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Quantum Theory and Consciousness: A Link between Human Mind and Quantum Physics

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ABSTRACT

The nature and idea of consciousness is very mysterious and has profound importance, with existential, medical and spiritual implications and productivity. Behavior and functioning of the brain or, in other words, material brain activity is in some way correlated to the consciousness or mental activity. Since it is the most fundamental theory about the matter that is currently available, in efforts to understand the consciousness we can assume that the Quantum theory can be helpful. Various steps and studies have been carried out to achieve the extent of relation of quantum theory to the different neurophysiological levels of descriptions. In past and in current scenario efforts have been made to adopt quantum theory in different ways that correlate it to consciousness. The concept that this is solely a quantum effect and does not work for a classical case is also discussed. Researchers studied this about the notorious puzzles and contradiction of quantum mechanics, the theory physicists use to describe the tiniest objects in the Universe.

Key Words: Computability, Consciousness, Quantum Theory, Interdisciplinarity.

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INTRODUCTION

Quantum approaches to consciousness occasionally said to be prompted simply by the idea that quantum theory is a mysterious thing and consciousness is also a mystery, so perhaps the two are co-related. Those perspectives denounce a profound misinterpretation of the nature and character of quantum mechanics, which consists fundamentally of a pragmatic scientific solution to the problem of the connection between mind and matter. However, there is no single theory on Quantum Mechanics brain/mind theory. In fact a spectrum of more or less independent models have been proposed, that all have their intrinsic potentials and problems. Ilya Prigogine carried out studies on nonequilibrium thermodynamics; he initiated and achieved major insights concerning topics such as dissipative structures, complex behavior, and the arrow of time, the relation between determinism and stochasticity, and other fundamental questions of the sciences. In most recent research he showed that, to a certain extent, all these topics can be addressed within a generalization of traditional quantum theory, based on the formalism of rigged Hilbert spaces. [1]

The key philosophical and scientific achievement of the founders of quantum theory was to establish a rationally logical and practically and pragmatically useful linkage between the two kinds of descriptions that jointly incorporate the foundation of science. Descriptions of the first kind are accounts of psychologically experienced empirical findings, expressed in a language that allows to us interface and communicate to our colleagues what we have done and what we have learned. Descriptions of the second kind are specifications of physical properties, which are expressed by assigning mathematical properties to space-time points, and formulating laws that dictate and determine how these properties evolve over the course of time. Bohr, Heisenberg, Pauli, and the other inventors of quantum theory discovered a useful way to connect these two kinds of descriptions by causal laws, and their seminal discovery was extended by John von Neumann from the domain of atomic science to the realm of neuroscience, and in particular to the problem of grasping and reporting the causal interconnection between the minds and the brains of human beings. [2]

These studies made a prominent way in the coming studies of mind and body problems. The problem and complication of how mind and matter are interconnected, has many dimensions, and it can be approached from many different starting points. Research in the field of artificial intelligence, which attempts to impersonate and replicate intelligent activities using a machine, has evolved along with the development of information technology [3,4] Georgiev, 2008, claims to have spotted a critical mathematical error in the relationship between brain and mater showing the incompatibility between quantum theory and consciousness. This was finally proven false by the further clearance and made easy way to initiate more studies towards the topic. [5]

Studies involving mental activities have generally remained unnoticed due to a range of reasons, within the physics research community. However, a mental process is definitely a part of nature and, in principle, should be perfectly narrated by quantum theory if the universe is indeed quantum mechanical. The main reason this part of study was largely overlooked by physicists was due to the belief that mental activities should be explained by biological means such as with a better understanding of how a brain works etc. [6,7]

One should keep it in mind that, previously, there have been a number of attempts and proposals to connect consciousness with quantum theory. In particular, people have long suspected that a conscious process, which appears to happen in the brain, has some relationship with quantum theory. It has been advocated that a non-computability of consciousness and suggested that microtubules may have a relevance to this non-algorithmic process. One of the important issues covers quantum theory and consciousness has involved the so-called quantum measurement process. [6, 8]

Adoption of Quantum Theory

There are many points discussing quantum theory in relation to consciousness which adopt basic ideas of quantum theory in a complete and pure *metaphorical* way. Quantum theoretical terms such as entanglement, collapse, superposition, complementarity, and others are used without specific reference to how they are defined exactly and how they are useful for the specific situations. Conscious acts are just *hypothesized* as interpretable and computable *analogously* to physical acts of measurement or correlations in psychological systems are just *hypothesized* as interpretable *analogously* to physical involvement. Such accounts may produce captivating science fiction, and they may even be relevant to inspire nuclei of ideas to be worked out in detail. But unless this whole work leads beyond pure metaphors and analogies, they do not yet constitute scientific progress. A perspective which falls into this category will not be discussed in this contribution. Another category includes approaches that use the *status quo* of present quantum theory to elaborate neurophysiological and/or neuropsychological procedure. Von Neumann in the 1930s initiated the approach and has the longest history, later taken up by Wigner, and currently championed by Stapp. This is characterized as the proposal to *identify* intentional conscious acts with physical state reductions. Clearly, such identification is a much stronger statement than a mere metaphor or analogy. The third category refers to clearer and further developments or simplification of present-day quantum theory. An obvious candidate in this respect is the proposal by Penrose to relate elementary conscious acts to gravitation-induced reductions of quantum states. Eventually, this requires the composition of a future theory of quantum gravity which is far from developed. Together with Penrose, Hamer off has argued that microtubuli might be the right place to look for such state reductions. Another set of approaches is based on generalizations of quantum theory beyond quantum *physics* proper. In this way, general concepts such as complementarity and entanglement can be used to phenomena in both mental and material domains. In particular, relations between the two can be conceived in terms of dual aspects of one underlying "reality." [8]

Interdisciplinarity

The importance of interdisciplinary studies is well known in academia. Numerous cases have had fruitful outcomes resulting from collaboration among two or more traditional disciplines. For example, recent success in quantum information processing has resulted from collaboration among multiple disciplines, including quantum physics and computer science. Indeed, this collaborative effort has provided completely new and efficient ways of processing information, such as quantum computation and quantum cryptography. This approach yields a simple and diverse way of interdisciplinary education. Moreover, it can be done as a complementary approach to training in a traditional field of study. To conceptualize the particular Interdisciplinarity model, the concept of computable and noncomputable are discussed: In a strict sense, the definition of computable can be discussed using the concept of Turing machines and, in such case, non-computable corresponds to a nonalgorithmic process However, for our purpose of discussing Interdisciplinarity, it is sufficient to presume that by computable means something that can be calculated, mathematically modeled, or numerically quantified and predicted. The disciplines that are in this category may incorporate science, engineering, mathematics, and so on. For example, the path of the moon, the mass of a proton, the price of a smartphone, and the economic growth rate may be considered as computable. On the other hand, non-computable items involve abstract, metaphysical, emotional, and other elements that are often found in the humanities or arts.

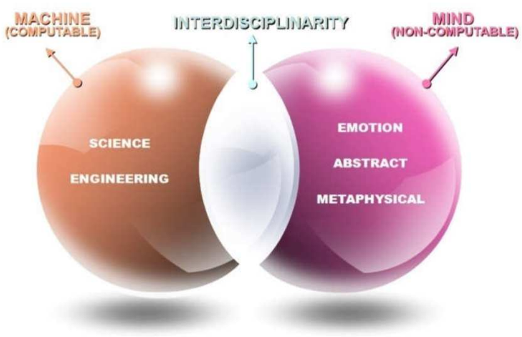

Figure 2: Interdisciplinary between areas of inquiry that are computable (science and engineering) and noncomputable (emotional, abstract, or metaphysical elements, which are often found in disciplines such as music, the humanities, etc.).

In some sense, the entire world and its associated problems fall into either one of these two categories; that is, everything may be considered either computable or noncomputable. This simple categorization connotes one of the great advantages of Interdisciplinarity. [9]

Epistemological Hypothesis

In the history of science it has always been a very challenging issue to correlate the brain functioning and the material science. Various different literature and studies shows different viewpoints about this and it's very puzzling. In its most general form, the mind-matter distinction comprises not only the distinction between minds and body but also, even more specifically, that of mind and brain. [9, 10]

The main part of all debate about the relation between mind and matter is the distinction or divergence between correlation and causation regarding mental and material states. The experimental and empirical science is based on finding correlations between states and properties of observed systems. By contrast, the concept of causation (or causality) is used to make sense of correlations. [9] This has been very successful and result producing. Thus we can say, correlation is a descriptive term with experimental relevance, while causation is an explanatory term associated with theoretical attempts to understand correlations. Causation implicit correlations between cause and effect, but this does not always apply the other way around. In physics, for instance, there are four basic kinds of interactions (electromagnetic, weak, strong, and gravitational) which aid to explain the interconnection that are observed in physical systems. When we talk about the mind-matter problem, the situation is more difficult. Far from a theoretical understanding in this field, the existing body of knowledge basically consists of empirical correlations between material and mental states. These interconnections are illustrative, not explanatory; and are not causally conditioned. It is (for some purposes) interesting to know that particular brain areas are activated during particular mental activities; but this does not, of course, explain why they are. Thus, it would be early to talk about mind-matter interactions in the sense of causal relations. [11]

Neurophysiological Levels of Description

In a normal human brain there can be different mental states and these states are called consciousness. Depending upon the individual the consciousness can be more or less stable. According to the standard belief the mental representation is correlated with the activity of the neurons. The neural correlate of a mental representation can be characterized by the fact that the connectivity, or couplings, among those neurons form an assembly confined with respect to its environment, to which connectivities are weaker than within the assembly. The neural correlate of a mental representation is activated if the neurons forming the assembly operate more actively; for example, produce higher firing rates, than in their default mode. To get a stable operation of a brain there must be optimum balance between excitatory and inhibitory connections among neurons.

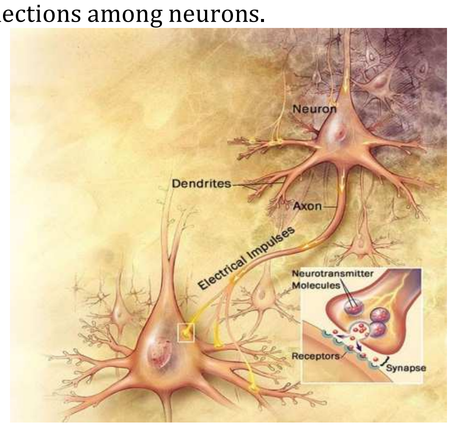

Figure 1: Chemical synapse

Quantum Field Theory of Mind/Matter States

In the 1960s, Ricciardi and Umezawa suggested to utilize the formalism of quantum field theory to report brain states, with particular accentuation on memory. The main aim is to conceive memory states, analogously to states of many-particle systems, as in equivalent representations of vacuum states of quantum fields Quantum field theory has been exceptionally successful in statistical physics, thermodynamics, and condensed matter physics. [12] A pivotal distinction between standard quantum mechanics and quantum field theory is that quantum field theory is not restricted to the validity domain of the uniqueness theorem by Stone and von Neumann. This theorem defines the framework for quantum mechanics with finitely many degrees of freedom. It states that all representations of the canonical commutation relations in a noncommutative algebra of observables over a compact state space are unitarily equivalent. [13]

Incompatibility between Quantum Theory and Consciousness

In recent times study of neuroscience has received a lot of surveillance recently from different branches of different faculties, the natural procedure of self-observing consciousness is considered to be the most difficult phenomenon to understand and grasp. This is because self-observing consciousness manifests a peculiar property that is not observed in other natural phenomena, i.e., an observer observes his own mental state. Another challenge in studying the natural phenomenon involving mental activities has been that it is hard to define the mental state in precise mathematical terms, as is possible with other physical systems. This mathematical description of the observer's mental state allows us to inspect consciousness within the standard axioms of quantum theory. The distinction between the observing party and the physical system being perceived, imposed by the axiom of quantum theory, produces a problem when the observer is observing his own mental state, i.e., self-observing consciousness [13]

Can Quantum Physics Explain Consciousness?

The topic of "quantum consciousness" makes most physicists cringe, as the phrase seems to evoke the vague, insipid musings and introspection of a modern spiritual thinker. But if a new hypothesis proves to be correct, quantum effects might indeed play some role in human cognition. Recent studies by a physicist at the university of California shows that the nuclear spins of phosphorus atoms can serve as a primary qubits for the brain, and can make the brain to function like a quantum computer. [14] The American physicist Richard Feynman studied this about the notorious puzzles and contradiction of quantum mechanics, the theory physicists use to describe the tiniest objects in the Universe. But he might as well have been talking about the equally knotty problem of consciousness. The everlasting puzzle of consciousness has even led some scientists to solicit quantum physics to describe it. That belief has always been met with some doubt or misbelief, which is not surprising: it does not sound wise to explain one mystery with another. But such ideas are not obviously nonsensical, and neither are they unpredictable. [15] Over the centuries various monistic and dualistic theories have been proposed, and the subject has had renewed interest as we try to assimilate the implications of quantum physics. These implications may make us reexamine our views of brains and bodies, but it is still not clear what consequences they have for our understanding of minds. [16]

DISCUSSION

The antediluvian inspiration for investigating, quantum theory in trying to understand consciousness derived from the realization that collapse-type quantum events introduce an element of randomness, which is primary rather than merely due to ignorance or missing information. perspectives such as those of Wigner, of Stapp, and of Beck and Eccles influence this in different ways. That is, the possibility that conscious mental acts can influence brain behavior. Many approaches focus on state collapse, but with a notable move from mental causation to the noncomputability of (particular) conscious acts. Any conversation of state collapse or state reduction refers, at least implicitly; to entangled tates since those are the states that are reduced. In this sense, entanglement is always co addressed when state reduction is discussed. By contrast, dual-aspect quantum approaches utilize the topic of entanglement differently, and independent of state reduction in the first place. Inspired by the entanglement-induced nonlocal correlations of quantum physics, mind-matter entanglement is conceived as the hypothetical origin of mind-matter correlations. This reflects the highly speculative picture of a basically holistic, psychophysically neutral level of reality from which correlated mental and material domains emerge. The brain is a paradigmatic example of a complex system establishing dissipative structures far from thermal equilibrium. Given the tight relation between these issues and the mind-matter problem, Prigogine's visions will most likely prove to be fruitful for future research on consciousness.

CONCLUSION

This is only a start. In itself it tells us nothing about how such a foundational display in the brain. Rather than having a solution, we are only at the start of a very difficult journey towards something with illustrative value. Not only do we have to find some system that is truly fundamental, but, given the lack of apparent consciousness in the rest of the universe, we need a process that is unique in operating only in brains, and not in other physical systems. Quantum consciousness is really a misnomer for the sort of system that we are looking for. To peruse such metaphors to a productive and useful level it is must to impart consciousness related properties to available mathematical and physical indices of the formal theory.

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