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Reclaiming Volition

An Alternative Interpretation of Libet's Experiment

Abstract: *Based on his experimental studies, Libet claims that voluntary actions are initiated by unconscious brain activities well before intentions or decisions to act are consciously experienced by people. This account conflicts with our common-sense conception of human agency, in which people consciously and intentionally exert volitions or acts of will to initiate voluntary actions. This paper offers an alternative interpretation of Libet's experiment. The cause of the intentional acts performed by the subjects in Libet's experiment should not be* ***exclusively*** *attributed to special cerebral processes; conscious intentions formed at the beginning of the experiment, when the subjects received experimental instructions, must be taken into account. In addition, what the subjects were required to report was not a conscious* ***intention*** *or* ***decision*** *to act that conventionally figures in the etiology of voluntary action, but rather a perceived effective* ***urge*** *to move induced by specific experimental instructions. According to the alternative interpretation, the most suitable mental term correlated with the specific brain activity that precedes conscious, self-initiated voluntary bodily movements is* ***volition****. This account is supported by recent theories of function of the supplementary motor area (SMA). Therefore, the notion that we are the authors or originators of our own actions, which is fundamental to our common understanding of free will, moral responsibility and human dignity, can be preserved.*

I: Introduction

According to a common-sense image of human agency, we are the authors or originators of our own actions. The conception of full-fledged agency implies that an agent is not only able to accept or refuse what is up to him, but also can *originally* make things happen. This notion is related to our understanding of moral responsibility: a person could be more responsible if he intentionally *brought about* some events, other than just omitted or failed to prevent them.

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This notion is also relevant to our sense of human dignity. Kant, for example, maintains that all rational beings should be treated as 'ends in themselves' because they are 'the ultimate creators of their own ends' (Kant, 1959, p. 52).

The idea that we can consciously, intentionally initiate our own actions, however, is challenged by the neurophysiologist Benjamin Libet. In his experimental investigation, Libet found that our voluntary acts are 'initiated by unconscious cerebral processes before conscious intention appears' (Libet, 1985, p. 529). Thus it is our unconscious brain processes, rather than ourselves as conscious agents, who originally bring about voluntary actions. But Libet wants to preserve a functional role for conscious human agents as controllers of the final motor acts: one can veto in the final stage of cerebral motor processing, to block the actual muscle movements occurring. Libet hopes that the existence of the veto mechanism can salvage doctrines of free will and moral responsibility, but they must be substantively revised: 'Processes associated with individual responsibility and free will would "operate" not to initiate a voluntary act but to select and control volitional outcomes.' (Libet, 1985, p. 538; see also Libet, 1999.)

Despite a variety of criticisms on his experimental paradigm and his interpretation of the experimental results, Libet's account has received wide acceptance and is becoming the standard story (e.g. Freeman, 2000, pp. 122–4; Haggard and Libet, 2001; Norretranders, 1998, ch. 9; McCrone, 1999, ch. 6; Wegner, 2002, pp. 50–6). Part of the reason is that alternatives to his interpretation have rarely been fully developed and articulated. This paper aims to remedy the deficiency. I will show that we can preserve our self-image as the originators of our own actions based on a more plausible interpretation of Libet's experiment. My focus is on volition, which is conventionally regarded as action initiator, bridging the gap between intentions and actual bodily movements (Section II). Libet's account undermines the classical view of volition by eliminating its initiating role in the etiology of voluntary action (Section III). An alternative to Libet's account is developed (Section IV), on the basis of Keller and Heckhausen's elegant experiments, which include a replication of Libet's study (Keller and Heckhausen, 1990). This alternative interpretation is supported by recent theories of function of the supplementary motor area (Section V). If the alternative interpretation of Libet's experiment developed here is plausible, the classical doctrine of volition as action initiator is tenable, and our common-sense picture of human agency can be preserved.

II: Volition, Intention and Action

The volitional theory of human action has been a prominent account of voluntary behaviour at least since Aquinas. Actions are usually embodied in voluntary bodily movement. A central task for theories of action is to specify the conditions that distinguish voluntary and involuntary bodily movement. Actions are generally understood as things that we voluntarily do, perform and initiate, rather than things that we undergo or that merely happen to us. A general way to understand the nature of action is to view actions as bodily movements preceded by certain

forms of thought, such as appropriate combinations of beliefs and desires, intentions or reasons. It is these particular forms of thought that characterize the voluntariness of human action. However, how can a certain piece of thought bring about physical bodily movement? It is traditionally conceived that the acts of will, namely volitions, play a role in bridging the gap between thoughts and bodily movements. Volitions, then, are 'action initiators'.

Many modern philosophers held this version of volitional theory of action. Locke, for example, put the classical view succinctly:

> *Volition* or *Willing* is an act of the Mind directing its thought to the production of any Action, and thereby exerting its power to produce it. (*An Essay Concerning Human Understanding*, II.XXI.28.)

Unlike most classical volitionists, William James does not think that *all* voluntary actions are preceded by 'the feeling of innervation', the subjective experience of 'a special current of energy going out from the brain into the appropriate muscles' (James, 1981, p. 1104). James argues that many *simple voluntary acts* can take place once the mental representation of the desired bodily movement is brought into consciousness. There is no 'express fiat' needed when the conditions are simple (p. 1134). But for the cases involving conflicting or antagonistic ideas, as illustrated by his famous example of getting out of bed on a freezing morning, 'an additional conscious element, in the shape of a fiat, mandate, or express consent, has to intervene and precede the movement' (p. 1130).

In his recent book *Rationality in Action*, John Searle argues that there are three gaps in human practical reasoning and action:

> First, there is the gap of rational decision making, where you try to make up your mind what you are going to do. Here the gap is between the reasons for making up your mind, and the actual decision that you make. Second, there is a gap between the decision and the action. Just as the reasons for the decision were not causally sufficient to produce the decision, so the decision is not causally sufficient to produce the action. There comes the point, after you have made up your mind, when you actually have to do it. And once again, you cannot sit back and let the decision cause the action, any more than you can sit back and let the reasons cause the decision . . . There is a third gap that arises for actions and activities extended in time, a gap between the initiation of the action and its continuation to completion . . . Even once you have started you cannot let the causes operate by themselves; you have to make a continuous voluntary effort to keep going with the action or activity to its completion. (Searle, 2001, pp. 14–15.)

The first gap that Searle describes is between reasons for decision, which can be certain combinations of beliefs and desires, preferences or some emotions, and the decision or the intention to be formed. The second and the third gap are between the decision or the intention to act and the initiation of the intended action as well as the sustained execution and implementation of the intention. Whereas the first gap is between some thoughts (reasons) and another thought (a decision or intention), the second and the third gap are between thoughts (decisions or intentions) and actions (actual voluntary bodily movements). Searle maintains that these gaps are the source from which some traditional philosophical problems, such as

'the freedom of the will', arise, and where the mental activities conventionally called 'volitions' take place (see Searle, 2000). A comprehensive, unifying conception of volition has been proposed and developed in light of recent findings in psychology and neuroscience, which views volitions as special kinds of mental acts or activities by which an agent actively and consciously bridges the gaps in his practical reasoning and intentional action that Searle describes (see Zhu, forthcoming a, b).

Classical volitionists view volitions as being essential in bridging the second gap, which translate thoughts into actual bodily movements by triggering the initiation of action. One can have a decision or intention to act, but the decision or intention will remain as thought in the head until it is executed by relevant bodily parts. Volition is thus postulated as a mediating executive mental process, which somehow puts the bodily parts into action.

Volitions, conceived of as action initiators, play a significant role in human agency. Volitions are the mental acts by which an agent exerts his agency through directly driving bodily movements. An agent is the originator of his actions in that he consciously, intentionally, *brings about* the events by the acts of his will. Thereby he is not a passive bystander, but rather the creator of his own deeds. Thus volition is crucial to a full-blown conception of agency, which is fundamental to our understanding of moral responsibility, free will and human dignity.

Whereas volitions are *acts* of will by which an agent voluntarily initiates or drives his bodily movements, intentions are '*states* of mind that persist through time and guide actions' (Kane, 1996, p. 24). Intentions have many important functions in human behaviour, such as motivationally sustaining intentional actions, guiding and monitoring the execution of intentional actions, coordinating an individual agent's behaviour over time and the interactions between agents (Brand, 1984; Bratman, 1987, 1999; Mele, 1992). A striking feature of intention, which is lacked in other motivational states such as desires and wishes, is about the agent's practical commitment: intending to do A implies being settled upon doing A, which means the agent is committed to carrying out the intention either in the future or at the present, although the commitment is not necessarily irrevocable (see Mele, 1992, chs. 9 and 10).

Searle makes a very useful distinction between two kinds of intention (Searle, 1983, ch. 3): *prior intentions* are those formed *before* the actions to be initiated and executed; an *intention in action* is formed or acquired in the process of execution of an action. Searle suggests at least two ways to distinguish a prior intention from an intention in action (pp. 84–5). First, many of the intentional actions that we perform in daily life are quite routine, habitual and spontaneous. They are performed without forming, consciously or unconsciously, any prior intention to do those things. Second, in many circumstances, when one has a prior intention to do some action, there are usually many subsidiary actions that are not represented in the prior intention, but are performed intentionally nonetheless, whose corresponding intentions are formed or acquired in the course of action. Conceptually, it is apparent that prior intentions can participate in initiating intentional

actions, while an intention in action, which is formed or acquired after the course of action has already begun, has no initiating function.

Bodily movements can be classified as either internally initiated (self-initiated) or externally triggered (by events taking place in the outside world). Externally triggered movements are not necessarily merely *reactions* in response to the stimuli from the environment. They can be voluntary actions, or even intentional actions. For example, in a choice reaction time experiment, subjects are trained to respond to a certain external stimulus as quickly as possible. This sort of response is clearly voluntary and intentional, under the influence of a prior intention formed at the beginning of the experiment. On the other hand, not all internally initiated bodily movements are voluntary and intentional. Some compulsive behaviours or tics are apparently involuntary and unintentional. But there is a significant class of bodily movements that we experience as truly self-initiated, endogenous and willed actions. A prior intention is usually formed before the initiation of the action, and an act of will seems to be involved in triggering intended bodily movement, which is independent from any external cue or stimulus. This kind of action is generally understood as volitional action. Volitions, then, are generally involved in the implementation of intentions (see Heckhausen, 1991, ch. 6).

III: Libet's Challenge

In 1964, Kornhuber and Deecke discovered that self-paced voluntary bodily movements are preceded by a slow negative cortical potential (Kornhuber and Deecke, 1964, 1965; Deecke *et al.*, 1976). Subjects were instructed to perform rapid flexion of their index fingers at irregular intervals that were determined by themselves, independent of any external stimulus. A slow, negative potential shift measured by electrical activity on the scalp starts about one second or so prior to the initiation of the bodily movement (measured by the electrical activity in the muscles involved). It has been called *Bereitschaftpotential* or *readiness potential* (RP). The phenomenon of RP is a well-established one in psychophysiology, which does not occur in involuntary movements such as tics or reflex behaviours (Brunia, 1987).

The long interval (ranging from several hundred milliseconds to one and a half seconds) between the onset of RP and the corresponding self-initiated voluntary movement raises a crucial question for understanding the etiology of voluntary action. If a conscious decision to act or volition actually initiates a voluntary movement, then the subjective experience of this act of will should precede or at least coincide with the onset of the brain event that mediates the movement. So where is volition temporally situated? Does it precede or coincide with the onset of RP, thereby causing a voluntary action, or occur after the RP has already emerged? These were the questions that Libet asked and tried to answer by experimental investigation.

In a series of experiments conducted by Libet and his colleagues, subjects were instructed to perform quick flexion of their fingers or wrist of the right hand

on their own initiative (Libet *et al.*, 1982, 1983a, 1983b). For each trial, subjects were asked to perform the act at any time they felt the 'urge' or desire to do so. Thus the act appeared to arise endogenously or spontaneously, not in response to any external stimulus or cue. Subjects reported that they were aware of the urge or intention to move before every act. Libet and his colleagues recorded the RPs, and found that the averaged RP generally had an onset for its main negative rise at about 550 ms before the actual motor movement began. Perhaps the most ingenious and controversial part of Libet's experimental paradigm is the operational method for determining the time at which the subjects first become aware of the urge or decision to act. In the experiment, subjects were required to watch the 'clock position' of a spot of light revolving in a circle on the face of a screen, then recall the clock time of the first awareness of the urge to move. It was found that the average time for the awareness of the urge to move is 200 ms before the activation of the muscle (Libet *et al.*, 1983a). This result indicates that a subject was aware of the urge to act 350 ms *later* than the RP had already emerged in performing a self-initiated flexion.

Based on these experimental findings Libet concludes that spontaneous voluntary movements are actually initiated unconsciously by cerebral processes, instead of conscious intentions or volitions as conventionally conceived (Libet, 1985). Onsets of RPs regularly begin at least several hundred ms before conscious intention appears. This suggests that 'the brain "decides" to initiate or, at least, to prepare to initiate the act before there is any reportable subjective awareness that such a decision has taken place', which entails that 'some neuronal activity associated with the eventual performance of the act has started well before any (recallable) conscious initiation or intervention is possible' (Libet, 1985, p. 536). However, Libet wishes to preserve the functional role of conscious intention and free will in volitional action. He proposes:

> [C]onscious control can be exerted before the final motor outflow to select or control volitional outcome. The volitional process, initiated unconsciously, can either be consciously permitted to proceed to consummation in the motor act or be consciously 'vetoed'. In a veto, the later phase of cerebral motor processing would be blocked, so that actual activation of the motorneurons to the muscles would not occur (pp. 536–7).

After all, there remains a period of about 100 to 200 ms in which conscious control could block the actual muscle activation. Some subjects in Libet's experiment did report that during some of the trials, a recallable conscious urge to act appeared but was 'aborted' or suppressed before any actual movement occurred.

Libet's experimental investigation has a direct impact on our understanding of volition and agency. If a primary function of volition is to initiate voluntary bodily movement, then according to Libet's account, this volitional process must be unconscious, for the triggering process takes place several hundred milliseconds before the agent is able to be aware of the intention or decision to act. Therefore the agent is unaware of the act of will which actually triggers a willed action. The agent does not know when an intended action will be initiated, hence has no direct control over when to start a voluntary movement. On the other hand,

if volition occurs after a conscious intention has formed, it cannot have the function of initiating a voluntary act, for the triggering process has already begun before the conscious intention is formed. So volition is not an action initiator; it is an action censor at best. Libet hence proposes that 'conscious volitional control may operate not to initiate the volitional process but to select and control it, either by permitting or triggering the final motor outcome of the unconsciously initiated process or by vetoing the progression to actual motor activation' (Libet, 1985, p. 529). Therefore, the conception of conscious volition as action initiator seems to be undermined by Libet's experimental studies. As Dennett nicely puts it:

> We are not quite 'out of the loop' (as they say in the White House), but since our access to information is thus delayed, the most we can do is intervene with last-moment 'vetoes' or 'triggers.' Downstream from (unconscious) Command Headquarters, I take no real initiative, am never in on the birth of a project, but do exercise a modicum of executive modulation of the formulated policies streaming through my office. (Dennett, 1991, p. 164.)

Libet hopes that the existence of a conscious veto mechanism, which can block the final progress of the volitional process to actual muscle movement, preserves the possibility that 'conscious will could thus affect the outcome of the volitional process even though the latter is initiated by unconscious cerebral processes' (Libet, 1999, pp. 51–2; but see Dennett, 2003, ch. 8 for an incisive criticism of this idea). However, even if such a veto mechanism exists, our common-sense picture of human agency, which is fundamental to our ordinary understanding of moral responsibility and human dignity, is seriously under threat. As Libet states, 'we may view the unconscious initiatives for voluntary actions as "bubbling up" in the brain. The conscious will then selects which of these initiatives may go forward to an action or which ones to veto and abort, with no act appearing' (Libet, 1999, p. 54). Thus if you failed to do something obligatory it is not you who should be responsible for this neglect, for the unconscious activities of your brain simply had not brought up the option to you. If a person did something guilty, he is not responsible for originally bringing about the misdeed or guilt, but only for the failure of not vetoing to stop it, since an intention to act cannot be *fully*, consciously controlled — only its final consummation in a motor movement can be consciously censored. On Libet's account, the conscious volitional process relevant to a person's moral responsibility takes place only in the final moment of one-tenth of a second in the course of moral decision-making: after an unconsciously initiated decision or intention to act has been consciously experienced by the agent, and before the final motor command is sent to the muscles. Thus the common-sense image of human agency must be rejected (Rosenthal, 2002), and part of our moral, legal and religious systems need to be reformed (Libet, 1999).

IV: An Alternative Interpretation of Libet's Experiment

We should be cautious, however, in interpreting Libet's experiment and in drawing implications for understanding volitional action *in general*. Two issues

of the interpretation appear to be especially relevant to our understanding of volition. First, what were the subjects introspectively aware of at the moment associated with the clock position that they recalled later? Was it a conscious intention, decision, *or* perceived urge to act? Second, what mental phenomenon might be correlated with the RPs, which precede self-initiated, voluntary movements by approximately half a second? By answering these questions I will attempt to provide an alternative to Libet's interpretation and show that this alternative is more plausible than Libet's.

1. Experimental setting and prior intention

As noted by many critics, the simple flexion acts performed by the subjects in the Libet experiment were not as free and spontaneous as Libet implies (Breitmeyer, 1985; Bridgeman, 1985; Näätänen, 1985; Dennett, 1991, pp. 162–8; Flanagan, 1996, ch. 4). The small, sharp movements that the subjects were instructed to perform were not freely willed but were requested by the experimenter. As the Finnish psychologist Risto Näätänen, who is also an expert in the research of movement-relevant potentials, points out:

> [T]he specific nature of the movements was determined in detail by the instructions, practice, and preceding repetitions . . . hence the only decision of the subject [just] involved the *timing* of this *preplanned* movement. Moreover, even the decisions to perform this movement can be regarded as already having been made (consciously) by him at the beginning of the experiment: The subject knows and has agreed that he is going to produce quite a large number of these movements sooner or later, within some reasonable time, before he can leave (and received his payment), and that it is only the timing of each single movement of this specified type that is under his control . . . Consequently, it appears to be somewhat questionable to describe this motor act as 'spontaneous' or 'fully endogenous' and occurring with 'no preplanning'. It is accordingly not possible to agree with Libet's main conclusion that 'cerebral initiation of spontaneous voluntary act begins unconsciously' . . . since the type of motor act and whether it would be repeatedly performed during the session was *consciously* decided by the subject on receiving the experimental instructions. (Näätänen, 1985, p. 59.)

The point is that the subjects were first instructed 'to *make a conscious effort* to let flexion occur spontaneously. To do so, the subjects had to load from conscious awareness an instruction to perform a certain task' (Flanagan, 1996, p. 61). In the actual experiment the instructions were given to fully conscious individuals who agreed to comply with the experimental instructions and who made an effort to do so. Thus at the beginning of the experiment, the subjects formed a *prior* conscious intention to perform required acts in order to follow the instructions (Searle, 2000). The only thing unspecified was the exact time when the movements would occur. It remains obscure how this general prior intention or plan actually influences the cerebral processes associated with voluntary movements. Some of the brain processes are indeed *unconscious* events. For example, people are apparently unaware of the RPs that precede voluntary bodily movements. But it does not follow that these brain processes can occur *unconsciously*, and the

subjects did not consciously know what they were doing. The subjects felt they had spontaneously, voluntarily and volitionally initiated their acts. It is clearly unreasonable to attribute the causes of the initiation of these actions *exclusively* to unconscious cerebral processes, as Libet does. The subjects' prior intention to comply with the experimental instructions and their effort to complete the task as prescribed contributed to determine what they were doing in the experiment.

To exclude the effects of a prior conscious intention, it seems necessary to satisfy the following requirements of experimental setting: (a) subjects are not induced to form such prior intention in the experiment; (b) subjects are distracted or refrained from executing the intention; and (c) subjects will not feel introspectively that they performed the intended actions. In Libet's experiment, none of the requirements were satisfied (in one of Keller and Heckhausen's experiments (1990), which will be discussed later, all three requirements were satisfied). On the contrary, the nature of Libet's experiment demands that (i) the subjects form a general prior intention to perform certain bodily acts as instructed; (ii) the subjects effortfully carry out the prior intention; and (iii) they have the subjective feeling that they voluntarily performed the intended actions. Specific brain processes such as the RPs are generated under the influences of these conditions. So the prior intention formed at the beginning of the experiment, when the subjects received experimental instructions, must be taken into account in the interpretation of Libet's study.

2. Conscious intention versus perceived urge

Libet uses such terms as 'urge', 'wish', 'desire' and 'intention' interchangeably (see Libet, 1985). This treatment brings about a considerable degree of conceptual ambiguity and confusion in interpreting his work (cf. Mele, 1997; Gomes, 1999). Libet variously describes the subjects' experience associated with the recalled 'clock position' as a conscious 'intention', 'wish', 'decision' or 'urge' to act. Mele argues that, in accordance with Libet's interpretation, this conscious experience should be interpreted in terms of the urge or desire to act, rather than the (prior) intention or decision (Mele, 1997). Intending to do something is conceptually distinguishable from desiring to do something. One can have a desire to do A without being at all settled upon doing A. In contrast, to intend to do something is to be settled upon or to commit oneself to doing it. According to Libet's account, the initiating process associated with RP onset and lately reflected in the subjects' conscious awareness is susceptible to final 'veto' control, before it can lead to actual motor movement. This implies that the agent has not yet settled upon flexing his fingers or wrist before the veto control takes place. So the most suitable mental terms for describing the process associated with RP onset and the subjects' experience associated with the recalled 'clock position' are 'urges' or 'desires', rather than 'intentions' or 'decisions'.

I agree with Mele that the term 'intention', especially 'conscious intention' which is adopted by Libet to describe the subjects' *instructed* self-report of the earliest awareness of wanting to move, is ambiguous and misleading. A perceived

intention can be either a prior intention, which can contribute in the initiation of the intended action, or an intention in action, which is formed or acquired *after* the course of an action has already begun. But we should also take Mele's suggestion for 'urge' with caution. According to Mele's reinterpretation, the onset of RP reflects a subject's acquiring an urge or desire of which he is not conscious, more precisely, an urge or desire that is stronger than any competing urge or desire at the time. What the subjects were consciously aware of at a time 350 ms later was an urge or desire to act, rather than an intention or decision. This strongest urge or motivation, though, will not *necessarily* lead to actual motor action because of the mechanism of veto control, which has the capacity to block or suppress the actual motor activation.

However, the special experimental setting of Libet's studies should not be neglected. The subjects consciously agreed to follow the instructions to perform certain specific movements 'spontaneously'. They were also required to pay introspective attention to the earliest awareness of the 'urge' to move, at the same time remembering the clock position associated with the urge. The movements that the subjects were instructed to perform were not freely willed but demanded by the experimenter. It seems unnatural to say that the subjects had a real *spontaneous* urge or *intrinsic* motivation to make such movements, *and* the urge was the strongest one at that moment. The subjects made a conscious effort to follow the instructions and to do what the experimenter asked them to do. That is, the subjects needed to pay special selective attention to their urges and intentionally *make* certain when they were strongest, so that the designed 'spontaneous' actions could occur. For instance, it might be possible that the subject adaptively adjusted the threshold so that an otherwise ineffective urge could move the agent all the way to the prescribed action (Ringo, 1985). The point is that in the Libet experiment the subjects were not just passive bystanders who were watching for their strongest urge to initiate a certain action. They were rather active agents who exerted their volitional control to make the required movements happen.

Subjects in Libet's experiment were instructed 'to let the urge to act appear on its own at any time without any pre-planning or concentration on when to act' and 'to try to be "spontaneous" in deciding when to perform each act' (Libet *et al.*, 1982, p. 324). Whenever an urge appeared, a prescribed motor act was triggered. Since the general intention to move has already been consciously formed at the beginning of the experiment, 'the perceived urge to move can be interpreted as an internal stimulus which triggered the release of a predefined motor act. It might be argued that these movements are similar to motor acts in reaction time experiments where an external signal induces the execution of a specified movement' (Keller and Heckhausen, 1990, p. 352).

To test this hypothesis, Keller and Heckhausen conducted a set of experiments (1990). In Experiment 1, the subjects were asked to concentrate on some demanding mental tasks (viz., mental calculating), which distracted their attention from the sensation of the bodily urge to move, while the RPs of their spontaneous but unconscious bodily movements (such as slight flexions of the fingers, hand or wrist) were recorded. Experiment 2 was a replication of Libet's study. In

both experiments, the scalp distributions of the RPs were measured. The results show that it was possible to record RPs with both experimental settings, which suggests that the RPs are associated with both conscious and *unconscious* spontaneous movements. Onset times of the RPs for unconscious and conscious movements were nearly the same, beginning approximately 500 ms prior to the muscle movement. There are two remarkable differences between the two types of RP. First, RPs due to unconscious bodily movements had much smaller amplitudes than RPs associated with conscious movements (Libet situation), which suggests the greater amplitude of RP may be associated with conscious effort. Second, but more striking, the scalp distribution of RPs correlated with conscious spontaneous motor acts was different from that measured from unconsciously performed movements. This implies that the generation of RP in the two different conditions may involve different neural structures. Whereas the RPs of subjects performing conscious spontaneous motor acts had their maximal amplitude at the medial premotor cortex, especially the supplementary motor area (SMA), the RPs correlated with unconscious spontaneous movements were mainly generated from the lateral premotor cortex.

Keller and Heckhausen's experimental results support an alternative interpretation of the subjects' self-reported conscious experience associated with the recalled 'clock position'. The subjects in the Libet's experiment were instructed to look for feelings of 'wanting to move'. A mechanism of selective attention was thereby activated to detect the urge to move. They were in a state of readiness to move and expected a signal, which then triggered the predefined well-learnt motor act. When such an urge is detected, the SMA participates in initiating conscious spontaneous movements, which correspond to the onset of a typical RP. As a result of selective attention, the subjects could perceive a normally unconscious process which was later reflected in the subjects' introspective awareness. 'It was the advice to introspectively monitor internal processes which led the subjects to perceive a feeling of "want to move." Subjects crossed the borderline between unconscious and conscious acts by focusing attention on internal events.' (Keller and Heckhausen, 1990, p. 360.)

3. Volition and readiness potential

In contrast to Libet's account, the alternative interpretation advanced here allows volition to play a crucial role in initiating voluntary action. In Libet's experiment and in Keller and Heckhausen's Experiment 2, subjects formed a conscious intention to perform required actions when they were introduced into an experiment, and made an effort to accomplish the tasks in the experiment. They felt that they acted spontaneously and they were in voluntary control of their movements. Their actions are the prototype of what we widely judge as volitional action. In contrast, in Keller and Heckhausen's Experiment 1, subjects had no conscious intention to perform any motor acts, and they were fully unaware of the bodily movements they made. In any sense, their unconscious spontaneous movements will not be considered as volitional actions. How can we account for the

difference between the two kinds of internally initiated movements? A plausible answer is that, in the Libet situation, people exert volitions to initiate intentional actions, whereas for unconscious spontaneous movements, such as those in Keller and Heckhausen's Experiment 2, no volition is involved.

I propose that the RPs originated from the SMA are the neural correlates of volition. RPs with maximal amplitude at the scalp site above the SMA consistently occur prior to voluntary, self-initiated movements at an interval from several hundred milliseconds up to two seconds. In Libet's experiment, subjects were instructed to attentively watch for urges to move, then let the urge trigger a prescribed motor act. In this special circumstance, the volitional process to initiate an intended action becomes an internally induced event. So the suitable mental items associated with RP onset in Libet's experiment can be urges or desires (see Mele, 1997). But in more general circumstances, where there are no apparent external and internal cues, actions are initiated more voluntarily and are self-determined, volition is the most suitable mental term that corresponds with the onset of RP.

Different volitional experiences may be induced by the initiation of different actions. Some actions are evoked so readily and effortlessly that we can hardly experience any acts of will; but for some actions, which involve irresolute decisions or require significant mental or physical effort to overcome the inertia, as Williams James puts it, we generally feel that 'an additional conscious element, in the shape of a fiat, mandate, or express consent, has to intervene and precede the movement' (James, 1981, p. 1130). Some actions can be triggered quite spontaneously and capriciously, while some actions involve deliberation, pre-planning or complex preparation. The differences of subjective volitional experience are reflected in variations in the amplitude, timing and duration of RP. It has been found that greater RP amplitudes are correlated with greater effort and attention in the initiation of voluntary movements, and the onset time of a RP is influenced by the complexity of the task (see Deecke *et al.*, 1997). In Libet's experiments (Libet *et al.*, 1982, 1983a), it was found that when subjects reported some pre-planning of the time to perform the act, the RP had a distinctly earlier onset and was larger in amplitude than the RP without such pre-planning. Additionally, onsets of RP associated with spontaneous acts were more abrupt, while those for deliberate, pre-planned movements were smoother. Libet's interpretation offers no explanation for this phenomenon, but in our alternative interpretation, there is a natural explanation: the RPs that originate from the SMA are the neural correlates of volition; volitions are different in terms of content and intensity, which are reflected in the variations of the amplitude, timing and duration of RP, and correspond to different subjective volitional experience.

V: The SMA and Volition

In their experiments, Keller and Heckhausen found that even though onset times of the RPs for conscious voluntary and unconscious spontaneous movements were nearly the same, the scalp distributions of the RPs correlated with the two

kinds of movement were significantly different. Whereas the RPs correlated with unconscious spontaneous movements were mainly generated from the lateral premotor cortex (Experiment 1), the RPs of subjects who performed conscious spontaneous motor acts (Experiment 2) had their maximal amplitude at the medial premotor cortex, in particular the SMA. This observation is in accordance with Kornhuber and Deecke's finding that the RPs preceding various kinds of voluntary, self-initiated bodily movement consistently have the maximal amplitude at the vertex of the head, a scalp site which is above and adjacent to the SMA (Deecke *et al.*, 1976; Kornhuber, 1984, Kornhuber *et al.*, 1989).

The human motor cortex consists of several structurally different areas. The primary motor cortex (PMC) is the major source of descending projections to motor neurons in the spinal cord. The lateral premotor cortex (LPC) and the supplementary motor area (SMA) both lie anterior to the PMC. The SMA was first systematically studied by Penfield and Welch (Penfield and Welch, 1949, 1951). In the last few decades, there have been intensive empirical and theoretical studies on the structure and functioning of the SMA (Goldberg, 1985; Lüders, 1996).

A prominent theory of the functioning of the SMA emphasizes its essential role in the preparation, selection and initiation of self-initiated voluntary movements concerned with the process of converting motivation and intention into voluntary movement (Deecke, 1987; Eccles, 1982; Goldberg, 1985, 1987; Kornhuber and Deecke, 1985, Kornhuber *et al.*, 1989; Orgogozo and Larsen, 1979). The contribution of the SMA to the preparation and initiation of self-initiated voluntary movements has been revealed by a variety of experimental methods, including studies of movement-related cortical potentials recorded from surface and subdural electrodes, extracellular recordings from SMA neurons in monkeys, studies of regional cerebral blood flow, and clinical studies of movement deficits associated with SMA lesions and some cases of Parkinson's disease (see Tanji, 1994; Cunnington *et al.*, 1996; Passingham, 1996 for reviews). Experimental studies with various methods consistently found that in internally-generated voluntary movements, the activation of the SMA is prior to that of the PMC and the onset of bodily movement. Monkeys with lesions in the SMA show a significant decrease of spontaneous behaviour. Patients with Parkinson's disease suffer from akinesia, and experiments found that there is an impairment in activation of the SMA in these patients. Neuroimaging studies found that there is more activity in the SMA when subjects actually perform self-initiated movements than when they imagine making movements but do not actually perform them. These findings suggest that the SMA plays a crucial role in the initiation of voluntary, self-initiated movements.

RPs start bilaterally symmetrical from the medial area of the scalp. If the bodily movement to be performed is unilateral, the RP will lately shift towards the hemisphere contralateral to the side of the body that will undergo the movement. For instance, in a flexion of the right index finger, the RP becomes lateralized in the left hemisphere about 500 ms prior to the onset of movement (Deecke *et al.*, 1976). It is hypothesized that the symmetric RP in the early stage is principally generated by the fronto-central cortex including the SMA, while

the later lateralized, asymmetric RP reflects cortical activity of the primary motor cortex. This hypothesis implies that the activation of the SMA precedes the activation of the PMC in self-initiated voluntary movement, which has been confirmed by various experimental studies with different methodology (Deecke *et al.*, 1997). The fact that the activation of the SMA precedes that of the PMC in self-initiated voluntary movements suggests that 'the SMA is upstream in the final motor cascade when it comes to channelling motivation, intention or the act of will into motor execution' (Deecke *et al.*, 1997).

Another interesting observation is drawn from electrical stimulation studies of the motor cortex. In his classic research, Penfield found that when an electrical stimulus was applied to the patients' primary motor cortex, it would elicit certain simple bodily movements. But the patients usually experienced involuntariness of the movements: 'I didn't do that. You did.' or 'I didn't make that sound. You pulled it out of me.' (Penfield, 1975, p. 76). A recent electrical stimulation study found that in some patients, stimulation of certain sites in the SMA elicited a subjective experience of an urge to perform a movement or anticipation that a movement was about to occur (Fried *et al.*, 1991). In some cases this urge was elicited at low current strength, while a higher current at the same contact elicited an overt movement. This finding suggests that the SMA may play a special role in the generation of conscious experience of volitional agency: I am the initiator and controller of my own actions.

VI: Concluding Remarks

Libet's interpretation of his well-known experiment contains two flaws. First, he ignores the effects of the special experimental setting and attributes the cause of the subjects' predefined voluntary movements *exclusively* to unconscious cerebral events such as the onset of RP. After all, the RPs associated with the bodily movements performed by the subjects could not be generated in an unconscious, unintentional state. The subjects had formed a prior conscious intention to perform specific actions at the beginning of the experiment. Following the instructions, they made special efforts to make the required movements occur. The active role of a conscious agent in the production of the intentional actions should not be neglected. Second, Libet mistakes the subjects' instructed self-report of the perceived *urges* to move as the subjective experience of 'conscious intentions' or 'decisions' to act, which usually figure in the etiology of intentional action. As Keller and Heckhausen's experiments have revealed, it was the experimental instruction to introspectively monitor internal processes which led the subjects to perceive a feeling of 'wanting to move', which could normally be an unconscious processing. Thus Libet's inference that spontaneous voluntary actions are initiated unconsciously — because the causing unconscious cerebral processes have taken place well before conscious intention appears — is defective.

According to the alternative interpretation developed here, a general conscious intention was formed when the subjects were introduced to the

experiment, which contributed to causing their special voluntary behaviours in the experiment. The subjects needed to make an effort to bring about the required movements in order to follow the experimental instructions. What the subjects were aware of was an *effective urge* which triggered the release of a predefined motor movement, rather than a conscious intention or decision to act that conventionally figures in the etiology of voluntary action. The RPs originated from the SMA reflected the crucial role of the SMA in the preparation and initiation of conscious, voluntary bodily movements. The most suitable mental term that correlates with the onset of the RP of this type is volition.

Therefore the functional role of volition in initiating voluntary actions is not undermined by Libet's experimental studies. We are not only the censor or controller, but also the author or originator of our own actions. This common-sense image of human agency, which is fundamental to our understanding of responsibility, freedom and human dignity, can be preserved.

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