Why Quantum Mechanics Matters in the Philosophy of Mind

Abstract

Quantum physics and consciousness are generally considered separate fields of philosophical investigation. However, in acknowledging the depth of the mind-body problem and that of the measurement problem in quantum physics, a possible ground of convergence can be found as both problems concern the relationship between existence and phenomenality: either the existence of the subject from the perspective of the world, or conversely. In this paper, it is argued that both problems arise when uncritically assuming the closure of physical reality independently of phenomenality on the one hand and human specificity of phenomenality on the other. Refusing both postulates makes it possible to adopt a clear picture of the world as a relational structure of existing entities, consistent with a notion of strong emergence, thus dissolving the measurement problem and the mind-body problem at the same time.

Introduction

When quantum physics emerged, it raised profound discussion among physicists around the issue now commonly referred to as the measurement problem. Some notorious physicists, such as Pauli, Bohr, Planck, Schrödinger or Wigner, stressed the particular role played by the observer in quantum physics and attempted to establish a link between quantum physics and consciousness. Yet despite a few attempts in this direction (Stapp 2007, Hameroff & Penrose 2003), it is often claimed today that quantum physics is irrelevant to the philosophy of mind (and conversely), mainly on the basis of the following arguments:

(1) Invoking a role of consciousness in the instantiation of reality in quantum physics is dubious, for this attributes a specific ontological status to the human brain. Who can believe, to take Einstein's words, that 'the moon does not exist when no one is looking at it' or that the whole universe did not exist before life appeared on earth?

(2) Invoking a role of quantum physics in consciousness and free will is dubious as well, because the problem of consciousness is a biological or neurological problem, not a physical one. Quantum effects are only relevant at very small scales and can be seen as merely microscopic noise at the level of the human brain. Besides, randomness is not a proper substitute for free will (Esfeld 2000*a*).

The generic assumption that quantum physics is irrelevant to the philosophy of mind undoubtedly restrains the usage of concepts from quantum physics in the context of philosophical discussions where they seem at first sight appropriate and could have an insightful influence; for example, the no-cloning theorem (Wootters

1982) in debates involving mental or physical state duplication, including in the definition of supervenience, the free-will theorem (Conway & Kochen 2006) in debates involving free-will or the non-separability of quantum physical states in debates involving emergence and the unity of consciousness.

In this article, I will argue that quantum physics has its place in discussions regarding consciousness, and conversely. My position can be summed up as follows: on the one hand, claiming that the problem of consciousness is only a biological problem disregards its ontological depth, while on the other, claiming that the measurement problem of quantum physics is foreign to consciousness and is reduced to microscopic noise disregards its epistemological depth. Moreover, I will show that arguments (1) and (2) above are almost circular and akin to begging the question.

This article is divided into three sections. The first section addresses ontological issues regarding the relationship between existence and phenomenality and discusses the claim that the problem of consciousness is a strictly biological problem. The second section addresses epistemological issues, in particular the claim that consciousness is irrelevant to the measurement problem of quantum physics, by exposing the ties between the measurement problem and phenomenality. In the third section, I will attempt to show that arguments (1) and (2) above are based on circular postulates, which are at the origin of the measurement problem and the problem of consciousness, and therefore should be rejected. I will discuss some consequences of these observations with respect to the philosophy of mind and the philosophy of science, and in particular the notions of emergence and of mental causation.

The technical question of microscopic confinement of quantum effects will not be addressed in length in this paper. Let us just remark that this confinement is generally attributed to decoherence (e.g. Tegmark 2000) which is highly dependent on the conditions of application and thus cannot be generalised to applying to all types of systems (Anglins, Paz & Zurek 1997). Moreover, entanglement, and even more so the generalised notion of 'quantum discord' introduced by Ollivier & Zurek (2002), are hardly measurable on complex systems and recent research tends to show that the former could be involved in biological systems at room temperature (Collini, Wong, Wilk, Curmi, Brumer & Scholes 2010). If true, it might occur that the problem of consciousness, even if biological, would have to deal with quantum physics anyway. For a detailed argument on the possibility of entanglement in brain processes, see Ruyant (2011) or Pessa & Vitiello (2003).

1. Is the mind-body problem a biological problem?

Scientific reductionism and the hard problem of consciousness

Let us first address the problem of deciding if the mind-body problem is concerned by physics or if it is restricted to the scope of biology.

If one is committed to any form of scientific reductionism, one will assume that quantum physics provides the most fundamental description of reality at our disposal, and therefore has a privileged bound with ontology. That is to say, physics addresses the fundamental entities of ontology, while other disciplines involve entities which could in principle be derived from physical ones; it is for convenience, because of practical limitations and for addressing problems specific to particular experimental contexts, that we generally adopt simpler, more approximate but more operative descriptions.

Assuming scientific reductionism, I will define a strictly biological problem (might it be a philosophical problem too) as a problem that is only specific to the particular experimental contexts addressed by biology.

Chalmers (1995) famously contrasted the 'easy problems of consciousness', which concern our cognitive abilities as human beings, with the 'hard problem of consciousness', which concerns phenomenal existence per se. Assuming this distinction, it is not controversial to consider that the easy problems of consciousness are purely biological problems, and more specifically neurological problems. However, this is much less certain for the hard problem of consciousness. Phenomenal existence is not an empirical concept that can be straightforwardly associated with any particular experimental context, and subordinating this metaphysical notion to biological concepts such as 'brain' or 'neuron' or simply to our cognitive abilities seems to be in contradiction with scientific reductionism: it amounts to describing something apparently fundamental and ontologically irreducible – since phenomenal consciousness, might it be consciousness of a composite, is experienced as single (Strawson 1997) – in terms of something apparently reducible and less fundamental.

In that sense, the statement that 'having phenomenal experience per se requires certain cognitive abilities, which in turn requires some biological structures such as a brain' is problematic: we can fear that precisely with this statement, a suspiciously privileged ontological status of the brain was introduced. Note that this is not the case of other statements such as 'knowing and reporting that one has phenomenal experience requires certain cognitive abilities', or 'certain types of phenomenal experiences require cognitive abilities'.

Subordinating existence to phenomenality

This fear of introducing a privileged ontological status to the brain is well-founded, unless, of course, this privileged status is denied to phenomenal existence itself – which is in fact the main concern of this section. Indeed, one could argue that phenomenal or 'first-person' existence is distinct from 'third-person' existence and that the former derives from the latter. Here, phenomenal existence is not a terminus but a derivative or contextual notion which can be bounded by cognitive aspects, thus not being directly related to physical concepts any more.

However, this position does not go without saying. Indeed, the concept of third-person existence construed independently of any actual or potential awareness is very problematic. Such an attribution of existence to an entity cannot be proved nor disproved, since any assumption of existence finds its justification at some level in first-person perception: something that cannot be observed in any fashion can as well not exist at all. Of course, this does not mean that 'the moon does not exist when no one is looking at it': the fact that we can potentially look at it at any moment and expect to see it, or the fact that, according to our best theories, there would be gravitational consequences on earth that would have measurable effects if it ceased to exist, are all sufficient reasons to declare that it exists persistently. But if the moon or any other entity had no more measurable effects on anything that we can be aware of, then assuming its existence would no longer be falsifiable and the principle of parsimony would force us to conclude that it does not exist.

On the contrary, phenomenal existence, defined as awareness 'of something', is an autonomous notion. It is not necessary that the 'something' one is aware of exists in any sense except as the object of one's awareness and it is actually conceivable that one's whole experience is a delusion.

It follows that any serviceable notion of existence has to entail the possibility of being phenomenal; otherwise it can be rejected for being indistinguishable from non-existence. Moreover, in virtue of the autonomy of phenomenal existence, being an actual source of awareness is a sufficient condition for existing. By means of consequence, a definition of existence can be fully derived from phenomenal existence as follows: something exists if and only if it is potentially or actually, directly or indirectly, perceived by one or more subjects and third-person existence can be ultimately conceived as the ideal correlate of different first-person perspectives; that on the existence of which everyone would ideally agree.

From that view, which will find echoes in pragmatist approaches, the main task of epistemology is to decide what counts as valid 'indirect' and 'potential' perception of theoretical entities. I will leave this problem aside, while only retaining the necessary subordination of existence to awareness and its possible derivation from it.

The converse derivation, however, is much less obvious. Phenomenality, defined as the property of being an object of awareness, does not appear to be an organisational feature. The assumption that it would somehow arise from peculiar organisations of aware-free entities with absolute necessity seems to be in contradiction with the metaphysical autonomy of phenomenal existence outlined previously, and leads to several difficulties, as shown for example by the zombie-argument of Chalmers (1995) or by the difficulties in conceiving phenomenal experience as emergent (Strawson 2006). This problem actually constitutes the heart of the mind-body problem. It follows that simply deriving existence from phenomenality might be a much more desirable option.

Subordinating existence to knowledge

An objection to this argument can be raised on the basis of the observation that the same line of reasoning applies to knowledge as well. Here, something exists if and only if it can potentially be known to exist. But then any definition of existence has to be subordinated to our cognitive abilities, which, as suggested before, are not fundamental enough within scientific reductionism to be involved in a definition of existence. More importantly, restricting our conception of existence to what we know is not acceptable: we think that things already existed before anyone knew they did (for example atoms, bacteria and distant planets) and therefore we assume that there are things that exist now even though no one knows that they do. In other words, we need an ontological definition of existence, not an epistemological one.

This objection can be overcome by stressing the importance of 'potentially' in the definition of existence presented above. This definition can be reformulated as follows: something exists if it satisfies the conditions for being a potential source of knowledge independently of there being an organism capable of knowing it (or more generally speaking, independently of being embedded in a cognitive situation.) Existence can thus be defined on the basis of these conditions without being subordinated to our cognitive abilities, to the extent that these conditions are independent of our cognitive abilities. Following that definition, it is conceivable that things exist despite not being known to exist if they satisfy these conditions.

Phenomenality, if construed as independent of our cognitive abilities, is precisely one such condition of knowledge and a sufficient one. An entity embedded in a cognitive situation must be (directly or indirectly) phenomenal in order to be known to exist and we can reasonably assume that for any entity generating a phenomenal experience within a cognitive situation, there can be an organism with sufficiently advanced abilities to infer from this experience that this entity exists. Finally, phenomenality is logically independent of cognitive situations. Sellars (1956) has notoriously argued that sense-data per se do not constitute knowledge, and it is conceivable that something exists phenomenally while not being known (though obviously none of us can remember having had such a phenomenal experience; this would require knowing it). Note that the phenomenal experience generated by an entity alone might well be different of that generated by the same entity embedded in a cognitive situation.

The difference between phenomenality and knowledge

As we can see, existence can be subordinated to knowability while still being defined independently of it. The case of phenomenality, however, is quite different from that of knowledge.

It seems absurd to consider that things come to existence at the time they are known, since it contradicts our very knowledge that those things existed before; hence the necessary independence of existence on knowledge. However the same observation does not apply to phenomenality, for the simple reason that phenomenality has no pretension to atemporality but is only attached to our present. Claiming that things come to existence only when they are phenomenally experienced does not contradict any 'phenomenality of the past' (which is an inconsistent notion) as in the case of knowledge. In other words, the independence of existence from phenomenality is not required in the same way that its independence from knowledge is required. We assume that the existence of bacteria was indirectly experienced (through diseases) before we knew they existed, otherwise our knowledge would be inconsistent, but claiming that bacteria had to exist before they could be experienced at all is but an unfalsifiable position. Only the assumption that phenomenal experience is somehow correlated to superior cognitive abilities associated with superior living organisms, whose existence is supposedly posterior to that of bacteria, begs the question.

Of course this leaves open the possibility that phenomenality per se (and not particular types of phenomenality) crucially depends on cognitive situations, for example if it is itself generated by cognition. In this case, solely the ability to interact with other entities would be a sufficient condition for existence. There could be a cognitive system that would infer from its interaction with an entity that this entity exists and somehow generate the corresponding phenomenal experience, thus creating a complete knowledge of there being such an entity. This alternative, which probably constitutes the standard position on this question, is not dismissed in principle by the present argumentation, but as already mentioned, it is not only unfalsifiable, but raises some problematic issues. More specifically, this alternative is bounded by the assumption that cognitive situations simply arise through specific kinds of interactions, which appeals to view cognitive systems as merely peculiar forms of existing entities, whereas phenomenality per se is apparently not a formal concept and can be conceived independently of any formal constraints. The irreducibility of phenomenal experience (the so-called 'binding problem') also constitutes a challenge for this option.

In summary, existence is fundamentally subordinated to phenomenality, its logical independence from it is not required and deriving phenomenality from existence is problematic. For these reasons we shall assume the ontological primacy of phenomenality (or in Merleau-Ponty's (1945) terms the 'primacy of perception'), from which a definition of existence might be derived, as exemplified above. Notably, if the term 'potentially' were to be retained in this definition of existence, it would have to be interpreted as constitutive of existence and not as referring to particular conditions (contrarily to our usage of the notion with respect to the conditions of knowledge). We would then have a dispositional ontology.

Phenomenality and consciousness

It follows from the ontological primacy of phenomenality and from scientific reductionism that phenomenal existence does not concern biology nor neurology, but rather (the philosophy of) physics and that it has to be distinguished from consciousness per se if by consciousness we refer to the biological or specifically human features addressed by the 'easy problems' of consciousness (and in particular the cognitive ability to know and report that oneself is aware of something). In this context, giving a particular role to awareness in physics does not amount to giving a privileged ontological status to the human brain but in turn, phenomenality can no longer be considered specific to human consciousness. However, this view does not preclude the assumption that cognition gives rise to specific types of phenomenal experiences. Consciousness can indeed be defined as a particular mode of phenomenal existence which involves a persistent representation of self and of the world (Ruyant 2011). The common assumption that phenomenality is something biological would result from a confusion between phenomenality per se and representational abilities, which are specific to cognition.

The position we reached is not novel: the distinction between consciousness and awareness was already put forth by proponents of second-order theories of consciousness (Armstrong 1968) and it is more directly related to panpsychism or panexperientalism, with a long tradition demonstrated by Spinoza, Leibniz, Whitehead, Russell, James and today Strawson.

Of course it is hard to deny that a relationship exists between phenomenal existence and the human brain – as far as the brain can be dissociated from the rest of our organism in this regard – if only to the extent that the brain (or our organism) is capable of instantiating this particular mode of phenomenal existence that is consciousness. However then, the relationship between phenomenal existence and consciousness is comparable to that between physics and biology, in the sense that biological systems are particular instances of physical systems. That does not make phenomenality a biological concept, although defining further the notion of ontic instantiation, associated with the unity of consciousness, will be crucial in addressing the problem of consciousness.

2. Is consciousness foreign to the measurement problem?

The measurement problem

The conclusion that phenomenality should be addressed within physics strikingly converges with the epistemological issues faced in quantum physics. These issues crystallise in the measurement problem and constitute the second important reason why quantum physics is relevant to the problem of consciousness. First, let us briefly review the essence of this problem (through a non-technical formulation of it). Then we will attempt to decide how exactly phenomenality can be addressed in physics.

In quantum physics, the measurement procedure is not part of the physical model of reality and is not itself a measurable process. However without measurement, our model of reality can be described as a superposition of all possible states relatively to any definite observable quantity, the so-called 'wave function', which is in contradiction with empirical evidence where only one definite state for the measured quantity is ever observed, with probabilities corresponding to its weight in the superposition. Yet this superposition of possible states cannot be interpreted solely as an epistemic model expressing a lack of knowledge: it is in a sense 'real' since superposed states for non-measured quantities are able to interfere together in a measurable way.

It follows that the different ways of measuring a system are fundamentally incompatible, and what we decide to measure has an impact on the outcome of the measurement. Moreover, this contextuality of measurement and the associated indeterminacy does not necessarily concern the properties of localised and separable particles, but those of any complex material system, including non-local and non-simultaneous correlations between fundamental properties of its constituents however far apart they are. It follows that quantum systems are generally non-separable, or 'entangled' (though bigger systems in an open environment tend toward a more separable state, in virtue of decoherence).

The 'measurement problem' is the specific problem of interpreting the measurement procedure, also called the 'wave function collapse', by which a non-local superposition of states for a definite quantity becomes an unpredictable single state after a measurement of that quantity occurs, and the fact that this procedure is not itself a physical process that we could infer from the theory or measure 'from the outside' (without actually 'provoking' the collapse). In brief, the physical model provided by quantum physics seems to be ontic and epistemic at the same time, and both aspects are entangled and cannot be straightforwardly separated.

The phenomenalist interpretation and the problem of other observers

Obviously, the epistemological problem of measurement in quantum physics is more profound than a problem of 'microscopic noise' and does not simply consist in the introduction of indeterminism in physics, since it is theoretically conceivable, though counter-intuitive, that no definite reality is instantiated from a superposition of state until a conscious observer acknowledges the result of a measurement (This position was actually held by Wigner 1976). Indeed, the definite status of reality with regards to observable quantities is epistemologically subordinated to our conscious observation of the world, in that it is only fundamentally constrained by the fact that we only ever observe single definite states for measured quantities. This subordination of existence to phenomenality echoes the discussions of section 1 and remarkably supports the conclusion that phenomenality should be considered prior to existence and that it should be addressed within physics.

Many realist interpretations of quantum physics aim at removing this dependence between physical description and phenomenality, either by naturalising the measurement procedure, which requires unverifiable and problematic physical speculations (either non-local physical collapses, retro-causal actions or pilot-waves and hidden variables...), or by eliminating it, which entails extravagant and as much unverifiable consequences (alternative realities in Everett's many worlds interpretation). Both approaches are problematic, basically because quantum physics alone does not permit us to untie the physical existence of definite states from phenomenality on an empirical basis.

After having reached the conclusion in section 1 that phenomenality should be addressed within physics, maintaining the tie between phenomenality and the measurement problem could be considered a good option: it does not require any unverifiable speculation, nor does it entail any unobservable feature. Following this interpretation, the wave-function collapse occurs when a physical state comes to existence by becoming phenomenal.

However this option raises a problematic issue: since phenomenality is by definition private, the same would go, in quantum physics, of any physical representation of reality. The essence of the measurement problem precisely lies in the fundamental impossibility of an agreement on a representation of reality that would be the same from any viewpoint, without any gratuitous speculation. Only an approximate agreement might be found at a macroscopic level, under the conditions of decoherence.

This problematic issue is clearly highlighted by physicist Rovelli (1996). He observes that in quantum physics, different observers can have different representations of the exact same system at the same time, one seeing it as a single definite state corresponding to what she just measured, and the other as a superposition of possible states entangled with the first observer. No common representation of what exists can be reached for our two observers until they share the outcomes of their respective measurements. Without any possible representation of a reality common to all observers, it seems that a phenomenalist interpretation of quantum physics is doomed to fail.

The relational interpretation

At this point, if we still wanted to stick strictly to scientific realism while keeping the connection between phenomenality and measurement, this would leave us with nothing but a 'solipsist interpretation' of quantum physics, according to which the wave-function collapse only occurs when 'I' become aware of the state of a system. As noted by Wigner (1976), this solution would indeed be perfectly consistent and devoid of paradoxes (putting apart, of course, the philosophical problems of solipsism).

However another option remains, proposed by Rovelli (1996) in his relational interpretation of quantum physics. It lies in the loosening of our faith in the existence of an absolutely objective reality that would exist independently of any viewpoint or act of observation. One does not need to deny that other conscious observers exist in order to prevent the problem of other observers to arise, but only that an absolute representation of what exists independently of any viewpoint is possible.

Rovelli suggests that physical representation in quantum physics is relative to an observer (here construed as any physical system, as in special relativity) and that the wave-function is a description of the relations between an observer and their objects. Then assuming that phenomenality is a fundamental characteristic of observers, the wave-function is precisely a representation of what exists, in the sense given in section 1: it is a representation of what an observer can potentially or actually, indirectly or directly perceive. These relations are the only 'reality' at our disposal.

Importantly, this interpretation of quantum physics is not a speculation but a cautious stance, as far as predicting the observations of a subject is what any applied physical theory boils down to: as Kant has shown, the speculation actually lies in the assumption that our models describe an absolute 'reality in itself'. This interpretation is more parsimonious than other interpretations, including Everett's many worlds interpretation, since it is nothing but a refusal to speculate gratuitously on the absolute existence of physical entities beyond any measurement.

Structural realism

However, this interpretation should not be interpreted as an anti-realist stance, but rather as a strong form of epistemic structural realism, or the view that science only addresses the relational structure of reality (Worrall 1989).

Cassirer (1923) observed that general relativity involves abandoning any notion of an absolute frame of reference for measuring speeds and positions in favour of universal laws applicable to any frame of reference. Without any absolute reference, then as Cassirer states, 'the essence of a physical process is wholly expressed in its quantitative relations'. For Cassirer, the object of physics is not reality itself but its relational structure, which translates into a general movement of science abandoning successive absolute references in favour of relational laws. Stated differently, a scientific theory is not universal in that it refers to a reality independent of any observer, but because it successfully applies to any observer.

The relational interpretation of Quantum Physics is one more step in this direction: not only is the notion of absolute frame of reference abandoned, but the notion of absolute state of a system and absolute definiteness of measured quantities as well. As Bitbol (2010) observes, this amounts to supplementing the relativity of quantities together with the relativity to the observer.

Interestingly, this form of epistemic structural realism does not reduce to an ontic structural realism (Ladyman 1998), as far as different subjects cannot agree on a common and complete description of the world, be it relational, that would constitute an objective reality, even though their respective descriptions can always be made compatible afterwards.

According to this view, the world is, loosely speaking, a dynamic relational network of phenomenal viewpoints which do not fully overlap. From this picture, our familiar macroscopic objectivity can be construed as an approximate limiting case which emerges through the subject's interactions. This emergence of a classical reality from a quantum substrate through interactions is already well accounted for by the notions of decoherence and einselection (Zurek 2003).

A convergence between the measurement problem and the mind-body problem

At this point, it should be clear that the measurement problem and the mind-body problem are far from being foreign, as both concern the relation between phenomenality and our physical description. If the tie between measurement and phenomenality is retained, the fact that the measurement procedure is not itself a measurable physical process can be related to the fact that someone else's phenomenal experience is not itself a phenomenon (as supported again by the zombie argument of Chalmers). Thus reformulated, the measurement problem in quantum physics appears to be merely a physical version of the philosophical problem of the existence of others, which, in turn, is related to the mind-body problem.

In the final analysis, both problems have their source in the same presumption: while going from a cautious 'theory of what exists for any observer' to an adventurous 'theory of what exists in the absolute', we drain our representation of any phenomenal aspect and reach a situation where it is impossible to simply account for empirical observations in physics nor to explain our own consciousness. Refusing this presumption through the subordination of physical existence to subjectivity thus enables a convergence and a common treatment of the mind-body problem and the measurement problem. (The downside to this view is that objectivity has to be construed as approximate and emergent rather than absolute, but this is more an inevitable consequence of quantum physics.)

However, the possibility of a common treatment does not entail that the problem is solved. Rather is it dissolved, and a fundamental question remains unanswered: what exactly counts as an observer? Everyone knows that one can perform measurements and obtain a definite physical state, but neither quantum measurements nor phenomenality can be measured nor observed ‘from the outside’, which makes it impossible to determine where other observers are located inside of one’s personal representation of the world. Additionally, if the world is a relational structure of phenomenal observers all the way down, aren’t the most fundamental entities of physics the only legitimate ’observers’ to be found inside one’s representation? How is it, then, that macroscopic and coherent viewpoints such as ours are possible and why do we think that other people are legitimate ’observers’?

Here we reach again the problem of ‘ontic instantiation’ that was touched upon in section one. Inconveniently, we can fear that this question is metaphysical and cannot be answered empirically. However, a proper concept of emergence might help.

3. Philosophical consequences

A circular argument

There are many common aspects in the above analysis, which lie in the rejection of commonly accepted postulates. In summary, arguments (1) and (2) formulated in the introduction are based on two postulates, both concerning phenomenality. The first postulate, in the philosophy of mind, consists of assuming that phenomenal existence is specifically attached to human or animal cognition. The second postulate, in the philosophy of science, consists of stating the closure of physical reality independently of any phenomenal observer. Both postulates legitimate each other and form the basis of a circular argument.

Indeed, the closure of physical reality as something independent of phenomenality legitimates the idea that the latter is only specific to certain physical conditions, and in particular to cognition, thus supporting the first postulate (which then leads to argument (2) in the introduction, through the observation that cognition is biological). The specificity of cognition with regard to phenomenality, in return, legitimates the impossibility of giving a fundamental role to phenomenality in physics, since it would give a privileged status to human or animal brains (following argument (1)). This impossibility induces the necessity of naturalising quantum measurement, thus interpreting quantum physics in a way which supports the closure of physical reality. The circle is thus complete.

These postulates are at the origin of the mind-body problem and the measurement problem respectively. Conceiving physical reality as devoid of phenomenality raises the mind-body problem, since it is not clear how phenomenality could arise from non-phenomenal situations. From this observation derives all forms of dualism, epiphenomenalism or dual aspects theories of consciousness. Chalmers' zombie argument, which is based on the hypotheses of the closure of physical reality, remarkably illustrates this point [1]. Similarly, naturalising quantum measurement in the perspective of closing physical reality gives birth to the measurement problem and forces us to admit the existence of either hidden variables, multiple worlds, retro-causal or non-local actions, disconnected 'classical' and 'quantum' levels of reality and so on; all unverifiable features whose sole aim is to save the realist presumption on which modern physics is desperately silent and ambiguous.

Clearly, both these postulates are very problematic and should be abandoned. If physical reality is relative to an observer, if it merely refers to the relations between this observer and other subjects (including indirect relations to microscopic non-conscious subjects), then we do not need to account for the emergence of phenomenality from a non-phenomenal substrate, nor do we have to naturalise the measurement procedure. The only remaining problem is that of ontic instantiation: the problem of locating other observers inside one's physical representation and of understanding how a macroscopic viewpoint is possible at all.

This view, which amounts to an inversion of ontic priority between objectivity and subjectivity, has important consequences on today's debates in the philosophy of science and in the philosophy of mind. I will now attempt to draw some of these consequences in both fields, with regards to the concept of emergence and to the problem of mental causation, respectively.

[1] Interestingly Chalmer's observation that a zombie world is conceivable still holds, but relatively to an observer. It does not entail property dualism anymore, since the only duality to be retained concerns the two poles of the subject/object relation.

An application to the physical foundations of emergence

One might question the relevance of discussing the relational nature of quantum physics as far as it only concerns microscopic reality. Obviously, the fundamental quantum layer of reality boils down to something simpler, what we call 'objective reality', and weird quantum effects, as well as the relativity of definiteness discussed above, simply vanish during the process. If we do not look too close, what remains is a set of classically physical objects reducible to a material substance with specific space-time positions, independently of any observer, obeying causal laws, and that we can measure ad libidum without any perturbative effect. If ever such substrate is phenomenal at a microscopic level, its phenomenality is – for us – epiphenomenal. This observation could lead to a rehabilitation of the causal closure of physical reality as something 'approximately true'.

However this objective reality is only a tiny part of our subjective experience of the world (and a tiny part of our scientific knowledge as well). Our thoughts and feelings are not obviously physical in that specific 'classical' sense: they are relative to someone and cannot always be perceived without any perturbative effect, nor can they be assigned a precise time of occurrence or a definite spatial position, as Dennett & Kinsbourne (1991) have notably shown. Thoughts and feelings are largely involved in our social life, of which several aspects (such as values, symbols, institutions, conventions...) seem difficult to reduce to something exclusively 'physical' although they are definitely correlated to classically 'physical' objects, such as inscriptions on papers, buildings or physical bodies.

For these reasons, it is tempting to view mental states as irreducible, or emergent, and causally efficient states. However, the idea that there could exist a non-epiphenomenal strong emergence, following Bedau's (1997) terminology, is often dismissed on the basis that any downward causality could in principle be reduced to causality at the most basic level of reality (Kim 1999). Only an epistemic weak emergence should be retained. This impossibility of a strong emergence is very problematic, for it forces us to fall back on the notion of supervenience whose compatibility with intentional states, let alone certain emergent physical states (Humphreys 1997), is a matter of debate.

However the relativity of definiteness of physical states to the observer threatens Kim's argument against strong emergence. Bitbol (2012) proposed an interventionist conception of downward causation which resists this argument. The latter, Bitbol argues, rests on an asymmetry between a basic level of reality and a derived upper level of reality, but such an asymmetry does not necessarily hold. Typically, in quantum physics, interventions at different levels of reality are mutually exclusive which precludes the reduction of one level to another. This is manifest when measuring an entanglement, which can be considered a non-supervenient relation that does not reduce to its relata (Teller 1986).

The failure of Kim's argument, in the case of entanglement, comes from the fact that measurement is not considered part of the physical model, and therefore physical closure does not obtain. In particular, measuring non-local or a-temporal correlations requires a coherent experimental set-up which then refers to the coherence of the experimenter's viewpoint and motivation. Of course, it can be argued that the global coherence of the experimental set-up and of the experimenter's viewpoint are themselves reducible to a more fundamental physical level, and that quantum measurement can be naturalised as well, thus restoring the validity of Kim's argument. However, these are precisely the postulates that, as I have argued, should be abandoned. Given the ontological primacy of viewpoints over physical states and the non-closure of physical reality, a strong emergence can thus be consistently envisioned on the basis of quantum entanglement and the contrary assumption is but question begging.

The emergence of intentional states

Note that emergence, in that case, is circular. A system can only display emergent properties in a coherent context, which supposes an emergent observer. However this is not a problem. If this statement could be generalised to our intentional states, we would understand that our everyday concepts (including symbols, values and conventions) seem objective although they are not explicitly reducible to physical facts, nor to our sense-data, precisely because they circularly refer to other non-reducible concepts in a holistic manner as Sellars (1956) has argued. Interestingly, Quine (1951) has also argued for a semantic holism which, following Esfeld (2000*b*), has the same conceptual content as quantum holism.

Following this analogy, our high-level social concepts could be considered akin to global measurements that can bring out the irreducible coherence of their object, while translating the irreducible (spatial and/or temporal) coherence of the observer. Though definitely correlated with 'physical facts', they would be partly grounded on an implicit innate or socially acquired, holistic 'common nature' between the observer and the observed subject, thus precluding their definitive reduction to an unequivocal interpretation of empirical data on the observer's side. The observation that mental states and social concepts share some characteristics with quantum states, such as the fact that they are not fully 'discovered' nor fully 'created' but rather emerge from the interaction (Bitbol 2009, Hacking 1995) supports this view.

However these similarities between intentional states and micro-physical systems could be superficial. One cannot preclude that a non-emergent mechanism causes an intentional state to arise. A different, but related impediment to this view is the alleged microscopic confinement of quantum entanglement. Both these difficulties could be overcome if ever a link could be brought out between cognition and the persistence of quantum entanglement. Recent research in quantum biology, which shows that entanglement could be constantly generated and maintained in spite of decoherence at the edge of quantum chaos (Vattay, Kauffman & Niiranen 2012), is an interesting step in that direction: the edge of chaos is precisely a condition involved in the auto-organisation of living organisms.

If confirmed, such a concept of emergence could well provide a solution to the problem of ontic instantiation mentioned above. We could suspect that biological organisms, and human beings in particular, exemplify a strong emergence, both spatial and temporal, and as such can be considered instances of macroscopic and persistent viewpoints on the world.

Application to the problem of mental causation

The inversion of priority between objectivity and subjectivity proposed in this paper also has consequences on the problem of mental causation. Esfeld (2005) poses the problem of mental causation in terms of three statements, which, according to him, are all plausible but cannot be all true taken together[2]:

(1) Mental states are distinct from physical states

(2) Mental states cause physical states

[2] under the additional condition that there is no systematic overdetermination

(3) For any physical state p, insofar as p has a cause, it has a complete physical cause

At first sight, the first statement does not follow anymore in the relational conception of physics advocated here. Without an absolute reality, there is no physical states distinct from mental states. From a subject's viewpoint, physical states are mere relations between her and the world (other subjects) and as such, as far as this subject's phenomenal world is considered mental, they are mental states as well.

However it could be argued, on the one hand, that not all phenomenal states should be considered mental, but only those embedded in cognitive situations. On the other hand, it could be observed that objective physical states emerge through the processes of decoherence and einselection. Such states are independent on the observer and can be measured without any perturbative effects. We could decide to restrain our usage of the term 'physical' to such states, thus recovering its familiar meaning in classical physics, and to call 'mental' the states which remain persistently entangled at a macroscopic level, and whose definiteness might therefore depend on the observer (assuming that this condition involves cognition).

Following this new terminology, the first statement becomes valid, although both physical and mental states can be viewed as emerging from a common (relational) substrate. The former emerges in a weak sense through decoherence and einselection and the latter in the stronger sense detailed above, through entanglement and cognition. Then we have a potential formalisation of Russell's neutral monism or of the Russellian theory of mind (Holman 2008).

Assuming this view, the second statement is valid as well and can be made more precise: mental causation is conveyed by decoherence and einselection, by which private subjective states become public objective states (The private state does not vanish in the process if an entanglement is constantly generated, as suggested above.)

In this view, however, the third statement is not valid as far as classically physical states do not have complete physical causes. This translates concretely into the randomness which quantum physics brings during the process of state reduction (the selection of a single state from a superposition of state), and which entanglement allows to apply coherently at any level of description.

Randomness and volition

The main reason why randomness is generally not considered a valid violation of the closure of physical reality is that mental causation is apparently all but random: our decisions are motivated, deliberated, they have reasons (Esfeld 2000*a*). However these reasons and motivations are private, or even when they are shared by different actors, they are not expressible in classically physical terms. Granted that intentional states are strongly emergent, their resulting actions could still appear random in a purely physical analysis at the lowest level of reality, that is, without referring to high-level social concepts during the analysis.

My guess is that the rejection of randomness as a basis for mental causation involves a misconception of randomness as something absolute and independent on the observer. The relativity to the observer advocated here undermines this conception: at the light of the present discussions, it appears that quantum indeterminacy is better construed as akin to privacy, while the familiar determinacy of macroscopic objects is more akin to publicy.

Indeed, as explained in section 2, it is conceivable that a system be in a definite state relatively to an observable quantity according to one observer while being in a superposition of state relatively to the same quantity according to another observer. Then the first observer and the observed system are entangled, according to the second observer. This situation can be interpreted in terms of privacy: the information on the system is private to the first observer and the system. Allied with the conception of emergence detailed above, such privacy could well apply to cognitive states and to knowledge in general.

Randomness as a characterisation of something that is not predictable for an observer rather than something that is not predictable in the absolute, is more akin to a will. Privacy thus construed could serve as a criterion for distinguishing causes from reasons (as in Davidson 1982). Indeed, reading one's intentions is a matter of cognitive proximity: a hacker's behaviour, for example, will appear random to someone who does not know anything about computers (and even more so from a purely physical point of view). Following this view, intentional behaviour would appear random only to those who do not share the same cognitive background as the agent, who are not 'entangled'. Note that just as entanglement is a matter of degree, this cognitive proximity is probably a matter of degree too.

Further, reformulating the determinism/indeterminism dichotomy in terms of publicy and privacy could lead to interesting conclusions with regards to the ongoing debate on the compatibility between determinism and free will.

Conclusion

The philosophy of mind and the philosophy of science are tightly related: the former is concerned about describing the mind from the perspective of the world, while the latter is about describing the world from the perspective of the mind. In a sense, both are about the same subject but from different perspectives.

It is not surprising, then, that two central issues in these fields, the mind-body problem and the measurement problem, can converge into a single fundamental problem, which is that of the relation between physicality and phenomenality.

Here, I attempted to show that this convergence is indeed possible, and that this fundamental problem can be solved by refusing two commonly assumed postulates regarding phenomenality: the independence of physical reality from it and its specific attachment to cognition. If any scientific representation is construed as relative to a subject rather than a representation of what exists in the absolute, and if phenomenality is introduced right into our ontology, then the problem dissolves, and reality can be construed as a relational structure of existing entities from which the mental and the physical emerge. Such a view allows for a consistent notion of strong emergence and a solution to the problem of mental causation.

This view amounts to an epistemic structural realism wherein the unknowable fundamental 'nodes' of reality are 'observers', that is, phenomenal existential processes analogous in nature, if not in richness, to our own existential experiences (Herein we come very close to Whitehead's (1929) process philosophy). These existential processes can be metaphysically construed as a movement uniting awareness, attentional focus and dispositional instantiation of a reality for others (Ruyant, 2011). Our objects exist in that they instantiate a reality for us (and for themselves mutually), and consciousness is itself, in that sense, a peculiar form of existence. Expressed in Sartre's terminology, reality 'in itself' is the reverse side of reality 'for-itself'.

However consciousness must be distinguished from mere phenomenal existence. It can be associated with knowledge more specifically. How exactly knowledge arises from phenomenal structures and its link with the concept of emergence proposed in this paper remain to be explored, among other aspects that were not directly addressed here, and in particular the question of qualia and the question of time. In this respect, learning from the phenomenological tradition, which has long advocated for the primacy of subjectivity over objectivity, could provide some fruitful insights.

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