



## Has neuroscience disproven free will?

**Thomas Binns** (Aberdeen) explores whether neuroscience has disproven the theory of free will.

Neuroscientific investigations into free will have centred on the readiness potential (RP) – a negative build-up of electrical potential preceding self-initiated movement. The classic interpretation of the RP is that it reflects movement preparation processes for self-initiated acts. In a seminal paper, Libet and colleagues found that the onset of the RP preceded the reported time at which subjects became aware of their intention to act. They concluded that unconscious brain processes determine our decisions long before we become consciously aware of them, which has been used to argue that free will is an illusion.

However, much research has since been conducted on this topic, with some concluding that Libet's findings do not seriously threaten free will. This is due to criticisms of the experimental task

– such as a lack of ecological validity, generalisability and internal validity – as well as findings that humans are able to veto a decision until the very last moments before an action is completed, even if movement has already begun and an RP is present. Other arguments against Libet's conclusion stem from alternative interpretations of the RP.

Two such models with alternative interpretations are the stochastic accumulator model and the slow cortical potential sampling hypothesis. Despite differences between these models, they both argue that the early part of the RP (from its onset until a few hundred milliseconds before movement) does not reflect unconscious movement preparation processes. Instead, the decision to act is said to occur very late in the time course of the RP, close to the

reported time of awareness of intention. Hence, Libet's conclusion, based on the classic interpretation of the RP, that unconscious processes determine our decisions far in advance of our conscious awareness is challenged.

As for the brain areas involved in this process, the early RP is thought to originate in the supplementary motor area (SMA), pre-SMA, and anterior mid-cingulate cortex. These areas may be connected, via the basal ganglia, to the primary motor cortex, where activity in the hemisphere contralateral to movement is associated with the late RP.

Recent neuroscientific evidence has greatly weakened Libet's conclusion, which challenged our intuition of free will. Therefore, it can be strongly argued that neuroscience has not disproven free will.

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• A version of this article with references can be found on the [BNA website](http://www.bna.org.uk).