

No 29 BENJAMIN LIBET (I) (1916-2007)

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1. Last time we looked at the work of David Garlick a medical scientist and an Alexander teacher himself. He did not leave a great body of work behind him but he had a variety of interesting and AT-relevant things to say about muscle-functioning. I particularly mentioned his little book *The lost sixth sense*.
2. Today I want to look at an American scientist, Benjamin Libet, who was born in 1916 and died a couple of years ago, in July 2007, at the age of 91.
3. Libet first came to the attention of AT people in 1985 when he published a paper called *Unconscious cerebral initiative and the role of conscious will in voluntary action*. This created a lot of interest among neuroscientists and was quite controversial in a wider public because of what it had to say about free will.
4. The paper struck certain chords in the AT community and the late Chris Stevens, who was running a training school in Denmark at the time, put on a workshop in Aarhus which was attended by Libet himself. Walter and John Brown went there from here. Libet also presented his paper at a workshop run by AmSAT in 1988.
5. I have not been able to find any reports on these workshops apart from a short paper on the American one by an Alexander teacher called David Sheppard.
6. Libet had some Alexander work from Walter and from David Sheppard but he does not seem to have seriously engaged with the Technique like Dart or Tinbergen. To the best of my knowledge, he does not mention the Technique in any of his published work.
7. Nevertheless one sees quite a few references to his work in various publications by AT people. He also gets mentioned on various AT websites as one of the scientists whose work supports the AT.
8. He produced a book called *Mind Time: the temporal factor in consciousness* in 2004 when he was eighty-eight. I am all in favour of people of advanced years producing books. This one sums up his Libet's life's work and is available in the library.
9. I might also mention that one of the people who has taken Libet's neuroscientific work forward is Professor Patrick

Haggard, of the Institute of Cognitive Neuroscience and Psychology in University College, London. He has given a couple of interesting talks to Alexander teachers and trainees here in Lansdowne Road but to the best of my knowledge has stayed clear of having any lessons or directly doing any research into the Technique.

10. So who was Benjamin Libet? He was born in 1916 in Chicago of Ukrainian Jewish parents and his father and grandfather were tailors. But he did well in school and went to the University of Chicago where he got a PhD at the early age of 23. It was for studies on the electro-physiological activities in the isolated frog brain.
11. He taught for a while at universities in New York and Philadelphia and joined the University of California in San Francisco in 1950. He stayed there for the rest of his working life.
12. In his book he says that it was while he was learning his technical trade working on frog's brains that he became interested in what was to be his life's work. This is the question of how, in human beings, conscious subjective experience relates to physical activity in the brain.
13. When we talk of brain activity, we are talking of tiny electric currents which can be picked up by sensitive measuring devices which are placed in or on the brain. Sometimes this is done with little probes or wires which are pushed right into different areas of the brain. At other times it can be done by attaching pads to the outside of the skull and detecting the electrical activity going on in the brain – the equipment for this is called an electroencephalograph, EEG.
14. The question Libet asked himself was
*How can the physical activities of nerve cells in the brain give rise to the nonphysical phenomena of conscious subjective experiences, which include sensory awareness of the external world, thoughts, feelings of beauty, inspiration, spirituality, soulfulness, and so on?*¹
15. In asking this question Libet, as a neuroscientist, was well in advance of his time. Studies of consciousness or awareness were not regarded as a proper subject for real scientists at that

¹ Libet (2004)p3

time. This was because they relied on subjective reports rather than objective scientific measurements.

16. He only got his chance to start serious experimental work when he teamed up at the University of California with a well-known neurosurgeon called Bertram Feinstein in 1958.
17. Feinstein was a pioneer in what is known as stereotaxic neurosurgery. In this, three dimensional images of the brain are used to guide a very thin probe into it to reach a specific part. At that time, Feinstein was using the probes to knock out a certain number of brain cells in particular parts of the brain to relieve Parkinson's disease.
18. This is now one of the standard treatments for Parkinson's – though they don't destroy the cells. They just stimulate them with tiny electric currents. They put the probes into the brain and they implant a controller and a battery in the chest and it sends little pulses of electricity deep into the brain which reduces the tremor.
19. One of the odd things about the brain is that once you get into it, it does not feel pain. If you have a hole in your head, it is likely to hurt but this is because of the nerves in the scalp and the meninges – the covering of the brain – but the brain itself does not hurt. So if you apply a local anaesthetic to the skull, the person can be perfectly conscious and feel no pain when the probe is inserted deep in the brain.
20. While Feinstein was pioneering this work, he offered Libet the opportunity to devise experiments which would take advantage of these probes in the brain – with the consent of the patients. In effect Libet was given access to conscious people with little electrodes sitting on the surface or sticking out of deeper bits of their brain.
21. The collaboration between Libet and Feinstein went on for twenty years, from 1958 to 1978, when Feinstein died of cancer.
22. It was a unique – and probably unrepeatable - opportunity for research into the functioning of the brain. Even though the patients gave their full consent to what was happening, I doubt if any hospital ethics committee or insurance company would permit it nowadays.
23. At that time, scientists already knew that if you stimulate a particular part of the body, say the thumb, a little electric current will flow in a particular part of the brain and will show up on a

brain scan. The area of the brain in which this shows up is known as the somatosensory cortex.

24. The other interesting thing is that if you go the other way about it and apply a tiny electric shock to the part of the somatosensory cortex linked to the thumb there is a twitch in the thumb.
25. So when Libet started his research, the linkages between the different bits of the body and different areas of the somatosensory cortex were well known. Libet wanted to take this further. What he was interested in was consciousness – the awareness that something is happening in the thumb.
26. So he carried out a variety of experiments in which an electric stimulus was applied to a spot on the somatosensory cortex and the subject reported when they were aware of the sensation in the appropriate bit of the body – say the thumb.
27. The first thing he found was that there is a minimum level of stimulus to the brain below which there is no conscious sensation in the thumb no matter how long the stimulus lasts. He called this a liminal or threshold stimulus.²
28. When a stimulus is just above this threshold, he found that the stimulus applied to the thumb area in somatosensory cortex had to continue for 0.5 sec for the person to become aware of something happening in their thumb.³
29. Stimuli stronger than the threshold did not need to be so long but had to last a minimum of a fifth of a second before the person felt anything in their thumb.
30. In normal life, of course, we do not stimulate the brain directly. Things happen the other way round. The stimulus is applied to the skin of the thumb and is registered by the brain. So Libet looked in detail how things worked when this happened.
31. This is all quite curious and interesting and needs a little thinking about.
32. The first thing is that when a stimulus is applied to the skin of the thumb the first sign of electrical activity in the brain, what Libet calls the evoked potential, occurs in 15-20 ms – a millisecond is a thousandth of a second – so the signal reaches

² Ibid. p39

³ Ibid. p38

the brain between one and a half and two-hundredths of a second.⁴

33. So if I touch your hand, the brain registers it in about two hundredths of a second. It may be three or four hundredths of a second if the stimulus is applied to your foot⁵ but this is still very fast.
34. But again he found that it was only when the brain had been active for half a second that the person became aware of the stimulus. It did not mean that the stimulus had to last for half of a second. It could be just a single pulse but it was only after the brain had been digesting it for 0.5 sec that there was a conscious awareness of it.⁶
35. If the stimulus to the brain was much stronger, awareness developed faster. But the important conclusion from his experiments was that following the brain receiving a stimulus, it takes anything from a fifth to half a second for awareness to develop.
36. In practical terms, what he was saying means that if a fly lands on my face, there is an electrical response in my brain in about two hundredths – a fiftieth of a second – but the brain has to digest this for between a fifth up to half a second if I am to have a conscious awareness of it.
37. If the brain activity after the stimulus does not last this length of time – if there is another stimulus which overrides it – I will never be aware of that particular fly landing on me.
38. These are very interesting findings and help explain certain things. Take the runners in a sprint race. If you time them, you find they are leaving their blocks in just 100 ms, a tenth of a second, after the starter's gun.
39. This is the time for the auditory signal received in the ears to travel to the primary auditory area, to be processed, sent off to the motor cortex and for the running muscles to be activated.
40. This is well below the time required for conscious awareness of even a strong stimulus like the starter's gun.⁷ If you wait until you are consciously aware of the sound of the gun, the other runners will be well out of their blocks in front of you.

⁴ Ibid. p47

⁵ Ibid. p47

⁶ Ibid. p50

⁷ Ibid. p34

41. As a result of this work, we can say there are two kinds of response to a stimulus. The first and the quickest is the unconscious one. The stimulus is received by the brain and the muscular response is activated without any conscious awareness – as when the runners are out of their blocks within a hundredth of a second.
42. This takes us back into the area of reflex actions and learned responses which can be triggered at an unconscious level without bringing the whole brain into it. We discussed this a while ago when we were beginning to look at the work of Sherrington and Magnus (Talk No 13).
43. The other kind of response is when we become consciously aware of a stimulus and do something about it. This is much slower since as Libet found, the development of awareness in the brain takes between a fifth and half a second.
44. You might wonder why we have this two-speed response system. It is, in fact, extremely important for the speed and efficiency with which the body works. It means that the response of the body to the majority of stimuli can be handled by the reflex system, or by learned responses which are triggered at an unconscious level, without bringing the whole brain into it.
45. Libet gives the example of a driver seeing a child step into the road. Responding automatically, we can slam on the brakes in 150 ms.⁸ The conscious awareness of the child stepping into the road takes about three times as long.
46. As well as being quick, this two-speed responsiveness of the brain is economical in its use of brain processing power.⁹ Once we become consciously aware of something, far more of the brain becomes involved. We start making choices on how or whether we should respond to the particular stimulus.
47. Let us now look at how my vision works when I am walking along the footpath. As my eyes move about, images of everywhere my eyes point are formed on the retina and signals are transmitted to the brain. But according to Libet, it is only the things that my brain works on for 0.5 secs that come into conscious awareness. The rest are just transitory sensations.

⁸ Ibid. p91

⁹ Ibid. p115

48. So when I am walking along, thinking about keeping my neck free, I am managing the changes and level in the footpath and automatically using my learned responses to avoid tripping over paving slabs or stepping into the various bits of dog mess all without being consciously aware of it.
49. But every now and again one of these passing stimuli is unconsciously selected by my brain as more interesting. Libet does not says how the brain decides to select any particular stimulus beyond saying that it is perhaps “*the attention mechanism*” that does it.¹⁰
50. The particular stimulus could be a hole in the road, a huge lump of dog mess, or someone I think I recognise. The brain via the attention mechanism holds this sensation and after 0.5 secs it registers in my awareness.
51. One other point I need to mention for anyone reading Libet’s book, in addition to his ability to gloss over something as important as how the attention mechanism might work, is his tendency to see problems where no one else does.
52. I personally don’t find the idea that our conscious awareness of things is slightly delayed particularly difficult to deal with. Everything takes time to happen.
53. But it is a major issue for Libet.

If we look at some of the ramifications of our findings for a delay in sensory awareness, the implications are quite astounding...What we become aware of has already happened about 0.5 sec earlier. We are not conscious of the actual moment of the present. We are always a little late. If that is so, how can one explain the fact that subjectively we feel that we are aware of the actual moment of a sensory event.¹¹

54. He calls it a *strange paradox* that

Neural activity requirements in the brain indicate that the experience or awareness of a skin stimulus cannot appear until after some 500 ms, yet subjectively we believe it was experienced without such a delay.¹²

¹⁰ Ibid. p115

¹¹ Ibid. p70

¹² Ibid. p72

55. He proposes what he calls *a rather outrageous hypothesis* to deal with this problem. He envisages that somehow the mind manages a backward referral in time to account for this.

*The sensory experience is automatically and unconsciously subjectively referred backward to the time of the first, fast cortical response to the sensory signal.*¹³

56. I think he means by this that the competitors in the race think they are aware of the gun when they spring out of the blocks but in fact they are responding automatically to the direct cortical stimulus, with the awareness coming a fraction of a second later.

57. The obvious question is how exactly the brain manages to do this backward referral and what bits of it are involved. Libet has no answer to this and says

*There appears to be no neural mechanism that could be viewed as directly mediating or accounting for the referrals.*¹⁴

58. This is something you will notice about Libet as you read him. His direct experimental results are often very interesting but he has a tendency to introduce complications which he does not deal with very satisfactorily.

59. Nevertheless, in these experiments Libet genuinely pushed back the frontiers of neuroscience. His finding that there is a significant time difference between the registering of a stimulus in the brain, and our becoming consciously aware of it helps explain quite a lot of our observed behaviour.

60. This phase of Libet's work which ended in 1978 when his neurosurgeon friend Bertram Feinstein died. It is covered in the first half of the book *Mind Time*. In the next talk I will tell you about the next stage in Libet's work which is covered in the second half of the book – and why it attracted so much attention in the AT world.

61. He begins it with the chapter entitled: *Intention to act: do we have free will?*

¹³ Ibid. p79

¹⁴ Ibid. p85

References

LIBET, B. (2004) *Mind time: the temporal factor in consciousness* - Harvard University Press, Cambridge, Mass.