Research Article

The Brain as a Filter: Introducing a Quantum Ground into Integrated Information Theory

George Williams[1]

1. Independent researcher

Integrated Information Theory (IIT) is an influential framework for understanding the link between the brain's neural structure and consciousness. However, based on arguments that purely structural explanations, such as IIT, cannot address the hard problem of consciousness, I supplement IIT with an intrinsic element that includes properties extending beyond the purely structural, and which, according to arguments within philosophy of mind, provides the basis for conscious experience. I argue that a promising candidate for such an intrinsic element is the ontologically fundamental domain of the quantum wave function. Introducing this fundamental reality, or quantum ground, as an intrinsic element within IIT's framework leads to interpreting the brain as a kind of filter or tuner that supports a range of experience from a more fundamental source of consciousness. For this approach, I propose the term Filter Integrated Information Theory (FIIT), which does not change IIT's formalism, yet views its structure as grounded on an ontologically deeper source of consciousness. In addition, I consider how this new interpretation can assist toward improving our understanding in recent empirical research on psychedelics and meditation, as well as anomalous mind-matter perturbation.

1. Introduction

Integrated Information Theory (IIT) has become an important and influential framework for understanding conscious experience, guiding much research on the link between the brain's system of neurons and consciousness. In a nutshell, the theory, developed by Giulio Tononi and colleagues, explains consciousness in terms of integrated information. This notion of integrated information follows an intuition based on prior work that suggested conscious experience is associated with the

more integrated areas of the brain. IIT's key axioms are taken from phenomenological claims involving our direct experience, which in turn are used to justify a sophisticated mathematical framework.

However, IIT has also attracted critical attention. One influential argument notes that IIT's key metric, Φ, would indicate consciousness in some physical systems that we would not normally think to be conscious, such as a large grid of logic gates (Aaronson 2014). Another issue is that notion of information, including IIT's integrated version, presupposes an observer that can interpret or translate the information and hence does not possess the resources to explain consciousness itself (Searle 2013). Among other criticisms, Kelly characterizes IIT's claim that consciousness can be based on a system's ability to causally affect itself as "pure sophistry" (Kelly 2022).

Arguably, many of the criticisms leveled against IIT are indications that it falls short of addressing the hard problem of consciousness, also known as problem of phenomenal experience. Recently, one of Tononi's principal collaborators, Cristof Koch, has acknowledged this in the form of payment on a wager to David Chalmers (the philosopher who coined the term 'hard problem of consciousness'). Twenty-five years ago, Koch offered a bet to Chalmers that brain researchers would by now solve how the brain generates consciousness. At a recent conference, Koch acknowledged that this promise had not been met and awarded Chalmers a case of wine (Lenharo 2023).

I wish to focus here on what I believe is the crucial ingredient missing from IIT, and the primary source of its difficulty for addressing the hard problem: that its thoroughly mathematical approach arguably leaves out something essential. Recent arguments in philosophy of mind known as Russellian monism have called attention to how our scientific understanding of the world, based on structural or relational descriptions, fall short of completely characterizing our world. Something, the argument goes, must ground the structure or provide the basis for the structural descriptions. Put another way, physics reveals in the form of elegant mathematical equations the behavior of the particles that constitute our world, but not the intrinsic nature of those particles. And importantly, Russellian monism also suggests that this intrinsic aspect of the world provides the basis of consciousness.

In this paper, I propose addressing IIT's difficulty with the hard problem by introducing an intrinsic element (in a Russellian sense) into its framework. In the next section (§2), after a brief overview of IIT, I review recent arguments that IIT's purely structural framework cannot fully address the hard problem, the problem of phenomenal consciousness. I then take up Russellian monism, which

clarifies how we might locate the base of consciousness in the world's intrinsic aspect, which eludes purely structural descriptions. The question then becomes how to characterize or further pin down this intrinsic aspect, which, by definition, eludes our scientific methods.

In section §3, I'll argue that an appealing candidate for the world's intrinsic or fundamental aspect is the ontologically deeper entity of wave function space. Recent work suggests that the property of entanglement leads to the high-dimensional space of the wave function as a quantum ground. I also discuss how Russellian monism gives us reason to consider that this underlying stratum, if truly the intrinsic aspect of the world, provides the source for conscious experience. And establishing the source of consciousness in an inherently nonlocal quantum ground leads to a version of cosmopsychism, the position that the conscious experiences of all living organisms are aspects of a more fundamental cosmic mind.

In section §4, I discuss how we might fit this preferred notion of an intrinsic aspect within IIT's framework. As it happens, both IIT and the fundamental ground inhabiting wave function space require a high-dimensional probability space. From this, I'll argue that a high-dimensional quantum ground as the basis for phenomenal experience likely provides the right kind of resources to help IIT account for our more familiar conscious experience. However, supplementing IIT with this sort of intrinsic element leads us toward a different interpretation for IIT. Rather than providing an understanding for the generation of conscious experience, I suggest that we see IIT in the context of our brain as a kind of filter or tuner with respect to a deeper ground of aware potentiality. I propose applying the term FIIT (Filter Integrated Information Theory) for this view of IIT.

In the 5^{th} section (§5), I consider some implications that this interpretation has for recent findings within the literature on brain imagery. In two areas, psychedelic research and meditation, I argue that the introduction of an underlying ground of consciousness provides a more natural interpretations of the findings. I also suggest that the FIIT interpretation provides a better fit in that research with first person reports of profound oneness or deeper connection. In addition, I argue that such a framework that incorporates an ontologically deeper ground is consistent with recent findings of anomalous mind-matter interaction. Given the implications on how FIIT addresses these areas of brain research, I touch on implications FIIT has for further empirical work.

2. What is Intrinsic in Integrated Information Theory?

Integrated Information Theory (IIT), developed Gulioni Tononi and his collaborators over the past two decades, is a theoretical framework that bases conscious experience on the brain's structure (Tononi 2008; Oizumi, Albantakis, and Tononi 2014; Tononi et al. 2016). The core claim of IIT is that it is only informational properties, which are based solely on the structural and causal relationships of a system of elements (such as the brain's neurons) that determine whether the system is conscious. And the relevant sort of information, according to Tononi, is integrated information, which is "the amount of information generated by a complex of elements, above and beyond the information generated by its parts" (Tononi 2008, p.216). Within its mathematical framework, IIT defines a formal measure of consciousness, Φ, which quantifies how much consciousness an appropriately integrated system of elements possesses. Later work has expanded IIT's framework in the form of a high-dimensional geometric "space" (Q space), to analyze the quality of conscious experiences (Balduzzi and Tononi, 2009).

An appealing aspect of IIT is that it is constructed from axioms that are arguably rooted directly in experience. IIT is established around 5 key phenomenological axiomatic claims which, in summary form, include: intrinsic existence, composition, information, integration, and exclusion. These axioms, which characterize aspects of our experience, are in turn used to justify 5 postulates that are used to build a framework through which an identity is claimed between the phenomenological properties of experience and the informational (causal) properties of physical systems. This leads to IIT's claim that the "the maximal irreducible conceptual structure (MICS) generated by a complex of elements is identical to its experience" (Oizumi, Albantakis, and Tononi, 2014, p.3). Here, 'irreducible' refers to how a complex network of elements is integrated in such a way that its information is higher than that associated with the sum of its members.

The axioms and their corresponding postulates are not without controversy. For example, the exclusion postulate entails that only a network of elements with the highest Φ will be conscious. Thus, it is conceivable that a complex of elements within the brain might be conscious, rather than the brain as a whole, if the subnetwork has the higher Φ. Also, the theory does not rule out consciousness switching between alternate subsystems within the brain. Of course, such possible scenarios are difficult to square with our phenomenal experience (which presumably is the basis of IIT's axioms).

Advocates note that IIT has some explanatory power with respect to locating consciousness with various states of the brain. For example, Tononi and his colleagues argue that IIT helps to explain why our experience depends more on the cerebral cortex than the cerebellum (despite the fact that the latter contains more neurons): the brain cells within the cerebral cortex are more integrated than the cerebellum (Tononi and Koch, 2015). Further, IIT appears to provide insight in the cases of patients with split-brain. (cite?) Additional questions that might be addressed have included why consciousness fades in sleep while brain cells are active, and why consciousness is lost in seizures when neural activity is intense and synchronous (Tononi and Koch, 2015; Tononi et al., 2016).

But for all its virtues, the question remains concerning IIT's ability to truly address the hard problem of consciousness or the problem of conscious experience. Mindt, borrowing arguments from Chalmers, questioned whether IIT as a purely structural framework can truly account for phenomenal experience (Mindt, 2017). According to Chalmers, the easy problems involve explaining behavioral or cognitive functions, which might include the ability to distinguish between perceptual stimuli, access memory, or control behavior. We can explain the easy problems, according to Chalmers, by identifying the appropriate mechanisms or functions. But the hard problem concerns how physical systems such as brains are associated with phenomenal experience (Chalmers, 2003).

Chalmers also notes that physical explanations "explain only structure and function, where the relevant structures are causal roles in the production of a system's behavior. And one can argue that explaining structures and functions does not suffice to explain consciousness." (D. J. Chalmers 2003, pp.104-105). While Chalmers is making a general characterization on physicalist explanations, Mindt notes that the argument also applies to IIT, a framework described in terms of a structure of elements causally linked.[1]

But if we accept this argument that structure and function are inadequate to account for phenomenal experience, how do we proceed? Chalmers and others who accept his characterization of the hard problem view the most likely solution as taking consciousness as fundamental in some sense. From here, possible directions include versions of dualism, idealism, panpsychism, and neutral monism. Recently a particularly influential path follows arguments associated with Bertrand Russell (Russell 1927). Russellian monism, as this approach is usually called, notes that structural explanations of the world, often obtained via scientific methods, appear to leave something crucial out. That is, advocates of this view note that physics provides us with only structural or relational understandings of the physical world (usually in terms of mathematical equations) that leave us ignorant on whatever relata

ultimately ground the relationships. Russell argued that such scientific descriptions leave out the intrinsic aspect of our world. However, he also argued that the only real knowledge we have of something intrinsic is the direct knowledge we have of the nature of our own conscious states. These states, Russell held, which we acquire without abstract equations or theories, give us our only knowledge of an intrinsic aspect within the world. These two arguments can then be combined to provide a deeply interlinked view of mind and matter. Since physics tells us nothing of the intrinsic aspect of our physical world, we may posit that this aspect is the same (or has the same basis) as our own conscious experiences.

This argument appears to suggest a way of escaping the problems faced by physicalism and dualism. That is, taking consciousness as intimately linked with the intrinsic aspect of our physical world indicates a way to avoid the radical emergence that physicalism seems to require. Also, this union between matter and consciousness at the core of our existence implies that the causal closure of the physical world does not present a problem, as it does with dualism. Thus, Russellian monism looks very promising for those who view consciousness as fundamental in some sense.

However, Tononi and colleagues do include the notion of 'intrinsic existence' as its first axiom. They argue that "every experience exists intrinsically." They proceed to note, borrowing from Descartes, "my own experience is the only thing whose existence is immediately and absolutely evident, and it exists for myself, from my own intrinsic perspective" (Tononi et al. 2016, p.1). However, there is a tension between IIT's notion of intrinsicality and the notion of intrinsic nature characterized by Russellian monism. Within IIT, this notion of intrinsic perspective is associated with a notion of information that is defined in terms of causal relationships within a network of elements. Oizumi and colleagues state that "An experience is thus an intrinsic property of a complex of mechanisms in a state...the maximally irreducible conceptual structure specified by a complex exists intrinsically (from its own intrinsic perspective), without the need for an external observer" (Oizumi, Albantakis, and Tononi 2014, p.3). This description on the intrinsic nature of conscious experience, as existing for itself, is used to associate intrinsic existence with the ability of system's causal structure to support causal power over itself.

However, one might reject the claim that a system causally acting on itself can be the basis for its own subjective experience (Kelly 2022). We can also note that associating the phrase, 'in and of itself' with intrinsic nature has usually been interpreted to describe a property that does not depend on outside forces or relations. Another way the notion of intrinsic nature has usually been invoked is to note that

there must be some ultimate relata or basic stuff beyond the relational or structural descriptions of various objects. However, IIT employs a purely structural (mathematical) framework and invokes no notion of anything that grounds the structure. It is a structure of elements in causal relationships with each other that generates conscious experience, not an intrinsic aspect in the sense developed in Russellian monism.

Chalmers and Mørch have considered the tension between intrinsicality within IIT's framework and intrinsic nature as it is generally understood within Russellian monism (D. Chalmers, 2017; Morch, 2019). They note that IIT's exclusion postulate, which we touched on above, claims that consciousness requires maximal Φ and does not allow conscious states for smaller values of Φ within subsets of the system (or a larger system that the system of maximal phi is part of). A problem arises in the case where some change in the larger system that subsumes the conscious system increases its Φ to a new maximum, causing the subsumed system to lose consciousness. This case arguably qualifies as an external circumstance relative to the formerly conscious system, and suggests that consciousness, as defined by IIT, is inconsistent with intrinsic nature in the sense described within Russellian monism.

I wish to consider introducing an intrinsic element within IIT's framework that is consistent with how the term is used in Russellian monism. Alter and Nagasawa have recently provided a useful formulation of Russellian monism, arguing that basic properties described by physics are structural or relational (Alter and Nagasawa, 2015). They use the term *inscrutables* to characterize properties that ground the physical structure (or relations) that physics describes. That is, they define *inscrutables* as "natures that are not fully characterized by structural/relational descriptions" (p. 425). According to Alter and Nagasawa's formulation of Russellian monism, at least some inscrutables are phenomenal properties.[2] Therefore, our own experience of consciousness is grounded or based in a deeper, fundamental aspect of our world that eludes purely structural or mathematical frameworks. Thus, Russellian monism makes a clear distinction between the structural or relational aspect of the world and the intrinsic aspect that arguably provides the ground for such structure or relationships.

We can contrast what we might call this Russellian notion of intrinsicality with our earlier discussion with respect to IIT. In Russell's words: 'the aim of physics, consciously or unconsciously, has always been to discover the causal skeleton of the world' (Russell 1927, p.391). And in another work, Russell noted:

> It is not always realized how exceedingly abstract is the information that theoretical physics has to give. It lays down certain fundamental equations which enable it to deal with the logical structure of events, while leaving it completely unknown what is the intrinsic character of the events that have the structure. (Russell 1959, p.17-18)

Thus, Russellian monism argues that the structural characterizations of the world obtained from physics ultimately requires some stuff or ground that has more than just structure.

If Russellian monism is sound, then IIT is currently incomplete. Based on a solely structural framework, IIT has no intrinsic element that can provide the basis of phenomenal experience. I propose considering some sort of intrinsic element into IIT. However, if intrinsic nature is located within the inscrutable aspect of our world, outside of what physics reveals, how do we proceed to pin down its nature? It seems doubtful that we could simply introduce something relatively vague into IIT's highly abstract and formal framework. The difficulty of further characterizing intrinsic nature has led to multiple frameworks of Russelliam monism. Although it is usually associated with panpsychism and neutral monism, Alter and Nagasawa noted that some versions of Russellian monism are compatible with idealism, dualism, or even physicalism.

Constitutional panpsychism is the most common application of Russelian monism and posits that some or all subatomic particles possess a rudimentary level of consciousness.[3] Thus, the different varieties of consciousness presumably result from complex aggregates of particles which possess micro-experiences. But this leads to the combination problem: how do micro-experiences combine to yield our familiar macro-experiences? Many consider the combination problem to be a formidable issue for constitutive panpsychism.[4] Recently Mørch has considered somehow combining IIT and constitutional panpsychism, noting that IIT might offer something of an answer to the combination problem (Mørch, 2019). While she notes that the two are not currently compatible, she argues they might be if IIT is suitably modified. However, in the next section I will argue there is reason think that particles do not represent the most fundamental level of our world, and that by pursuing a deeper ontological strata, we can arguably sidestep the combination problem.

3. A Quantum Ground as the Intrinsic Aspect of Matter

I have argued that IIT cannot succeed in accounting for the hard problem because its framework is based solely on structure and lacks a real intrinsic element, which I submit would ground the

structure. With respect to the brain, we might say that we still fall short of explaining why a vast, complex network of neurons, even one that is highly integrated, yet ultimately based on physical processes, would generate consciousness. However, Russellian monism suggests that something at the very root or essence of matter may also provide the resources to support phenomenal experience.

But how do we proceed to apply Russellian monism here? Any attempt to further pin down this inscrutable aspect of the world arguably leads us to consider quantum mechanics. But quantum mechanics remains a branch of physics and therefore, as we've discussed, seems unlikely to give us insight on the inscrutable aspect of our world. And while the formalism of quantum mechanics has been highly successful, what it indicates about the ontologically deeper aspect of reality remains unclear.

Nevertheless, there is good reason to think that quantum mechanics at least points us in a worthwhile direction. Recent work on the mind-body problem has highlighted the intriguing parallel between the unified and holistic nature of consciousness and the holistic nature of entangled systems within quantum mechanics (Simon, 2019; Seager, 1995). If we hold that the paradoxical behavior of quantum mechanics is revealing something about the intrinsic nature of the world (again in a Russellian sense), we arguably have grounds to consider that something in the deeper ontology of our world provides the basis of conscious experience. That said, all we truly understand about quantum mechanics is the formalism. Answers remain murky on what, if anything, quantum mechanics tells us about the ontologically deeper nature of reality.

Schaffer has considered that the property of quantum entanglement indicates something fundamental or ontologically prior concerning the particles that constitute our world (Schaffer, 2010). That is, entanglement between particles suggests an ontologically deeper system of which they are parts. Schaffer noted that an entangled system is one whose state vector (the possible observed states) cannot be separable into smaller subsets or components of the state vector. "Thus, the quantum state of an entangled system contains information over and above that of the quantum states of its components" (Schaffer 2010, p.51). Schaffer also proceeds to argue that entanglement is a property spread throughout the universe and thus it follows that the universe as whole is the most fundamental entity. The striking similarity between Schaffer's statement and Tononi's (2008) quote (see above) appears to be consistent with our earlier conjecture that both the universe and the structure of the brain can be characterized as irreducible wholes in an informational sense.

Ismael and Schaffer developed Schaffer's argument to consider that the nonseparable correlations between entangled entities are indicative of an ontologically deeper ground (Ismael and Schaffer, 2020). On entanglement between entities, Ismael and Schaffer noted that such correlations cannot be explained by causal connections between such entities because relativity rules out instantaneous causality in spacetime. Instead, such correlated behavior between entities suggests the presence of a common source or ground--beyond our spatiotemporal order--that coordinates the probabilities of the quantum wave function that characterize possible states.

But how do we characterize this common ground underlying quantum entities, organizing or managing the probabilities of the wave function? Ismael and Schaffer describe this as a metaphysical ground, ontologically prior to the quantum system. Thus, the quantum system's particles are fragments of an ontologically deeper whole. But this reasoning also leads us toward a version of wave function realism, the position that the entanglement described by the wave function entails a "space" with an extraordinary number of dimensions (Albert 2013; North 2013; Ney 2020).[5] Thus, this most fundamental entity, inhabiting an ontologically deeper "space" outside of our more familiar spatiotemporal order, is fundamentally integrated with respect to all spatiotemporally separated entities. Of course, the "space" that this ontologically prior ground inhabits is inherently nonlocal, and therefore this fundamental ground extends throughout the universe.

Recently, Seager has considered Bohm and Hiley's (1993) preferred interpretation of quantum mechanics, which also suggests an ontologically deeper and holistic level of reality, and in turn suggests properties that extend beyond the purely structural (Seager 2018; Bohm and Hiley 1993). Like Ismael and Schaffer, Bohm and Hiley considered that that the particles which constitute our world are derivative fragments or projections of this high-dimensional entity. Borrowing arguments from Russellian monism, Seager has reasoned that Bohm and Hiley's notion of a deeper ground could be described as a domain of "intrinsic information," and noted that their view of a high-dimensional reality served as a foundation for conscious experience, however in a neutral monist sense. In Bohm's words: "...we are led to propose further that the more comprehensive, deeper, and more inward actuality is neither mind nor body but rather a yet higher-dimensional actuality, which is their common ground and which is of a nature beyond both" (p.209). Seager suggests that this framework holds promise for an understanding of how information is intrinsically organized at the world's fundamental level, and he is sympathetic to Bohm and Hiley's neutral monist characterization.[6]

I also believe that Russellian monism can be fruitfully applied to this notion of fundamental ground and is thus arguably a promising candidate for the world's intrinsic aspect. However, instead of taking a neutral direction to both matter and consciousness, I suggest that this intrinsic ground possesses phenomenal properties; that is, (borrowing a phrase from Nagel) *there is something it is like* to be the fundamental ground of the universe. Alternatively, we might consider, like Bohm and Hiley, that consciousness emerges from a neutral base. Neutral monism holds that consciousness emerges from combining protophenomenal elements. However, it is not easy to see what this most fundamental and inherently unified ground might combine with to facilitate the emergence of consciousness. Such a view, arguably, faces its own version of the hard problem. Thus, I suggest taking this ontologically prior ground as the underlying basis for conscious experience. And this, in turn, leads us toward a version of cosmopsychism, the view that the universe as a whole is conscious, and that conscious organisms (such as ourselves) are aspects of this cosmic mind.[7,8]

A second way I deviate from Ismael and Schaffer's proposal (but closer to Bohm and Hiley) is to consider how we might further characterize this entity that lives in wave function space in terms of stuff or substance. How might we describe this intrinsic aspect of the world that is the foundation of the particles that constitute our world? I submit that wave function realism, which we have invoked, points us toward the notion of potential matter, real potentiality, or potentia, proposed by Heisenberg (Heisenberg, 1958). Within the context of the orthodox interpretation of quantum mechanics, involving superpositions of possible states, Heisenberg suggested that states of the world were composed of real potentialities or tendencies. However, I suggest that the notion of quantum ground we are exploring here might obviate the need for superposed states. If this ontologically prior grounding entity truly manages the probabilities of possible states described in the wave function, it arguably possesses the resources to guide particles toward their experimental outcomes (even during moments where no measurement occurs).[9] An additional attraction of this cosmopsychist view is its ability to avoid the combination problem we mentioned earlier. However, this position faces the decombination problem, or how a relatively derivative consciousness (such as our own) arises from the more fundamental cosmic mind. I'll consider this question in the next section.

4. A Filter Version of IIT

To recap, I propose extending Ismael and Schaffer's notion of an ontologically prior and fundamentally integrated quantum ground to be the underlying base of the world's potentiality and

conscious experience. But turning back to IIT, do we have reason to think that this high-dimensional and phenomenal ground can fit into IIT's framework? If so, this leads to a very different interpretation for IIT. Rather than an explanation for consciousness itself, the resulting framework suggests a way to think of the brain as a filter or tuner that supports, depending on its structure, a particular range of conscious experiences from an ontologically deeper field of aware potentiality.

The brain as filter view has had some prominent advocates, particularly near the beginning of the twentieth century. William James, for example, characterized the brain as possessing a transmissive function and compared it to a lens or prism that limits rays sourced from a "super-solar" source (James, 1899). Henri Bergson also presented something like a filter model and suggested that the human brain might be compared to a radio receiver capable of tuning to a variety of different "channels" (Bergson, 1968). Kelly has recently provided an overview of such proposals, but emphasizes F.W.H. Myers's filter model, especially in the context of anomalous cognition (Kelly and Kelly, 2007). In later work, Kelly and Peti suggest other findings in brain research consistent with viewing the brain as a filter, such as evidence that deterioration in some regions of the brain lead to enhanced artistic abilities (Kelly and Presti, 2015).

Of course, seeing the brain as a filter or tuner in some sense requires a radical change in our thinking. One question that arises is how we might identify areas of the brain that function as a filter, rather more conventional tasks (arguably related to the "easy" problems). Later, I'll make a preliminary attempt to address this question. But for now, I suggest we attempt to continue to explore supplementing IIT's framework to nudge ourselves into this challenging area.

I'll proceed with attempting to incorporate IIT within a more neutral framework along the lines suggested by McQueen (McQueen, 2019). This more neutral version of IIT would retain key features of IIT, such its metric for consciousness, Φ, and its framework (Q-shape) for analyzing the qualitative character of the system's experience, while stripping it of controversial philosophical assumptions. According to McQueen, a neutral version of IIT must (1) retain the mathematical content of the theory and (2) maintain a clear set of predictions that correlate information to observable symptoms of consciousness.

Around such a neutral version of IIT, I propose introducing the fundamental entity inhabiting wave function space as an appropriate intrinsic element. However, I also wish to avoid adding any further formal or mathematical structure. I believe this is justified due to the inherently holistic nature of this ontologically prior ground, which inhabits an ontologically deeper "space" relative to the 3-

dimensional space of the brain's system of neurons. I also wish to argue that the quantum ground as intrinsic element is fundamentally integrated and thus has the appropriate resources to serve as ground to the brain's structure. Thus, I have taken McQueen's notion of a neutral IIT and introduced (without additional mathematics) a notion of a quantum ground version of an intrinsic element. However, this requires interpreting the IIT framework in a way that suggests the brain acting as a filter on the more fundamental source of consciousness. For this approach of interpreting IIT as a filter with respect to a deeper source of consciousness, I suggest the acronym FIIT (Filter Integrated Information Theory).

The fact that this quantum ground is fundamentally integrated and the base of phenomenal experience (according to the reasoning developed here) makes it an attractive candidate for providing an intrinsic element to ground IIT. By intrinsic I mean an inscrutable part of the world that possesses more than what can be described in structural terms and yet has the capacity to ground the world's structural aspects. This might become clearer as we consider IIT's Q-shape, which is used to characterize the qualities of an experience within IIT's framework. IIT's Q-shape, in its attempt to capture the way an experience joins a wide variety of qualities in a seamless, holistic way, requires a very high number of dimensions in probability space. We can note the high-dimensional space of IIT's Q shape, while very high, does not approach the number of dimensions required by wave function realism. However there remains a sense that these two things that require very large dimensional size in probability space make an intriguing fit. The fact that the dimensional size of the quantum ground, which I've argued is the base of phenomenal experience, theoretically exceeds by orders of magnitude the dimensional size of IIT's qualia space suggests that this entity possesses more than sufficient resources for the system of elements (neurons) it is grounding.

To be clear, I'm not suggesting we can join IIT's Qualia space with the sort of high-dimensional ground in wave function space in a straightforward way. IIT's Q space, while within a high-dimensional probability space, is a framework that invokes a highly complex structure of causal relationships, as it is the case with IIT's entire framework. On the other hand, our familiar sense of causal structure is not available in wave function space, which remains outside our spatiotemporal order. But while the details are perhaps far from being worked out, I suggest the fact that these two different spaces require high-dimensional probability spaces strengthens our reasoning toward linking our inherently holistic and unified experiences of consciousness with the inherently holistic and unified common ground of wave function space.

Arguably, intuition suggests that the highly integrated aspects of the brain are more intimately linked with the fundamentally integrated quantum ground as the source of phenomenal experience. However, conscious experience involves specific qualities associated with an organism, its memory, and its environment. The brain's system of neurons of course is intimately connected to systems involving perceptions, memory, and behavior, which we earlier noted are likely associated with functions or mechanisms within the brain. These sorts of processes are necessary to support the kind of experiences we have in our environment, situated in our spatiotemporal frame. However, to have these conscious experiences, the brain must also be intimately linked with something else, which according to the reasoning developed here, is an ontologically prior, intrinsic aspect of reality. Thus, the brain's system must support functional and mechanistic processing as it also interacts with this deeper field of mind. The relatively highly integrated areas in our brain likely play a crucial role in facilitating our connection with this deeper ground of phenomenal experience. We might say that the brain *integrates* the perceptual inputs from our environment with the capacity to experience them. Thus, this proposed FIIT framework points us toward understanding the brain as a filter interacting with a deeper source of phenomenal experience.

We can note that a sophisticated computer, equipped with audio and visual sensors and accessing memory, also monitors its environment, but we have no basis for thinking such a system is conscious. I argue that there nothing it is like to be a computer, no matter how sophisticated. Without access to a fundamental source of phenomenal experience, the computer performs its functions with the lights out.

Within this view, the various kinds of conscious experience (some of which we have familiarity) are derivative from a fundamentally deeper cosmic mind. And reasoning suggests that the phenomenal properties of these less fundamental conscious states depend on an organism's biological structure, particularly the brain. Of course, this link between the brain and an ontologically prior phenomenal ground requires more understanding of quantum biology than what we currently have on hand. We might conjecture that biological systems have properties that allow a sort of extraction of experience from the deeper phenomenal base of aware potentiality. From the property of quantum contextuality, we can note quantum systems are extremely sensitive to the physical configuration of the given system. Perhaps physical configurations we characterize as biological interact with the underlying quantum (phenomenal) ground in a way that supports experience. As it happens, the emerging field of

quantum biology has identified quantum properties in a growing number of biological processes (Marais et al., 2018). And linking the brain with quantum processes is very much an ongoing project.

Microtubules represent an especially interesting direction for exploring how the brain might be linked with quantum processes. They appear to be at the center of a number of processes which can be expected to be involved with consciousness; these include axoplasmic transport, signaling, neuronal plasticity, and providing a mechanism for anesthesia (Tuszynski and Woolf, 2006). Hameroff has argued that microtubules possess the right properties for quantum coherence across the brain, which suggests the kind of quantum computing that supports a unified experience (Hameroff, 1994). Hameroff has worked with the physicist Roger Penrose to develop their Orch OR theory of quantum computation within the brain (Hameroff and Penrose, 2014). However, the Orch OR theory utilizes an "objective collapse" interpretation of quantum mechanics that differs substantially from what I have discussed.[10] But alternatively, more neutral interpretations linking the brain's microtubules with quantum processes are also being developed (Woolf, 2006; Edwards, 2020).

5. Empirical Implications

I propose in this paper supplementing IIT's framework with a particular notion of an intrinsic element that we have reason to believe corresponds with the most fundamental entity of our world, but also happens to provide something of a fit with IIT. And I believe that this modified version of IIT (FIIT) has the resources to address the hard problem of consciousness. But generally, various frameworks for addressing the problem of consciousness (perhaps invoking some form of panpsychism or dualism) focus on metaphysical properties that cannot be evaluated objectively. In addition to addressing the hard problem, I wish to consider here ways that my proposal might impact our understanding of current research in neuroscience. In his recent critical assessment of IIT, Kelly (2022) noted ways its framework falls short in some areas of brain research associated with psychedelics and meditation, as well as anomalous cognition and mind-matter interaction. I'll take these up next and argue that a brain as filter approach does a better job of explaining empirical findings in these areas.

5.1. Psychedelic research

Recently, advances in brain imaging technology such as fMRI have led to some interesting, perhaps surprising, results concerning the effects of psychedelics on brain processes. An especially key finding is that the overall activity within the brain under the influence of psychedelics, such as LSD and

psylocibin, falls substantially. This raises the question on how we can account for the remarkable and diverse phenomenal experiences reported during such episodes. Such experiences include perceptions with unusually vivid colors, complex geometries, and a higher resolution experience of the external world. Other types of experiences include more intense emotions, as well as a broader range of access to emotions., and heightened sensitivity to external stimuli such as music (Swanson 2018). Further, some argue that ego dissolution, feelings of oneness, and deep connection are common, if not the defining characteristics of psychedelic experiences (Swanson 2018; Lebedev et al. 2015; R. L. Carhart-Harris et al. 2018). Christof Koch, a collaborator of Tononi, described his astonishment at the contrast of reduced brain activity, including blood flow, with the diverse range of extraordinary experiences associated with psychedelics. He notes:

> What is intriguing is that the regions that show the strongest reduction in activity are among the most heavily interconnected in the brain. They act like traffic circles or hubs that link disparate regions. Thus, the brain on psilocybin becomes more disconnected, more fragmented...Yet why this state should cause the mind-expanding effects that are the prime reason these drugs are treasured are unclear (Koch, 2012).

Thus, one of the primary architects of IIT confronts the problem of why reduced activity and disconnection in key areas of the brain due to psylocibin leads to such vivid experiences, some of which have been found to have substantial therapeutic value.

Strong reduction in the brain's activity has been confirmed, especially in the region termed the default mode network (Robin L Carhart-Harris et al., 2012). The default mode network (DMN) is a large-scale network within the brain that includes the ventral medial prefrontal cortices, the medial temporal lobe, the precuneus, and the posterior cingulate gyrus (Greicius et al. 2003; Raichle et al. 2001). This network has been found to support emotional processing, self-referential mental activity, and recollection of prior experiences (Raichle 2015). DMN activation has also been found to be higher during talks involving self-projection (Buckner and Carroll 2007) as well as when reading stories containing first person pronouns.(Decety et al. 2002; Kjaer, Nowak, and Lou 2002). Based on these and other interesting findings, it is widely considered that the DMN maintains the mind's background mind-wandering when it is not engaged on a particular activity; these various processes are also associated with maintaining an overall sense of self or ego. We can also note with interest that the cortices within the DMN are highly integrated in the sense defined by IIT.

Carhart-Harris and colleagues have explored this association of lower DMN activity with vivid experiences during psychedelic influence and have advocated the view that the DMN functions as a filter. Within a physicalist and evolutionary context, they see its role as a restrictive filter that facilitates the management of sensory input, memory, emotions, actions, and a sense of self (Robin L. Carhart-Harris et al., 2014). They propose an "entropic brain model" within which the DMN's limiting function may be excessively restrictive and narrow in some cases compared with what might be described as more creative or open-minded thinking. Psychedelics are suggested to assist in counteracting such narrow or restrictive tendencies, allowing exploration of more novel neural pathways, arguably characterized as "entropic" or pathways with less predictable nature. This in turn might open options for constructive or healthy thinking. Other approaches have invoked a similar notion of the brain regulating against unnecessary information in a way that serves the interests of the organism, while possibly becoming excessively restrictive or rigid (Swanson, 2018). With this framework in mind, advocates suggest that psychedelics can be used therapeutically to widen our inner lens in a healthy way.

Of course, the entropic brain model and similar approaches rely on physicalist assumptions and are not concerned with the hard problem of how phenomenal experience arises in a physical brain. Thus, their notion of filter does not go so far as positing an ontologically deeper source of phenomenal consciousness. But perhaps we might question whether the notion of entropy, usually associated with randomness, uncertainty, or noise, is an adequate characterization for experiences involving intense emotions of meaning and connectedness, that for many participants are profound, life-changing events (Pollan, 2019). A large study that attempted to characterize such "mystical" states of psylocibin noted reports of sacredness, unity, and transcendence of time and space (MacLean et al. 2012). While such experiences are truly novel *relative to the more familiar and typical experiences available without being under the influence of psychedelics*, they nevertheless appear to be relatively common among those participating in high dosage therapeutic sessions.

Perhaps, in the brain's functioning to filter out some categories of information, it reduces access to what we might characterize as a genuinely deeper reservoir of creativity, meaning, or connectedness. Consider this well-known quote from Huxley on his experiences with mescaline:

> To be shaken out of the ruts of ordinary perception, to be shown for a few timeless hours the outer and the inner world, not as they appear to an animal obsessed with survival or to a human being obsessed with words and notions, but as they are apprehended,

> directly and unconditionally, by Mind at Large---this is an experience of inestimable value to everyone and especially to the intellectual (Huxley, 1954).

Here, Huxley's experience suggests something like a filter model of the brain against a deeper level of consciousness. In a letter to Oxmond (who coined the term psychedelic) Huxley described a brain as filter approach (which he borrowed from Bergson) as a "utilitarian device for limiting, and making selections from, the enormous possible world of consciousness, and for canalizing experience into biologically profitable channels..."(Swanson 2018). Such an interpretation is congruent with the class of filter models touched on above, all of which invoke some notion of a deeper source of consciousness, or what Huxley referred to as "Mind at Large."

I suggest that the version of brain as filter I've been exploring here has resources to better understand such intensely profound and meaningful experiences. But that said, I am not sure my preferred interpretation is without challenge. Earlier, I speculated that the highly integrated areas of the brain (which advocates of IIT claim are strongly linked with consciousness) are more likely connected with the far more integrated quantum ground. However, these highly integrated areas are key components in the default mode network which are believed to play a key role maintaining the ego, self, or sense of separation. Is there a contradiction that needs to be reconciled?

I'll attempt here to sketch out a possible resolution. Let's first accept the observation from Tononi and others that highly integrated areas of the brain are more important or more strongly associated with conscious experience (without necessarily accepting all IIT's core assumptions). We can also note that the current literature indicates that psylocibin, LSD, and other psychedelics lower the activity of the DMN and thus block the neural pathways associated with habitual tendences, identity, and narratives involving the self. The DMN is highly integrated because of its intimate connection, by necessity, with the highly interconnected portions of the brain most associated with consciousness. Thus, some (but not all) highly integrated portions of the brain become less active. As a result, awareness explores novel pathways that likely include what I've suggested as the deeper source of all conscious experience. Therefore, we might consider a different way of interpretating reports of profound meaning and deeper connection. Thus, reducing activity in some highly integrated areas of the brain may be leading to experiences of a deeper level of highly integrated consciousness.[11]

Also, research has found that psilocybin disrupts the organization of neural integration, and yet somehow produces an overall effect of increasing the degree of integration in the neural system

(Gallimore 2015). Perhaps such an increase in connectivity across a wide range of the brain's function and regions should raise IIT's metric Φ; *yet this increased interconnectivity was achieved through durations of reduced brain activity and disorganization*, especially in areas associated with default operation. Is this consistent with IIT? Some caution is warranted in considering how psychedelic episodes affect the metric Φ. The overall effect might be unclear given a reduction of some aspects of cognition under such episodes, while overall integration is increased (Gallimore 2015). Further, incorporating a high-dimensional, highly integrated ground along the lines I suggest into the calculation of Φ is arguably not possible. Perhaps we might view Φ as a lowball estimate of conscious experience if cases of deeply meaningful or profound states of experience are associated with deeper source or ground of consciousness.

The finding of increased interconnectivity across a wide range of the brain's functions is nevertheless something interesting to consider. Perhaps one might argue that the chemical activity of the agent itself simply induces this kind of change in the brain's neural structure. But alternatively, conscious experiences that more directly access a highly integrated, deeper field of consciousness perhaps leads the system (due to its neuroplastic nature) toward greater neural connection across a wide range of the brain's functions and regions. This remains speculative, but the extended framework developed here makes available such an interpretation. However, consciousness directly influencing the physical structure of the brain requires a different way of thinking about the direction of causality from more conventional understanding.

5.2. Meditation Research

Recent research has also revealed changes in the brain's neural structure due to meditation, especially for long-term practitioners. Changes in brain structure associated with meditation include increases in gray matter concentration in the regions of the brain involved in emotional regulation and self-referential processing (Hölzel et al., 2011). Additional reports include linking long-term meditation with neurophysiological dissociability (Fox et al., 2016). But an especially intriguing area that overlaps with the findings on psychedelics is the evidence that practices of meditation weakened the default mode network (DMN). Long-term meditation appears to weaken the connections involving the DMN, and additional research shows changes in brain structure that inhibit the default areas or habitual associations within the mind.(Goleman and Davidson, 2017).

Of course, the term 'meditation' is arguably too broad to refer to the range of different contemplative practices that differ in various ways. Perhaps the use of such an umbrella term can be defended by noting "there is a common purpose between all practices: to decrease psychological suffering through regulatory (e.g. attentional, emotional, proprioceptive, and interoceptive) processes"(Cooper, Ventura, and Northoff, 2022). A recent survey of the literature suggests attenuation in the functioning of the DMN brain regions associated with mindfulness meditation and mantra recitation. Thus, decreases of activity in key nodes of the DMN appears to be a finding with respect to meditation techniques that focus attention on the breath, a mantra, or another target.

But the question of causality we touched on above with psychedelics appears here with meditation also. The empirical research on meditation suggests that some classes of mental techniques used to direct attention away from the mind's habitual tendencies and toward the breath, a mantra, etc. reduce the activity of the DMN, which involves self-reflection, supporting a sense of self (ego), and maintaining narrative cognitive processes. Directing the mind to deviate from habitual tendencies of mind wandering and self-narratives, appears in the long-term to lead to changes in neural structure. But such changes in the brain's structure along these lines suggests (as noted previously) an interpretation supporting mental causation. Unlike the case with psychedelics, no strong chemical agents are interacting with the brain. Can IIT, where the brain's structure plays such a crucial role in explaining consciousness, account for findings that suggest mental practices such as meditation can in the long-term lead to changes in brain structure?

Interpreting the causal link as running from mental choices or practices to changes in neural structure (especially for long-term meditators) is arguably more straightforward than the alternative reverse direction. However, such reasoning, if correct, presents a problem for IIT (not to mention physicalist orientations generally). But the notion that conscious attention affects the brain's structure is consistent with a view that consciousness is in some sense fundamental. Thus, this reasoning suggests considering an approach which includes the notion of an intrinsic aspect that we have reason to think provides the base of our conscious experience (and arguably our ability to make choices).

Further, FIIT provides a preferable framework for understanding the notion of "non-dual awareness," the long-term aim for many meditation practices (Josipovic, 2010). Various background teachings associated with contemplative practices describe an experience of ego dissolution, which in the long-term leads to non-dual awareness, where the distinction between the experiencer and the objects of experience are found to be insubstantial or illusory (Josipovic 2010; Dunne 2011). Arguably,

the core teachings from Buddhist and Hindu traditions involve relinquishing the hold of the ego or self-involved mind to ultimately arrive at non-dual awareness.[12] (MacKenzie 2016; Kuznetsova, Ganeri, and Ram-Prasad, 2016) I suggest that such views fit well with the framework explored here, where the intrinsic aspect of the world is a fundamentally unified ground of consciousness. Through such an interpretation, an individual experiencing non-dual awareness would (presumably) be recognizing his individual experience as an aspect of a deeper source of awareness.

As was the case for at least some psychedelics, evidence has accumulated showing greater integration between the DMN and various other brain regions in long-term mindfulness meditators.(Kilpatrick et al., 2011; Berkovich-Ohana et al., 2016; Brewer et al., 2011) Perhaps this supports my conjecture that the greater overall degree of integration resulted from increased access to what I believe is the more integrated nature of the ground level of consciousness.

5.3. Evidence of Anomalous Mind-Matter Interaction

As noted above, the nonlocal nature of the ground under discussion, as the (Russellian) intrinsic aspect of the world, leads to a class of cosmopsychism, the view that all conscious experience is derivative from the consciousness of the universe as a whole. While some philosophers of mind find variations of this view attractive (perhaps for its ability to avoid the combination problem), others may find it a hard pill to swallow. However, an important point in favor of this nonlocal ground of aware potentiality is its capacity to address a growing literature on anomalous cognition, as well as mind-matter perturbation.

Recently Cardeña (2018) has summarized the extant meta-analysis on anomalous cognition experiments, as well as others termed anomalous perturbation. With respect to the latter, Cardeña summarizes the evidence that mental intention can influence random streams of 1's and 0's (produced by quantum processes) (Bösch, Steinkamp, and Boller, 2006). I submit that my proposed supplementation of IIT with a notion of a quantum ground of aware potentiality, has the capacity to address these findings.[13] Thus, FIIT as proposed, with its ontologically deeper source of conscious experience, possesses the resources to support mental intention influencing the field of potentialities fundamental to quantum processes. This requires both 1) a notion of true mental causation or free agency, and 2) that our conscious experience has roots in an ontologically deeper ground of aware potentiality.

Two additional research projects of interest on anomalous mind-matter perturbation are in relatively early development and were not included in Cardeña's survey. In one case, mind-matter influence on random number outputs was tested within the context of Bergson's brain as filter argument. Researchers have found significant mind-matter influence in participants that had some damage in their left medial middle frontal portion of the brain. The results were consistent with a view of the brain acting as a filter, inhibiting psi (Freedman et al., 2018). Recently, this finding was confirmed in another study that employed a technique of temporarily inducing brain lesions in those areas of the cortex thought to be psi inhibiting (Freedman et al., 2023).

Recently another experimental protocol has been developed to explore the influence of mental focus on quantum processes. Building on previous work(Ibison and Jeffers 1998), Radin and colleagues have explored the influence of mental intention within the context of the quantum double-slit experiment, including some variations (Radin et al., 2012). In the textbook quantum mechanical experiment, photons are fired through a barrier with two slits, resulting in a fringe pattern that is associated with wavelike behavior. As is well-known, blocking one of the slits results in more particle-like behavior, as the resulting particles hit the plate detector around a singular target. Radin and colleagues explored a number of variations investigating the effects of focused attention in the double slit experiment; however, the basic setup involved participants being asked to focus their attention in the direction of the experimental setup and imagine (or attempt to mentally influence) the photons striking a target.[14] Overall, significant effects have been reported by three different research teams, with twenty-nine experiments having been conducted and eleven yielding significant results, generating a cumulative binomial probability $P<10^{-7}$ (Radin et al., 2020; Milojević and Elliott, 2023).

Radin and his colleagues have invoked the "consciousness collapses the wave function" interpretation of quantum mechanics to explain the results. They find that focused attention results in greater concentration in the diffraction pattern, which they interpret to support the view, associated with Von-Neumann and Wigner, that consciousness collapses the superposed wave function into the experimental outcomes. However, I suggest the results are also consistent with an alternative interpretation: that focused attention by the experiment's participants influences the system's wave function *as a whole* (altering the Born probabilities) and thus leading to a more concentrated diffraction pattern. That is, the participant's focused intention toward hitting the center of the target could influence wave function probabilities such that the likelihood of hitting the center is increased, thus narrowing the diffraction pattern.

In addition, stronger effects were found when the participants are long-term meditators (Radin et al., 2012). Earlier discussion cited evidence that the default control networks for long-term meditators is weakened, likely indicating greater capacity for focused attention (as opposed to habitual mind-wandering and story making around the self). But despite weakening of DMN control, I speculated that the brain structure of long-term meditators would show greater integration across different brain functions, which I reasoned would foster greater access with the more fundamentally integrated level of consciousness. We might take things a step further and conjecture that a higher degree of integration across wide regions of the brain, increasing its capacity to access the more fundamental source of consciousness, strengthens the likelihood that meditators can influence the underlying field of potentiality. This arguably can be tested in future anomalous perturbation experiments.

6. Conclusion

Following the reasoning that structural explanations are not sufficient to explain conscious experience, I have attempted to supplement IIT's structural framework with an intrinsic aspect that possesses more than purely structural properties and thus provides a suitable ground for the structure. Through adding this fundamentally integrated ground inhabiting wave function space as the base of phenomenal experience, I aim to provide an alternative interpretation (FIIT) where we consider the brain as a filter or tuner rather than a generator of conscious experience. Of course, much work remains to be done. Future work must make progress toward pinning down the quantum processes that link our individual conscious experiences with what I've proposed as an ontologically deeper ground of aware potentiality.

However, despite its limitations, I suggest that IIT provides a valuable contribution in its linking conscious experience with integrated information. While I don't believe that IIT has the resources to completely solve the problem of consciousness, it arguably directs our attention in a helpful direction. That is, its emphasis on integrated information suggests something about the property of an appropriate intrinsic element that might fit within its structure. And this suggests reason to consider the ontologically prior quantum ground as an attractive candidate for the right intrinsic element.

I suggest that this alternative framework, in addition to addressing the hard problem of consciousness, offers some interesting ways of interpreting recent data on brain research. As I've discussed, the brain imaging on psychedelic research that show reduced brain activity in the presence of vivid experiences under the influence of psychedelics is better understood in the context of a

framework that provides a place for a more fundamental field or ground of consciousness. The introduction of a nonseparable quantum ground as the source of conscious experiences likely provides a better fit for first person accounts during meditation or psychedelic episodes that describe deep and profound connection with the world. I also suggest that this interpretation offers a more natural explanation of increased integration across diverse functions and regions of the brain during episodes of strong psychedelic influence as well as advanced meditators. In addition, such a framework accommodates the data on anomalous cognition and mind-matter perturbation and suggests why advanced meditators are likely to have greater success in such experiments.

Footnotes

[1] Koch and other advocates of IIT have suggested that some notion of panpsychism—that the constituents of matter are sentient—may be required to make IIT work. However, this argument does not appear in the IIT's fundamental axioms or postulates that provide the basis for its framework. It appears to be an addition with little motivation, justification, or integration with the rest of IIT's framework.

[2] Alter and Nagasawa also consider that inscrutables may be protophenomenal properties, which require other conditions or properties to instantiate consciousness (D. J. Chalmers, 1997). I will not take up the possibility of protophenomenal properties here.

[3] For a recent collection of papers that explored the attractions and problems of panpsychism, see (D. J. Chalmers, Brüntrup, and Jaskolla 2017).

[4] Seager discussed the problem and coined the term *combination problem*.(Seager 1995) However, William James recognized the problem earlier and characterized it vividly (Schmidgen 2000). For a recent overview, see (D. J. Chalmers 2017).

[5] Some conceptions of wave function space require a dimension of 3 x N, where N is the number of particles in the universe. However, if particles are not fundamental, as some advocates of quantum field theory argue, then the dimensional size could arguably be infinite (Ney, 2013).

[6] However, colleagues of Bohm have also considered that this more fundamental ground possessed a rudimentary degree of sentience (Hiley and Pylkkänen, 2005).

[7] There have been a number of recent contributions on cosmopsychism (Goff, 2017; Nagasawa and Wager, 2017; Shani, 2015; Shani and Keppler, 2018). Most of these are indebted to Schaffer's (2010)

work proposing that the cosmos is the one truly fundamental and whole object, and thus ontologically prior to all of the more derivative objects within the universe. Much of this work does not attempt to link theories of cosmopsychism with quantum mechanics, with the exception of Shani and Keppler (2018).

[8] The case that this ground contains only mental properties also yields a version of cosmic idealism (Chalmers, 2020). I retain here the label cosmopsychism for the case that this ground may contain both mental and non-mental properties.

[9]This parallels the argument from Bohm and Hiley that active information within a high-dimensional quantum ground acts as a hidden factor that guides variables to the positions or states eventually observed (Bohm and Hiley, 1993). However, their argument was not linked with Russellian monism. In previous work, I have provided more discussion on the distinctions between the notion of the quantum ground developed here and other interpretations, such as Bohm and Hiley (1993) as well as more orthodox interpretations (Williams, 2021).

[10] In Hameroff and Penrose's theory, the brain's microtubules sustain coherent superposition of quantum states, and consciousness results through a gravitation-induced collapse of these states. As I've discussed, my preferred interpretation is closer to Bohm and Hiley's notion of an underlying quantum ground that possesses phenomenal properties.

[11] The physicist David Bohm described his own view of an ontologically deeper ground as possessing intrinsic meaning and an implicate order.(Bohm 1980)

[12]In a recent translation of the Bhagavad Gita, the commenter expresses the point concisely by affirming that meditation is "the direct means of becoming integrated, united with one's truest, deepest Self." (Easwaran and Morrison, 2007)

[13] In previous work, I've explored how linking a Russellian view of the world's intrinsic aspect with the notion of a quantum ground can address these empirical findings on anomalous cognition and mind-matter perturbation summarized by Cardeña (Williams 2021).

[14] The protocol also allowed participants visual feedback on the resulting diffraction pattern.

References

- Aaronson, S. 2014. 'Why I Am Not an Integrated Information Theorist (or, the Unconscious Expander)'. Www.Scottaaronson.Com/Blog. 30 May 2014.
- Albert, David Z. 2013. 'Wave Function Realism'. In *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*, edited by Allysa Neye and David Z. Albert, 52–57. New York: Oxford University Press.
- Alter, Torin, and Yujin Nagasawa. 2015. 'What Is Russellian Monism?' In *Consciousness in the Physical World*, 422–51. New York.
- Balduzzi, David, and Giulio Tononi. 2009. 'Qualia: The Geometry of Integrated Information'. *PLoS Computational Biology* 5 (8). https://doi.org/10.1371/journal.pcbi.1000462
- Bergson, Henri. 1968. 'The Creative Mind. Translated by Mabelle L. Andison.--'.
- Berkovich-Ohana, Aviva, Michal Harel, Avital Hahamy, Amos Arieli, and Rafael Malach. 2016. 'Alterations in Task-Induced Activity and Resting-State Fluctuations in Visual and DMN Areas Revealed in Long-Term Meditators'. *NeuroImage* 135: 125–34.
- Bohm, David. 1980. *The Implicate Order*. London: Routledge.
- Bohm, David, and Basil J. Hiley. 1993. *The Undivided Universe: An Ontological Interpretation of Quantum Theory*. London: Routledge.
- Bösch, Holger, Fiona Steinkamp, and Emil Boller. 2006. 'Examining Psychokinesis: The Interaction of Human Intention with Random Number Generators- A Meta-Analysis'. *Psychological Bulletin* 132 (4): 497–523. https://doi.org/10.1037/0033-2909.132.4.497
- Brewer, Judson A, Patrick D Worhunsky, Jeremy R Gray, Yi-Yuan Tang, Jochen Weber, and Hedy Kober. 2011. 'Meditation Experience Is Associated with Differences in Default Mode Network Activity and Connectivity'. *Proceedings of the National Academy of Sciences* 108 (50): 20254–59.
- Buckner, Randy L, and Daniel C Carroll. 2007. 'Self-Projection and the Brain'. *Trends in Cognitive Sciences* 11 (2): 49–57.
- Carhart-Harris, R. L., D. Erritzoe, E. Haijen, M. Kaelen, and R. Watts. 2018. 'Psychedelics and Connectedness'. *Psychopharmacology*. Springer Verlag. https://doi.org/10.1007/s00213-017-4701-y
- Carhart-Harris, Robin L, David Erritzoe, Tim Williams, James M Stone, Laurence J Reed, Alessandro Colasanti, Robin J Tyacke, Robert Leech, Andrea L Malizia, and Kevin Murphy. 2012. 'Neural Correlates of the Psychedelic State as Determined by FMRI Studies with Psilocybin'. *Proceedings of the National Academy of Sciences* 109 (6): 2138–43.

- Carhart-Harris, Robin L., Robert Leech, Peter J. Hellyer, Murray Shanahan, Amanda Feilding, Enzo Tagliazucchi, Dante R. Chialvo, and David Nutt. 2014. 'The Entropic Brain: A Theory of Conscious States Informed by Neuroimaging Research with Psychedelic Drugs'. *Frontiers in Human Neuroscience* 8 (1 FEB). https://doi.org/10.3389/fnhum.2014.00020
- Chalmers, David. 2017. 'The Combination Problem for Panpsychism'. In *Panpsychism: Contemporary Perspectives*, edited by G. Bruntrup and L. Jaskolla, 179–214. Oxford: Oxford University Press.
- ———. 2020. 'Idealism and the Mind-Body Problem'. In *The Routledge Handbook of Panpsychism*, edited by William Seager, 353–73. London: Routledge.
- Chalmers, David J. 1997. *The Conscious Mind: In Search of a Fundamental Theory*. Oxford University Press.
- ———. 2003. 'Consciousness and Its Place in Nature'. *The Blackwell Guide to Philosophy of Mind*, 102–42.
- ———. 2017. 'The Combination Problem for Panpsychism'. *Panpsychism: Contemporary Perspectives* 179: 214.
- Chalmers, David J, G Brüntrup, and L Jaskolla. 2017. 'Panpsychism: Contemporary Perspectives'. *Panpsychism: Contemporary Perspectives*, 19–47.
- Cooper, Austin Clinton, Bianca Ventura, and Georg Northoff. 2022. 'Beyond the Veil of Duality-Topographic Reorganization Model of Meditation'. http://orcid.org/0000-0003-2574-8958§GeorgNorthoff, http://orcid.org/0000-0002-5236-0951
- Decety, Jean, Thierry Chaminade, Julie Grèzes, and Andrew N Meltzoff. 2002. 'A PET Exploration of the Neural Mechanisms Involved in Reciprocal Imitation'. *Neuroimage* 15 (1): 265–72.
- Dunne, John. 2011. 'Toward an Understanding of Non-Dual Mindfulness'. *Contemporary Buddhism* 12 (1): 71–88.
- Easwaran, Eknath, and Diane Morrison. 2007. *The Bhagavad Gita*. Nilgiri Press.
- Edwards, Jonathan C W. 2020. 'Quantum-Level Experience in Neural Dendrites An Interpretation-Neutral Model'. *Journal of Consciousness Studies*. Vol. 27.
- Fox, Kieran C.R., Matthew L. Dixon, Savannah Nijeboer, Manesh Girn, James L. Floman, Michael Lifshitz, Melissa Ellamil, Peter Sedlmeier, and Kalina Christoff. 2016. 'Functional Neuroanatomy of Meditation: A Review and Meta-Analysis of 78 Functional Neuroimaging Investigations'. *Neuroscience and Biobehavioral Reviews*. Elsevier Ltd. https://doi.org/10.1016/j.neubiorev.2016.03.021

- Freedman, Morris, Malcolm Binns, Fuqiang Gao, Melissa Holmes, Austyn Roseborough, Stephen Strother, Antonino Vallesi, et al. 2018. 'Mind–Matter Interactions and the Frontal Lobes of the Brain: A Novel Neurobiological Model of Psi Inhibition'. *Explore* 14 (1): 76–85. https://doi.org/10.1016/j.explore.2017.08.003
- Freedman, Morris, Malcolm Binns, Jed Meltzer, Rohila Hashimi, Robert Chen, 2023. 'Enhanced Mind-Matter Interactions Following rTMS Induced Frontal Lobe Inhibition'. *Cortex*, *In Press*. https://doi.org/10.1016/j.cortex.2023.10.016
- Gallimore, Andrew R. 2015. 'Restructuring Consciousness -The Psychedelic State in Light of Integrated Information Theory'. *Frontiers in Human Neuroscience* 9 (June). https://doi.org/10.3389/fnhum.2015.00346
- Goff, Philip. 2017. *Consciousness and Fundamental Reality*. Oxford University Press.
- Goleman, Daniel, and Richard J. Davidson. 2017. *Altered Traits: Science Reveals How Meditation Changes Your Mind, Brain, and Body*. Avery Publishing.
- Greicius, Michael D, Ben Krasnow, Allan L Reiss, and Vinod Menon. 2003. 'Functional Connectivity in the Resting Brain: A Network Analysis of the Default Mode Hypothesis'. *Proceedings of the National Academy of Sciences* 100 (1): 253–58.
- Hameroff, Stuart, and Roger Penrose. 2014. 'Consciousness in the Universe: A Review of the ''Orch OR'' Theory'. *Physics of Life Reviews*. https://doi.org/10.1016/j.plrev.2013.08.002
- Hameroff, Stuart R. 1994. 'Quantum Coherence in Microtubles: A Neural Basis for Emergent Consciousness?' *Journal of Consciousness Studies* 1 (1): 91–118.
- Heisenberg, Werner. 1958. 'Physics and Philosophy: The Revolution in Modern Science'.
- Hiley, Basil J, and Paavo Pylkkänen. 2005. 'Can Mind Affect Matter Via Active Information?' *Imprint Academic Mind & Matter*. Vol. 3.
- Hölzel, Britta K., James Carmody, Mark Vangel, Christina Congleton, Sita M. Yerramsetti, Tim Gard, and Sara W. Lazar. 2011. 'Mindfulness Practice Leads to Increases in Regional Brain Gray Matter Density'. *Psychiatry Research - Neuroimaging* 191 (1): 36–43. https://doi.org/10.1016/j.pscychresns.2010.08.006
- Huxley, Aldous. 1954. *The Doors of Perception and Heaven and Hell*. London: Chatto and Windus.
- Ibison, Michael, and Stanley Jeffers. 1998. 'A Double-Slit Diffraction Experiment to Investigate Claims of Consciousness-Related Anomalies'. *Journal of Scientific Exploration* 12 (4): 543–50.
- Ismael, Jenann, and Jonathan Schaffer. 2020. 'Quantum Holism: Nonseparability as Common Ground'. *Synthese* 197: 4131–60.

- James, William. 1899. *Human Immortality: Two Supposed Objections to the Doctrine*. Archibald Constable.
- Josipovic, Zoran. 2010. 'Duality and Nonduality in Meditation Research'. *Consciousness and Cognition* 19 (4): 1119–21.
- Kelly, Edward F. 2022. 'Some Conceptual and Empirical Shortcomings of IIT'. *Journal of Anomalous Experience and Cognition* 2 (2): 223–63. https://doi.org/10.31156/jaex.24123
- Kelly, Edward F, and Emily Williams Kelly. 2007. *Irreducible Mind: Toward a Psychology for the 21st Century*. Rowman & Littlefield.
- Kelly, Edward F., and David E. Presti. 2015. 'A Psychobiological Perspective on "Transmission Models"'. In *Beyond Physicalism: Toward Reconciliation of Science and Spirit*, edited by Edward F. Kelly, Adam Crabtree, and Paul Marshall. Lanham: Rowan & Littlefield.
- Kilpatrick, Lisa A, Brandall Y Suyenobu, Suzanne R Smith, Joshua A Bueller, Trudy Goodman, J David Creswell, Kirsten Tillisch, Emeran A Mayer, and Bruce D Naliboff. 2011. 'Impact of Mindfulness-Based Stress Reduction Training on Intrinsic Brain Connectivity'. *Neuroimage* 56 (1): 290–98.
- Kjaer, Troels W, Markus Nowak, and Hans C Lou. 2002. 'Reflective Self-Awareness and Conscious States: PET Evidence for a Common Midline Parietofrontal Core'. *Neuroimage* 17 (2): 1080–86.
- Koch, Christof. 2012. 'This Is Your Brain on Drugs'. *Scientific American Mind* 23 (2): 18–19.
- Kuznetsova, Irina, Jonardon Ganeri, and Chakravarthi Ram-Prasad. 2016. *Hindu and Buddhist Ideas in Dialogue: Self and No-Self*. Routledge.
- Lebedev, Alexander V, Martin Lövdén, Gidon Rosenthal, Amanda Feilding, David J Nutt, and Robin L Carhart-Harris. 2015. 'Finding the Self by Losing the Self: Neural Correlates of Ego-dissolution under Psilocybin'. *Human Brain Mapping* 36 (8): 3137–53.
- Lenharo, Mariana. 2023. 'Decades-Long Bet on Consciousness Ends-and It's Philosopher 1, Neuroscientist 0.' *Nature*.
- MacKenzie, Matthew. 2016. '(Re-) Constructing the Self'. *Journal of Consciousness Studies* 23 (1–2): 105–24.
- MacLean, Katherine A, Jeannie-Marie S Leoutsakos, Matthew W Johnson, and Roland R Griffiths. 2012. 'Factor Analysis of the Mystical Experience Questionnaire: A Study of Experiences Occasioned by the Hallucinogen Psilocybin'. *Journal for the Scientific Study of Religion* 51 (4): 721–37.
- Marais, Adriana, Betony Adams, Andrew K. Ringsmuth, Marco Ferretti, J. Michael Gruber, Ruud Hendrikx, Maria Schuld, et al. 2018. 'The Future of Quantum Biology'. *Journal of the Royal Society*

Interface. Royal Society Publishing. https://doi.org/10.1098/rsif.2018.0640

- McQueen, Kelvin J. 2019. 'Interpretation-Neutral Integrated Information Theory'. *Journal of Consciousness Studies* 26 (1–2): 76–106.
- Milojević, Teodora, and Mark A. Elliott. 2023. 'The Causal Influence of Conscious Engagement on Photonic Behavior: A Review of the Mind-Matter Interaction'. In *Progress in Brain Research*. Elsevier B.V. https://doi.org/10.1016/bs.pbr.2023.03.005
- Mindt, Garrett. 2017. 'The Problem with the "information" in Integrated Information Theory'. *Journal of Consciousness Studies* 24 (7–8): 130–54.
- Morch, Hedda Hassel. 2019. 'Is Consciousness Intrinsic? A Problem for the Integrated Information Theory'. *Journal of Consciousness Studies* 26 (1–2): 133–62.
- Mørch, Hedda Hassel. 2019. 'Is the Integrated Information Theory of Consciousness Compatible with Russellian Panpsychism?' *Erkenntnis* 84 (5): 1065–85.
- Nagasawa, Yujin, and Khai Wager. 2017. 'Panpsychism and Priority Cosmopsychism'. *Panpsychism: Contemporary Perspectives*, 113–29.
- Ney, Alyssa. 2020. 'Separability, Locality, and Higher Dimensions in Quantum Mechanics'. In *Current Controversies in Philosophy of Science*, edited by Shamik Dasgupta, Ravit Dotan, and Brad Weslake, 75–89. London: Routledge.
- North, Jill. 2013. 'The Structure of a Quantum World'. In *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*, edited by Alyssa Ney and David Z. Albert, 184–202. New York: Oxford University Press.
- Oizumi, Masafumi, Larissa Albantakis, and Giulio Tononi. 2014. 'From the Phenomenology to the Mechanisms of Consciousness: Integrated Information Theory 3.0'. *PLoS Computational Biology* 10 (5). https://doi.org/10.1371/journal.pcbi.1003588
- Pollan, Michael. 2019. *How to Change Your Mind: What the New Science of Psychedelics Teaches Us about Consciousness, Dying, Addiction, and Transcendence*. Penguin.
- Radin, Dean, Leena Michel, Karla Galdamez, Paul Wendland, Robert Rickenbach, and Arnaud Delorme. 2012. 'Consciousness and the Double-Slit Interference Pattern: Six Experiments'. *Physics Essays* 25 (2): 157–71. https://doi.org/10.4006/0836-1398-25.2.157
- Radin, Dean, Helané Wahbeh, Leena Michel, and Arnaud Delorme. 2020. 'Commentary: False-Positive Effect in the Radin Double-Slit Experiment on Observer Consciousness as Determined with the Advanced Meta-Experimental Protocol'. *Frontiers in Psychology* 11: 726.

- Raichle, Marcus E. 2015. 'The Brain's Default Mode Network'. *Annual Review of Neuroscience* 38 (July): 433–47. https://doi.org/10.1146/annurev-neuro-071013-014030
- Raichle, Marcus E, Ann Mary MacLeod, Abraham Z Snyder, William J Powers, Debra A Gusnard, and Gordon L Shulman. 2001. 'A Default Mode of Brain Function'. *Proceedings of the National Academy of Sciences* 98 (2): 676–82.
- Russell, Bertrand. 1927. *The Analysis of Matter*. London: Kegan Paul.
- ———. 1959. *My Philosophical Development*. New York: Simon & Schuster.
- Schaffer, Jonathan. 2010. 'Monism: The Priority of the Whole'. *Philosophical Review* 119 (1): 31–76. https://doi.org/10.1215/00318108-2009-025
- Schmidgen, Henning. 2000. 'William James, The Principles of Psychology (1890)'. In *Die Klassiker Der Psychologie*, 72–77. Kohlhammer.
- Seager, William. 1995. 'Consciousness, Information, and Panpsychism'. *Journal of Consciousness Studies* 2 (3): 272–88.
- ———. 2018. 'The Philosophical and Scientific Metaphysics of David Bohm'. *Entropy* 20 (7). https://doi.org/10.3390/e20070493
- Searle, John R. 2013. 'Can Information Theory Explain Consciousness?' *The New York Review of Books*, 10 January 2013.
- Shani, I. 2015. 'Cosmopsychism: A Holistic Approach to the Metaphysics of Experience'. *Philosophical Papers* 44 (3): 289–437.
- Shani, I., and J. Keppler. 2018. 'Beyond Combination: Cosmic Consciousness Grounds Ordinary Experience'. *Journal of the American Philosophical Association* 4 (3): 390–410.
- Simon, C. 2019. 'Can Quantum Physics Help Solve the Hard Problem of Consciousness?' *Journal of Consciousness Studies* 26 (5–6): 204–18.
- Swanson, Link R. 2018. 'Unifying Theories of Psychedelic Drug Effects'. *Frontiers in Pharmacology*. Frontiers Media S.A. https://doi.org/10.3389/fphar.2018.00172
- Tononi, Giulio. 2008. 'Consciousness as Integrated Information: A Provisional Manifesto'.
- Tononi, Giulio, Melanie Boly, Marcello Massimini, and Christof Koch. 2016. 'Integrated Information Theory: From Consciousness to Its Physical Substrate'. *Nature Reviews Neuroscience*. Nature Publishing Group. https://doi.org/10.1038/nrn.2016.44
- Tononi, Giulio, and Christof Koch. 2015. 'Consciousness: Here, There and Everywhere?' *Philosophical Transactions of the Royal Society B: Biological Sciences*. Royal Society of London. https://doi.org/10.1098/rstb.2014.0167

- Tuszynski, Jack A., and Nancy Woolf. 2006. 'The Path Ahead'. In *The Emerging Physics of Consciousness*, edited by Jack. A. Tuszynski, 1–26.
- Williams, George. 2021. 'Can the Psi Data Help Us Make Progress on the Problem of Consciousness?' *Journal of Consciousness Studies* 28 (5–6): 145–72.
- Woolf, Nancy J. 2006. 'Microtubules in the Cerebral Cortex: Role in Memory and Consciousness'. In *The Emerging Physics of Consciousness*, 49–94. Springer.

Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.