History of neuroscience of self-initiated action and volition: recent developments and paradigm shift

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History of neuroscience of self-initiated action and volition: recent developments and paradigm shift

B. Trovò & A. Schurger

**Definitions**

Self-initiated movements: endogenous actions (also called internally generated or internally determined) that are controlled according to the individual’s free will. Conversely, exogenous actions are governed by environmental conditions.

Integration-to-bound models and evidence accumulator models: two classes of computational models of decision-making. Integration-to-bound models assume that decisions are made when the accumulated evidence reaches a threshold. Evidence accumulator models assume that decisions are made when the accumulated evidence reaches a threshold.

**History (1): discovery of the Bereitschaftspotential ~60’s**

In 1960, Libet & Janzen report the discovery of a voltage change (the Bereitschaftspotential) in humans, the activity of which precedes the voluntary movement and can be recorded in the EEG. Libet & Janzen believe that the Bereitschaftspotential is a neural correlate of the readiness to act, which is a prerequisite for voluntary action. Libet & Janzen believe that the Bereitschaftspotential is a neural correlate of the readiness to act, which is a prerequisite for voluntary action.

**History (2): the ‘Libet paradox’ ~80’s**

In 1983, Libet et al. report a study on the relationship between the time of conscious intention to act and the time of cerebral activity. Libet et al. find that the time of conscious intention to act precedes the time of cerebral activity by several seconds. Libet et al. believe that the time of conscious intention to act precedes the time of cerebral activity by several seconds.

Schurger 2012: make integration & paradigm shift

Subjects were asked to perform a motion discrimination task, where they had to judge whether a stimulus was faster or slower than a reference stimulus. Schurger et al. find that the response time of the subjects is determined by the time of the conscious intention to act, which is reported by the subjects after the task.

**Conscious intention & free will ~80’s-2000’s**

Chalmers (1996) is the most influential proponent of the ‘hard problem’ of consciousness. Chalmers argues that consciousness is a fundamental property of the universe, which cannot be explained by the physical laws of the universe. Chalmers argues that consciousness is a fundamental property of the universe, which cannot be explained by the physical laws of the universe.

Integration-to-bound models for spontaneous action initiation studies ~2010’s

The convergence of empirical studies and computational modeling has led to the development of several models of spontaneous action initiation. The models that have been tested include the leaky accumulator model, the stochastic decision model, and the model of the signal-to-noise ratio.

Perceptual–decision paradigms for SVM studies ~2010’s

The application of computational models in the study of spontaneous action initiation has been accompanied by another very recent change in the experimental paradigms in the domain of volition. As extensively discussed by Haggard et al. (2017), empirical studies have been conducted in a large variety of contexts, including neuroimaging, single-neuron recordings, animal models, and psychophysical experiments.