ON CAUSALITY, READYNESS POTENTIAL (RP) & FREEWILL

In their 2012 article: ***An accumulator model for spontaneous neural activity prior to self-initiated movement***, published in the Proceedings of the National Academy of Sciences, August, 2012, (www.pnas.org/cgi/doi/10.1073/pnas.1210467109), Aaron Schurger, Cohen and Joshua Greene challenged the concept of conscious will (freewill), with evidence based on Benjamin Libet's experiments. The pre-movement buildup of neuronal activity apparent in the readiness potential (RP) and the assumption of causality invested in it is considered an important area in the study of volition. Libet et al. tried to measure the temporal relationship between the onset of the RP and the feeling of an "urge" to move. The results of Libet's experiments suggested that the objective neural events in the brain that cause movement precede the "urge" to move by 300 ms or more. Schurger's team confirms the same "pre-urge buildup" at the single-neuron level. Such demonstrations have been interpreted to imply that movement is initiated pre-consciously and the feeling of intending to move is grafted on after that. The researchers claim that the Libet experiments prove that our conscious will and subsequent actions are caused by prior neural activity – justifying the view "my neurons made me do it" – hence we have no moral obligation for our actions.

A gradual increase in neural activity preceding spontaneous movements, common to both vertebrates and invertebrates alike, appears to be a very general phenomenon. For example, both humans and crayfish exhibit the same 1 to 2-s buildup of neural activity in advance of self-initiated movements. Kornhuber and Deecke's interpretation of the RP as a sign of planning and preparation for movement fails to explain what specific neural operations underlie the spontaneous self-initiation of movement and why these operations are reflected in the specific exponential shape of the RP. The researchers have produced evidence that the RP seen before voluntary self-initiated movements, is not necessarily causal and determinative of the action. We will explain their findings in a different way to establish freewill.

Before analyzing Libet's and Schurger's experiments, it is necessary to discuss causality. Causality is the relationship between cause and effect - the principle that for every effect there is a cause. It is a genetic relationship through which one thing (the cause) gets transformed into or causes something else (the effect). The essence of causality is the generation and determination of one phenomenon by another. Causality is closely related to determinism. Causal determinism is the idea that every event is necessitated by antecedent events and conditions based on the laws of nature. It is a theory or doctrine, which stipulates that acts of the will, occurrences in nature, social or psychological phenomena, etc. are causally determined by preceding events or natural laws.

Determinism is the doctrine that all events, including human action, are ultimately determined by causes regarded as external to and independent of the freewill. Some put it as: individual human beings have no freewill and cannot be held morally responsible for their actions. Determinism is deeply connected with our understanding of the physical sciences and their explanatory ambitions, as well as, our views about freewill. In the determinist approach, all behavior is caused by preceding factors - thus predictable. The causal laws of determinism form the basis of science. Freewill is its counter concept – the idea that we have some choice in how to act or choose our behavior. In other words, our actions are self-determined. Past is the frozen result of measurement – hence unchangeable. But a possible future event may not necessarily occur from past external factors only. It might depend on the freewill of a conscious agent. According to freewill doctrine,

a person is responsible for his/her own actions. We have a choice to agree or not to agree to an action. Our behavior is not random, but we are free from the causal influences of past events.

Necessity, which is often opposed to chance and contingency, is the idea that everything that has ever happened and ever will happen, is necessary leaving nothing to chance. Everything that happens is necessitated. Leucippus stated it as the first dogma of determinism, an absolute necessity: "Nothing occurs at random, but everything for a reason and by necessity". This reflects the ancient Indian dictum: प्रयोजनमनुद्दिश्य मन्दोऽपि न प्रवर्त्तते meaning the same thing. Leibniz distinguished two forms of necessity: 1) necessary necessity and 2) contingent necessity, by distinguishing logical necessity from physical (or empirical) necessity, which he calls "truth of reason" and "truth of facts" respectively. What is absolutely necessary, depends upon the nature of the individual substances. This does not invalidate causality, because uncertainty is inherent in Nature. The final necessity is determined by ALL factors influencing an outcome. These factors are not always known or under our control, (कर्मण्येवाधिकारस्ते मा फलेषु कदाचन - Gita).

Some distinguish between physical necessity and the simpler logical necessity of formal systems. Aristotle's logic defended the logical necessity that only one of two contradictory statements can be true, and the other false. But it is not different from physical necessity or the principle of minimum action. In fact Diodorus Cronus developed the Master Argument to show that only one answer to a question about a future event can be true. Either Yes or No. This led to the Megarian idea of actualism: there is no future contingency and only one possible future. Diodorus' paradox was the result of the principle of bivalence or the law of the excluded middle. Only one of two logically contradictory statements can be necessarily true. Aristotle solved the paradox by saying that the truth of statements about the future is contingent on the actual future. For example, "A sea battle must either take place tomorrow or not, but it is not necessary that it should take place tomorrow, neither is it necessary that it should not take place, yet it is necessary that it either should or should not take place to-morrow" (De Interpretatione IX, 19 a 30).

All these views were discussed by Vyasa over 5000 years' ego. In *Yogasootrabhaashyam* he says: time evolution (त्र्यध्वा कालः) is perceived in three parts. Whatever forms the content of our memory, i.e., experienced by us (अनुभूति व्यञ्जक) is called past. Whatever we are experiencing now (स्वव्यापारारुढ) is called present. Whatever is expected to happen (भवितव्य व्यञ्जक) is called future. Some people may call these as "constructal law of evolutionary flow organization". These three are like digitized segments of an analog field. For example, if you are reading a story book, the pages read by you is past, the page you are reading is present. The pages remaining are future. The present page makes sense only if it is based on the previous pages. The remaining pages will make sense only if they are based on the present page. All combined makes a whole book. If they are not connected as cause and effect, how do we relate the story? Everything is known only during its transition from a potential state to kinetic state. The present is based on the potential past being converted to kinetic state. The future is contingent on the potential present being converted to kinetic state. If somehow we can know the total content of the book beforehand, we will link any page with any other page. Similarly, if somehow we can find all potential states and their dynamics, we can overcome the time barrier. This is the concept of Omniscience (सर्वज्ञता). If the buildup of related factors lead to a battle tomorrow, it will take place. If there is a change in related conditions, the future will change. But such change will depend on today's buildup of events.

The relativistic postulate that no process or signal can travel faster than the speed of light poses a challenge to determinism, as, a Dictator (also God), however powerful He may be, cannot reach far off places instantly to solve a problem or control it. Since light travels at various speeds in different mediums and there is nothing like a "free space" (there is at least vacuum energy, which interferes with anything moving with it) nor true "vacuum" (space is full of vacuum energy), and since the mathematics of relativity postulates tachyons which travels at super-luminal speeds, the postulate of Einstein is questionable. It has never been tried and proved outside our galaxy or even Solar system. A static, unchanging spacetime structure, like the Higg's field, which supposedly permeated the entire universe, makes space-time itself stable and non-singular - unlike the dynamic space-time of General Relativity. For source-free electromagnetic fields in special-relativistic space-time, a form of Laplacean determinism is provable. We are not elaborating these.

The core idea of indeterminism is: an event without a cause. Quantum mechanics does not demand that there should be absolutely no causal connection with the events of the immediate past, such as the distribution of matter and motions. It introduces the concept of statistical cause and makes predictions of the probabilities for the different random outcomes. This they say statistical causality without strict determinism. In the flip of a coin example often quoted by them, the event is not caused by the coin flip, result of which is not predictable. It only helps in selecting one among two equally plausible options. This does not deny prior events as causes, because both the plausible options are already determined and only choosing one of the two option was lacking. The coin flip determined that decision. This decision led to action, which resulted in the effect. Thus, the action is deterministic. Statistical causality operates only within a predetermined band. An electron must be somewhere within any of the known energy levels. Its exact location cannot be predicted because in spite of the available information regarding what an electron does, modern scientists do not know "*what an electron is*". We have written about it elsewhere.

Hume's ideas are close to ancient Indian views in some respects. Hume defines "cause" in the following two ways:

- An object precedent and contiguous to another, and where all the objects resembling the former are placed in like relations of precedency and contiguity to those objects that resemble the latter.
- An object precedent and contiguous to another, and so united with it, that the idea of the one determined the mind to form the idea of the other, and the impression of the one to form a more lively idea of the other.

The essence of both is "immediate precedence" (नियत पूर्ववर्त्तित्व). Vaisheshika texts in ancient India have held that it is the only condition for causality. However, they classify cause into three categories: material or constituent cause (समवायी कारण), non-material or catalytic cause (असमवायी कारण) and instrumental cause (निमित्त कारण). For example, in creating a necklace, gold is the material or constituent cause, the instruments used by the goldsmith is the non-material or catalytic cause and the goldsmith himself is the instrumental cause. The instrumental cause is always a conscious agent. This definition of "immediate precedence" can be misleading as there can be many things, which could be present immediately before the reaction starts. Or several factors may be necessary before the reaction starts and while others except any one may be present, the reaction will not take place till that specific cause comes into the picture. For this reason, Vaisheshikas

divide the cause into 13 different categories (हेतुर्निमित्तं प्रकृतिश्च योनिः प्रारब्धमूले प्रभवोद्भवौ तथा। विवर्तसंचारिरसप्रवाहिकप्रकृत्यपूर्वं समवायिका मताः।). Effect starts only when all necessary causes are present. Because of these reasons, some people talk about soft causality, chance and indeterminism. But there are six types of combinatorial alternatives and three types of relations between cause and effect, which can explain all. We are not discussing these here.

According to Hume, all constituents of our thoughts come from experience. Hume's impressions can be thought of as those, which have their genesis in the senses, whereas ideas can be thought of as products of the intellect. Impressions, which are either sensation or reflection (memory), are called sensory inputs (प्रज्ञानम् or ईन्द्रियग्राह्य ज्ञानम्) by the Vaisheshika texts. According to Hume, these are more vivid than ideas. According to the Vaisheshika texts, it (विज्ञानम्) is the final determination by intelligence after comparison with the stored information in memory.

The second of Hume's influential causal arguments is known as the problem of induction - about experience limiting our causal knowledge to constant conjunction. Hume only pursues the justification for matters of fact, of which there are two categories:

- Reports of direct experience, both past and present.
- Claims about states of affairs not directly observed

The first category includes sensory experience and memory. The second category includes both predictions and the laws of nature upon which predictions rest.

These are similar to what has been elaborated by the Vaisheshika texts like Prashastapaada Bhaashya and Nyaya texts like Vaatsaayana Bhaashya in ancient India as perception or direct evidence (प्रत्यक्ष) and inference (अनुमान) respectively. The Buddhists admit these also. Perception is cognition of the result of measurement, which, in turn, is a comparison between similars. Eyes only can see because they emit electromagnetic radiation (which other organs cannot), which measures similar incoming radiation. After measurement, it is carried to the brain through the neural network, where it is processed not only with similar stored impressions, but also mixed with related other impressions. In *Mahaabhaashya*, Patanjali describes the process for auditory cognition as: "उदाहरणं प्रत्युदाहरणं वाक्याध्याहार इत्येतत् समुदितं व्याख्यानं भवति". This means, after the impulse is received in the brain, it is compared with not only earlier similar or counter perceptions, but also lateral or non-linear memory. A similar process follows for all other types of perceptions.

Vyasa, in his commentary on the Yogasootram written about 5000 years ego, describes perception as: ईन्द्रियप्रणालिकया चित्तस्य वाह्यवस्तूपरागात् तद्विषया सामान्यविशेषात्मनोऽर्थस्य विशेषावधारणप्रधाना वृत्तिः प्रत्यक्षम्. This means, after the external impulse is received, the intelligence becomes detached from the external source and after scouting the related memory non-linearly (mixing), settles on the special features of the perception. Since measurement is a comparison between similars, it is said that the operations of the intelligence becomes similar to the result of perception. This mixed product is cognized by the consciousness as perception of that object, which is nothing but a concept of the object different from the object itself. The conception is stored internally, whereas the object remains outside. When we see a snake and become afraid, the cause of our fear, the snake, is outside, but our brain reacts in ways to produce adrenalin. This leads to the three mental faculties of reason called: perception, conception and comprehension.

Regarding inference or as Hume puts it – ideas, Vyasa says: अनुमेयस्य तुल्यजातियेष्वनुवृत्तो भिन्नजातियेभ्यो व्यावृत्तोः सम्बन्धो यस्तद्विषया सामान्यावधारणप्रधाना वृत्तिरनुमानम्. When the perception is about similar perceptions earlier as segregated from all other lateral perceptions, it couples to a fixed concept. All perceptions similar to that coupled concept is inference. In the case of direct perception, both the perceived concept and object are identical. In the case of inference, the identity has similarity. Idea is also inference about something based on past experience. In case of comprehension, it is non-physical action at a distance (आरादुपकारक). We are not discussing it now.

Hume's Copy Principle states that all our ideas are products of impressions. The Copy Principle essentially demands that the simplest constituent ideas that we relate, must come from impressions, which, according to the Vaisheshika texts, is the memory (स्मृति). This means that any complex idea can eventually be traced back to genesis constituent impressions. But the Vaisheshika texts in ancient India give example of a rabbit's horns or flying horses, which is contradictory to his example and explanations of a golden hill (we may think of a golden hill, even though no such thing exists). The mind is not bound by the rigid laws of Nature in dream state. Hence it may combine different ideas without the constraints of the perceptible world. We have seen horses running and birds flying. In the dream state, we can combine the horse and flying to dream of flying horses, which is not possible in the physical world. We may remember the concept of flying horses upon getting up. This refutes the Copy Principle.

Continued perception, conception, cognition generates randomness in the brain in the form of quantum level and thermal noise. Patanjali describes these as: क्षिप्त, मूढ and विक्षिप्त चित्तभूमि. There are two more states that cut off noise: एकाग्र and निरोध. These are known as alpha, beta, delta and theta mind waves and gamma coupling in modern science. Vedas describe their mechanism by the five types of interactions between the observer and the observed: नित्यगति, सम्प्रसादगति, यज्ञगति, साम्परायगति उरुगायप्रतिष्ठा due to the five types of relationships: अन्तर्याम, वहिर्याम, उपयाम, यातयाम, उद्याम. Noise can introduce random errors into stored memories. Noise could create random associations of ideas during memory recall and the important process of memory consolidation, which are amplified in the macroscopic level. Our senses (related to Macro Mind - मनः) needs the processing power of the intelligence (same as the Micro Mind - बुद्धिः) for choosing the action objectives and thoughts with alternative possibilities. This de-liberates the mind from confusion and ambiguity and "frees" the "will" to choose the determinate actions.

The original discovery that an electrical potential (of just a few microvolts - μV) is visible in the brain long before the subject flexes a finger was made by Kornhuber and Deecke (1964). They called it a "*Bereitschaftspotential*" or Readiness Potential. As shown on Kornhuber's RP diagram, the rise in the readiness potential was clearly visible at about 550 milliseconds before the flex of the wrist. John Eccles speculated that the subject must become conscious of the intention to act before the onset of this readiness potential. Benjamin Libet had the idea that he should test Eccles's prediction. Libet's sequence of events were: cerebral (readiness potential - RPs) and subjective (W - conscious will) that precede a self-initiated voluntary act. Relative to "0" time (muscle activation), cerebral RPs begin first, either with pre-planned acts (RP I) or with no pre-planning (RP II). Subjective experience of earliest awareness of the wish to move (W) appears at about 200

msec; this is well before the act ("0" time) but is some 350 msec after even RP II. Subjective timings of the skin stimulus (S) averaged about 50 msec, before the actual stimulus delivery time. Libet says there is room for a "conscious veto".

The reasoning that the volitional process is initiated unconsciously leads to the question: Is there any role for conscious will in the performance of a voluntary act (Libet, 1985)? The conscious will (W) does appear 150 msec before the motor act, even though it follows the onset of the cerebral action (1W) by at least 400 msec. That allows it, potentially, to affect or control the final outcome of the volitional process. An interval msecs before a muscle is activated is the time for the primary motor cortex to activate the spinal motor nerve cells, and through them, the muscles. During this final 50 msec, the act goes to completion with no possibility of its being stopped by the rest of the cerebral cortex. The conscious will could decide to allow the volitional process to go to completion, resulting in the motor act itself. Or, the conscious will could block or "veto" the process, so that no motor act occurs.

Libet's results were interpreted by some to indicate that the mind had been made up unconsciously, long before any awareness of "conscious will" or freewill. Some Psychologists thinks that freewill may be just an epiphenomenon, something that is caused by brain events, not the cause of such events. In the book The Illusion of Conscious Will, MIT Press, p.55, the author says: "We don't know what specific unconscious mental processes the RP might represent....The position of conscious will in the time line suggests perhaps that the experience of will is a link in a causal chain leading to action, but in fact it might not even be that. It might just be a loose end - one of those things, like the action, that is caused by prior brain and mental events".

Alfred Mele criticizes the interpretation of the Libet results on two grounds. First, the mere appearance of the RP a half-second or more before the action in no way makes the RP the cause of the action. It may simply mark the beginning of forming an intention to act. In the two-stage model, the rise of the RP might simply reflect the considering of possible options. Secondly, Libet himself argued that there is enough time after the W moment (a window of opportunity) to veto the action. Mele's second criticism points out that such examples of "free won't" would not be captured in the classic Libet experiments, because the recording device is triggered by the action (typically flicking the wrist) itself. Thus, although all Libet experiments ended with the wrist flicking, why assume that the rise of the RP (well before the moment of conscious will) is a cause of the wrist flicking? Libet was aware that RP rose at other times also, but those did not lead to a flick of the wrist, so his experiment could not detect them.

Daniel Wegner, Patrick Haggard, etc. claim that the Libet experiments prove that our conscious will and subsequent actions are caused by prior neural activity - the view that "my neurons made me do it" - are simply wrong. The abrupt decisions to flex a finger measured by Libet do not conform to the two-stage deliberate decisions: first freely generate alternative possibilities for action, and then evaluate and select (in an adequately causal way) which is the best of these options using reasons, motives, and desires, i.e., first "free", and then "will".

Schurger et al., found that the shape of the RP can be explained if the brain uses a common machinery for decision making, specifically if a threshold is applied to the output of a stochastic neural accumulator. They say: Decision-making tasks are typically modeled in terms of the

accumulation of evidence. The spontaneous-movement task is unique because subjects are specifically instructed not to base their movement decisions on any specific evidence, sensory or otherwise. Given these instructions, one simple solution is to apply the same accumulator-plus-threshold decision mechanism, but fed solely with internal physiological noise (p.2 ibid).

The stochastic-decision model reproduces the distribution of waiting times as well as the characteristic shape and time course of the readiness potential. Schurger et al. repeated the Libet experiments, but also added a variation that they call *Libetus Interruptus*. In the classic Libet experiment, the subject observes a rotating clock dial and notices the clock's position when the subject, without preplanning, flicks a wrist at a random time. The *Libetus interruptus* task is identical to the classic Libet task except for the addition of random interruptions: an audible "click" that cues the subject to make the movement as quickly as possible after the click.

Schurger et al. note this backward selection bias, that only epochs ending with an actual movement are subject to analysis (p.6, ibid). Their *Libetus interruptus* explores those time intervals when the RP might rise, their accumulator model might get to, or even surpass the threshold, and yet there might be no wrist flick. They offer a new model for what the RP represents, beyond the vague phrases of the past four decades of research, that it reflects "planning and preparation for movement". Their model for the RP is divided into two nonlinear components: an early pre-commitment phase (or stage in our terminology) dominated by stochastic fluctuations (with an evolving spatial distribution) and a late post-commitment motor execution phase (the last 150 ms). Schurger et al. challenge the notion that the early buildup of activity biases supposedly "voluntary" decisions (as argued by Soon et al., among others). They say that their model is consistent with such pre-decision biases, but suggests that they may reflect stochastic fluctuations rather than an intentional (preconscious) decision process:

It is widely assumed that the neural decision to move coincides with the onset of the RP (which, given its slow nonlinear character, is difficult to pinpoint). This model challenges that assumption by suggesting that the "neural decision to move now" might come very late in the time course of the RP. Prior research shows an involvement of motor areas, including primary motor cortex, in motor imagery, in the absence of overt movement. Thus, movement-specific activity in motor cortex, even primary motor cortex, although it might vary with the probability that a movement will occur, does not necessarily signal the final commitment to produce a movement now. Thus, according to this model, un-cued movements in a task like Libet's tend to be preceded by a gradual increase in neural activity (measured at the scalp or the single-neuron level) whose causal role is incidental - not directed (consciously or otherwise) at producing a movement (*ibid*, p.6).

Although their "model is silent with respect to the urge to move and its temporal relation to motor decisions, they claim that it helps dissolve another puzzling question that seemed to arise from Libet's paradigm. Libet himself found that subjects were able to estimate the time of a tactile sensory decision in relation to a quickly rotating clock dial with only about 50 ms of error on average. Why then should there be such a long and variable gap between the time of a motor decision and the subjective estimate of the time of the motor decision, whereas no such gap exists for sensory decisions? In fact, this question arises only if it is assumed that the motor decision coincides in time with the onset of the RP. They have argued that this need not be the case and that the neural decision to move may come much closer in time to the movement itself (e.g., −150 ms).

They propose that the neural decision to move coincides in time with average subjective estimates of the time of awareness of intention to move and that the brain produces a reasonably accurate estimate of the time of its movement-causing decision events (*ibid*, p.7).

They can correlate the beginnings of the readiness potential (350ms before Libet's conscious will time "W" appears) with the early stage of the two-stage model, when alternative possibilities are being generated, in part at random. The early stage may be delegated to the subconscious, which is capable of considering multiple alternatives (William James' "blooming, buzzing confusion") that would congest the single stream of consciousness.

The experience of consciously willing action occurs as the result of an interpretive system, a course-sensing mechanism that examines the relations between our thoughts and actions and responds with "I willed this" when the two correspond appropriately. This experience thus serves as a kind of compass, alerting the conscious mind when actions occur that are likely to be the result of one's own agency. The experience of will is therefore an indicator, one of those gauges on the control panel to which we refer as we steer. Like a compass reading, the feeling of doing tells us something about the operation of the ship. But also like a compass reading, this information must be understood as a conscious experience, a candidate for the dreaded "epiphenomenon" label. (*The Illusion of Conscious Will*, MIT Press, p.317).

Others say there are two important time scales of consciousness: Sensory events occurring within a tenth of a second merge into a single conscious sensory experience, suggesting a 100-millisecond scale. But working memory, the domain in which we talk to ourselves or use our visual imagination, stretches out over roughly 10-second steps. The tenth-of-a-second level is automatic, while the 10-second level is shaped by conscious plans and goals. (*In the Theater of Consciousness*, p.48). The kinds of deliberative and evaluative processes that are important for free will involve longer time periods than those studied by Benjamin Libet.

Many philosophers have called freewill "unintelligible" because of the internal contradiction and the presumed simultaneity and identity of free and will. Specifically, they mistakenly have assumed that "free" is a time-independent adjective modifying "will". A careful examination of ordinary language usage shows that free will is actually a temporal sequence of two opposing concepts - first "free" and then "will". First comes the consideration of alternative possibilities, which are generated unpredictably by a-causal events (simply noise in neural network communications). This free creation of possible thoughts and actions allow one to feel "I can do otherwise". Next comes de-liberation and determination by the will, the un-freeing of possibilities into actuality, the decision that directs the tongue or body to speak or act. After the deliberation of the will, the true sentence "I can do otherwise" can be changed to the past tense and remain true as a "hard fact" in the "fixed past", and written "I could have done otherwise". Thus we have the temporal sequence with chance in a present time of random alternatives, leading to a choice which grants consent to one possibility and transforms an equivocal future into an inalterable and simple past. Free undetermined alternatives are followed by willed, determined choices. Free is an adjective that describes not the will, but the human mind.

All these confusion can be avoided if the mechanism of cognition and action are examined from empirical principles. Nature follows the principle of least action. As has been discussed earlier,

everything in the universe tends to be in equilibrium and nothing happens without a necessity. The same is true for conscious actions also. The mechanism for conscious actions as discussed in Upanishads, Ayurveda and Vaisheshika texts show that action starts after a need is felt and the mechanism of the ways to satisfy that need is known (अविद्यायां मृत्युंतीर्त्वा विद्ययामृतमश्नुते - अविद्या here implies the opposite of विद्या, which implies non-action. It means; overcoming the obstacle or disturbance through appropriate action, one reaches the immutable state through knowledge).

The basic mechanism for conscious action has been described as: ज्ञानजन्य भवेदिच्छा इच्छाजन्य कृतिभवेत् । कृतिजन्य भवेत् कार्य तदेतत् कृतमुच्यते ।. Literally, this means: (when there is a deficiency, a need is felt to overcome it through appropriate action. If one has such) knowledge (it) leads to a mental desire or necessity (for such action). This desire directs the appropriate faculties to execute the task. This leads to its execution – hence called the desired effect. There is always a time lag between these steps because *Kanaada Sootram* 3-2-3 stipulates that neither two effects nor knowledge of two objects are simultaneous (प्रयत्नायौगपद्याज्ज्ञानायौगपद्याच्चैकम्).

Libet ignores the initial desire: "let it be like this" (भवत्विति चित्तवृत्तिरिच्छा), which can be of two types. This cerebral condition that arises after the necessity is felt (in Libet's experiment, instructions to the participants, is the desire: इच्छा or भाव. Libet and others call the response to it as the RP). The desire: इच्छा or भाव could be related to self and necessary to be executed by self (ममेदं भवत्विति कर्मणः स्वीयत्वसापेक्षा स्वीया). Or it could be related to others and necessary to be executed by others (तस्येदं भवत्विति कर्मणः परकीयत्वसापेक्षा परकीया). Thus, it is subjective. Libet and others call these the conscious will (W) or freewill. In case, it is related to others and necessary to be executed by others, one's desire is transposed on another person's mind through sound or signal medium (through skin stimulus), which is called language (स्वहृदयस्थो भावो यया परहृदये समुन्नीयते सा भाषा). But where the execution is necessary to be executed by self, the skin stimulus is directed by the conscious will (W) or freewill. This is done with pre-planning (RP I). When language is used for others to do the execution, or there is sudden change in the circumstances, there is no necessity for such pre-planning (RP II). Subjective experience of earliest awareness of the wish to move (W) appears at about 200 msec; as Libet and others noticed. But both types of RP are felt only after the initial desire: इच्छा or भाव which they ignore. Their subjects were told how to respond (indicating the need to respond and imparting the knowledge of how to respond) before the measurement started. Thus, it is a part of the experimental set up and cannot be ignored.

While the Libet and Schurger's experiments are important, since they have not considered the pre-experiment instruction to the participants, and since that forms an important part of the experiment, and since Libet admits that the conscious will could block or "veto" the process, so that no motor act occurs, their conclusions are based on incomplete data. Thus, freewill cannot be denied, though how far freewill is really free, needs to be considered. We have written about that separately.

N.B.: No separate Bibliography, since the various authors have been named at appropriate places.