Article

On the Quantum Mechanics of Consciousness: Sartre's Contribution

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Abstract

The present paper constitutes an effort to integrate the knowledge of two distinct scientific disciplines: psychology and quantum physics. This intention will be fuelled by the current need of clarification on what concerns quantum measurement problem, consciousness and respective relationship. For this matter, we choose to use the concept of consciousness described by Jean Paul Sartre in his work. After a brief review of the main presuppositions of quantum theory and Sartre's ontology, we will proceed with the establishment of proper correspondences between these models eventually defining an isomorphism between its correspondent systems.

Keywords: consciousness, quantum measurement problem, quantum system, Sartre, isomorphism.

I. INTRODUCTION

Quantum theory is the most accurate scientific theory of today with none of its predictions having ever been wrong. It assumes a major role in a large spectrum of researches, ranging from cosmology to biophysics, replacing "classic" physics as the regulatory mechanics of our world. However, despite its explicative supremacy, quantum theory hasn't been able to superimpose on our classical worldview which remains dominated by Newtonian premises. Even in the scientific field only with great effort can we escape its influence. The main reason for this incongruence is the quantum theory's incapacity to provide an explicative model of the world that doesn't collide with our everyday experience. If we must accept quantum mechanics we must necessarily re-evaluate some of our most obvious intuitions such as: a single object cannot occupy two distinct locations at the same time; the world has a real existence independently of its observation; time has an exclusively anterograde progression; two objects, with no physical connections between them, cannot instantaneously affect themselves, etc.

Recognized the practical applicability of quantum theory, the efforts of the physicists' community were therefore deviated to a blind profiteering of its predictions *for all practical purposes*, leaving the meaning of quantum theory as a taboo issue over most of the last century. From Jauch we read that,

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"The interpretation [of quantum mechanics] has remained a source of conflict from its inception. . . . For many thoughtful physicists, it has remained a kind of "skeleton in the closet." [1]

Despite the orthodox Copenhagen's interpretation, assuming that science should not give explanations of the world but instead be used as a tool of measuring and predicting, there were still some unresigned physicists which persisted in the study of this enigma. Soon, these investigators established an inextricable link between quantum mechanics and consciousness eventually leading to an increasing interest in epistemological and psychological issues. Wigner commented on this matter stating that,

"When the province of physical theory was extended to encompass microscopic phenomena through the creation of quantum mechanics, the concept of consciousness came to the fore again: It was not possible to formulate the laws of quantum mechanics in a fully consistent way without reference to the consciousness."[2]

At the same time, challenging current deterministic and rationalist conceptions, also Jean-Paul Sartre (1905-1980) founds a new theory. Unsatisfied with the dominant psychological theories, he reviews the psychology's foundations, as well as the basilar aspects of occidental rationality, eventually elaborating a new ontology able to provide a solid ground for a new psychology. In his project he clashes with some dominant conceptions, namely the notion of consciousness.

Previously to Sartre, the study of consciousness remained throughout centuries a theme of strong debates and controversies varying between philosophical and psychological streams. For this reason, a unanimous and consensual notion of consciousness was never achieved. In his work, Sartre proposes a reformulation of psychology (re)introducing a valid concept of consciousness while discussing some dilemmas and misconceptions which compromise its development:

"For most philosophers the ego is an "inhabitant" of consciousness. Some affirm its formal presence at the heart of Erlebnisse, as an empty principle of unification. Others—psychologists for the most part—claim to discover its material presence, as the center of desires and acts, in each moment of our psychic life. We should like to show here that the ego is neither formally nor materially in consciousness: it is outside, in the world. It is a being of the world, like the ego of another."[3]

Quantum enigma and consciousness have been considered the two major mysteries of contemporaneous science. As David Chalmers says: "when there are two mysteries, it is tempting to suppose that they have a common source"[4]. Is consciousness a quantum phenomenon? This approach has been strongly debated by the scientific community in the last three decades. Nevertheless, this question remains an empirical one, lacking a precise formulation and philosophical support on what concerns the notions of "consciousness" and "quantum phenomenon".

With this paper we attempt to contribute for the development of a response for these mysteries. After a brief review of the presuppositions of quantum theory and Sartre's ontology, we should adopt Sartre's notion of consciousness and establish a set of correspondences between quantum and conscious mechanisms eventually defining an isomorphism between correspondent systems.

II. QUANTUM MECHANICS

A. Superposition Principle, Wavefunction Collapse and the Quantum Measurement Problem

"[The two-slit experiment] contains the only mystery. We cannot make the mystery go away by "explaining" how it works . . . In telling you how it works we will have told you about the basic peculiarities of all quantum mechanics."[5]

Feynman

One of the basilar aspects of quantum physics is the superposition principle, mathematically determined in the linearity of the Hilbert state space. If $|1\rangle$ and $|2\rangle$ are two states, then this property tells us that any linear combination $\alpha|1\rangle + \beta|2\rangle$ also correspond to a possible state.

This superposition of states is fundamentally different from a classic grouping of states where the system is already in an *a priori* defined state although unknown to us. Contrary to this classical probability of discovering the actual state, in quantum mechanics probability is all there is. This can be shown experimentally, especially on a microscopic level, through the direct observation of interference patterns using, for example, an experimental setup where electrons pass individually (one at a time) through a double slit. Accordingly, the electron must not be described by none of the wavefunctions which illustrate the individual crossing through a particular slit but only by the superposition of these wavefunctions.

How can we integrate the superposition principle in our everyday experience of the world? What happens in the borderland between quantum and classical world? We know that wavefunctions evolve deterministically, according to the Schrödinger equation, in a linear superposition of different states; however a real measurement always finds the physical system in a definite state which will constitute the starting point for further evolution. This means that the measurement has "done something" to the previous superposed system, arbitrarily collapsing wavefunctions and interleaving indeterminism in the process. These questions constitute the basis of the unresolved problem of quantum measurement, which is nothing more than the problem of how (or if) the wavefunction's collapse occurs.

B. Quantum Entanglement

"It's getting even spookier out there. Particles can be strangely connected … the measurement of one particle will instantaneously determine the state of the other."[6]

Einstein

Another fundamental aspect inherent to quantum mechanics, designated by Einstein as "a spooky action at distance"[6], is "entanglement". It constitutes one of the main qualities of quantum theory, specifically non-locality – the technical designation for an instantaneous action at distance, free of interconnecting physical forces. According to this principle, any objects that have ever interacted will forever remain entangled and therefore what happens to one of them will necessarily affect the other(s) in an instantaneous way. This interaction between one system's entities will thus define their transition from being in a superposed state to an entangled state.

C. (Un)Observed (Un)Reality

"In the experiments about atomic events we have to do with things and facts, the phenomena that are just as real as any phenomena in daily life. But the atoms or elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts."[7]

Heisenberg

In 1927, Heisenberg formulates the uncertainty principle, which assumes the impossibility of simultaneously defining position and speed for a particle. More broadly, the complementarity principle of Niels Bohr assumes that the ascertainment of a determinate aspect of a system (of atomic proportions) annihilates any further possibility of knowledge of a complementary aspect of the same system. Altogether, these principles suggest that, in microscopic terms, there isn't a defined subjacent reality since, as Wheeler puts it, *"no elementary phenomenon is a phenomenon until it is a registered phenomenon"*[8].

As we saw above, physical systems exist in a superposed state of potentialities with the reduction of these possibilities to a defined state being dependent on how the observer chooses to know them. It is the "free choice" of the observer that will determine the previous physical situation transforming it into a defined and *real* state. Macroscopic objects are real because they are always under observation and therefore cannot be isolated.

D. Inversion of Temporal Progression

"We have a strange inversion of the normal temporal order…an unavoidable effect on what we have a right to say about the already past history of that photon".[9]

Wheeler

By affirming itself as the regulatory equation of all micro and macroscopic phenomena, Schrödinger's equation presents us with another implication which collides with our basic intuition of temporal progression. In the story told by Schrödinger we have a cat in a "mixed" state, containing "equal parts of living and dead cat"[10], until an observation of it eventually causes its definite state of deadness or aliveness. This reduction of states was already described above, however, what the Schrödinger equation also tells us is that, after the observation, what follows is a construction of a *real* past compatible with the measured state; this will happen on a retrograde temporal progression. Observing a dead cat determines the history of its development of *rigor mortis*; finding it alive determines the history of its developing hunger: the observation not only creates reality but also creates a history consistent with that same reality

III. SARTREAN'S CONSCIOUSNESS

After the exposure of some of the principles and dilemmas of quantum theory, we follow with the description of some key-aspects of the Sartrean ontology. Special attention will be given to the notion of consciousness so that a subsequent clarification of its relationship with quantum mechanics may be facilitated.

A. The Problem of Solipsism

"The impossibility of distinguishing in our customary way between physical phenomena and their observation places us, indeed, in a position quite similar to that which is so familiar in psychology where we are continually reminded of the difficulty of distinguishing between subject and object."[11]

Bohr

The problem of human reality and necessarily the problem of the existence of the *Other* have always been themes of reflection for many philosophers along the history of mankind. This question was typically translated in an effort to refute solipsism. Sartre develops an ontology which seeks precisely a solution to these questions, justifying the importance and necessity of the Other as a fundamental aspect in the existence of the subject and of his consciousness.

B. (Non-Reflexive) Consciousness

Sartre subverts the dominant Cartesian concept of consciousness abandoning the primacy of reflection over consciousness; instead, Sartre justifies the existence of a non-reflexive consciousness which in its turn allows the emergence of reflection.

Contemporaneously to Sartre, consciousness was already considered as an escape from itself: from there comes the Heideggerian's concept of transcendence; also Husserl and Brentano's intentionality have, in more than one way, the character of detachment from itself. Nevertheless, Sartre innovates by adding:

"…every positional consciousness of an object is at the same time a non-positional consciousness of itself."[12]

In this citation we find a reference to the Sartrean cogito. Accordingly, there is an assumption of a non-thetic consciousness where the subject is present in his totality to himself. Contrary to what happens in reflexion where the Ego is grasped directly as an object, consciousness doesn't collect the person directly or as its subject – the person is present to consciousness while being an object to the Other. Therefore, consciousness is not the product of a reflexive ego, as a voluntary choice of an abstract possibility, but instead appears in the very kernel of being, constituting an adequate milieu for the appearance and support of its essence: in Sartre's words, "to the synthetic order of its possibilities."[12]. In this way, and contrary to previous philosophical analyses which endeavoured to drain the consciousness's contents, the author of "Being and Nothingness" refuses the substantial character of consciousness, affirming it as pure appearance.

Assuming a phenomenological tradition, Sartre assumes the existence of two distinct kinds of being: the being of phenomena and the (true) being of consciousness. These modes of being correspond to two distinct and not superimposable ways of being: respectively, the in-itself and the for-itself. While the former is subject to the principle of identity, affirming itself as being what it is, "the being of for-itself is defined, on the contrary, as being what it is not and not being what it is"[12]. In this way, the for-itself finds a lack between itself and the world of phenomena. Sartre calls this lack "nothingness" affirming the act of being conscious as a nihilating one. Accordingly, every consciousness is positional because it transcends itself in order to reach an object eventually annihilating itself in that position.

Thus seen, consciousness, separated from the world of things by nothingness, may be considered as a total emptiness. However, because of its conjoined identity of existing appearance, Sartrean consciousness may also be regarded as a non-substantial absolute:

"A pure consciousness is an absolute quite simply because it is consciousness of itself."[3]

At this time, we hope to have eliminated the obscuring transcendental ego from pure unreflective consciousness and shown that ipseity, the true fundament of personal existence, is completely different from an ego or from a remission of the ego to itself. Consciousness' existence does not depend on the Other because the being of consciousness is independent of knowledge and pre-exists to its ascertainment:

"The World has not created the me: the me has not created the World. These are two objects for absolute, impersonal consciousness, and it is by virtue of this consciousness that they are connected. This absolute consciousness, when it is purified of the I, no longer has anything of the subject. It is no longer a collection of representations. It is quite simply a first condition and an absolute source of existence."[3]

C. The World of the Other

"The Other is no longer first a particular existence which I encounter in the world and which could not be indispensable to my own existence since I existed before encountering it. The Other is the ex-centric limit which contributes to the constitution of my being. He is the test of my being inasmuch as he throws me outside of myself toward structures which at once both escape me and define me; it is this test which originally reveals the Other to me."[12]

Following Hegel's postulates, Sartre develops his theory using the Other as its propellent. In this way, he stresses that consciousness and the Other are mutually implicating elements, existing one for the other. Accordingly, in a world where the subject finds himself immersed in the Other, he sees his subjectivity inevitably compromised by it. The ego is nothing more than his own conscious existence caught up by another from whom he depends to recognize himself as he is. His existence will be marked by consciousness (of) existing, which will be constantly escaping and being petrified into an ego that will constitute an object to the Other:

"I grasp the Other's look at the very center of my act as the solidification and alienation of my own possibilities...of the world which I organize" [12]

Nevertheless, the conscious being refuses to be the in-itself that the Other coagulates and proclaims its subjectivity knowing that its existence is ipseity, is consciousness (of) existing. Seeking to occupy this lack between itself and the world of phenomena, the for-itself perpetually projects itself towards one of its possibilities aspiring to become an everlasting in-itself-for-itself. However, this desire will be necessarily condemned to failure since there will always be a nothingness between them that will never wane.

The world emerges in this circuit of ipseity revealing itself as a choice of potentialities, as an indication of acts, ensuring its unity and sense of the world. It humanizes the subject through the

attribution of an existence-defining situation and, at the same time, is humanized by him since the subject will constantly transcend what is given to him organizing it in a structure with individual meaning. In Sartre's words:

"The individual claims his achievement as an individual, the recognition of his concrete being, and of the objective specification of a universal structure ... the universal in this case could have no meaning if it did not exist for the purpose of the individual." [12]

D. Freedom

Sartre's philosophy escapes the classical model which establishes freedom over the domain of reason and translates into a carelessly individuality with no rules. Assuming its incompleteness, consciousness is determined to desire, to act upon the world, to be free. Possessing its own structure, consciousness bestows upon itself its own purposes, projects towards its possibilities, and detaches its motives from the world. Motives, far from determining action, only appear through its project. Consequently, voluntary deliberation is always illusory: when the will gets involved not only the ends are set but also its whole interpretation system. The role of reflection will be simply to choose the way to achieve an already positioned end. This elaboration will be done by a transcendental ego which is,

"… an object apprehended, but also an object constituted by reflective consciousness. The ego is a virtual locus of unity, and consciousness constitutes it in a direction contrary to that actually taken by the production: really, consciousnesses are first; through these are constituted states; and then, through the latter, the ego is constituted."[3]

IV. QUANTUM - CONSCIOUSNESS ISOMORPHISM

"When there are two mysteries, it is tempting to suppose that they have a common source. This temptation is magnified by the fact that the problems in quantum mechanics seem to be deeply tied to the notion of observership, crucially involving the relation between a subject's experience and the rest of the world."[4]

David Chalmers

An isomorphism exists when common characteristics, structures, formulas and form of organization are in agreement in different systems. That is, when formally similar laws governing the functioning of different phenomena exist. The establishment of isomorphisms has been used in the acquisition of predictive knowledge concerning phenomena's behaviour in the

world. Because these systems are governed by identical laws, it is predictable that through one system's behaviour we may be able to map the intrinsic structure of the other(s).

Through the analysis of the presuppositions of consciousness and quantum theories we find some aspects which, because of their similarities, lead inevitably to the establishment of a parallelism between these two models.

We saw that consciousness is defined by nothingness because all objects, truths and values are found outside it. On the other side, nothingness is everything since it is non-thetically conscious of all those objects. This is analogous to what happens in superposed quantum systems which despite being isolated from the world, find themselves constituted by a plenitude of potentialities of eventual worldly objects. When extended to composite systems, with more than one particle, the superposition principle conveys a situation of entanglement between these particles with the establishment of an instantaneous reciprocity in their behaviours. Also consciousness is arranged with its possibles being perpetually and instantaneously affected by each other thus guaranteeing its action in the world as a whole. Here, the particular mode consciousness has of holding to its possibles is affectivity.

Both systems are dependent on an observation by an external spectator in order to become real. It is the gaze of the Other that coagulates the consciousness' possibilities into a defined object; also in quantum experiments, the transition from a quantum to a classical state depends on an external measurement which will select one of the superposed possibilities (at the expense of all the others) and objectify it. This measurement will typically introduce an indeterminism alien to both previous and posterior states which will be the responsibility of the observer.

After the measurement of a quantum system, quantum theory tells us that the construction of a suitable past will occur backwards in time in order to *validate* the measured state. Wheeler puts it in these terms: *"Thus one decides the photon shall have come by one route or by both routes after it has already done its travel"*[9]. In Sartre's perspective, existence precedes essence: consciousness pre-exists its knowledge guaranteeing a pre-judicious and pre-reflexive evidence of the subject which inevitably condemns him to be free in relation to the Other. In this way, the task of the reflexive ego will be the announcement of the path to reach a certain end which, nevertheless, has already been defined by consciousness. When it does so, it also does it in a retrograde temporal progression, announcing itself from the end.

Table 1. Correspondences between quantum system and consciousness

Quantum System	**Consciousness**
Superposed state	For-itself (Non-reflexive consciousness)
Entanglement	Affectivity
Wavefunction Collapse	Nihilation
Measurement	The gaze of the Other
History of the measured state	Reflection

V. CONCLUDING REMARKS

Almost one century after quantum theory's conception, and despite all the proposed attempts of interpretation, physicists' still haven't been able to provide a consensual clarification on how an observation *hic et nunc* changes one system's state in a manner not translated in any known mathematically formulated principle. The difficulty associated with the resolution of this problem seems to reside in a concept which, after all, seems not to be as remote from physics as originally thought – consciousness. Confronted with this insurmountable link many physicists eventually relegated this question to psychology. Psychology, on its hand, has seen its evolution trespassed by methodological, epistemological and ideological impasses which posed serious obstacles in the definition of its object. These restraints have seriously compromised its development inevitably leading to a dispersion of knowledge and leaving consciousness as an elusive concept with no defined place in psychology.

One of the most compelling applications in the isomorphic research has been the comparison of artificial models of a natural system with the same system's real existence in nature. In this article we attempted to demonstrate that quantum experimental systems may constitute artificial models of consciousness, therefore permitting not only an increasing comprehension of quantum theory's meaning but also the indirect study of consciousness through the study of quantum phenomena.

Despite our reduction of conscious functioning to quantum mechanics, we don't necessarily affirm the opposite, i.e. that all quantum systems are conscious. For that to happen, the quantum system would require a proper transducer device similar to the human brain.

We reject a mechanicist view of human condition, stressing the importance of the Other in the construction of the subject. Because, as Giles Deleuze poses it: "in the Other's absence, consciousness and its object are one"[13]. Quantum theory woke us up from the Laplacean dream of a mechanical world independent of the observer and no more will a system remain unchanged after its measurement. Instead every observation must now be seen as a unique individual act derived from a specific perspective on reality.

If we accept a quantum mechanics for consciousness, a new scientific approach is inaugurated with totally new ways of exploring and studying the human mind. Therefore, there is a call for an interdisciplinary approach, integrating knowledge and expertises from quantum physics, psychology and even philosophy. It is time to take Russell Ackoff's advice and "stop acting as though nature is organized into disciplines in the same way that universities are"[14].

The topic of this paper is a very wide one and only a brief presentation like this couldn't possibly cover all the prospects that could be derived from the establishment of a quantum-consciousness isomorphism. We hope to have raised the reader's curiosity on this matter, fostering additional reading and researching on this matter, because as Bohr concludes,

"...the analogies with some fundamental features of the quantum theory, exhibited by the laws of psychology, may not merely make it easier for us to adjust ourselves to the new situation in physics, but it is perhaps not too ambitious to hope that the lessons we have learned from the very much simpler physical problems will also prove of value in our endeavours to obtain a comprehensive survey of the more subtle psychological questions....it is clear to the writer that for the time being we must be content with more or less appropriate analogies. Yet it may well be that behind these analogies there lies not only a kinship with regard to the epistemological aspects, but that a more profound relationship is hidden behind the fundamental biological problems which are directly connected to both sides. "[15]

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