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EXPERT COMMENTARY

Quantum Cognition and Eastern Wisdom Thinking

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Background

Over the past two decades, there has been a significant rise in quantum cognition literature with a fresh and frequently insightful approach that provides new descriptive and normative frameworks for understanding the human mind and cognition.

Quantum cognition is a multilayered interface between mathematical–philosophical concepts of quantum information science - cognitive science in general and high-level cognition, in particular, like decision making processes to information retrieval to image perception, and other complex processes. Standard neo-classical decision theory (which has re-formulated neo-classical economic theory) has been based on an ideal construct of rationality, based on several platonic assumptions, for example, full knowledge of all possible contingencies in the world of choice making, and also common knowledge of that rationality. It is not difficult to understand that such highly abstract ideals are not representative of the world that we inherit; rather, orthodox theoreticians (e.g., Arrow or Debrue, who were among the high priests of such frameworks) were very much aware of the pure mathematical nature of their works. Unfortunately, over the course of time, such a rationality construct has become standard thinking about rational choice making, and any deviation has been rendered anomalous and irrational. The rise of behavioral economics is within the context of the emergence of a large domain of cognitive science. Cognitive scientists provided numerous data points on several systematic deviations of human behaviors from the ideal rationality construct, which laid

down the path for behavioral economics or finance as a subject. Loss aversion, ambiguity aversion, her behavior, other regarding preferences, and numerous similar features of human behaviors started occupying pages of academic texts, and now they are systematically studied across universities (even though the overarching influence of neoclassicism die hard).

However, there can be some limitations of extant behavioral literature, one for example, is that there is a lack of coherence and consistency among numerous models proposed to depict certain different features of mind and behavior. Hence, a natural question to ask is whether an alternative coherent and consistent theoretical framework which contains the standard results and explains deviations as well, is possible. Quantum-cognition is one such alternative, which has stood the test of time and criticisms.

Is It All Math?

Adapting the language or formalism of quantum information theory for explaining (in the descriptive and normative senses) choice behaviors would only seem like a full hardy mathematical program; indeed, there is a deep involvement of mathematical modelling. Finite dimensional Hilbert space modelling, with suitable operator algebras and description of states (density operators) corresponding to cognitive or mental states, are basic building blocks of the framework. Analogies between quantum state updating through 'measurement' processes, as in quantum information, need to be carefully mathematicized, and most of the work happens in this direction. Even here, mathematicians are careful not to fully emulate quantum mathematics, since there are several unique features of mind and cognition which may not be fully captured by orthodox quantum formulation. Hence, new apparatuses are required, and the challenge of building a new mathematical formulation is at our hands. However, even given this emphasis on math modelling, one should note that the literature is deep and wide.

Philosophical Underpinnings

There are striking analogies between the philosophy of quantum mechanics and that of the mind in general. From the beginning of modern quantum mechanics (roughly 1925 when a very radical and young Heisenberg described Hydrogen atom spectrum using at that time a very strange math framework of

matrices, from which his celebrated uncertainty principle emerged, though no less important is the contribution of Indian genius SN Bose who formulated the first of quantum statistics with Albert Einstein), the founders (Bohr, Heisenberg, Schrodinger, Pauli, Born, Dirac, Neumann, Jordon) also thought deeply on philosophical questions. The central idea being, what does quantum mechanics tell us about reality? Or does it say anything at all? The debate is still ongoing, given the immaculate success of the formalism over decades, given that all future technologies will fundamentally depend on quantum mechanics (AI or machine learning or quantum computing, with their numerous potential applications from foundational research to even financial markets). Analogously, philosophy of mind has always been a baffling domain. Rather, Bohr and later Pauli, in their own ways, thought of several synergies between mind and matter, or the applicability of certain general underlying principles to both quantum matter and the human mind. Namely, indeterminacy, contextuality, and entanglement-like features are systematically found in human mind states. Recently, a quantum-like qualia hypothesis has been proposed. The role of consciousness (in a more functional sense) in the quantum measurement problem is still debated. On a different route, QBism takes an agential perspective for quantum mechanics, suggesting that quantum mechanics is a novel guide book for any ideal rational agent to navigate in an external world, on which they can act and get feedback from, rather probabilities calculated are just personal subjective credence for possible future experiences for those agents themselves.

Insights from Wisdom Thinking

Eastern wisdom thinking, encompassing different perspectives from Buddhism, Vedanta, and Jainism, among others, has long contributed to the philosophy of modern science. For example, the ongoing dialogues between quantum mechanics and Middle Path Buddhism are well known. One modern interpretation of quantum mechanics, relational quantum mechanics, is deeply inspired by Nagarjuna's Mula Madhyamaka Karika, where reality can only be understood as relational between diverse processes. Analogously, Eastern wisdom thinking has contributed, and it itself has very deep discourses on philosophy of mind. For example, the Nyaya philosophy is a forerunner to the modern subject of social epistemology, where art and science of argumentation is discussed in painstaking detail. Can wisdom perspectives be insightful to quantum-cognition literature? The current author thinks yes.

Contextual Logic

First, mind is not per se quantum mechanical, for example, there are various cognitive effects (order effects, or response replicability, for a good review see) which in isolation can be well explained by quantum formalism, but when they are in conjunction, it's a problem, and new mathematical concepts are needed. These issues are indicative of general contextual features of mind and cognition, even beyond orthodox quantum formalism.

Contextuality, no doubt has been a fundamental feature of quantum science, there are many sophisticated mathematical constructs of the same, but in simple language it means that any 'observation' or 'outcomes' thus obtained can only be understood in the context of the experimental setting, hence the Newtonian belief of an objective non-contextual reality out there to be discovered, is no longer tenable. The human mind and cognition are deeply contextual, rather more complex in its contextuality. For example, in quantum mechanics, certain pairs of conjugate observables are inherently non-compatible - most famously, position and momentum. By contrast, such fixed non-compatibility does not apply to mental observables or states, suggesting the need for a broader and more general framework of contextuality. Second, is such general contextual logic to understand reality possible (both physical and mental)? Interestingly, wisdom thinking directions offer good help here. The current author is involved in building a multivalued contextual logic frame which can illuminate both quantum and cognitive worlds, which is founded on Syadvada logic of Jainism. Syadvada or Anekantavada of Jain philosophy treats potentialities as equally real as actualities, rather true, false, and unmanifest or Avyaktam are equally valid judgments. A seven-fold propositional logic is produced, which can be insightful for understanding contextuality in both physical and cognitive worlds.

Author Biography

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