better off moving far afield and starting afresh.

But this was thought to rely on feedback from the environment, and not to be intrinsic to the animals' brains. Brembs and colleagues say that in contrast there exists a 'spontaneity generator' in the flies' brains that does not depend on external information in a determinate way. This seems to have proven useful in evolutionary terms, and so has become hard-wired into the fly brain.

Such a neural circuit could, the researchers say, be a kind of precursor to the mental wiring of humans that enables us to ignore environmentally conditioned responses and 'make up our own minds' — to exercise what is commonly interpreted as free will. "If such circuits exist in flies, it would be unlikely that they do not exist in humans, as this would entail that humans were more robot-like than flies," Brembs says. The researchers now intend to search for the neural machinery involved.

My brain made me do it

The existence of such neural circuits would mean that you can know everything about an organism's genes and environment yet still be unable to anticipate its caprices. If that's so, this adds a new twist to the current debate that neuroscience has provoked about human free will.

Some neuroscientists have argued that, as we become increasingly informed about the way our behaviour is conditioned by the physical and chemical make-up of our brains, the notion of free will and therefore legal responsibility will be eroded. Criminals will be able to argue their lack of culpability on the grounds that "my brain made me do it".

While right-wingers and libertarians feel this will hinder the law's ability to punish and will strip the backbone from the penal system, others say it will merely change the law's rationale, making it concerned less with retribution and more with utilitarian prevention and social welfare. According to psychologists Joshua Greene of Harvard University, Massachusetts, and Jonathan Cohen of Princeton University, New Jersey, "Neuroscience will challenge and ultimately reshape our intuitive sense(s) of justice."[2]

If neuroscience indeed threatens the notion of free will, some of the concerns of the traditionalists are understandable. For if our actions are simply automatic responses to external stimuli, it is then only a short step to the pre-emptive totalitarianism depicted in the movie Minority Report, where people are arrested for crimes they have yet to commit.

But the results of Brembs and colleagues suggest that, thanks to the spontaneity circuit, even the fly's brain is highly nonlinear, like the weather system, and not susceptible to precise prediction based on known inputs.

Or maybe society made me do it?

In any case, our behaviour is not governed by the way our minds work in isolation — and so our responsibilities should not be evaluated that way. As neuroscientists Michael Gazzaniga of Dartmouth College in New Hampshire and Megan Steven of the Beth Israel Deaconess Medical Center in Boson have pointed out, we act in a social context. "Responsibility is a social construct and exists in the rules of society," they say. "It does not exist in the neuronal structures of the brain."[3]

This should be trivially obvious, but is routinely overlooked. Other things being equal, violent crime is frequently greater where there is socioeconomic deprivation. This doesn't make it a valid defence to say "society made me do it", but it shows that the interactions between environment, neurology and behaviour are complex and ill-served by either neurological determinism or a libertarian insistence on untrammelled 'free will' as the basis of responsibility and penal law.

Brembs and his colleagues have made a nice case for why the absolute determinism advocated by some neuroscientists may not work. But it is a mistake to think that the indeterminacy they highlight is the same 'free will' that philosophers discuss (see Box On free will), any more than talking about 'love' in terms of brain chemistry means we are analysing what Shakespeare wrote about.

The fact is that 'free will' is (like 'life' and 'love') one of those culturally useful notions that become meaningless when we try to make them 'scientific'. That's why it is unhelpful to imply that the brains of flies or humans might contain a 'free will' module simply because they have a capacity to scramble the link between cause and effect.

Free will is a concept for poets and novelists, and, if it keeps them happy, for philosophers and moralists. In science and politics, it deserves no place.

Visit our flieshavefreewill.html">newsblog to read and post comments about this story.

References

1. Maye A., *et al*. PLoS ONE, e443 (2007).
2. Greene J. & Cohen J. J. Phil. Trans. R. Soc. Lond. B, 359 . 1775 - 1785 (2004).
3. Gazzaniga M. S. & Steven M. S. Sci. Am. MIND, (2005).