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Quantum information and consciousness: a gentle introduction. (English) Zbl 1390.81001

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There is a long lasting controversy concerning our mind and consciousness. This book criticises and deconstructs popular "classical" explanations of mind, like the pseudo scientific explanation in which the mind is nothing more then a kind of computer program. Consequently we could live for ever in a computer as a simulation. The resulting gap that results from the classical explanations could be field by the description of the real world around us, namely by quantum physics.

The first part of the book defines consciousness and mind. Consciousness and mind are often used to refer to a variety of things, including the ability to think logically, to behave rationally or to solve problems. However none of the features seems essential for defining consciousness. We can do it similar to what a computer program does, but we are still consciousness when we don't do it. The definition of consciousness is according to the book: "Consciousness refers to subjective, first-person point of view of our mental states, experiences or feelings. A conscious state is a state of experience. The terms consciousness, mind and experience will be used interchangeably hereafter." It is based on qualia: "Qualia (quale) are the subjective, first-person, phenomenal, qualitative properties of conscious experiences. When you experience a red rose, there is something it is like for you undergo that experience. Experience of redness of the rose..."

Out of this definition seven problems result: i) The first problem is the Physical boundary problem. Where is the physical boundary of one's own mind and the world. In ancient world people believed that the seat of consciousness is the heart, however the clinical evidence suggest that the seat of human consciousness is within the brain cortex. ii) The second problem is the Binding Problem: Experience of sense organs is experienced as a single seamlessly integrated mental picture. There is a unity of mind. Unity of mind requires integrity of the brain, since after certain surgical operations one brain can host more than one individual mind. Split brain patients have two minds unaware of the existence of each other. iii) The causal potency problem: We feel in control of our bodies. And we think that we are able to transform the world. Why was consciousness selected by natural selection (evolution)? Why do we need consciousness at all? iv) Free will problem: We can chose a course of action if there are at leat two different alternatives. Because of this we are moral responsible. We define ourselves by our actions, we can be good or evil. v) The inner privacy problem: There is no scientific way to determine if any other person, animal or object is consciousness or not. There are some things that are not observable, the phenomenal nature of individual consciousness experience is incommunicable. vi) Mind-brain relationship: The brain is publicly observable, the mind not. I cannot doubt that I have a mind but can doubt that I have a brain. Anaesthetised brain has no mind, means that the brain is not the mind. vii) The last problem is the most difficult one, the hard problem It would be easy to say that consciousness is what brain does, however there are counterexamples. For example less consciousness could occur to a sudden drop of glucose level, inhalation of anaesthetic gases or mechanical brain trauma. Brain states are not identical with states of conscious experience. The main question is why do qualia exist?

The second part of the book deals with scientific conception of the world, about logic and classical physics. Determinism and complete observability are the two characteristic features of classical physical theories. Mathematical concepts and the classical probability theory is introduced followed by axioms of classical mechanics and classical electrodynamics. Then the world of quantum physics and its mathematical foundations are introduced. The foundations are based on complex numbers and wave functions. The central theorem that is essential role in the definition of consciousness is the Kochen-Specker theorem: "Quantum information is contextual, namely, it is not possible for all quantum mechanical observables of a quantum system to have predetermined values ahead of time and independent of the apparatus used to measure those observables." It means that the values of quantum physical observables are made up answers generated at the time of measurement.

The third part of the book introduces the quantum information theory of consciousness. Classical physics does not identify consciousness with any of these fundamental physical quantities, consciousness does not exist in classical world. Mind boundary cannot be fixed and a computer is incapable of consciously experience the contents of the stored files. Some classical explanation of the binding problem are presented

and criticised. In the binding by convergence, binding by assembly, binding by synchrony, binding through integrated information and finally binding through electromagnetic fields.

Computationalism states that mind is a computer program. Thinking a form of computing, mind is just the running software. This classical reductionism implies trivial immortality that can be achieved by current technology. Representationalism is related to computationalism, the act of representing through physical processes in the brain is itself generating the experience. Another classical definition of human consciousness reduces it to a product of a material brain that emerges when the brain structure reaches certain level of complexity, a kind of magic trick. Consistent with the deterministic physical laws of classical physics consciousness is finally reduces the to the level of an epiphenomenon. A physical phenomenon produced by the accompanying brain processes, but itself having no causal influence upon the brain processes. It does not give any evolutionary advantage. This leads to the hard problem of consciousness, why do we have mind and consciousness experience at all? Other problems concern the free will which is either denied, we are without free will or contradicted. We cannot live in a universe that is governed by deterministic physical laws

Consciousness in quantum physics can solve most of the discussed problems. In the proposed model each individual mind corresponds to entangled state vector that resides in a subspace. To each non-factorizable state vector corresponds a single mind. Such a definition endorses panpsychism and explains the free will through the wave function collapse

The book closes with an overview of quantum neuroscience and research programs and conscious experience.

The book is an essential compilation of knowledge the theory of quantum systems and about consciousness. It is recommended to any one interested in the field of the science of mind. It brings a fresh insight in the never ending philosophical debate of what consciousness and mind is. It manages it without hidden metaphysical indigents that are found in so many related books.

Reviewer: Andreas Wichert (Lisboa)

MSC:

81-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to quantum theory	Cited in **1** Document
81P05	General and philosophical questions in quantum theory	
81P45	Quantum information, communication, networks (quantum-theoretic aspects)	
81P40	Quantum coherence, entanglement, quantum correlations	
81P13	Contextuality in quantum theory	

Keywords:

quantum information; entanglement; mind; consciousness

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