Quantum Mentality: Panpsychism or Panintentionalism?

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Abstract: In this paper we argue that an access-consciousness version of panpsychism, which we call "panintentionalism" suffices, and is better equipped to account for the type of mentality involved in quantum mechanics than the standard one, based on phenomenal-consciousness. We provide details concerning the notion of "observer" in quantum mechanics to support our claims and conclude that, even if one accepts a panpsychist view of the universe, only a panintentionalist version is justified.

1. Introduction

Panpsychism is gaining momentum as a theoretical explanation of phenomenal consciousness. Recent volumes and discussion about scientific interpretations of panpsychist views are evidence of this. A powerful combination of arguments and interpretations of quantum mechanics strengthens the case for panpsychism as a plausible view of fundamental reality. In fact, according to some authors, the case for panpsychism is now so strong that it should be considered superior to the, until recently prevailing, physicalist view, particularly in light of the hard problem of consciousness and considerations regarding the nature of intrinsic properties.

The theoretical and empirical arguments in favor of panpsychism are based on epistemic and metaphysical considerations. The main arguments are roughly as follows. If physicalism were true, the relational and functional vocabulary of physics should be capable, at least in principle, of explaining all the properties of fundamental reality. It is clear, however, that such sparse vocabulary cannot account for all the properties that are metaphysically fundamental. In particular, scientific models can only capture the relational properties of fundamental entities that are described in terms of mathematical relations. This clearly indicates that such a vocabulary is insufficient since those relational, dynamical, structural, and dispositional properties must depend on their categorical bases. These properties, the categorical bases, must specify what fundamental entities are intrinsically, in themselves, and not only in relation to other fundamental entities. Therefore, metaphysicians have the task of complementing the physicalist picture with these fundamental, intrinsic properties.

This argument about intrinsic properties can be combined with an intuitive argument about the epistemic status of consciousness. The epistemic argument states that the best candidates for intrinsic properties are those associated with phenomenal consciousness. The redness of red, for instance, is fully displayed in our experience of red. It is intrinsic to the experience. We could build mathematical models regarding how to describe red in physics, as part of the spectrum of light and our knowledge of light detection by our retina and signal processing by the brain. But what red is, essentially and intrinsically, is fully given in our experience of red. This is not only an aspect of our experience, but the sole epistemic access we have to the redness of objects in our immediate environment. Thus, properties associated with our conscious awareness are epistemically and ontologically fundamental.

There are, then, good reasons to conclude that the categorical bases of the dispositional properties defined in fundamental physics are conscious, because qualia are the intrinsic properties we know in an immediate and robust manner (throughout, by qualia we mean the specific phenomenal properties of conscious experiences)[1]. One way of presenting this conclusion is that microphysical properties are conscious, in some relevant sense of "conscious." They either combine into larger conscious structures like us, or are related through some kind of emergence relation to robustly phenomenal conscious experiences. These are two very different formulations of panpsychism, but they are both committed to the presence of consciousness at a fundamental level.

A substantial portion of the debate surrounding these two versions of panpsychism focuses on two key difficulties: the combination problem, and the problem of micro to macro causation. The main approaches to solve these problems are the constitutive and non-constitutive views. The constitutive view claims that macro phenomenal properties depend on, and are realized by, micro properties that are intrinsically phenomenal (non-relational or dispositional). This view has the advantage that the same relation of composition holds between micro and macro properties and this helps with the thorny problem of causation. The key difficulty for the constitutive view is the combination problem: how exactly is it that the micro-properties organize themselves into macro-structures with conscious experiences, such as ours? What kinds of macro-structures are conscious like us? How are the experiences of macro conscious beings different from the conscious states of elementary particles?

The non-constitutive view avoids the combination problem because it appeals to an emergence-like relation that does not depend on the same fundamental composition relation at the micro level. The cost of this advantage is that the problem of causation

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[1] For a recent collection of papers on quantum mentality, including both non-phenomenal approaches, as well as skeptical accounts of the connections between mind and quanta, see de Barros and Montemayor (in press).

(causal overdeterminism and downward causation) becomes intractable because the micro level causation is not directly responsible for macro level causal interactions, thereby generating the need for new macro to micro and macro to macro causal relations that cannot be explained at the micro level. Thus, even though the micro properties are conscious, it is unclear how exactly they casually determine the macro properties. Moreover, one might suspect that this non-constitutive view is compatible with a dual-aspect monistic view or even with standard physicalist emergentism, because the emergent properties may be radically different than the micro properties and thus, the macro could be conscious while the micro is semi-unconscious or just “minimally” conscious. We will not explore this difficulty here and interpret this view as somehow requiring the micro to be conscious (for a review see Bruntrup and Jaskolla, 2017).

If panpsychism is interpreted as the claim that the micro level properties, the categorical bases for physical dispositional and relational properties, are conscious, it would be important to explain how exactly this claim should be scientifically understood. It seems that without some scientific explanation, the panpsychist is merely playing with intuitions about the metaphysics of dispositions, appealing to infinite regresses that might not be relevant for a scientifically rigorous understanding of fundamental reality. This is particularly pressing for panpsychism since phenomenal consciousness is the type of thing we intuitively attribute only to creatures that look very much like us—intuitively, only animals very similar to us seem to be robustly conscious and, certainly, we never think inanimate matter is conscious. Therefore, the argument in favor of panpsychism cannot purely proceed in terms of intuitive appeal, because there are strong intuitive reactions against it.

Here is where quantum mechanics comes in, allegedly providing strong support to panpsychism. An explanation of the relation between quanta and qualia can be provided by many of the major interpretations of quantum mechanics (e.g., Copenhagen, many-minds, observer dependent). The appeal is neither unintuitive nor unnatural because, according to many physicists working on the foundations of quantum mechanics, the explanation of how the theory works must appeal somehow to a (conscious?) observer. This provides the crucial missing piece for the argument in favor of panpsychism: panpsychism might go against our commonsensical views about what kind of living organisms are conscious (only those that strongly resemble us in social skills and biology), but this is no obstacle because any explanation of fundamental reality, such as quantum mechanics, is unintuitive in that exact way.

We will not dispute, for the sake of argument, that micro-physical properties are conscious in *some* sense. Our objection is that phenomenal consciousness is not the best characterization of the type of mentality that is needed to understand fundamental reality because it does not capture essential features of the type of mentality physicist assume in their interpretations of quantum mechanics. We also think there are good reasons to reject panpsychism as a view of fundamental reality (see Montemayor, 2017, for an argument based in terms of the nature of information). Our focus here, however, is on developing an objection to the claim that the type of mentality involved at the micro level is *necessarily* phenomenally conscious. This is a challenge that affects, as far as we can see, the two prominent versions of panpsychism described above. We specifically target the key empirical claim that quantum mechanics might provide the scientific explanation of why panpsychism is the best view of fundamental reality, but we also provide reasons for thinking that even for the epistemic argument there might be reasons to distinguish between rational access to information and phenomenal consciousness.

2. Rational categorical bases and indexical information

A key aspect of our argument is to explain how could anything else, other than phenomenal consciousness, be intrinsic. Intentionality, as Franz Brentano first noticed, is essential to the mind. Mental states have aboutness in an intrinsic way—they are directed towards semantic contents intrinsically, without necessitating the existence of the objects or situations they are about in any specific extrinsic way. It is because of this that Brentano called this property of mental states their “intentional inexistence.” This property of aboutness, moreover, provides rational access to semantic contents in the sense that, for a creature with conceptual capacities like us, being directed towards a semantic content provides immediate access to how that content is related to other contents, in a coherent way. Any creature with language will likely have a mind that is intrinsically intentional. The question is whether such a mind needs to also have the kind of phenomenology our minds have.

Although there are good reasons to think that only qualia can provide the mind with its intrinsic intentionality, there are at least equally powerful reasons to reject this view. One of them is based on the possibility of unconscious mental representation. The mind eliminates possibilities concerning contents in a way that can only be explained in terms of intentionality, even though in many cases it does so without any specific phenomenology. Think about syntax processing, for instance. We understand the content of words, and their meaning is part of the phenomenology of listening to and thinking in language. But the rules of syntax we use in decoding the meaning of words have no phenomenology. This is intentional aboutness, intrinsic to our mental states concerning language, but without phenomenology.

This kind of content, in spite of its lack of phenomenology, is still intrinsic to our minds. It is qualitative, rather than purely quantitative and mathematically modelled information. It makes possible the drastic qualitative difference between human beings and species without language. But this qualitative informational difference, which is intrinsic to the human mind, need not be defined phenomenally—this is a case of qualitative information without qualia. This does not entail that qualia play no role in determining some intrinsic features of our mind. On the contrary, qualia are indeed obvious candidates for intrinsic properties, and we are not disputing this. Our claim is that there are other aspects of our mind that are also intrinsic to the mind and which might be independent from qualia. The case of unconscious perception and cognition is one example.

Argument for panintentionalism:

1. There are intrinsic properties of our mind without phenomenal character: they are *purely intentional* properties.
2. Purely Intentional properties suffice to explain the mentality involved in quantum mechanics and the micro properties.
3. Qualia are not necessary to explain the mentality involved in quantum mechanics.

Premise (1) is incompatible with the view that all intentionality depends on phenomenology, but it is compatible with many other views of the mind, including functionalist and physicalist views. In fact, this view is compatible with views that give phenomenal consciousness a primary or foundational epistemic role but also make room for unconscious mental representation. We take premise (1) to be uncontroversial enough to accept it without further defense. Defending premise (2) is the purpose of the remainder of this paper.

One could go further than this sufficiency argument and propose that qualia are *inadequate* to explain the kind of mentality involved in quantum mechanics. Although this stronger claim is compatible with some of our views, we will defend the weaker claim since that is enough to show that quantum mechanics is best understood in terms of panintentionalism. More precisely, our main conclusion is that although both purely intentional properties and qualia are intrinsic, it is easier and more parsimonious to assume that intrinsic properties at the micro level are purely intentional. The central claim is, therefore, that purely intentional properties of the mind related to content and qualitative information specification are better suited to explain the type of mentality involved in quantum mechanics. Panintentionalism is a form of panpsychism to the extent that it assumes some type of mentality at the micro level, but it is incompatible with the prevailing view of panpsychism that assumes that these mental properties at the micro level are necessarily phenomenal.

A key aspect of our argument is that semantic relations represented in purely intentional properties are informational in an indexical way, without invoking the qualitative character of experiences. They eliminate possibilities in a way that is intrinsically related to the perspective of a mind or an observer that has at least some rational basis to determine an outcome from her perspective. Information in this sense, need not be essentially relational, and in fact, quantum mechanics itself demands a distinction between purely relational or mathematically modeled information and qualitative or indexical information.

As Šafránek, et. al. (2019) argue, information cannot just be relational in fundamental physics, and a distinction is needed between actual and potential information. But as it is clear from his discussion, this does not entail that intrinsic information is necessarily phenomenal (IIT assumes this, but it need not be an essential assumption of intrinsic indexical information, see de Barros et al. 2017 or Montemayor et al. 2019). Šafránek et al. say that such an understanding of indexical information must account for the fundamental physical notions of thermodynamics and entropy at the quantum level, a notion Šafránek et al. call “Observational entropy” (Šafránek, et al. 2019).

Influential interpretations of the central cases that are used to argue for the alleged metaphysical necessity of phenomenal consciousness as independent from any physical descriptions, such as Jackson’s Mary, have explained the change Mary undergoes in terms of indexical information, and not qualia (Stalnaker, 2008; Perry, 1979) or as an observational ability Mary gains (which can also be understood in terms of indexical content, see Kwon, 2017).

One of the reasons offered in favor of qualia as natural candidates for being the categorical bases of physical dispositions is that they are associated with subjectivity and semantic content in an irreducible intrinsic manner. One of the more parsimonious ways to explain this claim is in terms of contextualized forms of agency (what David Lewis’ (1979) “two Gods” lack). In the case of Lewis’ two Gods, their omniscience of all facts is insufficient to provide them with the indexical belief “This is who I am.” This type of knowledge need not be phenomenal, as Perry’s messy shopper illustrates. What it certainly requires is a new type of belief with indexical content (a de se belief).

The essential change in Mary is a change in agency, which involves a kind of *personal-centering* that can be understood in terms of new agential abilities (Kwon, 2017). Perry characterizes the new type of information Mary learns in terms of a specific kind of content, which he calls “reflexive content” that does not require a new property but a new way of relating to it: a fundamentally contextual and self-referential way of referring to it. Perry writes: “Identities can be informative because there are two ways of knowing, two modes of presentation. If modes of presentation are limited to attributive conditions of reference, the situation cries out for *another property* to explain the informativeness of the identity. My solution has been to explain the twoness, in its various forms, not at the level of what is known about, but at the level of *what is involved in the knowing*: the level of reflexive content” (Perry, 2001, 207; our emphasis).

Contextual information for a specific kind of agency (an observation that is capable of grounding the reflective endorsement of further observation and action) is essential to draw the distinction between actual information centered on an agent and general or potential information concerning possibilities. Such capacities seem to require attention on the part of the agent, but not necessarily phenomenal consciousness (Fairweather and Montemayor, 2017). This centering and indexical relation depends on abilities to rationalize and expand our own contexts of information evaluation. As Stalnaker says:

“We begin … in more local contexts. We then develop means for expanding our representational resources, and for incorporating information from different contexts into more inclusive contexts. Doing this will involve representing ourselves and our local contexts within a more robust and inclusive context, and representing, in our conception of the world as it is in itself, *the relation between ourselves and the things we represent* (what John Perry called reflexive content). In the end, we must recognize that even our most stable and robust representations have the content that they have in virtue of our relations to what we represent.” (Stalnaker, 2008, 137; our emphasis)

So far, we have argued that the type of mentality required for certain interpretations of quantum mechanics should comply with a constraint: categorical bases at the micro level must explain the rational and semantically evaluable measurements that determine outcomes in quantum mechanics. If access consciousness or attention (or non-phenomenally conscious cognition) suffices to specify such observational capacities, then the argument for phenomenal consciousness is unjustified. Access consciousness or attention without qualia suffice to explain these capacities. Therefore, there is no need to postulate phenomenal properties at the micro level to explain the kind of mentality required for quantum mechanics.

3. The notion of observer in quantum mechanics

Let us now discuss the role of the observer in quantum mechanics in order to support our claims concerning access consciousness. In classical physics, the state of a system of particles is determined by their position and momenta, represented as a point in phase space (the space of all possible position and momenta, usually $\Re^{6N}$, where N is the number of particles). This comes from the fact that, in classical mechanics, the dynamics in phase space is given by a set of differential equations that are first order on time, and therefore the position and momenta for each particle determines their position and momenta at any other time.

Quantum mechanics has something similar. The state of a quantum system of particles is not their position and momenta, which cannot be simultaneously measured in the quantum world as accurately as we want, but is described by a vector in a Hilbert space[2]. The dimension of the Hilbert space depends on the number of independent properties that can be measured for this quantum system, and can be very large. The vector representing the state of a system of quantum particles is also governed by a first order differential equation, and given this vector at time t_0, its state vector at another time $t \geq t_0$ is also determined. However, there is a crucial caveat about the state at a later time: it is determined if no measurement is made. If a measurement is made, then the dynamics of the quantum system may go from deterministic to probabilistic.

This aspect of a measurement, where it can change the type of dynamics for a quantum system, leads to some important questions. What constitutes a measurement? What happens during a measurement? How do we model measurements? What makes measurements special, i.e. why are their interaction with a system different from other non-measurement interactions? Those issues are still the subject of intense discussion in the physics community, and they are intimately related to what is known as the *measurement problem.* So, given its importance and relationship to the notion of observers in quantum mechanics, we will briefly discuss the measurement problem here.

The measurement problem is a consequence of two important characteristics of quantum theory: its linear and unitary dynamics, and its state representation via vectors in a Hilbert space. Let us unpack each one of those, and show how it leads to some difficulties. First, let us start with the representation with vectors.

For simplicity, let us start with a two dimensional Hilbert space where we have two linearly independent and orthogonal vectors $\mathbf{v}$ and $\mathbf{w}$. Each vector $\mathbf{v}$ and $\mathbf{w}$, in quantum theory, represents a possible property for the quantum system, which we will represent using the projection operators P_v and P_w, defined as $P_v\mathbf{u} = (\mathbf{v} \cdot \mathbf{u})\mathbf{v}$ and

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[2] A Hilbert space is a vector space that is complete, i.e. all Cauchy sequences in it converge to an element in it, and is endowed with a metric.

$P_w\mathbf{u} = (\mathbf{w} \cdot \mathbf{u})\mathbf{w}$ for any vector $\mathbf{u}$ in the Hilbert space[3]. Projectors P_v and P_w, which can also be called observers, have two possible eigenvalues, 0 or 1, and their eigenvectors are, respectively, $\mathbf{v}$ and $\mathbf{w}$. These eigenvalues are interpreted as the two possible values of the properties associated with the projectors, with 1 being equivalent to "the system has the property" and 0 to "the system does not have the property." If the state is $\mathbf{w}$, it follows that it has property p_w but not P_v due to the orthogonality of $\mathbf{v}$ and $\mathbf{w}$, and similarly for $\mathbf{v}$.

Of course, there is nothing necessarily special about $\mathbf{v}$ and $\mathbf{w}$, and we could use another set of orthogonal vectors to represent the two properties. However, a consequence that the dynamics of quantum theory is linear and unitary is that it is possible to create an evolution of the quantum system such that it starts in a state, say, $\mathbf{w}$ and ends up in another state $\mathbf{s} = c_v\mathbf{v} + c_w\mathbf{w}$, with $|c_v|^2 + |c_w|^2 = 1$. The state $\mathbf{s}$ is said to be in a superposition of $\mathbf{v}$ and $\mathbf{w}$.

What can we say about the properties of $\mathbf{s}$? In particular, what are the values of P_v and P_w? A quick computation reveals that $P_v\mathbf{s} = c_v\mathbf{v}$ and $P_w\mathbf{s} = c_w\mathbf{w}$, which shows that $\mathbf{s}$ is not an eigenvector of the projectors, and therefore does not have a well-defined property before the measurement. However, after a measurement, either P_v or P_w is true, and the system "jumps" to their eigenvector, depending on the observed value. This jump, known as the *collapse of the state vector*, does not happen deterministically, but stochastically, with probabilities given by Born's rule, i.e. $|c_v|^2$ for P_v and $|c_w|^2$ for P_w. So, superposition states of the measurement basis lead to a probabilistic dynamics when interacting with a measurement device.

To understand what was special about superpositions, von Neumann (von Neumann, 1983) attempted to model the interaction of a quantum system with a measurement apparatus. His idea was that, if quantum mechanics was a universal theory, that we should be able to explain the outcomes of a measurement using only quantum theory. He then constructed a model where the measurement apparatus, when interacting with a system in the state $\mathbf{v}$, would end in a state where its "pointer" indicated that property P_v was true and that P_w was false. Similarly, when interacting with a system in the state $\mathbf{w}$ the "pointer" would indicate property P_v as false and that P_w as true. However, as von Neumann remarked, because the quantum evolution is unitary and linear, it follows that if the system starts at the superposition $\mathbf{s} = c_v\mathbf{v} + c_w\mathbf{w}$, it will evolve such that the measurement apparatus itself becomes in an superposition, and not in a quantum state where it has definite properties such as "pointer indicating P_v is true" or "pointer

[3] Usually the braket notation is used in quantum theory, but this needs the concept of a dual space, which we do not assume the reader is familiar with. Instead, we keep our discussion within elementary linear algebra.

indicating P_v is false." In other words, the interaction between the measurement apparatus and the system does not create the quantum jumps, nor does it explain why only one outcome happens.

But von Neumann went even further. He said that we could model also the interaction between our eyes, themselves considered a type of measurement apparatus, and the system composed of "original system plus measurement apparatus". If we do that, we end up with our eyes also in a state of superposition. We can then include in our model the interaction between our eyes and our optic nerves, or our brain, or even all the matter in the universe, and we will find that we still end with a superposition. But, as von Neumann emphasized, we never *see* a superposition. We never see Schroedinger's cat in a state that is neither dead nor alive. So, von Neumann claims, the interaction of the *observer* and the totality of system and measurement apparatuses is what causes the collapse of the wave function.

Von Neumman's idea was pushed even further by London and Bauer (London & Bauer, 1939), who argued that if we exhaust all matter, what is left, the observer, is not matter. Eugene Wigner (Wigner, 1961), and later Henry Stapp (Stapp, 2009) went so far as to say that this implied a dualist view of nature, where matter satisfied the linear and deterministic dynamics of Schroedinger's equation (or unitary evolution) only when it didn't interact with consciousness, itself a non-material entity not describable by quantum theory. So, from this line of reasoning, consciousness enters the quantum realm through the interaction between the conscious observer and the quantum system.

Could we confirm the idea that consciousness causes the collapse (CCC) of the wave function, i.e. that a what leads to the probabilistic dynamics that ends in a state with a definite property is the interaction of the system/measurement device and a conscious being? It so happens that confirming or falsifying this is very difficult, in fact probably impossible in principle. To understand this, let us examine a simple thought experiment that is, maybe even with today's technology, executable (de Barros & Oas, 2017).

Imagine a box isolated from any external environment. Inside the box, an animal whose eyes sensitive to single photons (e.g. a cockroach or locust) is stimulated with a single photon either on its left or right eye. This animal is conditioned to respond differently to photons on the right eye than from photons on the right eye. The response activates the release of a photon on output 1 of the box if the animal responds to a photon on the right, and output 2 if responding to a photon on the left (see (de Barros & Oas, 2017) for a detailed description of this thought experiment). If, after the interaction with the photon, the animal is guided back to its original state, we would be left with two possible outcomes. If CCC, then regardless of what type of input we enter in the box, the output would always be either an 1 or 2 photon, but never a superposition. However, if the CCC hypothesis is false, then we would end up with a superposition of output 1 and 2 photons. In principle, with repeated experiments, one could distinguish a superposition from a non-superposition (what is called a *proper mixture*).

The difficulty with the above experiment is the following. In order to preserve the quantum superposition, we need to ensure that, after the behavioral response occurs, the animal and box are brought back to their original state. To see how difficult this is, imagine that we conditioned a cockroach to respond to different photons. This means bringing each atom[4] in the cockroach's and box back to the state that the initially were in before the photon arrived. This is a gargantuan task, something that has never been accomplished even for such a small animals, such as the tardigrade. But we have an additional issue. On top of bring the system back to its original state, we also must ensure that the cockroach does not couple with the thermal bath, as this would lead to irreversible loss of quantum information, and make the experiment inconclusive (i.e. we would always see a mixture, regardless of whether CCC is true or not).

The difficulties above can be of fundamental importance to falsify the idea that CCC. Let us start with the fact that the experiment described above is with an insect, say a cockroach. It is not obvious that insects have phenomenal consciousness, and the idea that a locust or a cockroach are conscious is certainly not uncontroversial. However, on top of that, the experiment requires the cockroach to be set at a temperature close to 0K. First of all, it is hard to imagine behavioral responses happening at this temperature (probably impossible). But if it were possible, it is hard to imagine that any type of (uncontroversial) conscious process would exist under such conditions. So, this experiment, if found to falsify the CCC hypothesis, is open to many criticisms, and would be inconclusive.

But the measurement problem and its relationship to the observer is not the only argument about the importance of the observer in quantum physics, and it is worth discussing the other argument. The starting point is the famous Kochen and Specker's theorem (Kochen & Specker, 1967). We are not going to detail its proof, and the interested reader is referred to their original paper or to the discussions in (de Barros & Oas, 2017), but we will sketch its main idea. Imagine you have a Hilbert space with dimension greater than three. Because the dimension is three, it is always possible to find a set of three orthogonal vectors representing three distinct and compatible properties, P_{v_a}, P_{v_b}, P_{v_c} such that only one of them is true for the system. This means that there is an experiment we can perform where we can measure each of those properties, and ask which one is true for the quantum system. Now, imagine that we get

[4] At least the ones coupled with the impinging photons.

this first set of three vectors, and keep one of them fixed (i.e. the one associated with P_{v_a}), and rotate the three vectors around the fixed one. We now end with two more properties compatible with the first one, namely $P_{v_d},\ P_{v_e}$. It is “reasonable” to assume that if we measure the system, we will find the same answer for P_{v_a}. So, the question we can ask is this: can we now assign truth values to all properties associated to the set of possible measurements for this system? The answer is no: it is possible to construct a set of observables such that assuming such truth values can be assigned, independent of the experiment where it is obtained, we reach a contradiction.

The key aspect of the Kochen/Specker result is the assumption that we can assign truth values independent of the experimental conditions. In other words, the contradiction results from the assumption that the property P_{v_a} is the same when we measure it with $P_{v_b},\ P_{v_c}$ or with $P_{v_d},\ P_{v_e}$. This characteristic of quantum systems is called contextuality: the values of a property can change from one context to the other.

In quantum contextuality the observer enters the picture by selecting the context. When Alice, in her lab, decides to measure P_{v_a} with the pair $P_{v_b},\ P_{v_c}$ instead of $P_{v_d},\ P_{v_e}$, if we assume Alice has free will, she is deciding to create the values of P_{v_a} for the former context, and not for the latter. The experimental choice of the observer affects the observed quantities. This is a different issue from the measurement problem above.

Let us go back to the issue of the observer and consciousness in both cases: the measurement problem and quantum contextuality. In the first one, we have what is called the *Consciousness Causes Collapse hypothesis* (CCCH), where the presence of a conscious observer changes the dynamics of the system: deterministic and linear without consciousness, stochastic and non-linear with consciousness. In the second case, even if we do not postulate the CCCH, the outcomes of experiments dictate that the property of a quantum system depends on the choices of a free-willing observer.

In the CCCH, the argument is straightforward: if we believe that the linear and deterministic dynamics of Schroedinger’s equation (or unitary evolution) applies to all matter, except when interacting with a conscious observer, we may be compelled to conclude that the observer, or its mind, is not matter, as, if it were matter, it would follow that the evolution of its different mental states would also be in a superposition. This mind, with its recollection of the recorded experimental events never being in a superposition, is a conscious mind. It is this conscious realization of an observation that collapses the wave function.

As we mentioned above, this is not an argument that can be easily dismissed empirically, as any experiment attempting to falsify this theory needs to isolate a “conscious” observer from its surrounding thermal bath, virtually creating an unsurvivable environment for organisms that one could uncontroversially refer to as conscious. So, criticisms to the CCCH would have to come from metaphysical arguments.

In the contextual case, the connection between quantum mechanics and consciousness is a little less clear. Alice, the conscious observer, decides which sets of properties she measures at the same time. It is her (possibly) conscious decision that creates the objective reality of quantum properties. Consciousness comes here from a more indirect path: the observer’s decision making and, perhaps, her free will.

Regardless of how we want to approach it, we hit an important issue. In both cases, CCCH or decision making and free will, their proponents use the idea of a conscious being. However, neither cases require phenomenal consciousness. In CCCH, what is required is the irreversibility of memory registrations on the observer’s “mind”, which can be thought as related to access consciousness, and not phenomenal consciousness. In decision-making and free-willing decision making, we also need access consciousness, not phenomenal consciousness.

As we emphasized before, access consciousness is ideally suited to play the mental role that is fundamental to certain interpretations of quantum mechanics because of its relation to rationality and semantic content. Phenomenal consciousness is strictly dependent on appearance and qualitative properties. Access consciousness, by contrast, is strictly dependent on rational access to contents. The observer in quantum mechanics is an access conscious observer, rather than a phenomenally conscious observer, because measurements are not entirely determined by merely appearance properties of experiences, but rather by concrete interventions in an environment by a rational agent with specific goals that have unique theoretical meaning.

The observer in quantum mechanics, even in a panintentionalist or panpsychic interpretation, is a rational agent that speaks the language of mathematics and expects certain regularities from her environment. The act of observation is not merely “the universe reflecting on its experiential aspects” but rather, the universe understood under a rationally controlled *mental action* –the act of measurement. The extent to which mentality is involved in quantum mechanics at a fundamental level is not thoroughly undefined, unanalyzable, and beyond analysis. Even if mentality is intrinsic to the universe, the role of mentality must be understood in terms of acts of measurement, and this can be fully captured by access consciousness.

4. Conclusion

We have argued that even if one grants that panpsychism is true, that is, even if mentality is an intrinsic property of fundamental reality, it is inadequate to conclude that this kind of mentality must be understood in terms of phenomenal consciousness or subjective qualitative character. We propose that access consciousness is the type of mentality that best characterizes panpsychic mentality in quantum mechanics. One may object that this deprives the universe of the intense interest and value we attribute to the universe. This objection would be misplaced, because our argument concerns fundamental reality, and not the value we humans might attribute to the universe. But even if value is concerned, it is not clear that phenomenal consciousness if the only source of value one should consider--access consciousness is at least a plausible candidate, if not a superior one, as Levy (2014) proposes.

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