Determinism: Did Libet Make the Case?

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Benjamin Libet's influential publications have raised important questions about voluntarist accounts of action. His findings are taken as evidence that the processes in the central nervous system associated with the initiation of an action occur earlier than the decision to act. However, in light of the methods employed and of relevant findings drawn from research addressed to the timing of neurobehavioural processes, Libet's conclusions are untenable.

Joseph Seifert has recently raised fundamental conceptual issues associated with the influential research and theory advanced by Benjamin Libet on the question of freedom of the will.[1] As Seifert's intention was chiefly to draw attention to the deeper philosophical considerations judged to be overlooked by Libet, little attention was given to the status of the relevant findings on which Libet's position depends. In fact, most of the controversy in the years since Libet's findings were reported has generally taken the findings at face value and then proceeded to consider the warranted interpretations. However, at a time of growing interest in and even enthusiasm for 'neurophilosophy', it is important to be as cautious at the level of scientific method as it is at the level of philosophical analysis. In keeping with this, the present brief essay examines the extent to which Libet's methods do or even could support the quite daring conclusions thought to be established by them.

Libet's work has suggested to many that the traditional ('prescientific') conceptions of voluntary action must be revisited and revised in light of experimental findings generated by the following basic paradigm:

1. Subjects are 'free' to move a finger or flex their wrists at will, while attending to a timing device. The latter in most of the

[1] Josef Seifert, 'In defense of free will: A critique of Benjamin Libet', *Rev. Metaphys.* **65** (2011), 377–407. Benjamin Libet, 'Do we have free will?' in *The Oxford Handbook of Free Will*, (ed.) Robert Kane (Oxford: Oxford University Press, 2002), 551–564.

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studies is a circular array of lights coming on sequentially and rapidly.

2. Recordings of average evoked potentials are taken for periods extending from before any movement to a brief period following movement. Evoked potentials are the computer-averaged signals elicited from the brain by discrete stimulus presentations.[2]
3. Electromyographic (EMG) recordings are taken simultaneously, these providing evidence of the point at which relevant muscle groups are activated.
4. Replicative studies employing fMRIs produce comparable results.

The controversial but reliable finding is that the cortical sign of readiness to act occurs before the subject's decision to act. In other words, a cortical 'readiness potential' (RP) appears prior to the moment at which the subject is volitionally committed to act. This latter moment is determined by the subject's specification of the point in the arc of the sequentially illuminated lights at which 'volition' was first sensed or felt. The task facing the subject is choosing a point within a rapid sequence of points that most closely matches that subject's sense of having decided to make a movement. Based on the findings, the resulting conclusion is generally phrased in terms of the brain 'deciding' before the subject is (subjectively) aware of the relevant volitional state.

There are, however, grounds on which to challenge both the method and the conclusions drawn. First, fMRI data and evoked potentials are not reliably correlated.[3] This finding is important in

[2] As a given response recorded from the surface of the scalp is far weaker than the background electrical activity of the brain, an averaging procedure is required if the stimulus-locked reactions are to be distinguished from the background.

[3] See, e.g., R. Slater, 'Serial evoked potential studies and MRI imaging in chronic progressive multiple sclerosis'. *Journal of the Neurological Sciences*, **171**(2) (1999), 79–83; N. Shinoura, R. Yamada, Y. Suzuki, T. Kodama, K. Sekiguchi, M. Takahashi, K. Yag, 'Functional Magnetic Resonance Imaging Is More Reliable than Somatosensory Evoked Potential or Mapping for the Detection of the Primary Motor Cortex in Proximity to a Tumor', *Stereotactic and Functional Neurosurgery* **85** (2007); Zhongming Liu, Lei Ding, and Bin He, 'Integration of EEG/MEG with MRI and fMRI in Functional Neuroimaging', *IEEE Eng Med Biol Mag.* **25**(4) (2006), 46–53.

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two respects. It renders the fMRI findings less than 'confirmatory' of what has been found by way of evoked potentials. Moreover, it raises the more general question of precisely which record of brain activity is to be taken as dispositive in research of this kind.

With respect to behavioural indicators of volition, it should be noted that routine and well rehearsed actions are especially inapt as markers for actions based on choice and deliberation. Such routine actions as those employed by Libet are almost certainly *preplanned* in the sense discussed and explained by Karl Lashley a half-century ago.[4] The skilled bicycle rider does not deliberate on the sequence of motor actions constitutive of riding, though, after the fact, she will surely regard the actions as voluntary. Put another way, the neuromuscular events take place in a time frame different from that used by the subject in estimating the point at which decisions to act take place.

The processes at work in these contexts are complex and require careful methods of stimulus specification and experimental controls. Illustrative of the complexity is research by Haggard et al.[5] A subject is presented with a brief auditory signal after pressing a button. Under such conditions, subjective estimates of time at which the button-press occurred are shifted in the direction of time at which the signal was presented, and the judgment of the latter time is shifted toward the time at which the action occurred. Other studies have shown that a repeated stimulus is judged to be of longer duration.[6] Thus, it is likely that repeated chains of brief dots of light might well expand the observer's time-frame and thereby shift the temporal locus of events external to the stimulus array; i.e., the temporal locus of the intention to move. Indeed, such illusions as the inversion of temporal order are readily achieved when multiple stimuli are presented and judgments of the ordering of one's actions are required.[7] Simply put, subjective estimates of brief duration and of

[4] The *locus classicus* is Lashley, K. S. 'The problem of serial order in behavior' in L. A. Jeffress (ed.), *Cerebral mechanisms in behavior* New York: Wiley, (1951), 112–131. Consider a pianist attempting the final movement of the *Moonlight Sonata* and approaching the work by striking a note, assessing the consequences, then striking another, etc. Rather, the virtuoso has so overtrained that the entire template of the piece is what has been formed and stored, such that the *arpeggios* are, as it were, 'read out' *en bloc*.

[5] Haggard, P., Clark, S., & Kalogeras, J. 'Voluntary action and conscious awareness', *Nature Neuroscience* **5** (2002), 382–385.

[6] Rose, D. & Summers, J. 'Duration illusions in a train of visual stimuli', *Perception* **24** (1995), 1177–1187.

[7] Elizabeth Liddle and Stephen R. Jackson, 'Recalibrating Time: When Did I Do that?' *Current Biology* **16**(23) (2006).

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the intervals within which actions occurred are sensitive to any number of internal states and external features of the experimental context. As Eagleman and Periyadath have noted, 'Perceived duration is conventionally assumed to correspond with objective duration, but a growing literature suggests a more complex picture.[8]

With respect to readiness potentials (RPs), research by Keller and Keckhausen is especially useful in showing that such potentials are readily obtained from subjects performing non-consciously.[9] Their comments on Libet are instructive. As noted, Libet's principal finding is that the onset of the RP occurs 350 msec. earlier than the subject's estimation of a conscious intention to move. Libet reasoned that the actual initiation of the movement is therefore unconscious and thus involuntary. From these results Libet concluded that the cerebral initiation of a spontaneous voluntary act begins unconsciously. Keller and Keckhausen suggest instead that, as a result of the very instruction that subjects pay attention to the sense of 'wanting to move', otherwise automatic and unconscious motor acts reach the level of awareness.

Proceeding from this hypothesis, Keller and Keckhausen performed a series of experiments. In one, the RPs were recorded from subjects performing unconscious movements. In another, Libet's study was replicated. In a third, subjects were in a state of rest but encouraged to look introspectively for intentions to move. Interestingly, subjects displayed RPs 500 msec. before both conscious and unconscious movements. The warranted conclusion is that Libet's method results in focused attention on internal events, and this focus leads to the conscious awareness of a normally unconscious process. Indeed, robust readiness potentials are readily secured in sleeping subjects, thus raising further questions as to the plausibility of Libet's conclusions.[10]

[8] David M. Eagleman and Vani Pariyadath, 'Is subjective duration a signature of coding efficiency?' *Phil. Trans. R. Soc. B* **364** (2009), 1841–1851.

[9] I. Keller and H. Heckhausen, 'Readiness potentials preceding spontaneous motor acts: voluntary vs. involuntary control', *EEG Clin. Neurophysiol* **82** (1992), 85–86.

[10] S. Nishigan, Y. Hayasaka and K. Okamoto, 'Measurement of readiness potential of involuntary movement' *J. Adv. Sci.* **12**(1/2) (2000), 53–54. RPs were recorded for saliva swallowing in states of wakefulness and and light sleep. Evoked potentials after swallowing were observed in both conditions. The results established that RPs are present in sleeping subjects.

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There are yet other concerns associated with measures of RPs. Even the relevant neural pathways remain a topic of theoretical controversy. The earliest component of the RP is generally taken to arise from the pre- supplementary motor area (pre – SMA) and then, by way of feedback and feed-forward loops, the excitation results in the activation of motor centers. However, the so-called "readiness" potential is merely a recorded increase in voltage relative to a resting baseline. Recordings are in the form of repeated snapshots of a brief temporal epoch, beginning with the baseline, then extending to the RP and then stretching to embrace the duration of the action of interest. In such stimulus – locked recordings the baseline is normally recorded just before the delivery of the stimulus. In the Libet – type study, the RP is based on samples that begin a short time before the executed action. But with subjects in what is finally a vigilant mode, to what extent is a 'resting' level ever achieved? Is the subsequent increase in voltage an increase above 'rest' or an increase in what is already a state of readiness?

Current research continues to wrestle with the complexities of the neural mechanisms associated with preparation to act. What is clear is that a form of motor planning (again, of the sort envisaged decades ago by Lashley), is routinely observed in basic neurophysiological research.[11] Again, however, the complexity of the processes and of the factors that would influence subjective estimates of the onset of one's own volition have scarcely been noticed, let alone addressed either in Libet's own research or in later attempts at replication.

Whatever their introspective states might contain, experimental subjects in these studies are called upon to respond quickly to rapidly sequenced events; a task similar to traditional studies of reaction time. With this in mind, consider the older findings of Fehrer and Raab.[12] They demonstrated that reaction time to 'unseen' stimuli is as rapid as to readily perceived stimuli in a metacontrast context. That is, the subject responds as quickly to a stimulus 'masked' by a more intense subsequent stimulus as to the first stimulus when presented alone. One warranted conclusion is that reaction time is not a proper indicator of integrative processes such as those presumably associated with deliberation and volition.

[11] Afsheen Afshar, Gopal Santhanam, Byron M. Yu, Stephen I. Ryu, Maneesh Sahani, Krishna V. Shenoy. 'Single-Trial Neural Correlates of Arm Movement Preparation', *Neuron* **71**(3) (2011), 555–564.

[12] Fehrer, E., & Raab, D. 'Reaction time to stimuli masked by metacontrast', *Journal of Experimental Psychology* **23** (1962), 143–147.

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In recent and otherwise supportive research, Patrick Haggard has raised further questions regarding methodology and interpretation.[13] Haggard notes that in Libet – type studies there is an encouragement of subjects to perform in ways conformable to their notions of 'free will'. Haggard cautions that participants might thus interpret this as a requirement to monitor their performance and selectively vary it. Furthermore, the demands imposed on subjects in such research situate them in something of an indefinite domain in which actions are very much akin to reactions; contexts in which the 'voluntary' and the reflexive are inextricably bound.

Then, too, it remains unclear as to what precisely the experimental subjects are 'reporting' when selecting an interval putatively inclusive of their volitional commitment to act. It may well be that 'volition' is timed according to the sensory consequences (feedback) of the movements themselves, a possibility suggested by research employing EEG data.[14] In this research there is evidence of a slow negative shift in the baseline EEG associated with the facilitation of later movements. The subsequent positive deflections probably reflect movement-produced feedback. On this basis, it is plausible to ask whether Libet's subjects base their estimates of decision-time on just these afferent signals arising from the movements themselves.

Finally, there is a difference between a voluntary act and a plan with intended outcomes. I shall not belabor the point. One who 'intends' to be a surgeon must frame long-term action sequences, elements of which may consume years. Here is a thought – experiment: Smith does, indeed, intend to be a surgeon and to achieve this must perform a very large number of actions. Let's say three million. Thanks to technology, his brain can be non- invasively stimulated such that 2.84 million of these actions are made to occur automatically. Question: Did Smith freely intend to be a surgeon and was that intention freely realized? Of course, he could not be a surgeon had his hands been irreparably damaged in the fire that broke out in his room. But he responded to that event *reflexively* – which is to say *non-volitionally*. Do we subtract this from the overall 'volition' score? The point, of course, is that the issue of free will and determinism arises from such real life choices as to remove any and all skeptical questions as to whether portions of the activity

[13] Patrick Haggard, 'Human volition: towards a neuroscience of will', *Nature, Reviews Neuroscience* **9** (2008), 934–946.

[14] See, for example, L. Gilden, H. Vaughan and L. Const, 'Summated human EEG potentials with voluntary movement', *Electroencephalography and Clinical Neurophysiology* **20** (1966), 433–438.

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are reflexive or based on sensory feedback or are little more than musculo – skeletal events. Studies involving very limited reactions to dimensionless stimuli under the necessarily artificial constraints of the laboratory would be ill chosen as a means of addressing the larger issue even if less defective at the level of method, measurement and interpretation.

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