New Horizons in Consciousness Studies

Dr James Paul Pandarakalam

Introduction

This paper discusses some of the newer viewpoints about consciousness. Recently, particle physicists have made explorations into this challenging research arena that may initiate major paradigmatic shifts in cognitive neuroscience, resulting in the baton being passed to particle physics. Cross-pollination of ideas between particle physics and the cognitive sciences might help to develop a deeper understanding of consciousness, even though physicists' portrayal of the 'unphysical' is controversial. The objective of this paper is to promote a broader view of consciousness among mental health professionals and to prompt them to search for reasons for their patients' suffering beyond the prevailing neurobiological model of mind. It is also intended to overcome the time lag between what some physicists have to say about consciousness and psychiatrists' awareness of such work.

In the second half of 20th century, the tide of reductionism wiped away the concept of consciousness from scientific literature but recent studies have put it back on the map of neuroscience. In the past, reductionist neuroscientists tried to explain consciousness as a state of wakefulness or alertness, or simply as the ability to respond meaningfully to external stimuli - a behavioural definition of consciousness. However, we cannot define consciousness; we can only describe it. Consciousness and mind are terms that have sometimes been used interchangeably, even though the approach of objective science is that consciousness and mind are interdependent. There is no precise definition or description of either mind or consciousness. Most of the definitions of consciousness have been incompatible with each other, somewhat like the proverbial description of the elephant by a blind man.

Quantum World

In quantum mechanics, opposites merge into sameness and paradox reigns. Quantum theorists posit that quantum mechanical phenomenon such as quantum entanglement, uncertainty and superposition may play an important part in neurological function and could unmask the mysteries of consciousness.

Features of the Quantum World

- Superposition - particles can exist in multiple states or locations simultaneously.
- Quantum entanglement - unified particles that became separated remain connected over distance and time
- Quantum coherence - multiple particles can condense into one unified entity
- Uncertainty - precise location and momentum of quantum particles are undetermined

Briefly, matter is composed of atoms made of positively charged nuclei formed from nuclear protons and neutrons providing the mass, which in turn, are composed of u(up) and d(down) quarks held together by gluons. Each nucleus is surrounded by flying negatively charged electrons. Wave/particle duality is the quantum property that entities show in sometimes behaving in a particle-like, and sometimes behaving in a wave-like, way. Electrons are no longer considered as particles orbiting the nucleus of an atom, but are envisaged as disseminated throughout space like clouds in the form of probability waves that collapse into their space-time location only when a conscious observer makes a measurement.

Metaphorically, this is reminiscent of how the sensitive 'touch-me-not plant' closes up and collapses when touched: the collapse of the wave packet is a discontinuous change in the wave function brought about by the intervention of measurement.

Particle physicists still do not agree how to interpret wave collapse and some even think it is a philosophical issue. Experience shows that the material can act upon mental. The effects of drugs or brain damage substantiate such an observation. In a similar way, one may conjecture that a reciprocal power of the mental may also act upon matter. Thus the intervention of a conscious observer may determine the outcome of a measurement. Andrew Powell speculates, 'A mind of greater power can collapse the wave uniquely, apparently miraculously, on one notable occasion turning water into wine.'[1] However, quantum sceptics argue that the influence of observation on observed objects claimed by particle physicists may be negligible with regard to macro objects.

In the quantum world, the velocity and the position of the electron cannot both be known at the same time. It is merely a statistical probability that the electron will manifest where it is expected to be. Indeed, it may materialise millions of miles away, taking zero time for its transportation there. By-passing space and time, there is inherent in the cosmos a fundamental non-locality and interconnectedness. Without postulating any exotic quantum states, Henry Stapp holds the view that the fundamental processes of nature lie outside space-time, but generate events which may be located in space-time, a theory that represents a tectonic shift in the fundamentals of physics.[2] The transition between the quantum and the classical world is described as quantum reduction or decoherence (the untangling of quantum states in order to produce a single macroscopic reality). Particle physicists describe consciousness as a self-organising process existing on the border between these two worlds.

Neuro-computers

In the mid-twentieth century, computationalism became a prominent corollary to cognitive psychology. It was fashionable in the second half of the last century to depict the brain as a computer with neurones and with synapses as switches. In the neural network paradigm, computation is mediated by axonal action potentials and axonal-dendritic chemical synaptic connections of variable strength between

neurons. Individual dendrites of each neuron receive and integrate multiple input-generated post-synaptic potentials. When the threshold is met, firing of axonal action potential spikes as outputs occur. Such a 'neuronal integrate-and-fire cycle' is conjectured to produce consciousness.[3] This phenomenon is comparable to the production of music emerging from movement of air molecules - music only arising from complex and highly organised movement of the air molecules. However, computer analogies fail to explain the mechanism by which the brain generates thoughts and feelings. For instance, if a software engineer develops a program that enables a computer to beat a chess grand master, the computer will lack any awareness of its victory.[4] There is no provision for the 'programmer' in the computer analogy.

The analogy between brain and computer is superficial for other reasons. A multitude of observations suggest that neurotransmission in the brain is too slow to account for many coordinated spontaneous reactions or for their abrupt termination, while brain imaging techniques have demonstrated that patients with severe brain damage may have a degree of consciousness that appears to defy the extent of neurological injury.

Quantum Consciousness

Roger Penrose argues in his book *The Emperor's New Mind* that consciousness is an actual physical process, a sequence of quantum state reductions connected by a specific quantum formula to an objective threshold inherent in space-time geometry.[5] He also notes that consciousness transcends formal logic systems and that the established laws of physics are inadequate to explain it. According to Penrose, it is the inaccuracy of mind that deems it non-computational. He further argues that consciousness cannot be simulated. Human beings can always find a new way of looking at something, but algorithms cannot. If an algorithm could generate a new algorithm, the outcome would, by definition, be part of the original algorithm. Human mathematicians do not use a knowable algorithm in order to ascertain mathematical truth. Algorithm is everywhere except in the human mind. Penrose argues that a deterministic non-algorithmic process may come into play in quantum mechanical wave-function reduction, and may be harnessed by the brain. In that case, conscious experiencing, together with non-conscious mental processes, may be a qualial property of quantum reality in which the apparent opposites of experiential reality and inferred physical reality are in some way reconciled. Penrose has posited that the connection between neural cells is controlled by large-scale quantum-coherent behaviour occurring within the microtubules of the cytoskeleton of neuron.[6] Microtubules are self-assembling cylindrical polymers of protein tubulin. These protein lattices of the cell cytoskeleton function within brain's neurons. They organise neuronal shape and activity and function as molecular level cellular automata.

Stuart Hameroff suggests that ideas start out in superposition in the preconscious and then settle in the conscious mind as the superposition ends and the waveform collapses.[7] His thesis is that the collapse is where consciousness comes in, and consciousness is situated at the edge of quantum reduction or at the point of

collapse of waves between the quantum and the classical world. Thus there may be neural and quantum computers. Penrose and Hameroff showed how a tubulin-based quantum messaging system could act like a huge quantum computer that might be the site of our conscious experience and such a model of consciousness is known as Orchestrated Objective Reduction (Orch OR). Quantum superposition and a form of quantum computation occur in microtubules. In this model, consciousness is a sequence of discrete quantum computations, each culminating in a conscious moment in gamma EEG–synchronized integration phases of neuro-computational integrate-and-fire cycles[7]. Orch OR depicts consciousness as neuronal activity allied to fundamental ripples in space-time geometry.

Orch OR has met with a mixture of scepticism and enthusiasm. The three bases of the Penrose-Hameroff theory - non-computability, the involvement of quantum gravity and the role of tubulins are highly controversial.[8] Critics of Penrose argue that the brain is a hostile environment for delicate quantum phenomenon. According to Max Tegmark's calculations, the neurons in the brain are too warm to perform quantum computations.[9] The warm and wet inner environment of the brain does not permit any long-time entanglement and superposition of two functional units and poses obstacles to any explanation of the computational activity of the brain. Whatever the brain's quantum nature is, it decoheres far too rapidly for the neurons to take advantage of it, and it is unlikely that quantum behaviour evolved in the brain. David Chalmers, who identified the intractable problems of consciousness-qualitative phenomenal experiences or the qualia, holds the view that they are hard to explain even with the aid of quantum theories, and argues instead that consciousness is a fundamental constituent of the universe.[10] E.H. Walker has argued for the existence of disembodied 'proto-consciousness'.[11] Proto-consciousness, which is an elementary form of consciousness, may be the building block of human consciousness. Such an assumption is a weak form of panpsychism (that all matter has some degree of sentience).

Proponents of panpsychism and proto-consciousness argue that in addition to the four known forces of the universe, there may be another force that is responsible for human consciousness. Proto-consciousness is supposed to exist in the Planck scale of fundamentality in space-time geometry. Figuratively, it may be considered as the mud in which the lotus of consciousness has its origin. The proponents of this hypothesis are uncertain about its survival after physical extinction and do not postulate that it existed before the Big Bang. The counter argument is that consciousness lacks extension and other spatial properties; therefore it cannot arise from matter in space unless we change our concept of space. For panpsychism to be veridical we need a new concept of space, one that is currently not available.

David Bohm argued that all life and consciousness are present in time and space, that they are woven within the universe.[12] Every portion of any object contains the whole and every part of the universe enfolds the whole. According to Bohm, the apparently faster-than-light connectedness between subatomic particles implies a deeper level of reality and he argues that such particles are not individual entities, but are extensions of a fundament reality. He believed that there is a complex, gigantic and splendidly detailed super-hologram beyond our own, arguing that brain

is a cross-correlated system and the concreteness of reality is a holographic illusion.

John Smythies asserts that consciousness is in the 'brane' and not in the brain.[13] Such a conjecture illustrates the need to demarcate between phenomenal space-time and physical space-time.[14] According to membrane (M) theory, our visible world with three space-time dimensions and one time dimension is moving in a higher dimensional universe (the Bulk). Smythies suggests that the present four-dimensional model has to be supplemented with phenomenal space - a higher dimensional space. He contends that such a space is different from Kaluza-Klein or superstring space and contains consciousness; that it is a personal mental space. The consciousness module he proposes is composed of the various sensations and image fields plus possibly a subjective Self. He also argues that consciousness may be 'material' in its own right, as much as 'protons and electrons'. In other words, it would be composed of an 'as-yet-unknown-particle'. He also assumes that the physical body we experience in our earthly life is actually its image generated by the brain and a Self may be located in its head.

Some particle physicists have suggested that consciousness is fundamental to the universe and that consciousness was here from the start; it is matter that is secondary.[15] Accordingly, human consciousness is fundamental and non-epiphenomenal, and brain is secondary. Quantum mind may be only an interface between brain and a higher consciousness. Investigators of consciousness are also currently focussing on mystical experiences, a subject that scientists shied away in the past. Mysticism assigns to consciousness an essential and overarching reality, holding that such a reality has its own order.[16] Experiences that bestow a sense of what lies 'beyond' are described as mystical experiences. Computational theories and biophysicist theories of mind and consciousness cannot explain the inward mystical experience of a pure, unitary, undifferentiated and self-reflexive consciousness.[16] In this sense, mysticism may be telling us more about the bedrock of reality than particle physics which is, after all, only a rock bottom theory of matter. A theory of consciousness rooted in mysticism may turn out to have greater heuristic value than a discrete theory based on observations in particle physics.

Clinical Prospects

Quantum theories are helpful in explaining dream process and understanding certain aspects of the phenomenon of storage of memories.[17] To borrow a catch phrase from Sigmund Freud, dreams are the royal road to the quantum mind. Studies of quantum mind may have usefulness in explaining psychopathological experiences. Smythies' proposal [13] that perceptual images are stored in phenomenal space as 'quantum objects' has explanatory value in understanding three-dimensional visual hallucinations that sometimes baffle the clinicians as well as their patients, and also some pseudo-apparitional experiences. It is my contention that cognitive depression may be due to negative programming in the quantum computer of consciousness resulting in biological correlates. Even though bipolar disorder is essentially a biological disorder, the manic experience may have some contributions from the quantum part of the mind.

Consciousness studies have great potential significance in relation to psychiatric disorders from both etiological and therapeutic points of view. In their determination to squeeze consciousness into a tight neurobiological model, neuroscientists are missing a precious opportunity to participate in the emergence of a new paradigm – the search for the causes and remedies for psychiatric disorders within the framework of quantum psychiatry.

Concluding Remarks

In the quantum mechanics of consciousness, there are three views predominating. The first is the reductionist view that that brain evolves quantum consciousness. The second is that brain appropriates consciousness from somewhere in the universe and that proto-consciousness exists - property dualism. The third view promulgates the pre-existence of consciousness even before the Bing Bang and that consciousness is the fundamental driving force - substance dualism. I contend that all the three views together could lead to the formation of an integrated theory of consciousness.

Many subjective human attributes cannot be attributed to the brain or rational consciousness in isolation, even though the brain collaborates in such experiences. They are all unique 'human experiences' and they are indicative of a consciousness beyond the quantum mind. Penrose's consciousness cannot explain 'the unique human experience'. It is not just that the emperor was unclothed; it is that there is a further layer of transparency to be found in the 'emperor's new mind'. While it is possible to demonstrate the neurological and quantum correlates of subjective consciousness, that does not of itself constitute evidence that the brain and quantum mind generate such intrinsic experiences. Physics and mysticism are addressing two distinctly diverse domains, and even though there are important parallels between them, quantum consciousness should not be equated with spiritual consciousness.[18]

At present it is reasonable to hold the view that whatever the nature may be of brain/mind interaction, it takes place essentially in the domain of the quantum world: the processes of brain processing function where the properties of quantum physics prevail. Consciousness has many variables – an analogy for this is the myriad constituent colours of white light – and so theories of consciousness are bound to be multifaceted. We may postulate that there are likely to be a series of mind fields and states of consciousness. So much of the mind remains unrevealed that while it is tempting to try to map it with the aid of various analogies, yet it is our fate ultimately to remain frustrated. Colin McGinn has opined that human intelligence is wrongly designed for understanding consciousness: that there are natural ceilings to our understanding of consciousness. [19] He argues that we have a cognitive and intellectual disability in our make-up when it comes to probing this mystery and that our hidden secrets will always remain an obscurity.

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