Making Sense of the Mental Universe

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In 2005, an essay was published in Nature *asserting that the universe is mental and that we must abandon our tendency to conceptualize observations as things. Since then, experiments have confirmed that — as predicted by quantum mechanics — reality is contextual, which contradicts at least intuitive formulations of realism and corroborates the hypothesis of a mental universe. Yet, to give this hypothesis a coherent rendering, one must explain how a mental universe can — at least in principle — accommodate (a) our experience of ourselves as distinct individual minds sharing a world beyond the control of our volition; and (b) the empirical fact that this world is contextual despite being seemingly shared. By combining a modern formulation of the ontology of idealism with the relational interpretation of quantum mechanics, the present paper attempts to provide a viable explanatory framework for both points. In the process of doing so, the paper also addresses key philosophical qualms of the relational interpretation.*

Keywords: quantum mechanics, relational interpretation, metaphysics, ontology, idealism, mental universe

Introduction

The recent loophole-free verification of Bell's inequalities [Hensen et al., 2015] has shown that no theory based on the joint assumptions of realism and locality is tenable. This already restricts the viability of realism — the view that there is an *objective physical world;* that is, a world (a) ontologically distinct from mentation that (b) exists independently of being observed — to nonlocal hidden-variables theories. More specifically, other recent experiments have shown that the physical world is *contextual*: its measurable physical properties do not exist before being observed [Gröblacher et al., 2007; Lapkiewicz et al., 2011; Manning et al., 2015]. Contextuality is a formidable challenge to the viability of realism.

These developments seem to corroborate Richard Conn Henry's assertion in his 2005 *Nature* essay that "The Universe is entirely mental" [Henry, 2005: 29]. After all, in a mental universe (a) observation necessarily boils down to perceptual experience — what else? — and (b) the physical properties of the world exist only insofar as they are perceptually experienced. There is no ontological ground outside mind where these properties could otherwise reside before being represented in mind. Indeed, in a mental universe observation *is* the physical world — not merely a representation *of* the world — which not only echoes but makes sense of contextuality.

Realism, on the other hand — at least in its intuitive formulations — entails that the world should have *objective physical properties*; that is, properties ontologically distinct from mentation, which exist even without being observed. Accurate observation should simply *reveal* what the objective physical properties of the world already were immediately prior to being observed, which is contradicted by contextuality.

There have been attempts to preserve some form of realism by finding a subset of physical properties whose values can be determined in a non-contextual manner under certain circumstances. The idea is then to claim that this subset *is* the objective physical world. For instance, Philippe Grangier [Grangier, 2001], inspired by Einstein-Podolsky-Rosen's view of what constitutes physical objectivity, contends that the quantum state of a system, defined "by the values of a set of physical quantities, which can be predicted with certainty and measured repeatedly without perturbing in any way the system," [Grangier, 2001: 1] is an objective physical entity.

The problem with this approach is highlighted by Grangier himself: the "definition [of the quantum state] is inferred from observations which are made at the macroscopic level" [Grangier, 2001: 2]. In other words, the supposedly physically objective quantum state of a system depends on the *a priori* existence of a physically objective classical world surrounding the system. This begs the question of physical objectivity instead of rendering it viable under contextuality. Because "a quantum state 'involving the environment' cannot be consistently defined" [Grangier, 2001: 4], Grangier's approach fails to reconcile contextuality with a supposedly physically objective world.

Some nonlocal hidden variables theories that preserve non-intuitive forms of realism — such as perhaps Bohm's [Bohm, 1952a; Bohm, 1952b] — may still be reconcilable with contextuality. However, these theories postulate — often at the cost of mathematical acrobatics — extra theoretical entities that are both empirically ungrounded and unnecessary for predictive purposes.

Carlo Rovelli's *relational interpretation* [Rovelli, 2008], on the other hand, sticks to plain quantum theory and embraces contextuality. Instead of loading it with unnecessary baggage, it simply interprets what quantum theory tells us about the world and bites the bullet of its implications. Rovelli's goal "is not to modify quantum mechanics to make it consistent with [his] view of the world, but to modify [his] view of the world to make it consistent with quantum mechanics" [Rovelli, 2008: 16].

In the remainder of this paper, I shall take the relational interpretation as my working hypothesis. My motivation for doing so is three-fold: (a) the interpretation is consistent with experimentally-verified contextuality; (b) it is parsimonious in that it does not postulate predictively-redundant hidden variables; and (c) Rovelli's case for why other approaches are inferior to the relational interpretation is compelling [Rovelli, 2008: 16-19].

By embracing contextuality, the relational interpretation regards every property of the physical world as relative to the observer. This is analogous to how the speed of a particle with mass is always relative to its observer. *There are no absolute physical quantities*, but simply a set of relational properties that comes into existence depending on the context of observation. Rovelli summarizes it thus:

> If different observers give different accounts of the same sequence of events, then each quantum mechanical description has to be understood as relative to a particular observer. Thus, a quantum mechanical description of a certain system (state and/or values of physical quantities) cannot be taken as an "absolute" (observer independent) description of reality, but rather as a formalization, or codification, of properties of a system relative to a given observer. Quantum mechanics can therefore be viewed as a theory about the states of systems and values of physical quantities relative to other systems [Rovelli, 2008: 6].

Like the Copenhagen interpretation, the relational interpretation entails that (a) physical quantities are products of observation. But most significantly, it goes further than Copenhagen by asserting that (b) the world is *relational*: an observation does not create a world shared by everyone, but just the world of that particular observer.

This difference with respect to the Copenhagen interpretation is not trivial. After all, it is implausible but conceivable that observation could create an objective physical world shared by all observers. For instance, if never observed, the spin of an electron may lack physical objectivity. But its *first* observation would then, *ex hypothesi*, determine its physical value for all subsequent observers. The physical objectivity of this value — and thus of the world — could be inferred from *consensus* among these observers. Such a hypothesis is consistent with assertion (a) above but not (b).

It is also conceivable that each of us could be living alone in an objective physical world — that is, a world ontologically distinct and independent from our mentation — peculiar to ourselves. The physical objectivity of such a world could be inferred from *non-contextuality* verified by experiment. Such a hypothesis is consistent with assertion (b) above but not (a).

By combining assertions (a) and (b), the relational interpretation renders realism — the notion that there is an objective physical world — meaningless. After all, in the absence of consensus and non-contextuality, on the basis of what could we speak of physical objectivity? What meaning would the latter have? According to the relational interpretation, the world exists only insofar as the information associated with an observer is concerned.

Rovelli seeks to avoid ontological conjectures. Yet, the denial of realism seems to be a direct implication of the relational interpretation. In fact, it is only one among a handful of philosophical issues Rovelli admittedly leaves unaddressed: "I am aware of the 'philosophical qualm' that the ideas presented here may … generate," he writes. "I certainly do not want to venture into philosophical terrains, and I leave this aspect of the discussion to competent thinkers" [Rovelli, 2008: 19].

It is these philosophical qualms that the present paper attempts to tackle, without contradicting the relational interpretation. In doing so, it articulates a mind-only idealist framework consistent with contextuality and — contradictory as this may at first sound — our intuition that we are individual beings sharing experiences with each other.

First Qualm: The Intuition of a Shared World

The relational interpretation denies that we can all inhabit the same objective physical world. It implies instead that each of us — as different observers — lives alone in our own private physical world, created according to the context of our own private observations. Insofar as this resembles metaphysical solipsism, it may be philosophically problematic. However, there still is a way to uphold our intuition that there is a consensus reality we share with other people.

It is true that, according to the relational interpretation, observation is not a measurement *of* or *in* a shared physical world, but the process that brings a unique physical world into existence in relation to each particular observer. This way, there are as many physical worlds as there are observers. A way to visualize this is to imagine that each person sits alone in a car corresponding to his or her own physical world. No two people can ever sit in the same car. Any ontology that contradicts this is inconsistent with the relational interpretation.

However, we can still ask another question: *Can the physical worlds of different observers be consistent with, and similar to, each other?* Notice that this does not deny that different observers have their own physical worlds; it simply asks whether these distinct worlds can be *similar* or *mutually consistent*. In other words, the question is whether we could all be sitting in cars of the same make, model and year; cars that, although *distinct*, are nearly indistinguishable from each other. If so, we would each describe our own cars in a way consistent with all other descriptions.

Here is what the relational interpretation has to say about this: nothing precludes the *possibility* of the physical worlds of different observers being similar or mutually consistent. However, it is fundamentally impossible to assert that they *are* so, for "the information possessed by distinct observers cannot be compared directly" [Rovelli, 2008: 14]. The rationale here is as follows: the notion of a consensus physical reality emerges from inter-personal communication. If I stand on a beach watching the waves and the person next to me also reports seeing waves, it is this inter-personal communication that leads me to believe that I and the other person experience the same beach. However, what I hear the other person say is itself the result of *my* observation, which brings the other person's report into existence *in relation to me*. As such, the other person's report is itself part of *my* physical world as a particular observer; it has no absolute existence. For all I know, the physical worlds experienced by other people — as *distinct* observers who bring *distinct* physical worlds into existence — may be entirely different from mine. The consensus I believe to exist about external reality may itself be an element peculiar to *my* physical world, my car. Everybody is an observer locked in his or her own car. There is no privileged referee who could walk from car to car, collect and compare the descriptions of each car, and then verify whether there actually is a consensus.

All this said, the intuition of a consensus external reality is so strong that we must ask: Can there be an ontological underpinning for the relational interpretation whereby the respective physical worlds of different observers are at least *expected* to be similar or mutually consistent? In other words, can an ontology provide us *good reasons to believe* — even though we fundamentally could never verify it — that the physical worlds of different observers *should* look alike? The motivation for this question is admittedly subjective, but the exact same subjective motivation has been enough to marginalize metaphysical solipsism throughout the history of philosophy. Indeed, Bertrand Russell's argument against solipsism seems to be applicable here: the idea that we might each be alone in an idiosyncratic world of our own "is psychologically impossible to believe, and is rejected in fact even by those who mean to accept it" [Russell, 2009: 161].

I shall shortly attempt to articulate an idealist framework for the relational interpretation according to which similarity or consistency across physical worlds is the natural and expected case, even though it cannot be verified. This framework is meant to acknowledge and assuage the intuition that we share the experiences of life with other people, whilst upholding contextuality.

Second Qualm: The Ontological Ground of Information

The relational interpretation relies on Shannon's concept of information: "A *complete* description of the world is exhausted by the relevant *information* that systems have about each other" [Rovelli, 2008: 7] (emphasis added). Although Rovelli avoids explicit ontological commitments, his appeal to information according to Shannon's definition [Shannon, 1948] implies one such commitment. After all, Shannon defines information as a measure of the number of states discernible in a system. As such, information is an abstraction associated with the possible *configurations of* a system, not a thing unto itself (unless, of course, one is prepared to venture into the abstraction wilderness of ontic pancomputationalism [Fredkin, 2003; Tegmark, 2014]). Hence, insofar as it relies on (Shannon) information, the relational interpretation requires either a realist world — wherein information is grounded in the discernible states of objective physical arrangements — or an idealist world — wherein information is associated with the discernible qualities of experience. And since realism is meaningless under the relational interpretation, idealism seems to be implied by it.

However, idealism faces some challenges. In another work [Kastrup, 2017], I have addressed and hopefully refuted common objections to it. In this paper, two challenges will be more thoroughly looked at: If mind extends into the world itself, grounding it ontologically, why can we not mentally control or at least influence the laws of physics? Moreover, if all reality is mental, then there is no non-mental stuff to insulate different individual minds from one another. Why, then, can we not directly access each other's thoughts? Satisfactorily answering these challenges is another key objective of the idealist framework I shall attempt to articulate shortly. If successful, the articulation will render idealism a viable ontological underpinning for the notion of (Shannon) information intrinsic to the relational interpretation.

Third Qualm: Relationships without Absolutes

The central idea of the relational interpretation is the notion that "physics is fully relational, not just as far as the notions of rest and motion are considered, but with respect to *all* physical quantities" [Rovelli, 2008: 7] (emphasis added). The problem here is that the analogy with rest and motion, albeit intuitively appealing, breaks when applied to "all physical quantities."

Indeed, the relational nature of rest and motion depends on certain posited absolutes, such as defined particles. To say, for instance, that the speed of a particle A is one with respect to particle B and another with respect to particle C is conditioned upon the existence of particles A, B and C as non-relational entities. Rest and motion have meaning only insofar as they are relationships between absolutes. But if *all* physical quantities are to be regarded as relational, what absolutes give these relationships meaning? To speak of relationships between relationships immediately implies infinite regress.

Let us take a step back. What the relational interpretation actually requires is that all *physical* quantities be relational. As such, it would only imply infinite regress if physical quantities were all there is. On the other hand, if an ontological underpinning for the relational interpretation could accommodate absolutes that are *not* physical quantities, infinite regress could be avoided. This is what the idealist framework ahead also does, as I shall soon elaborate upon.

Notice that, although positing absolutes that are not physical quantities is necessarily a *meta*physical step, it is not empirically ungrounded. There is an empirically-accessible ontological ground where absolutes can be found that are not — unless *assumed* or, at best, *inferred* to be so on philosophical grounds — physical quantities: mind and its thoughts. I shall elaborate further on this claim shortly.

Fourth Qualm: The Meaning of 'Physical World'

When we speak of a 'physical world' we often make implicit ontological assumptions about it, such as non-contextuality and realism. However, as we have seen, these assumptions are stripped off by the relational interpretation. So what does 'physical world' mean under it?

The clarity of thought of Andrei Linde comes to our aid at this point:

> Let us remember that our knowledge of the world begins not with matter but with perceptions. … Later we find out that our perceptions obey some laws, which can be

> most conveniently formulated if we assume that there is some underlying reality beyond our perceptions. This model of material world obeying laws of physics is so successful that soon we forget about our starting point and say that matter is the only reality, and perceptions are only helpful for its description. This assumption is almost as natural (and maybe as false) as our previous assumption that space is only a mathematical tool for the description of matter. [Linde, 1998: 12]

So, in the absence of non-contextuality and realism, the ‘physical world’ of the relational interpretation can only be the *contents of perception*. There is nothing else the physical world could be. Indeed, as Linde pointed out, physics ultimately pertains to the study of the patterns and regularities of perception. As such, the “physical quantities” referred to by Rovelli are part of the contents of perception.

It could be argued at this point that quantum phenomena occur at a microscopic scale that cannot be perceived *directly*, but only through instrumentation. Yet, even in this case, whatever we know about these microscopic quantum phenomena is still a part of the contents of perception: physicists *perceive* the output of instrumentation. When predicting microscopic quantum behavior, physicists are in fact predicting the perceivable output of instrumentation. *Physics is entirely about what is perceived*, directly or indirectly.

We know that next to the physical world — that is, next to the contents of perception — there are also non-perceptual mental categories such as thoughts (for simplicity, I shall henceforth refer to all non-perceptual mental categories simply as ‘thoughts’). Many physicists posit that thoughts should be explainable in terms of physical quantities and, as such, become part of the physical world *by reduction*. However, this is a philosophical *assumption* that does not change the scientific fact that quantum mechanics does *not* predict thoughts; it only predicts the unfolding of perception. In the absence of non-contextuality and realism, the physical world of quantum mechanics *is* perception.

Attentive readers will have noticed that I have just opened a door for tackling the third qualm of the relational interpretation, as discussed in the previous section. More on this shortly.

Fifth Qualm: The Meaning of ‘Physical System’

Under the relational interpretation, all “physical systems” are valid observers and can, in turn, also be observed [Rovelli, 2008: 4]. This neutrality is a strength, for it circumvents a host of issues regarding what constitutes an observer. Yet, the same neutrality disguises the fact that a deeper question is left unanswered: *What constitutes a physical system to begin with?* From a philosophical perspective, the answer is not self-evident.

The intuition behind what we ordinarily regard as discrete physical systems — such as tabletop measurement apparatuses — entails (a) delineating a subset of the physical world on structural or functional grounds and (b) treating this subset as an entity in some sense separate from the rest of the physical world. The question is whether such delineation is ontic or epistemic.

If the delineation merely helps us structure our *conceptual knowledge of* the physical world, it is epistemic and — despite being convenient — arbitrary on an ontic level. For instance, although the handle of a mug is cognitively salient and can be conveniently treated as a separate entity, distinguishing it from the mug is arbitrary. Another example: the delineation of what we call a car, though based on structural and functional reasoning, is arbitrary. If I argue that, say, the spark plugs are integral to the car because without them the car cannot function, by the same token I would also have to include the fuel that makes its engine run, the environment air that allows combustion and cools the engine, the road gripped by the tires, the ground that sustains the road, the gravity that enables grip, and so on. The decision of where to stop is merely epistemic, motivated by convenience. As such, epistemic delineation is somewhat akin to finding faces in clouds or tracing figures on tree bark. Subsets of the physical world traced in this manner exist only conceptually and, therefore, cannot be considered proper physical systems in their own merit. There is no physical reason to carve them out of the context within which they were traced.

A proper physical system must be an internally integrated whole separate, in some *ontic* sense, from the rest of the physical world. The problem is that there are strong reasons — largely based on quantum mechanics itself — to think that the *entire universe* is one integrated whole without ultimate parts. Jonathan Schaffer, for instance, points out that

> physically, there is good evidence that the cosmos forms an entangled system and good reason to treat entangled systems as irreducible wholes. Modally, mereology allows for the possibility of *atomless gunk*, with no ultimate parts for the pluralist to invoke as the ground of being. [Schaffer, 2010: 32] (original emphasis)

Horgan and Potrč [Horgan & Potrč, 2000] have also argued that only the universe as a whole can be considered a concrete entity in its own merit, which they called the "blobject." Thus, only the "blobject" can be a proper physical system.

What this line of thought suggests is that no subset of the physical world can be considered a proper physical system; only the physical world *as a whole* can. Everything we regard as subsystems of the physical world — such as tabletop measurement apparatuses — arises from epistemic delineation and is, in a sense, akin to figures traced on tree bark. The physical substantiation of this conclusion is von Neumann's chains [von Neumann, 1996]: 'subsystems' of the inanimate world never perform measurements, but simply become entangled with each other upon interacting.

If only the universe as a whole were a proper physical system, observ*er* and observ*ed* would be the same system, leading to untreatable self-reference. But I contend that there is precisely *one* criterion of delineation that is *not* arbitrary, and by virtue of which we can ontologically ground observ*er* and observ*ed* without self-reference. I shall discuss this in the next section, wherein I begin to elaborate on my proposed idealist framework.

Mind and Alters

Here is a brief recapitulation of the preceding sections: (a) the relational interpretation renders the notion of realism meaningless. Therefore, (b) it implies idealism insofar as it relies on (Shannon) information, and (c) it implicitly defines the physical world as the contents of perception. However, it then raises problems such as (d) why we cannot mentally influence the laws of nature if mind extends into the physical world, (e) how distinct individual minds can exist in a fully mental universe, (f) what constitutes a proper physical system, and (g) how relationships can exist without absolutes to give them meaning and avoid infinite regress. Despite its relational character, the interpretation still (h) leaves a door open for the intuitively appealing possibility of similar or mutually consistent physical worlds across observers.

From (b), the most direct and parsimonious ontological underpinning for the relational interpretation is that *reality consists in patterns of excitation of a universal mind*. This is analogous to how quantum field theory posits that reality consists of patterns of excitation of a quantum field and M-theory those of a hyper-dimensional 'brane.' The universal mind could, in principle, even accommodate the same mathematical formalisms of these theories. The main difference is that, unlike the quantum field and the hyper-dimensional 'brane,' the universal mind is not an *object* but the *subject*. Its excitations are thus experiences — not objective physical values — though they can still be *modeled* or *described* mathematically by values.

Let me dwell a little longer on this move, for it is profoundly counterintuitive to most physicists and even philosophers. Every theory of nature must rely on at least one ontological primitive, since we cannot keep on explaining one thing in terms of another forever. According to quantum field theory, the quantum field is the ontological primitive, so everything about the physical world should be reducible to excitations of the quantum field. What I am proposing here is that *universal mind* is the ontological primitive. An alternative but equivalent way of saying the same thing is to say that the quantum field *is mind*; that is, the subject, not an abstract conceptual object. Inferring universal mind — not your or my *personal psyche*, mind you, but mind as a generic ontological class — to be nature's sole ontological primitive is thus a valid conjecture, at least in principle. It is equally valid to think of the dynamics of nature as being constituted by the *excitations of* universal mind — that is, experiences themselves, with all the entailed *qualities* — much as quantum field theory thinks of the dynamics of nature as excitations of an abstract quantum field and M-theory those of an abstract brane. The challenge, of course, is to explain the patterns and regularities of nature in terms of subjectivity alone.

Indeed, the idea that a universal mind is nature's single ontological primitive immediately brings problem (e) to the forefront. As it turns out, the solution of this problem is the same as that of problem (f), so I will start my argument by addressing the latter.

Rovelli "assume[s] that the world can be decomposed (possibly in a variety of ways) in a collection of systems, each of which can be equivalently considered as an observing system or as an observed system" [Rovelli, 2008: 10]. The problem, as we have seen in the previous section, is that the criteria for this decomposition seem arbitrary both from ontic and physical perspectives.

There is, however, one very natural ontic decomposition. To see it, notice that the boundaries of our own body are not arbitrary. Our ability to *perceive* ends at the surface of the body: our skin, retinas, eardrums, tongue and the mucous lining of our nose. We cannot perceive photons hitting a wall or air pressure oscillations bouncing off a window, but we *can* perceive those impinging on our retinas and eardrums, respectively. Moreover, our ability to act through direct intention also ends at the surface of the body: we can move our arms and legs simply by *intending* to move them. However, we cannot do the same with tables and chairs. Clearly, thus, the delineation of our body is not a question of epistemic convenience: it is an *empirical fact*. I cannot just decide that the chair I am sitting on is integral to my body, in the way that I *can* decide that the handle is integral to the mug. Neither can I decide that a patch of my skin is not integral to my body, in the way that I *can* decide that the hood is not integral to the jacket. The criterion here is not merely a functional or structural one, but *the range of mentation — sensory perception, intention — intrinsically associated with our body.* Based on this ontic criterion, there is no epistemic freedom to move boundaries at will.

Insofar as we can assume that all living creatures have mental life and inanimate objects do *not*, this conclusion can be generalized as follows: *living bodies are proper physical systems*; they *can* be carved out of their context. Therefore, only the *inanimate* universe *as a* *whole* — that is, one universal von Neumann chain — and individual living bodies are proper physical systems; only the inanimate universe and living bodies are observers. Everything else is akin to figures traced on tree bark.

Now, since the ontic criterion for delineating bodies is the range of mentation associated with them, *each proper physical system is associated with its own bounded mentation*. Yet, how can bounded mentation exist within one universal mind?

The answer is empirically motivated: it is now well-established in psychiatry that mental contents can become *dissociated* [Kelly et al, 2009: 167-174; Schlumpf et al., 2014; Strasburger & Waldvogel, 2015]; that is, undergo "a disruption of and/or discontinuity in [their] normal integration" [Black & Grant, 2014: 191]. Indeed, the normal integration of mental contents takes place through chains of *cognitive associations*: a perception may evoke an abstract idea, which may trigger a memory, which may inspire a thought, etc. These associations are *logical*, in the sense that e.g. the memory inspires the thought because of a certain *implicit logic* linking the two. Integrated mentation can then be modeled by a connected directed graph, as shown in Figure 1a. Each vertex represents a particular mental content and each edge a cognitive association logically linking mental contents together. Every mental content in the graph of Figure 1a can be reached from any other mental content through a chain of cognitive associations. Dissociation, in turn, occurs when the graph becomes disconnected, as shown in Figure 1b. Some mental contents can then no longer be reached from others. Following the psychiatric convention, I shall refer to the subgraph with grey vertices as a (dissociated) *alter.*

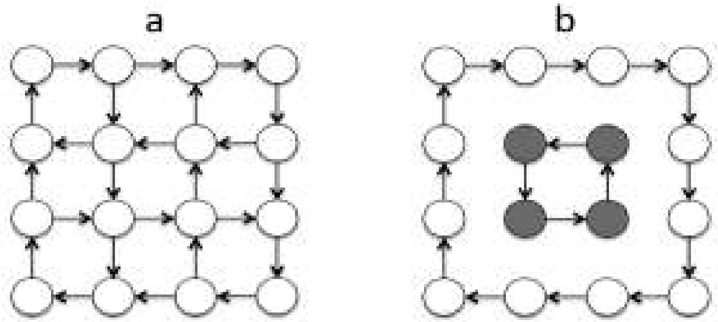

Figure 1. A connected graph (a) illustrating integration of mental contents, and a disconnected graph (b) illustrating dissociation and the corresponding formation of an alter (subgraph in grey).

Because cognitive associations are essentially logical, as opposed to spatio-temporal, the scheme of representation in Figure 1 allows for the *simultaneous* experience of multiple mental contents linked together in a connected subgraph. This is empirically justifiable: a perception, for instance, can be experienced at the same time as the thoughts it evokes and the emotions evoked by these thoughts. Moreover — and by the same token — the two disconnected subgraphs in Figure 1b can also represent two *concurrently conscious* dissociated subjects of experience. The motivation for this is again empirical: there is compelling evidence that different alters of the same psyche can be co-conscious [Kelly et al., 2009: 317-322; Braude, 1995: 67-68].

An alter loses direct access to mental contents surrounding it, *but remains integral to the mind that hosts it.* The disconnection between an alter and surrounding mental contents is merely logical. As an analogy, a database may contain entries that are not indexed and, therefore, cannot be reached, but this does not physically separate those entries from the rest of the database.

Dissociation elegantly explains how mental processes can become bounded and disconnected from each other without the need to invoke anything ontologically distinct from mind. As such, dissociation is at least a useful analogy to explain how distinct individual psyches can form under idealism: *each is an alter of universal mind*. A living body is simply the extrinsic appearance of an alter (more on this shortly). Dissociation thus solves not only problem (e), but also (d): we, as alters of universal mind, cannot mentally influence the laws of nature because we are dissociated — logically disconnected — from the corresponding mental contents.

At this point, the reader may feel tempted to explain away dissociation in terms of information flows in physically objective brain tissue. Notice, however, that this would assume realism and beg the very question of ontology being addressed here. The hypothesis I am just beginning to elaborate on is precisely that dissociation — as a phenomenon that *precedes* the physical world ontologically — can *explain* the physical world, as opposed to the other way around. This is somewhat analogous to saying, under quantum field theory, for instance, that certain fundamental excitatory phenomena of the quantum field give rise to the physical world we can measure. So please bear with me.

Mental Impingement across a Dissociative Boundary

By definition, mental contents inside an alter cannot directly evoke mental contents outside the alter, and vice-versa. But they can still *influence* each other. Indeed, mental impingement across a dissociative boundary is empirically known. Lynch and Kilmartin, for instance, report that dissociated feelings can dramatically affect our thoughts [Lynch & Kilmartin, 2013: 100], while Eagleman shows that dissociated expectations routinely mold our perceptions [Eagleman, 2011: 20-54]. We can visualize this as in Figure 2a, wherein the partial overlap of adjacent vertices internal and external to the alter represents impingement across the dissociative boundary.

Figure 2b illustrates the same thing according to a simplified representation unrelated to graph theory: the broader mind is represented as a white circle with an alter represented as a grey circle within it. These circles are no longer graph vertices but represent sets of mental contents. The dashed arrows represent the impingement of external and internal mental contents — not explicitly shown — on each other, across the alter's boundary. For clarity, notice that these dashed arrows do *not* represent cognitive associations. I shall use this simplified representation henceforth.

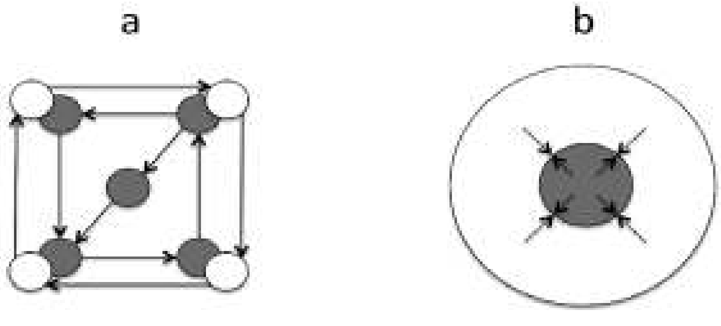

Figure 2. Mental contents impinging on the dissociative boundary of an alter, illustrated in two different but equivalent ways, (a) and (b).

A Physical World as Markov Blanket

If — as idealism posits — a universal mind is the single ontological primitive underlying all nature, then the formation of an alter defines a boundary within this mind that separates mental contents enclosed by the boundary from mental contents outside the boundary. Now, as we have seen in the previous section, certain mental contents within and outside the boundary can also impinge on each other (Figure 2). Three different types of mental state can then be defined with respect to an alter: internal, external and interactive state, the latter resulting from impingement. The boundary of an alter is thus akin to a Markov Blanket [Pearl, 1988]. For this reason, and inspired by Friston's model [Friston, 2013], I shall represent the interaction of an alter with its surrounding mental environment as illustrated in Figure 3.

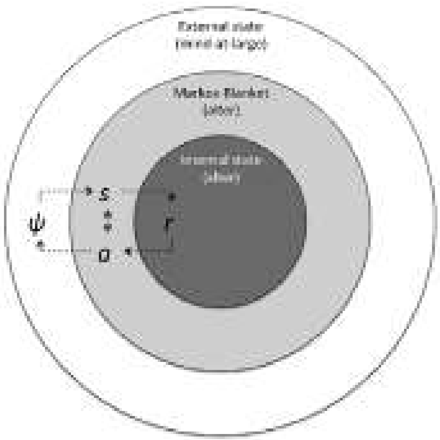

Figure 3. An alter — with internal mental state *r* — interacting with the surrounding environment — with external mental state ψ — through the sensory (*s*) and active (*a*) states of its Markov Blanket.

I shall refer to the segment of universal mind that is not comprised in any alter as 'mind-at-large.' Therefore, the state ψ of mind-at-large is external to all alters. An alter, in turn, has internal state *r* and interacts with mind-at-large through sensory state *s* and active state *a*, both comprised in its Markov Blanket. Sensory state *s* represents the (Shannon) information the alter has about its surrounding mental environment. Active state *a* represents the alter's manifest intent: mental action that perturbs the environment. Notice that 'environment' here does *not* refer to the physical world, but to *non-physical* thoughts surrounding the alter. I shall further clarify this shortly.

Sensory state *s* depends on external state ψ and action state *a*. The dependency of *s* on *a*, however, is both indirect — operating through the influence of *a* on ψ — and direct, as shown in Figure 3. The direct dependency represents the quantum mechanical fact that the information an alter — as observer — has about its surrounding environment depends both on the environment itself (ψ) and on how the alter's manifest intent (*a*) causes it to observe the environment. The classical example is the experimentally confirmed fact that even whole atoms behave either as waves or as particles depending on how the experimenter chooses to observe them [Manning et al., 2015].

The double dependency of sensory state *s* on active state *a* can be justified as follows: on the one hand, the manifest intent *a* of an alter perturbs — through mental impingement across its dissociative boundary, as illustrated in Figure 2b — the state ψ of mind-at-large itself. On the other hand, the manifest intent *a* also determines the specific 'vantage point' the alter has on mind-at-large and, therefore, what information the alter gathers about it. As an analogy, when one holds up a snow globe, this intentional action not only perturbs the state of the snow globe itself, but also determines the vantage point from which one looks at the snow globe.

The active state *a* depends on internal state *r* and sensory state *s*. The dependency of *a* on *s* is again both indirect — operating through the influence of *s* on *r* — and direct, as shown in Figure 3. A simple analogy justifies this double dependency: an alter's manifest intent depends both on the information the alter has about the environment (*s*) *and* on what the alter *thinks about* this information (*r*).

External state ψ and internal state *r* are *thoughts* of mind-at-large and an alter, respectively. I submit that quantum superposition states are *models* of these thoughts, the evolution of the latter being governed by Schrödinger's equation. To gain intuition about this, imagine the following: you have received a job offer but remain undecided about whether to accept it or not. Your thoughts then remain in a form of superposition, encompassing two binary alternatives simultaneously: accepting and refusing the offer. Each alternative is associated with the *degree of affinity* you have with it — which translates into your tendency to choose it — at that particular moment in time. I posit that a quantum superposition is simply a *second-person model* of this type of ambivalent mental state that we all experience from a first-person perspective. External state ψ is a model of what it is like to *be* mind-at-large in the process of entertaining conflicting alternatives concurrently in its imagination. As such, the wave function of ψ does represent epistemic uncertainty; *but — crucially — the epistemic uncertainty of mind-at-large itself, not of the alter observing it.*

I further posit that the process of observation consists in the interaction between external state ψ and internal state *r* through the Markov Blanket. In this context, it is tempting to simply say that active state *a* represents the intentional act of observation and sensory state *s* the outcome of this act. However, as discussed above and illustrated in Figure 3, *a* and *s* are co-dependent and cannot be teased apart. So a better way to think about the process of observation may be suggested by the following analogy: insofar as ψ and *r* can both be modeled by a wave function, they can be regarded as *thought waves* encompassing a set of binary alternatives with associated degrees of affinity, just as discussed in the example of a job offer above. Observation can then be modeled as the *interference pattern* — whose compound state is represented in Figure 3 by *s* and *a* — produced when these thought waves interact with each other within the Markov Blanket. Interference favors one of every pair of superposed alternatives in ψ by amplifying its experience while dampening the other. The result is our perception of a definite, classical world. The alternative favored can be regarded as the common denominator of the affinities embedded in ψ and *r*.

The interpretation suggested above shall remain a matter of philosophical speculation until somebody writes down the wave function for the thoughts of a conscious human being (*r*) and formalizes the interaction dynamics between it and ψ. This echoes Zurek's view that

> an exhaustive answer to [the question of why we perceive a definite world] would undoubtedly have to involve *a model of "consciousness,"* since what we are really asking concerns our (observers) impression that "we are conscious" of just one of the alternatives. Such model of consciousness is presently not available [Zurek, 1994: 29] (emphasis added).

Whatever the case, under the relational interpretation — as discussed earlier — the physical world *is* perception. Therefore, it is determined by sensory state s, which in turn is co-dependent on active state a. The next step in this line of reasoning is inevitable: *the physical world is the Markov Blanket.* Everything else — that is, ψ and r — is non-physical *thought*. It is the interaction between ψ and r that produces perception and, thus, the physical world. Only states s and a of the Markov Blanket are *physical* states, for only they are comprised in the physical world.

Since *all* states in Figure 3 are ultimately patterns of excitation of universal mind, physical states represent but a particular class of mental states: namely, perceptual states. Another class is exemplified by states ψ and r, which consist of pure thought. So, while discernible from each other qualitatively, *both physical and non-physical states are ultimately mental*.

Extrinsic Appearances

Figure 3 can be extended to multiple alters, as illustrated in Figure 4. The interaction between ψ and the internal state r of each alter creates the physical world *of this alter* in the form of its respective Markov Blanket encompassing sensory state s and active state a. Therefore, each alter has its own physical world. The wave function of ψ also becomes quantum mechanically correlated, upon interaction, with the active state a of each alter. This way, ψ accrues (Shannon) information about the presence and behavior of all alters interacting with mind-at-large.

This has a significant implication. When an alter A_1 interacts — through mental impingement across its dissociative boundary — with mind-at-large, ψ becomes quantum mechanically correlated with active state a_1 of A_1. Therefore, when an alter A_2 subsequently interacts with mind-at-large, the information its sensory state s_2 acquires can include information about A_1. The physical world of A_2 can thus reflect the presence and actions of A_1. I shall refer to the information about A_1 in s_2 as *A_1's extrinsic appearance in relation to A_2*.

For reasons discussed earlier, I posit that the extrinsic appearances of other alters in relation to us are the living bodies we *perceive* around ourselves: other people, animals, possibly plants. As such, biology is what betrays elements of our world as extrinsic appearances of other alters.

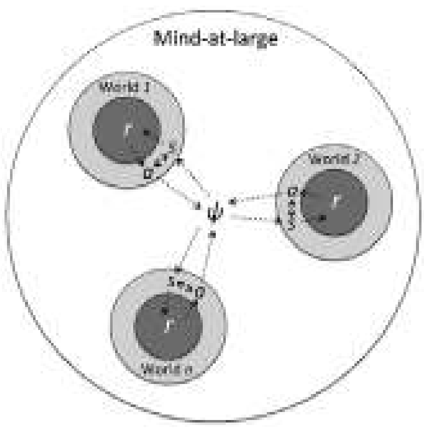

Figure 4. Mind-at-large and alters. When an alter interacts with mind-at-large, ψ becomes quantum mechanically correlated with the alter's active state a, so that each alter can indirectly obtain information about all other alters through its sensory state s.

This notion of extrinsic appearances can be extended to mind-at-large itself: the *inanimate* universe is the extrinsic appearance of mind-at-large in relation to us. That there is overwhelming evidence for the existence of the universe before the rise of life means solely that the universal mind existed before its first alter ever formed; that is, before abiogenesis.

The extrinsic appearances of other alters in relation to us are part of our respective physical world. They constitute proper physical systems within our Markov Blanket. Therefore, *only living beings and the inanimate universe as a whole constitute observers*. All other subsystems of the inanimate universe — such as tabletop measurement apparatuses — are only subsets of 'pixels' integral to mind-at-large's extrinsic appearance. There is no more reason to carve them out as separate subsystems in their own merit than there is reason to carve out the subset of reddish pixels of a photograph and treat it as a thing in its own merit.

At this point, it is important to notice that the external state ψ of mind-at-large and the internal state r of each alter do *not* have spatio-temporal extension, for they are *not* physical. Their seemingly spatial representation in Figure 4 is simply an artifact of depiction. Space is confined to Markov Blankets. Everything else is pure thought.

Consistency with the Relational Interpretation

Let us now verify, point by point, that the ontological framework discussed in the previous sections is consistent with the relational interpretation:

– *The relational interpretation entails that all physical quantities are created by observation.* This is reflected in Figure 3, wherein physical quantities are represented by the sensory state s of the alter, which arises only from the interaction — that is, observation — between ψ and r.
– *The relational interpretation asserts that there is no absolute physical world, all physical quantities being relational.* This is reflected in Figure 4, wherein each alter — as observer — has its own Markov Blanket, which arises from the alter's own interaction with mind-at-large.
– *The relational interpretation asserts that no physical system is privileged: all physical systems can observe and be observed.* Indeed, mind-at-large and all alters — that is, all physical systems — can both observe and be observed. The extra restriction I imposed pertains only to what constitutes a proper physical system to begin with, not to which of them can constitute an observer. The fact that mind-at-large and all alters are minded does not privilege them over anything else, for according to the proposed framework there is no proper physical system that is *not* minded.
– *The relational interpretation asserts that quantum mechanics provides a complete and self-consistent scheme of description of the physical world*. Indeed, since the physical world of an observer consists in the compound state of the Markov Blanket associated with that observer, quantum mechanics does provide a complete scheme of description of that world. I did suggest earlier that, if we could write down the wave function of a human psyche and formalize the dynamics of its interaction with ψ, we could solve the measurement problem. But this only means that, in practice, we have not yet exhausted the potential of the scheme of description provided by quantum mechanics. My suggestion does not require hidden variables.

The idealist ontology proposed is thus consistent with the relational interpretation and provides an ontological framework for its tenets.

Solving the Qualms of the Relational Interpretation

We now return to where we started: the philosophical qualms raised by the relational interpretation. The goal of this final section is to show that the ontological framework proposed in this paper solves those qualms. Point by point:

– *The intuition of a shared world:* the framework illustrated in Figure 4 shows that, even though we do not inhabit the same physical world, we do share a common non-physical environment — namely, mind-at-large. We are all alters of one mind, surrounded like islands by the ocean of its thoughts (ψ). Although each observer lives in its own physical world, this world is created by an interaction — perhaps an interference pattern — between ψ and the observer's own internal state r. Therefore, insofar as the internal state r is similar across observers — a reflection of our common humanity or even of the basic characteristics of life that we share with all organisms — such interaction should, at least in principle, lead to similar worlds.

– *The ontological ground of information:* according to the proposed framework, mind is the sole ontological primitive and ground of all reality. Information is thus given by the discernible qualities of experience, which are themselves patterns of excitation of mind. The problems of (a) why we cannot mentally influence the laws of physics and (b) why we cannot directly access each other's thoughts are both solved by positing dissociation to be a primary natural phenomenon.

– *Relationships without absolutes:* there are no such things. According to the proposed framework, all physical quantities are relationships between *mental* absolutes. A physical quantity encompassed by the sensory state s of an observer consists of a relationship between ψ and the observer's internal state r (see Figure 3 again). So there are absolutes: ψ and r. It is just that, in accord with the relational interpretation, these absolutes are not physical quantities.

– *The meaning of 'physical world':* according to the proposed framework, the physical world corresponds to the compound state s-a of the respective observer's Markov Blanket.

– *The meaning of 'physical system':* according to the proposed framework, only mind-at-large and alters are physical systems. Everything else is just segments of these systems' extrinsic appearances, delineated arbitrarily like figures traced on tree bark.

Conclusions

I have proposed an idealist framework as ontological underpinning for the relational interpretation of quantum mechanics. According to this framework, a universal mind is the sole ontological primitive underlying all reality. Physical systems consist of dissociated segments of this universal mind, which can observe and be observed by each other. The dissociated segments comprise alters immersed in mind-at-large. Alters have internal states r, which are quantum superposition states. Mind-at-large has state ψ, which is also a quantum superposition state. Alters interact with mind-at-large through mental impingement across their respective dissociative boundaries. This interaction is a quantum observation that creates the physical world of the alter and causes ψ to become correlated with the alter's state. This way, ψ accrues (Shannon) information about all alters. By arising from interactions with

ψ, the physical world of each alter can thus reflect the presence and actions of all other alters. I have referred to these reflections as the extrinsic appearances of other alters. Living bodies are the extrinsic appearances, in our respective physical worlds, of other alters.

The proposed ontological framework solves the philosophical qualms raised by the relational interpretation, such as: the intuition that we all share the same external environment, the ontological ground of (Shannon) information, the meaning of physical relationships in the absence of physical absolutes, the nature of the physical world and the criteria for decomposing the world into distinct physical systems.

It is hoped that the combination of the relational interpretation with the idealist framework articulated in this paper offers a promising avenue to make sense of reality in a parsimonious manner, consistent with experimentally confirmed contextuality.

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