Reconsidering the Metaphysics of Science from the Inside Out

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> The only thing you need to know to understand the deepest metaphysical secrets is this: that for every outside there is an inside and for every inside there is an outside, and although they are different, they go together. (Alan Watts, *Man, Nature, and the Nature of Man*, collected public lectures, 1991)

Abstract Material reductionism – the prevailing metaphysical view that reality can be understood entirely in terms of non-conscious physical stuff – is at odds with the existence of experience, the flow of time, and the privileged present. We propose an alternative scientifically-grounded metaphysical perspective that posits: (1) Consciousness represents a fundamental aspect of reality such that all material things enjoy some varying degree of consciousness (panpsychism); (2) nervous systems entail a nested hierarchy of distinct conscious observers; (3) both experience and the flow of time suggest the reality of a subjective realm of existence; (4) the flow of time suggests a process by which all observers collectively sample segments of continuous space/time at different rates, creating a composite of experienced moments of varying thickness; (5) the possibility that consciousness can influence the duration and selection of experienced moments affords a possible opportunity for genuine free will. Although speculative, these conjectures illustrate the type of alternative metaphysics that may be able to accommodate scientific observations without abandoning the self-evident facts that experience exists and time flows.

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Introduction

Humanity will be forever indebted to the participants of the Enlightenment who overcame the dominance of dogmatic religious beliefs, and ushered in a more rational pursuit of understanding. This commitment to rationalism led to modern science and all of the remarkable advances that it affords. However, today a new dogmatism has taken reign disguised as rationalism – the very movement that helped to overthrow the dogma of religious oppression. This set of beliefs, commonly referred to as material reductionism, asserts that the universe and all of its constituents (including us) can be entirely reduced to and understood in terms of the interactions of physical stuff that is itself lifeless and completely devoid of consciousness. As Francis Crick put it in 1994:

> You, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules. Who you are is nothing but a pack of neurons. (p. 3)

Material reductionism, it is said, has no room for antiquated concepts of free will, spirit, or any intelligence in the universe greater than our own (Dawkins 2006; Dennett 2003). From the vantage point of this doctrine, the misguided mass of humanity who still subscribe to these obsolete notions are merely responding to the built-in tendencies of their material brains (Bloom 2004). Indeed, those few scientists and philosophers who challenge the reigning material reductionist dogma are often ridiculed as "supernaturalists" lacking in rigor, and engaging in "panicky metaphysics" (Strawson 1974).

Underlying material reductionism's rejection of spiritual views of any sort is a resolute confidence that the extant scientific concepts are sufficient to illuminate all remaining outstanding scientific (and perhaps even non-scientific) questions. It is assumed that mysteries such as the nature of consciousness will in the end be understood with exactly the same set of principles as has revealed former mysteries (Dennett 1991). The prevailing material reductionist metaphysics asserts that just as nineteenth century vitalists were misguided in their view that something special is required to understand the emergence of life, so too the nature of consciousness will ultimately be understood using exactly the same physical principles that we currently use to understand rocks and toaster ovens.

Although there is little justification for religious reactionaries who reject well-established scientific principles, this does not mean that rigorous scientists must necessarily rally around the inviolability of material reductionism. We don't have to trade one dogmatic set of beliefs for another. Dedication to the scientific method does not require that one necessarily take on faith that deeply held intuitions regarding the fundamental nature of subjectivity are entirely illusory. To the contrary, the scientific method requires that one maintain an open mind, and be wary of dogmatic views wherever they exist. As the physicist Richard Feynman (1999) observed, "Learn from science that you must doubt the experts" (p. 186).

Central to the confidence that current scientists and philosophers have in material reductionism is the notion that it has successfully worked in the past and so is likely to continue to work in the future. Science has certainly made great advances on innumerable topics. Nevertheless, there are at least two fundamental aspects of reality that have resisted satisfactory explanation within the standard material reductionist world-view: the nature of consciousness and the flow of time. As we will argue, with these fundamental mysteries still unsolved, we should be cautious in assuming that their resolution will be solved within the context of the prevailing metaphysical assumptions of today's science. This is not to say that these issues cannot be advanced with the scientific method. We fully subscribe to the scientific method. Our point is, rather, that scientists should be cautious in adopting a metaphysical stance that requires abandoning certain phenomenologically self-evident facts that are, in our view, more certain than the ostensible *terra firma* of modern science's current metaphysical assumptions.

In the following discussion we first consider the limitations of material reductionism with respect to experience and time, and then consider several alternative metaphysical options for integrating human consciousness and the flow of time.

This paper itself is a good example of the kind of collaboration we would like to see more of, in that it is written by three authors with disparate positions, each of whom enjoys the debate and flow of ideas (See Shariff et al. 2009 for a similar example). Hunt parts ways with the Schoolers on some key issues and we have made that clear in the text, as well as including an Afterword explaining why Hunt does so.

The Nature of Consciousness

It is a peculiar testament to the myopic vision of the prevailing material reductionist view that the psychologist and philosopher William James, though widely acknowledged as providing some of history's most insightful analyses of consciousness and psychology more generally, is often ignored when it comes to his discussions of metaphysics (although see Wallace 2010). James (1917) recognized the stronghold of material reductionism that was similarly prevalent in his day, noting:

> [P]sychologists will tell you that only a few belated scholastics, or possibly some crack-brained theosophist or psychical researcher, can be found holding back, and still talking as if mental phenomena might exist as independent variables in the world. (p. 9–10)

While acknowledging the evidence that thought is produced by the brain, James pointed out that there are alternative ways in which it might be considered. The brain might, as material reductionists assert, be the *producer* of thought. Alternatively, the brain might merely *transmit* thought, like a prism refracts but does not actually produce light. James observed the fundamental challenge to the production view of consciousness: namely, while it is relatively straightforward to postulate a productive mechanism for mechanistic things, such as a tea kettle producing steam, it is far

less evident how material brains produce something as ontologically distinct as consciousness. As James (1898) noted:

> Into the mode of production of steam in a tea-kettle we have conjectural insight, for the terms that change are physically homogeneous one with another, and we can easily imagine the case to consist of nothing but alterations of molecular motion. But in the production of consciousness by the brain, the terms are heterogeneous natures altogether; and as far as our understanding goes, it is as great a miracle as if we said, Thought is 'spontaneously generated,' or 'created out of nothing.' … All that one need do, therefore, if the ordinary materialist should challenge one to explain how the brain can be an organ for limiting and determining to a certain form a consciousness elsewhere produced, is to [ask him] to explain how it can be an organ for producing consciousness out of whole cloth. (p. 21–22)

We are not necessarily endorsing James' view of the transmission of consciousness, but we have to agree with him that it is not precluded by the facts that are generally assumed to weigh unequivocally in favor of the brain as a producer of thought.

Since the time of William James, we have made notable progress in understanding consciousness, advancing such important topics as the neurocognitive correlate of conscious states (NCC, Koch 2004), differences between conscious and unconscious thought (Baumeister et al. 2011), and the relationship between consciousness and self-reports (Schooler 2002). While such findings represent important advancements, they do nothing to address James' fundamental question of how the brain produces consciousness "out of whole cloth". This issue, the eons-old "mind/body problem," and recently renamed "the hard problem" of consciousness (Chalmers 1995a), persists because consciousness seems to differ from all other scientific topics of inquiry in its apparent lack of any material properties.

Although differing in their conclusions regarding how to deal with the problem, many philosophers acknowledge that conscious experience fundamentally challenges material reductionist explanations. The philosopher Colin McGinn (1991) goes so far as to argue that the human mind is inherently incapable of coming up with an adequate account of consciousness, a view shared by Stephen Pinker (personal communication) who in other respects strictly allies himself with the material reductionist camp (Pinker 1997, 2007). While others vary on the difficulty that they see the problem of consciousness as posing, with few notable exceptions (e.g. Dennett 1991) there is widespread agreement that this is a nut that we have yet to crack. Moreover, not only do we currently lack an explanation for the arising of subjectivity, we do not even know what such an explanation could possibly look like. There simply is no evident place for subjectivity within in the prevailing material reductionism metaphysics.

The Flow of Time

Next to the experience of consciousness, few phenomena are as self-evident as the passage of time. From our first breath to our final gasp, time inexorably marches forward. Remarkably, however, there is at present no consensus for why time flows in only one direction, or even why it seems to moves at all. As the physicist Brian

Greene observes: "[E]ven though experience reveals over and over again that there is an arrow of how events unfold in time, this arrow seems not to be found in the fundamental laws of physics" (Greene 2004, p. 144–145). There have been various speculations about what underlies the apparently forward movement of time. Chief among them is the notion of entropy (Greene 2004). Entropy, the tendency for all things in the universe to become more disorganized with time, unquestionably provides a metric for the arrow of time. However, it is far from clear how entropy resolves the underlying question of what exactly is moving forward from one moment to the next. In other words, entropy provides a description of the direction of the flow of time, but does not provide an explanation for why it flows in that direction (i.e. why shouldn't things become more ordered with time?) or why it flows at all.

In considering the nature of time, physicists often "spatialize" it. In other words, they attempt to place it on a similar footing to the traditional three dimensions of space. Though differing from spatial dimensions in important respects (Einstein 1920/2001) the notion of time as similar to a spatial dimension is a key feature of the prevailing Einstein/Minkowski interpretation of special relativity theory. Space and time are combined into one concept: space-time. The spatialization of time allows the depiction of a "block universe" in which the traditional spatial dimensions are reduced (for purposes of visual illustration) to two dimensions, and time is added as a third dimension. Louis de Broglie (1959), a French physicist who played a key role in the development of quantum theory in the beginning of the twentieth century, clarified Einstein's view (what is more accurately labeled the Einstein/Minkowski view):

> In space-time, everything which for us constitutes the past, the present, and the future *is given in block*, and the entire collection of events, successive for us, which form the existence of a material particle is represented by a line, the world-line of the particle. Each observer, as his time passes, discovers, so to speak, new slices of space-time which appear to him as successive aspects of the material world, *though in reality the ensemble of events constituting space-time exist prior to his knowledge of them*. (p. 133)

Such a depiction can be thought of as a space-time "loaf of bread," where each narrow cross-section of the loaf ("slice") constitutes a moment in time of the entire universe. According to the block universe view (widely held by today's physicists), all slices – past, present and future – already exist. It is simply that the observer is privy to only one moment (slice) at a time. Critically, as will be further described shortly, this view offers no account for the privileged quality of the present, cannot adequately explain the subjective flow of time, and leaves the source of subjective movement through the posited block universe unexplained.

An Inside-Out Ontology

A central assumption of the current scientific ontology is that personal experience is inherently flawed as a basis for rigorous knowledge and that everything that we can claim to know about the universe should be derived from scientific (empirical)

investigation. Seemingly fundamental aspects of our universe, such as time (Einstein quoted in Hoffmann and Dukas 1972) and even consciousness itself (Hofstadter 2007), are characterized as mere illusions resulting from inadequately informed intuitions.

Although subjective experience is often erroneously dismissed as a fundamental source of knowledge, it is manifestly *all* that we can know about the universe and ourselves. As William James observed: "Introspective observation is what we have to rely on first and foremost and always." (James 1890/1918, p. 185). All scientific facts, literally, are communicated to us through our personal experience – there is no other way to receive information. As Descartes famously concluded, experience has more ontological certainty than external reality itself. You could be dreaming, you could be a brain in a vat, but there is simply no question but that you are an experiencing observer. Although now often overlooked, the status of subjective experience as the foundational core of any meaningful ontology was a critical element of phenomenological philosophy (Husserl 1980) and the essential insight of Descartes' (1637/1956) famous phrase "I think, therefore I am." Kant (1781/1896), Berkeley (1734/1971), Schopenhauer (1819/1995) and many other philosophers continued to build upon Descartes' insights about the necessary subjective starting point for all human knowledge.

To illustrate the unique ontological status of subjective experience, consider the following thought experiment. Imagine that an elite group of scientists, who have collectively received every imaginable recognition and accolade, told you that they had solved the hard problem of consciousness and had developed a technique that definitively discerned what possesses subjective experience and what does not. These scientists use their pioneering innovation on you and conclude that you do not in fact have consciousness … you just think you do. Would you accept their conclusion? You surely would accept any other conclusion such a group of scientists might offer. But in this case, it seems likely, you would be absolutely certain they had come to the wrong conclusion. Ultimately, when it comes to the existence of subjectivity, one's first-person experience trumps even the most authoritative scientific evidence.

Having established that subjective experience must serve as the foundation for building one's ontology, we can now pose the following question: are there any other ontologically necessary truths that follow from subjective experience alone? That is, are there other aspects of reality that we can derive entirely from our personal experience? In this regard, the passage of time is an appropriate candidate. Experience is always and invariably extended in time. Indeed, without duration there would be no experience. By acknowledging the existence of experience, we must also acknowledge the existence of time in which experience "extends".

Closely related to the experience of subjective time is the privileged nature of the present. We can remember the past and anticipate the future but we only exist in the present, now, now, now, and now… The privileged status of the present is, however, contradicted by prevailing physical theories. The privileged present is another aspect of our experience that is ultimately more self-evident than any contradictory claims by physics or any other area of knowledge.

In sum, we see that when we inspect what are the most fundamental aspects of our experienced existence, so fundamental that they do not require any empirical support for us to be absolutely certain of them, we find that they are the very same issues (subjectivity and the flow of time) that prevailing physics is at present incapable of explaining satisfactorily. So what are we to make of this impasse between the conclusions of prevailing scientific theories and those of subjective experience?

Acknowledging the Fundamental Nature of Subjective Experience and the Flow of Time

As noted, the current inability of science to satisfactorily account for subjective experience has led to a variety of reactions. Some have suggested that this is a problem that is simply beyond the ken of mankind to solve (McGinn 1999), others have argued that it will be resolved in some yet unimaginable way, and yet others have argued that it implies that consciousness itself is an illusion (e.g. Hofstadter 2007). A few thinkers, however, have recognized that subjective experience warrants consideration as an essential aspect of the universe. As the philosopher David Chalmers (1995b) observed:

> I propose that conscious experience be considered a fundamental feature, irreducible to anything more basic… In the 19th century it turned out that electromagnetic phenomena could not be explained in terms of previously known principles. As a consequence, scientists introduced electromagnetic charge, as a new fundamental observer. Similar reasoning should be applied to consciousness. If existing fundamental theories cannot encompass it, then something new is required. (pp. 96)

Suggesting that consciousness may represent a fundamental aspect of the universe is not limited to philosophers. Although a notable minority, some physicists have made very similar suggestions. For example, physicist Andrei Linde (1990) observed:

> Note, that the gravitational waves usually are so small and interact with matter so weakly that we did not find any of them as yet. However, their existence is absolutely crucial for the consistency of our theory, as well as for our understanding of certain astronomical data. Could it be that consciousness is an equally important part of the consistent picture of our world, despite the fact that so far one could safely ignore it in the description of the well studied physical processes? Will it not turn out, with the further development of science, that the study of the universe and the study of consciousness are inseparably linked, and that ultimate progress in the one will be impossible without progress in the other (p. 27)

We will return shortly to discuss how consciousness might potentially be treated as a fundamental aspect of reality, but first let us consider the second feature of existence that is as central to subjective experience as it is elusive to prevailing physical theories – the flow of time.

As noted, standard models of physics deny the subjective flow of time any objective reality. The physicist Paul Davies observes: “From the fixed past to the tangible

present to the undecided future, it feels as though time flows inexorably on. But that is an illusion." (Davies 2002, p. 32). Importantly, physicists acknowledge that the only place where the passage of time seems to have any meaning is in the context of consciousness. For example, Davies argues:

> Nothing other than a conscious observer registers the flow of time. A clock measures durations between events much as a measuring tape measures distance between places; it does not measure the "speed" with which one moment succeeds another. Therefore it appears that the flow is subjective, not objective. (p. 36)

The standard reaction to the observation that the privileged present and the flow of time only have meaning from the vantage point of a conscious observer is to dismiss these constructs as illusory. Just as we have come to terms with the facts that the earth is not flat and that species change over time, we shall, many physicists and philosophers assert, eventually come to terms with the idea of the flow of time being ultimately illusory. As Einstein observed "The past, present and future are only illusions even if stubborn ones" (quoted in Hoffmann and Dukas 1972, p. 258). However, others have recognized the inherent problem with this move: once we acknowledge the validity of subjective experience as the only source of knowledge about the universe, the privileged present and the flow of time become more certain than the physical theories that have been proposed to replace them. The philosopher David Ray Griffin (2007) observes: "The reality of time is a more fundamental and stubborn fact than the alleged facts on which its denial is based" (p. 119). In short, to abandon the certainty of time in favor of the theories of physics is like reading a map in the comfort of one's home, yet concluding on the basis of the interpretation of the map that one is lost. When ostensibly rational claims contradict a self-evident truth it is time to revisit the robustness of those claims.

Towards an Alternative Metaphysics

The current inability of prevailing physical theories to satisfactorily account for the two aspects of existence of which we can be most certain raises the genuine possibility that something very fundamental is missing from the prevailing scientific story. At a minimum, such core omissions undermine the view that prevailing theories have proven too successful to be challenged. In the following analysis, we consider several metaphysical alternatives that should be given due consideration. Importantly, we recognize the highly speculative nature of what follows. Indeed the authors themselves differ in important respects. In particular, Hunt (in press) has recently proposed an alternative perspective on a number of the following issues, including the nature of time, the meaning of information and the manner in which objectivity and subjectivity are distinguished. **The reader is also directed to the Afterword for further consideration of these issues of contention between the authors**.

Cognizant of its highly speculative nature, we present the following discussion not with the aim of persuading readers that these many contentious claims are necessarily correct, but rather to spur consideration of the types of alternative metaphysical views that might be capable of respecting *both* our intuitions drawn

from subjective experience and yet be potentially consistent with what empirical science has so far revealed about the world.

Consciousness Is Inherent in Everything

If we are to take seriously the notion that consciousness represents a fundamental aspect of the universe, a natural question arises: what would this mean? This question can be traced at least as far back as the ancient Greek philosopher Democritus, who in anticipating the notion that the universe is composed of atoms, further speculated that each atom holds some primitive dim consciousness. This is a type of *panpsychism,* the view that all things participate in two realms of existence: a private realm of subjectivity, and a public realm of physical reality. Although differing in their precise construal, many brilliant thinkers throughout history have endorsed some version of the panpsychist perspective including Spinoza (1677/1985), Leibniz (1714/1989), Schopenhauer (1819/1995), James (1909), Bergson (1896/1912) and Whitehead (1929). More recent advocates of this view include Hameroff (2001), Chalmers (1995b), Griffin (2007) (though he prefers the term "panexperientialism"), Skrbina (2005) and Strawson (2008).

Although some readers not previously familiar with the notion might be tempted to reject panpsychism out of hand, careful reflection on the theory reveals it to be at a minimum worthy of consideration, and quite possibly the most parsimonious account currently available for conceptualizing the relationship between consciousness and reality. Importantly, there are both logical and observational reasons to postulate that all matter may enjoy at least a rudimentary consciousness. Before explicating these arguments, however, it is important to clarify one essential aspect of panpsychism. Panpsychism assumes that all matter partakes in at least some rudimentary form of experience, however, this is not to say that *all* objects are themselves sentient beings. To use Nagel's (1974) terminology there need be nothing "that it is like to be" a rock, for example. Rather, the panpsychist/panexperiential claim is that at some level, the constituent elements of a rock (and all other material objects) partake in at least some very rudimentary kind of experience. The fundamental units of both matter and mind are what the physicist/philosopher Alfred North Whitehead (1929), referred to as "actual entities" or "occasions of experience". In some circumstances, and in particular when present in certain organic structures, actual entities may combine to form higher-order actual entities. (For further discussion of this issue see Whitehead (1929), Rosenberg (2005), Hunt (in press), and the present discussion of the combination problem). However, for the most part, when actual entities combine they generally form "mere aggregates" that do not entail a higher-order experience. Only the constituents of mere aggregates are actual entities – the combination is not conscious. In short, most modern versions of panpsychism assume that much of nature enjoys only the most primitive type of experience.. With those preliminaries behind us, let us now consider the arguments for panpsychsm, starting with logical argument and then moving on to observational ones.

Logical Arguments for Panpsychism

The Challenge of Emergentism

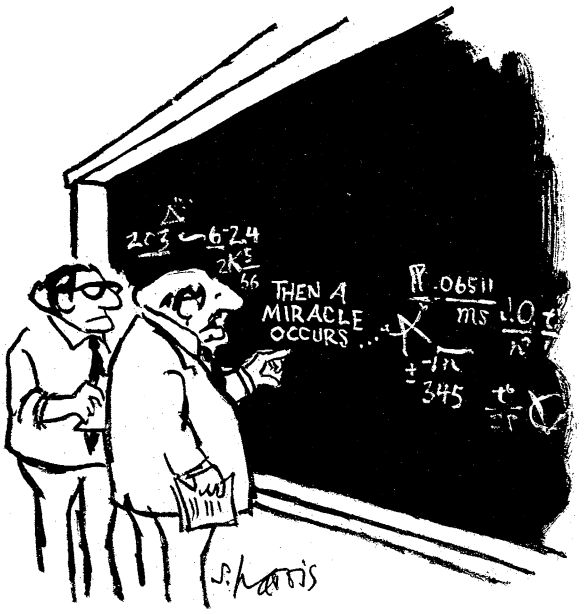
The first advantage of panpsychism is that it skirts one of the fundamental limitations of the materialist alternative – the problem of emergence. According to emergentism, consciousness somehow emerges from entirely non-conscious matter in a manner similar to the way in which a liquid emerges from the unwet atoms of which it is composed. The problem with this view, as alluded to by William James, is that it is entirely unclear how something as distinct as consciousness could come "out of whole cloth". No matter where or how in the phylogenetic order (or ontogenetic, for that matter) this fantastic leap occurred it is entirely inexplicable. It is as if gravity suddenly appeared on the universal scene where it had not existed before. Ultimately, the hurdle from inert matter to consciousness is reminiscent of the classic New Yorker cartoon below (Harris 2006) in which a scientist interjects "and then a miracle occurs" between two sets of formulae on a black board. The panpsychist perspective has the notable advantage of not requiring the explanation of how something so ontologically distinct as experience suddenly emerged where none existed before. Instead, where there is matter there is mind – the two go together always.

The standard reply to such a criticism is that there are other cases of emergence, e.g. liquidity, so why shouldn't consciousness be just another example like this? However, the problem with this argument, as articulately noted by the philosopher Galen Strawson (2008) is that emergence requires the existence of a necessary dependence between the pre-existing conditions and the emergent property. As Strawson puts it:

> It seems plain that there must be a fundamental sense in which any emergent phenomenon, say Y, is wholly dependent on that which it emerges from, say X. It seems, in fact, that this must be true by definition of 'emergent'; for if there is not this total dependence then it will not be true after all, not true without qualification, to say that Y is emergent from X. For in this case at least some part or aspect of Y will have to hail from somewhere else and will therefore not be emergent from X. Plainly this is not how it is with liquidity. (p. 64)

In the case of liquidity, there are a set of comprehensible properties of the pre-existing constituents (i.e. they possess a molecular structure that slides rather than binds) thereby leading in a principled and entirely explicable way to the emergence of liquidity. No such relationship has ever been established between ostensibly non-conscious matter and consciousness. To argue that experience/consciousness can emerge from matter is more analogous to suggesting the far less tractable notion that spatial extent can emerge from non-spatial extent. Again as Strawson observes:

> If one is being metaphysically straight, the intuition that nothing (concrete, spatiotemporal) can exist at a mathematical point, because there just isn't any room, is rock solid… So if the idea of unextended-to-extended emergence is offered as an analogy for non-experiential-to-experiential emergence, I don't think it can help. (p. 64)



In short, the suggestion that consciousness could emerge from entirely non-conscious matter requires the existence of a bridging principle that must on the one hand explain how consciousness could emerge from a medium that lacks any trace of it, while at the same time avoiding the introduction of any new elements that are not inherent in the matter from which consciousness is said to emerge. Otherwise, one is again back to positing "then a miracle occurs".

The Advantage of Parsimony

The second core logical advantage of panpsychism is parsimony. Each human being, being the possessor of a material yet experiencing brain, knows for a fact that matter can be conscious. However, we have no evidence and absolutely no way of knowing whether there is any matter that lacks consciousness. Given that we

know that matter can be conscious, and have no evidence that there exists any matter that is not conscious, parsimony strongly favors the conclusion that all matter enjoys some (albeit generally highly rudimentary) degree of sentience. Again as Strawson puts it:

> Returning to the case of experience, Occam cuts in again, with truly devastating effect. Given the undeniable reality of experience, he says, … why insist that physical stuff in itself, in its basic nature, is essentially non-experiential, thereby taking on [a] a commitment to something—wholly and essentially non-experiential stuff—for which there is absolutely no evidence whatever along with [b] the wholly unnecessary (and incoherent) burden of brute emergence otherwise known as magic? (p. 66)

Thus it seems that from a parsimony perspective it is far simpler to assume that consciousness is a fundamental property of matter/energy that extends and develops according to potentially identifiable principles, than to assume that consciousness somehow pops into existence out of material that prior to this remarkable transformation is entirely and utterly devoid of this property.

Observational Evidence for Panpsychism

As previously noted, there is no way to directly observe whether anything other than ourselves is conscious, so the notion of empirical evidence for panpsychism is admittedly a bit of an oxymoron. However, pragmatically speaking there are observations that inform our intuitions about what is conscious and what is not. That is, circumstantial evidence may be marshaled in our favor. If we observe an object's behavior that suggests the presence of intention we are inclined to believe that it is conscious. Indeed, a major reason why most of us assume that dogs are conscious but rocks are not is that dogs show behavioral evidence of intention while rocks (happily) do not.

It turns out, however, that when we look more carefully at the behavior of things to which we typically do not attribute experience our intuitions can change. The typical materialist view is that consciousness is a product of nervous systems that have reached some critical magnitude of complexity (though importantly there is no principled basis for determining how much neural complexity is required for consciousness to take place). However, many of the behaviors that lead us to attribute consciousness to organisms are also evidenced by eukaryotes that have no nervous system whatsoever (Fitch 2008). Paramecia can learn, avoid predators, find food, select mates and have sex, all without a nervous system (Margulis and Sagan 1995). If a larger creature with a nervous system evidenced these behaviors we might reasonably attribute sentience to that creature, so how can we be so sure that a single cell organism lacks it? And if some cells are conscious, on what grounds should we assume that others do not? And why should life be the defining precursor for consciousness? Isn't this a form of vitalism that is so often ridiculed by materialists? If there is nothing necessarily special about living things that enable consciousness to

arise, then the premise that non-living matter might also enjoy some type of experience should not be considered *a priori* infeasible. Indeed the principled yet unpredictable behavior of particles has led a number of physicists to speculate that even they may enjoy an iota of experience. The eminent American physicist Freeman Dyson (1979) was explicit on this point, noting:

> …mind is already inherent in every electron, and the processes of human consciousness differ only in degree but not in kind from the processes of choice between quantum states which we call "chance" when made by electrons. (p. 245)

The physicist David Bohm made a similar observation, observing "The ability of form to be active is the most characteristic feature of mind, and we have something that is mind-like already with the electron" (in Talbot 1991, p. 50). In describing the behaviors of electrons in plasma Bohm further (1987) observed:

> [T]he whole system is undergoing a co-ordinated movement more like a ballet dance than like a crowd of unorganized people… closer to the organized unity of the parts of a living being than it is to the kind of unity that is obtained by putting together the parts of a machine. (p. 38)

Many readers are likely to balk at the suggestion that seemingly senseless matter could possess even the remotest aspect of consciousness. We ask such readers the following: given that you are a material body capable of experience, how can you be so sure that other material things don't share a modicum of your good fortune? It may simply be a matter of perspective. From the vantage point of outer space, we could be viewed as nothing more than an infestation of "planet fungus" entirely void of consciousness. As noted, there is no known marker for determining whether or not something is conscious, therefore any view that asserts realms in which consciousness is necessarily lacking is simply a statement of personal faith and not scientific fact. William James (1902/2002), who arguably said more right things about consciousness than any one else in history, eloquently expressed his view that science could be premature in adopting a strictly impersonal view of physical reality.

> …The divorce between scientists' facts and religious facts may not necessarily be as eternal as at first sight seems, nor the personalism and romanticism of the world, as they appeared to primitive thinking, be matters so irrevocably outgrown. The final human opinion may, in short, now impossible to foresee, revert to the more personal style, just as any path of progress may follow a spiral rather then a straight line, the impersonal view of science might one day appear as having been a temporarily useful eccentricity rather than a definitively triumphant position which the sectarian scientist at present confidently announces it to be. p 545

Few today would deny either the physical universe or the interior private realm, notwithstanding some prominent philosophers that we have cited above. Once we acknowledge the co-existence of these domains, it seems no more unreasonable to suggest that they exist to varying degrees in all contexts, as dual aspects of a single reality, than to posit (with no hint of an explanation) how either could emerge whole cloth from the other.

Possible Corollaries of Consciousness

An inherent subjectivity to all of matter suggests the possible existence of attributes that intuitively go hand in hand with what we generically refer to as subjectivity, namely: feeling, understanding, intelligence and agency. To evaluate this intuition it may be helpful to consider the lowest level species for which most readers are probably prepared to grant the likelihood of consciousness. For the sake of argument, let us take the standard generally used as the ethical dividing line for research on animal: vertebrates.

If one thinks a simple vertebrate is conscious then one is also likely to think it has (a) feeling – e.g. experiencing pain, (b) at least some rudimentary understanding – recognizing food, danger, etc., (c) appetites/aversions – e.g. desire for food and avoidance of harm, (d) intelligence – capacity to discern a course of action in keeping with its appetites/aversions, and (e) agency – ability to act in keeping with its desires and rudimentary intelligence. Perhaps, some readers are prepared to grant some of these qualities but not others (e.g. feeling but not agency). However, we expect that these are common intuitions of what characterizes beings that are considered conscious. Thus if we are to seriously entertain the possibility that all of matter enjoys some degree of consciousness, then we must also be prepared to acknowledge that this may also entail at least some very primitive element of the likely components of consciousness, including feeling, understanding, intelligence and agency.

The Combination Problem

Once we grant that all of matter may enjoy some primitive level of consciousness, a critical issue, often referred to as the "combination problem" or "boundary problem" Hunt (in press) arises. The combination problem refers to the question: how do individual elements combine to form larger experiential entities? While the constituent elements of a rock are highly unlikely to cohere together into a singular "rock" experience, it seems clear that some of the elements of our brains unite into at least a semi-coherent higher-order experience, which we call our conscious mind. We suggest that the arising of higher-order entities may be a result of nested hierarchies of conscious agents.

It is now widely accepted that evolution entailed a process in which simple organisms combined to form the organelles (e.g. mitochondria) of more complex eukaryote cells, which in turn combined to become multi-cellular organisms (Margulis and Sagan 1995). We suggest that just as life evolved the capacity to integrate independent living creatures into more complex singular life forms, it may have similarly developed the capacity to integrate subjective experiences into nested hierarchies of higher-order experiencers. Indeed, such a hierarchical view of consciousness represents the basis of the neuroscientist Zeki's (Zeki and Bartels 1999; Zeki 2003) theory of how consciousness manifests in the brain.

Drawing on differences in the processing rates of different areas of the visual system, Zeki suggests that the brain engages in a nested hierarchy of distinct conscious experiences leading to a final unified experience. He proposes three hierarchical levels at which consciousness takes place in the brain: micro-consciousness corresponding to the different levels of the visual system that process distinct attributes (e.g. V4 processes color where as V5 processes motion), macro-consciousness that integrates multiple attributes of a system (e.g. binding color to motion), and unified consciousness corresponding to the experience of the perceiving person. Zeki further suggests that each of these nested levels of consciousness occur in a distinct temporal order, with the lower order levels being ahead of and feeding into the higher order levels. Zeki describes his model as follows.

> It thus becomes possible to distinguish three hierarchical levels of consciousness: the levels of micro-consciousness, of macro-consciousness, and of the unified consciousness. Of necessity, one level depends upon the presence of the previous one. Within each level, one can postulate a temporal hierarchy. This has been demonstrated for the level of micro-consciousness, because colour and motion are perceived at different times. It has also been demonstrated for the level of the macro-consciousnesses, because binding between attributes takes longer than binding within attributes…Micro- and macro-consciousnesses, with their individual temporal hierarchies, lead to the final, unified consciousness, that of myself as the perceiving person. (p. 217)

Although Zeki only describes three levels, in principle we could imagine that there could be many additional lower level micro-consciousness corresponding to the individual receptor cells of the retina, and ultimately down to the level of photons. Thus Zeki's model provides a manner of conceptualizing how reality may entail a hierarchical nesting of conscious observers. Accordingly, the non-organic world may involve only the most micro-level conscious observers. In contrast, life may have evolved the capacity to develop hierarchies of conscious observers within observers, with each level subsuming a more macroscopic perspective, leading ultimately to the highest level at which the unified experience of the organism occurs. Additionally, Zeki's approach offers a critical way of distinguishing these levels, namely, by the temporal order in which they occur, with higher order experiences occurring temporally downstream. In other words, Zeki's view suggests that the different conscious observers in the brain may experience the same events at different times, with the final unified consciousness entailing the longest lag.

The perspective on consciousness that emerges from considering Zeki's model in the context of panpsychism is both elegant and daunting. It requires thinking about consciousness in ways that are somewhat alien to our prevailing conceptualizations so it is worth carefully unpacking the elements.

1. *Nervous systems are composed of a hierarchy of distinct conscious observers each enjoying their own unique experience*. The tension between the unity and disunity of consciousness is a long-standing challenge. On the one hand, there is the phenomenal intuition of a unity of experience, a place in the mind where it all comes together, what Dennett (1991) refers to as the "Cartesian theatre". On the other hand there is the empirical fact that the various elements of our

ostensibly unified experience occur in different parts of the brain at different times. The fractionated nature of the processes that contribute to subjective experience is the principle source of Dennett's contention that the Cartesian theatre, i.e., the unity of consciousness, is an illusion. In its stead, Dennett's proposes a multiple drafts theory (1991) in which conscious reports are viewed as the disjointed amalgam of distinct and often competing information processing systems that never come together into a singular unified experience.[1] However, rather than concluding that there is no Cartesian theatre in which these strands of information processing come together, the alternative perspective suggested by Zeki's analysis, and the panpsychist perspective more generally, is that human consciousness entails a hierarchically organized "multiplex" of Cartesian theatres. From this perspective, every nervous system is actually a society of observers or conscious entities (Loftus and Schooler 1985; Minsky 1986), each organizing the information that they are presented with into distinct conscious experiences, and then passing those experiences on to the next level. In this model a final unified experience emerges as the highest order observer that enjoys the collective informational organization afforded by all of the prior separately conscious observers.

Various other lines of research also suggest that our brains may entail multiple distinct conscious experiences. Corpus callosotomy (split-brain) patients, for whom the primary neural bridge between the two brain hemispheres is severed, evidence a variety of behaviors suggesting that their two hemispheres maintain distinct streams of consciousness (Gazzaniga 2005). For example, when a word (e.g. bike) is presented to the left visual (right hemisphere) the patient reports not having seen anything. However, when the left hand is given the opportunity to draw what was presented it nevertheless draws a bicycle. Similarly, in the case of blindsight (Weiskrantz and Weiskrantz 2009), patients report not seeing anything when an object is placed in a particular area of their visual field, yet when given the opportunity they will reach directly for the object they had just claimed not to have seen. These and other dissociations can be readily understood by the notion that one part of the brain is experiencing a particular type of consciousness that is not available to the higher-level (or simply different) consciousness associated with the capacity for verbal reports.

2. *The various observers within a nervous system experience the same event at different times.* In Zeki's model, elements of the nervous system enjoying micro-consciousness and macro-consciousness experience different aspects of the same stimulus at successive moments in time. As Zeki observes:

[1] How phenomenal experience fits into this model has been a source of some consternation. In some places Dennett seems to suggest that phenomenal experience is just an illusion (Dennett 1991) and indeed many have interpreted him in this way (e.g. Searle 1990). In other places, however, he insists that we are conscious (Dennet 1997). Given that Dennett consistently denies that subjective experience offers any privileged information a critical question arises for him, namely, how it is that he knows that he is conscious.

> Because we become conscious of colour before we become conscious of motion, it follows that the micro-consciousnesses generated by activity at two distinct cortical sites are distributed in time as well. From this it follows that micro-consciousnesses are distributed in time and space, and that there is a temporal hierarchy of micro-consciousnesses, that for colour preceding that for motion. (p. 215)

The notion that different observers in the brain experience the same stimuli at different times also helps to account for various empirical conundrums. For example, when individuals view two lights flashing in close proximity and succession to one another, the phenomenal experience is of apparent motion in which an illusory light appears to move between the first flash and the second. If the first light is blue and the second light is yellow, the apparent motion appears to evolve from blue to green and then finally to yellow in the intervening locations between the two lights. The challenge of this illusion is how does the brain know to make the intervening value green before the yellow light has been perceived? In other words, phenomenally the order of events is blue light, green apparent motion, yellow light, whereas objectively the green apparent motion can only have been generated after the yellow light has been observed. Positing the existence of multiple experiencing observers that process their respective aspects of the event at different times helps to reconcile this apparent paradox (see Dennett 1991 for a related albeit staunchly different resolution). Accordingly, the micro-consciousnesses responsible for individual colors perceive the two flashing lights before the macro-consciousness that binds the two events together infers the illusory intervening color in between. The model that emerges from this analysis of consciousness is that the various observers entailed in the nervous system generate a layered construction of reality, with each layer passing an increasingly integrated and informationally rich experience back to the layer behind it.

3. *The grain size of temporal moments must be larger for observers that are higher in the hierarchy.* The notion that various observers in the brain pass organized experiences forward to later observers, which then integrate those experiences into yet more informationally rich experiences, necessarily requires a courser temporal grain size at the higher levels. (By temporal grain size we mean the duration of time constituting an individual psychological moment. As will be discussed further, temporal moments can be considered much like the perception of stills from a movie in which each static frame is integrated into a continuous experience. In this view, temporal grain size corresponds to the duration of time that the information entailed in any single still extends over). Consider again the case of apparent motion, in order for a macro-consciousness to infer the apparent motion and color shift between two individual flashes of light, the macro-consciousness cannot simply be delayed relative to the micro-consciousness, otherwise it would never be able to integrate the first event with the second event. In order to integrate, it must maintain both events in a larger temporal unit that extends between the two individual flashes. In short, in order to integrate distinct experiences in time, higher-order observers must necessarily have a larger temporal grain size, i.e., their psychological moments must span across longer durations than the observers that contributed to them.

4. *The impact of integrative experience is bi-directional*. One aspect of the relationship between micro, macro and unified consciousness that is not explicitly discussed in Zeki's model but which seems highly likely to be the case is that direction of information flow is both bottom up and top down. There is increasing evidence that the information processing states of higher order regions routinely work their way back to earlier levels impacting how those earlier levels process incoming information. Both the situational context (e.g. Kingstone et al. 2004) and attentional allocation (e.g. Kam et al. 2011) assessed at higher levels of processing routinely impact lower levels. It thus seems likely that not only do the low level observers pass their experiential state up to higher levels, but that the interpretations of higher level observers impact on the experience at the lower levels.

The view of consciousness that emerges from the above analysis is one in which all of matter enjoys an iota of conscious experience, but where life forms are able to construct increasingly complex experiences through hierarchies of distinct yet interrelated conscious observers. These hierarchies are akin to a society of minds, in which each observer organizes and passes experiences forward to higher-order observers. At each level of the hierarchy observers interpret the experiences they receive into an integrated and informationally richer experience that occurs later in time and subsumes a larger psychological moment. The interpretations created at these higher levels may then work their way back down to lower levels, in a recursive exchange of experiences.

The realm of information[2] – The notion that all matter (e.g. our brains) must be associated with both an inner experience and an outer condition seems to require the postulation of two sets of coordinates in order to fully describe any matter. That is, external coordinates corresponding to that matters' physical dimensions, and internal coordinates corresponding to the subjective information state that it enjoys. Thus an apparent implication of panpsychism is an additional dimensional space corresponding to the internal experience. We can call this additional dimensional space "information space." (Chalmers 1996). As the opening quote by Watts intimated, the recognition of an inside and an outside to all of reality suggests two complementary realms: the external physical realm and the internal subjective realm, or what may be described as physical space–time and information.

The neuroscientist Giulio Tononi (2008) has recently developed a sophisticated formalization of the nature of the information space that may characterize this inner realm of consciousness. Though he does not explicitly suggest the existence of two complementary realms Tononi does posit that consciousness is a fundamental aspect of the universe associated with "integrated information," which is defined as "the amount of information generated by a complex of elements, above and beyond the information generated by its parts" (p. 216). Tononi's information based theory of consciousness nicely complements many aspects of Zeki's neurocognitive theory, and the more general view presented here. Zeki's and Tononi's models assume that

[2]Hunt parts ways with the Schoolers on the ideas in this section due to its postulation of an ontological distinction between information and physical/reality, see Afterword.

the brain entails nested hierarchies of separate consciousnesses that sometimes exist in coordination and other times in exclusion of one another. Tononi's approach complements this analysis by providing a formal quantitative way of characterizing the information space that consciousness inhabits (see Hunt in press for a related approach). Critically however, neither Zeki nor Tononi fully come to terms with the implications of their complementary approaches, namely that they suggest two distinct realms of reality – the physical realm of space-time and subjective realm of experience and information. As will be seen, when we consider the challenge of conceptualizing movement in time, we again see the possible advantage of positing distinct yet inter-related realms of physical space-time and subjectivity.

The Flow of Time as a Wave of Experience[3]

As noted throughout this chapter, in addition to being unable to adequately account for subjective experience, current scientific notions offer little help in explaining the flow of time or the privileged status of the present moment, despite their phenomenological self-evidence. This challenge arises because time itself and movement in time are understood only with respect to the experience of a conscious observer, and consciousness generally has no explicit status in today's physics. A reasonable starting point for a solution is to introduce consciousness as a fundamental aspect of the universe by which movement in time is defined.

We propose that the present moment is akin to a wave of consciousness moving through physical space-time. As noted earlier, there is nothing in physics that corresponds to the flow of time. Physicist Linde (1990) observes "Thus we see that without introducing an observer, we have a dead universe which does not evolve in time" (p. 25). Yet it is self-evident that we, as conscious observers, experience change in time. If we are to maintain the self-evident fact that experience entails the passage of time, and if we maintain the Einsteinian notion that time has properties akin to a physical dimension, then it follows that the observer "moves" in relationship to time. Characterizing the collective movement of all observers in relationship to time as a wave of consciousness thus constitutes a reasonable, if not logically necessary, characterization of the flow of time.

Importantly, the claim that the ever-changing present entails in some sense the flow of consciousness through physical space-time highlights a central paradox about the experience of time whose resolution may require some further rather dramatic refinements to our current conceptualization of reality. The paradox arises from the following question: On what metric can the flow of time be gauged? The seeming answer would be time itself, but this becomes tautological, as a metric

[3]Hunt parts ways with the Schoolers on this section due to its endorsement of a block universe model of physical reality, and its suggestion of an ontological distinction between subjective and objective time (see Afterword).

cannot be both the measure and the object of measurement. The physicist Davies (2002) puts this paradox succinctly:

> But what meaning can be attached to the movement of time itself? Relative to what does it move? Whereas other types of motion relate one physical process to another, the putative flow of time relates time to itself. Posing the simple question "How fast does time pass?" exposes the absurdity of the very idea. The trivial answer "One second per second" tells us nothing at all. (p. 34)

Davies' solution to this paradox is to conclude that the flow of time is an illusion, but as we have argued such a claim is so counter to experience that it seems untenable, or at least deeply deserving of alternatives. Another option is to postulate that there may be a subjective realm of reality against which movement in objective time can be understood. Put another way, it seems possible (and perhaps even a mathematical necessity) that in order to move through space-time, there needs to be at least one additional dimension to provide the degree of freedom necessary to enable such movement, giving rise to objective time and subjective time.

Although the postulation of additional dimensions of reality should not be taken lightly, it is not without precedent. In physics, string theory has postulated seven additional spatial dimensions beyond the three dimensions of space and one dimension of time that are customarily acknowledged (Greene 2004). If there can be multiple dimensions of space, then might there not also be additional dimensions of time? Indeed, some physicists have argued that an additional dimension of time might be very useful for conceptualizing various issues in physics (Bars et al. 1998). If the postulation of an additional dimension of subjective time could also resolve the paradox of time and provide a realm for subjectivity then surely that would also warrant its consideration as a possibility.

We are not the first to suggest that the failure of objective time as it is currently conceptualized to afford the flow of time or inner experience requires the postulation of an additional subjective dimension (or dimensions) in which the observer moves relative to physical space-time. Noting the inability of current theories of physics to account for the flow of time or the existence of subjective experience, physicist Linde speculates that dimensions of consciousness may be required to provide the necessary degrees of freedom. Linde (2004) observes:

> Is it possible that consciousness, like space-time, has its own intrinsic degrees of freedom, and that neglecting these will lead to a description of the universe that is fundamentally incomplete? What if our perceptions are as real (or maybe, in a certain sense, are even more real) than material objects? What if my red, my blue, my pain, are really existing objects, not merely reflections of the really existing material world? Is it possible to introduce a 'space of elements of consciousness'….? (p. 451)

The neuroscientist/neurophilosopher John Smythies (2003) similarly observes the challenge of current conceptualizations of time for accommodating the flow of time, noting:

> If one wants to account for our psychological impression that there is a 'now' in time and moreover that time in some way flows, we must look elsewhere than contemporary physics, whether Newtonian or Relativity, to find it. (pp. 53)

Like Linde, Smythies (2003) concludes that in order for time to flow, consciousness must move in real time through both physical space/time and additional dimensions of phenomenal space. Concluding:

> So the new formulation of reality might consist of the following ontologically equal partners — (A) physical space-time (10 or more dimensions) containing physical matter (protons, electrons, etc.); (B) phenomenal space (3 more dimensions of a parallel universe) containing mind stuff (sensations and images); and (C) real time (time 2). A and B are in relative motion along the time 1 axis *in* time 2. Their contents are in causal relations via the brain. The psychological 'now' of time marks the point of contact of the two systems. (p. 55).

We remain agnostic regarding precisely how many additional dimensions may be required in order to provide the degrees of freedom necessary for time to flow and matter to have an experiential inside as well as an outside. Indeed we are not even committed to the notion that such a realm must necessarily be thought of as possessing all of the mathematical formalities of spatial dimensions. Our point is simply that the current material reductionist model of reality has left no "room" for time to flow or for matter to have internal experience. It is as if modern physics has built a pendulum clock but left no space for the pendulum to swing. In statistics there always must be one more degree of freedom than the total number of subjects and conditions so as to leave the freedom for variables to vary. We believe that such degrees of freedom are similarly required to enable the flow of time and a realm of experience. This space of subjectivity, which we believe could be formalized in much the same way that physical reality is formalized (e.g. Tononi 2008), needs to be given its due and recognized as a genuine aspect of reality requiring its own degrees of freedom.

Again consider the flow of time from an inside out perspective, i.e. from how each of us experiences it. What is evident is that each of us is moving both through objective time – clocks always tick – and information. At each moment in time we are exist as a slightly different informational state, a changed understanding of the situation. Conceiving of a subjective realm that changes with respect to, yet is distinct from, an objective realm provides a way of thinking about the flow of time that may enable the integration of two longstanding alternative views. One view, labeled by the philosopher McTaggart (1908) the "A theory of time" and stemming back as far as the Greek philosopher Heraclitus, characterizes reality as an ever-changing process of constant flux. In this view, the past is fixed, the present is the point at which reality continuously manifests, and the future is indeterminate. A second view, termed the "B theory of time" and stemming back to the Greek philosopher Parmenides, characterizes reality as fixed and existing in its entirety. According to this view, also entailed by today's standard block universe account, the past, present, and future all exist and are equally real. The view that we are suggesting here is a compromise between these two accounts, whereby the past and the future exist equally in the realm of physical space-time. In contrast, the present is realized exclusively in the subjective realm of experience. The general view of time that we are speculatively proposing has three key elements

1. *Physical space-time exists as continuous extension between past, present, and future.* This claim is largely in keeping with the notion of a block universe, in

which the past present and future are all equally real despite the fact that observers only perceive the present. However, in contrast to the naïve realism often associated with the materialist perspective (in which it is assumed that physical reality is directly experienced), in the present view observers never actually experience physical/space-time directly. Rather they construct representations of it in the subjective realm (discussed below). Importantly, the dimensions of physical space-time are assumed to be continuous, lending it to the mathematics of Newtonian physics and relativity theory..

2. *Subjective reality exists as a process of changing discrete states.* In stark contrast to continuous space-time, the subjective realm manifest as a series of discrete moments. Each observer moves in discrete intervals between successive values in space-time. The values encountered at each sampling are translated into experienced information. Subjectivity entails the sewing together of distinct informational states into the experience of a continuous flow of time. Because it entails discrete changes, the subjective realm is suited to the mathematics of quantum mechanics and information theory.[4]
3. *Given that physical space-time is continuous, every discrete subjective moment entails alternative potential instantiations.* Just as there are numerous ways that a loaf of bread can be sliced, so too the quantization of continuous space-time into corresponding discrete subjective moments affords multiple alternative instantiations of each subjective moment. In this context, the set of possible alternative instantiations of reality correspond to what is referred to in quantum physics as the probability cloud. The collapse of the probability cloud involves the measurement process, whereby specific values of space-time are extracted into a particular subjective moment. The upshot of this construal is that the subjective slicing up of objective space-time affords multiple possible ways in which experienced reality can unfold.

A Rudimentary Framework of Reality[5]

With these conjectures regarding the nature of consciousness and time in hand, we can now state our thesis succinctly – we suggest that *physical space-time exists as a multidimensional continuum, while subjectivity quantizes space-time*

[4]In this regard is notable that information theory specifically requires that observations proceed in discrete steps rather than being continuous. As Turing observes "It is easy to show using standard theory that if a system starts in an eigenstate of some observable, and measurements are made of that observable N times a second, then, even if the state is not a stationary one, the probability that the system will be in the same state after, say, one second, tends to one as N tends to infinity; that is, that continual observations will prevent motion …" Alan Turing quoted in Teuscher 2003 (p. 54)

[5]Hunt parts ways with the Schoolers on the ideas in this section because it builds on the previously noted disputed assumptions (see Afterword).

in the process of moving from one moment to the next.[6] An intuition of our thesis can be gleaned by considering the metaphor of making a movie. Rather than extracting a continuous representation of reality, a movie camera takes a series of stills, thereby converting a (seemingly) continuous stream of events into a discrete set of static images. However, when viewed, the movie is not perceived as a set of stills but rather as a moving picture. In fact, the speed at which each frame is presented relative to consciousness is so fast that were any frame presented alone, and sensory memory prevented, the frame would not be experienced at all. In effect, when we watch a movie, we are not seeing the actual physical frames at all. What we are seeing is the extended unpacking of the frames in our subjective experience. We suggest that the relationship between the subjective realm and physical space-time may be very much like the process of creating and watching a movie. Each observer moves in relationship to physical space-time, sampling moments (taking stills) as it goes. However, these individual moments are not experienced as such but rather inform the generation of a dynamic subjective representation (watching the movie). Much like Plato's cave metaphor, we don't observe objective reality itself, but rather the reflections of reality as they unfold in our subjective experience.

Closely akin to the snapshot/movie metaphor is the old-fashioned flip book, in which the flipping of pages creates a dynamic animation. We suggest that every entity engages in a process that is equivalent to taking two-sided snapshots of physical reality. One side – the out-facing side is then visible to all other observers. The other side – the in-facing side, corresponds to the observers' own personal perspective. Moreover, rather than taking full pictures of reality, like the layering of a cartoon, each observer does not necessarily provide an opaque frame but rather creates the equivalent of semi-transparencies in cartoons, thereby enabling the layered psychological moments of higher order consciousness. In this manner, each entity in the hierarchy is alternately audience and artist, as it perceives the layers ahead of it, and selects its own particular layer to add to the stack.

Now consider this model from the inside out perspective of the observer. When we attend to our visual experience, in effect we are seeing the experience of earlier entities in our sensory systems, the semi-transparent layers of the metaphorical cartoon flipbook that they have laid down. How many frames have been laid down before we add our own subjective viewpoint on reality depends on how far back in the temporal hierarchy one resides. Micro-consciousnesses experience fewer layers than macro-consciousnesses, which in turn receive fewer layers than the unified experience of the human self. Accordingly, the thickness (number of separate

[6]We note that this account shares some at least superficial similarity with the physicist Lynd's (2003) discussions of the relationship between subjective and physical instantiations of time. Lynd observes "there is not a precise static instant in time underlying a dynamical physical process… it is the human observer who subjectively projects, imposes and assigns a precise instant in time upon a physical process, for example, in order to gain a meaningful subjective picture or "mental snapshot" of the relative position of a body in relative motion" (p. 2).

frames an observer experiences) is inversely related to how early in the set of layers the observer exists. The simplest units of matter – strings, subatomic particles, or whatever units physicists decide are ultimately the tiniest units – have the thinnest duration, while representing the least amount of information in each slice. Consistent with our previous discussions, life may have taken advantage of this fundamental characteristic of the universe, and evolved hierarchical systems of distinct conscious observers that organize experienced moments of increasing numbers of layers, with ever longer (thicker psychological moments), including ever greater amounts of information.

This view also suggests that organisms may have developed increasingly layered systems that are able to amass more and more information, but with thicker and thicker experiential moments. For example, insects may have a relatively short hierarchy of layers leading their unified experience to have experiential moments that quickly processes the environment, but represent relatively little information between one moment and the next. The extended hierarchical structure leading to the higher-order thought associated with the human cortex, may enable us to represent vast amounts of information during each experiential moment, but with each moment corresponding to markedly longer durations. This may explain why it's so hard to swat flies: to them it is as if we are moving in slow motion.[7]

A crucial aspect of the present characterization is that it affords a meaningful way of conceptualizing the source of the unity of conscious experience. Accordingly, each observer maintains its own subjective distinctiveness by virtue of its unique sampling rate, the unique coherence that it maintains between its constituents from one snapshot of physical space-time to the next. Potentially, this sampling rate may correspond to the EEG synchronization that is observed between the neurons contributing to a coherent experience of consciousness (Hameroff 2010). An accumulating body of research suggests that the best neural marker of consciousness is the synchronization of the fluctuation of electrical activity associated with neurons.[8] Intriguingly, although EEG synchrony is one of the most promising neural signatures of consciousness (Hameroff 2010), at present there exists no complete explanation either for the source of this synchronization or the instantaneity by which it occurs across distributed brain regions. For example, Freeman and Vitiello (2006) examined the rate of EEG synchronization between the primary sensory and limbic areas in rabbits and cats. They found rates of

[7] We thank Rachel Schooler for this observation.

[8] Striking evidence from binocular rivalry studies (in which competing images are presented to each eye) suggest that while the magnitude of such synchronizations is greatest for the reported percept, synchronization is also associated with the image that is not currently being reported (Srinivasan et al. 2009). This suggests that in binocular rivalry experiments, a conscious experience of both images is maintained in the visual system and reflected by distinct coherent patterns of oscillation associated with each. However, at any one time only one of those conscious experiences is integrated into the higher order experience associated with the observer that is capable of verbal report.

resynchronization between these regions that exceeded the rates permitted by neural propagation mechanisms. As they observed:

> The dominant mechanism for neural interactions by axodendritic synaptic transmission should impose distance-dependent delays on the EEG oscillations owing to finite propagation velocities and sequential synaptic delays. It does not. (p. 93)

The difficulty of standard neuronal mechanisms in accounting for the instantaneity of EEG synchrony potentially represents the type of anomaly (Kuhn 1962/1996) that could leverage serious consideration of the kind of accounts being offered here. Indeed, others have similarly suggested that the synchronization of consciousness may be mediated by processes that are either not currently acknowledged (e.g. Libet's 2004 notion of a "conscious mental field") or that link processes that are currently viewed as entirely disparate (e.g. Hameroff and Penrose 2001 suggest that conscious awareness is associated with quantum collapse). Our suggestion is that it is their connectivity in a subjective realm that allow seemingly distinct elements to develop a synchrony of oscillations such that their temporal gap between one objective moment and the next is identical. From this perspective, then, it would be predicted that disparate brain regions corresponding to a singular subjective experience would evidence a speed of synchronization that would continue to defy recognized modes of transduction in the brain. Clearly, future research needs to carefully follow up on claims that EEG synchronization exceeds the maximum speed of electrochemical signaling, as this could prove a promising avenue for exploring the ideas proposed here.

Other Implications of the Present Approach[9]

The suggestion that the flow of time entails the process of translating segments of continuous space-time into a subjective informational realm that represents those segments as a series of experienced moments, affords a possible way of thinking about several other thorny issues, including (1) a substrate in which to construe meaning; (2) the postulation of laws of consciousness that parallel those of matter (3) an opportunity for postulating genuine free will. It is well beyond both the scope of this chapter or the capacity of the authors to fully defend these claims but allow us to make a few comments with respect to each.

The Domain of Meaning

There is a long tradition of thinkers including Plato (transl. 2008), Kant (1781/1896), Whitehead (1929), and more recently Penrose (1989), and Baumeister (2008a, b) who have argued that the domain of meaning is distinct from the material world.

[9]Hunt also does not agree with some of the ideas in this section, again because they build on disputed ontological distinctions (see Afterword).

From lofty mathematical theorems to simple perceptual interpretations, the understanding of information is, it is argued, is aligned with but distinguishable from the contents of the physical world. Baumeister (2008b) puts this idea as follows:

> Thus, what brains and bodies and other physically real things do conforms to the rules of nature. But they evolved (physically) to take input from another kind of reality that is invisible and not itself made of molecules. These realities include abstract concepts such as justice, credit limits, plausible deniability, floating exchange rates, identification with a religious sect and doctrine, and limited money-back guarantees. None of these things are made of molecules, but molecules are moved because of them. The proposition of a subjective realm in which consciousness extends would afford a landscape in which to represent the "kind of reality" that entails the understanding of information. (p. 37)

The existence of a subjective realm provides a domain of reality in which the understanding of such information is realized. Communication, and in particular language may dramatically enhance this realm by enabling the development of an inter-subjective domain of shared information. Although represented in, and an extension of each individuals private experience, this domain of shared understanding may serve as the foundation of culture and the repository of accumulated wisdom.

Laws of Consciousness

The hypothesis that consciousness represents a fundamental aspect of the universe suggests that consciousness may be guided by lawful rules that parallel physical systems (Schooler 2010, 2011) For example, coherent conscious entities may vary in their "size" in a manner akin to physical mass. Similar to the way in which physical solids are distinguished from gases by virtue of the synchronized movement of their atoms through physical time, higher order mental entities may exist by virtue of the synchronized sampling rate of physical time. In this sense, higher order mental entities might be thought of as possessing a greater "mental mass". Likewise the movement of mental entities through time may be likened to inertia, where the greater the mental mass the more force is required to shift the trajectory of the agent. Such "mental inertia" may play a significant role in constraining the opportunity for genuine free will (J.N. Schooler 2010, 2011). However, limited free will might still be possible if we add the further speculation (suggested previously and developed more below) that an intrinsic aspect of consciousness is its capacity for choice. Accordingly, in addition to being impacted by outside forces, mental agents may introduce their own internal source of impetus that is a function of the rate at which they sample physical time.

Free Will

One of the most disheartening implications of the standard block universe model of time is that it seems to rule out any genuine form of free will. If the future is already determined then in it is not possible for one to choose otherwise. And if one can't

choose otherwise, then in what sense can one's decisions really be said to be free? Importantly, the notion of alternative possible futures follows naturally from our suggestion that subjective experience samples discrete moments from continuous space-time. Because there are a potentially infinite number of ways to divide a continuous dimension the quantizing of continuous space-time into discrete subjective moments potentially affords multiple alternative instantiations of each subjective moment. Returning to the flipbook metaphor, depending on the timing of the snapshots the nature of the flip book could be quite different. For example, if a flip book of static images was created corresponding to snapshots of a serial alternation of two different patterns, the pattern that actually appeared in the flip book would depend on the timing of the snapshots relative to the timing of each patterns' respective appearance. If space-time entails continuous dimensions that are segmented by subjective moments, then how those moments are segmented may determine how they are perceived to unfold. Thus the present model potentially provides a way in which the future could remain indeterminate.

The possibility of alternative futures is a necessary but not sufficient condition for genuine free will. For free will to be meaningful, consciousness must have some role in how alternative futures manifest. One way that consciousness might exert control in the unfolding of the future is by discerning the precise intervals of physical space-time contributing to each psychological moment. As discussed above, if observers could control the intervals associated with every subjective moment they could then impact on how their flip book was constructed. In effect they could tune in to the frequency of space-time that was most desirable, decipherable or whatever criteria they were concerned with. In this regard, it is notable that a fundamental characteristic of sensory systems is the process of entrainment, whereby they come to oscillate at rhythms mirroring those associated with the stimulus to which they are attending. Such a process is exactly what one would expect if such systems corresponded to conscious observers attempting to select temporal intervals that provided maximum information regarding the variables they are concerned with. In short, conscious control of how reality unfolds could be implemented in the current framework simply by varying the rate at which observers sampled physical space-time.

Ultimately, however, the essence of free will depends on whether top down processing can be genuinely causal, or whether the only causal direction is (as commonly assumed in physics) bottom up. In other words, even if conscious observers could impact on the unfolding of reality by varying the frequency with which they sampled space/time, it would not necessarily follow that they were exerting genuine causal control. Their behavior could simply be the necessary consequence of bottom up prior causal factors. We acknowledge that the present view remains consistent with an ultimately impotent view of consciousness. However, we make a case for genuine downward causation by returning again to the inside out perspective we have advocated throughout this chapter.

Next to subjectivity and change, the third most self-evident aspect of experience is choice. When one chooses to raise a hand we typically do. More generally, the intentions and actions that we bring to consciousness are markedly more likely to come to pass than those that we don't. In a recent extensive review of studies

investigating the relationship between consciousness and action (Baumeister et al 2011) conclude:

> The evidence for conscious causation of behavior is profound, extensive, adaptive, multifaceted, and empirically strong. However, conscious causation is often indirect and delayed, and it depends on interplay with unconscious processes. (p. 1)

Thus, phenomenologically it certainly seems as if consciousness causally contributes to action, and the empirical data can certainly be interpreted in this manner. The only question is whether this intuition must be abandoned based on a commitment to the view that causality can only proceed upward.

One approach for enabling downward causation is to suggest that it is an emergent property that somehow in the chain of being a new direction of causality became possible where it did not exist before (e.g. Campbell 1974). We have already argued strenuously that the claim that a completely unprecedented element emerges where there was no hint of it before is nothing more than a reiteration of "then a miracle occurs". In our view, if one is going to posit entirely inexplicable elements to a system, they should posit them along with all the other inexplicable elements, as the initial axioms. We do not try to explain why gravity or mass exist, we simply take these and a host of other essential elements of the universe as fundamental and assume that they play out at all levels. We have already argued that the same seems appropriate for consciousness. Having acknowledged the potential fundamentality of consciousness it seems appropriate to consider whether along with consciousness may come the property with which it is most often linked namely – agency. Perhaps consciousness is just along for the ride and offers no causal impact of its own. But it certainly does not feel that way, none of us, not even hard nose determinist act this way, and within the broader context of the metaphysical approach articulated here, a coherent scientifically grounded world view does not demand that we accept that consciousness is impotent. While it may be true that there is only upward causation, and the seeming impact of consciousness is just an illusion, we feel it is not unreasonable to speculate that agency is an inherent aspect of consciousness, and that both are inherent aspects of the very fabric of the universe. Accordingly, all levels of the universe may entail a bi-directionality of causality. Upward causality may be a consequence of the inherent structure of physical-space time. Downward causality may be a consequence of the unfolding of subjective time, whereby consciousness exerts its control in the process of segmenting physical time into discrete subjective moments. At a minimum, such an account seems to keep the door open on the possible existence of genuine free will.

Flatland – An Allegory

We recognize that we have introduced a plethora of ideas that are likely to jolt many readers. There is a natural tendency when faced with alien ideas to recoil, to dismiss them out of hand. Indeed, when worldviews are challenged, individuals will often experience dissonant reactions, and respond by more stridently asserting ideas that affirm their core values (Proulx and Heine 2006). Even scientists, who often try to

present themselves as more rational than the average person, will vehemently cling to their existing paradigm long after facts suggest a change may be warranted (Kuhn 1962/1996). Undoubtedly, many readers are experiencing just such a response to the ideas presented here. Indeed, such reactions are both natural and appropriate. We believe we have reviewed some potentially serious problems with the current metaphysical assumptions of mainstream science, and some potential alternatives that might begin to redress these issues. However, we fully recognize that the alternative suggestions that we have proposed are far from fully fleshed out. They are merely presented as a springboard for opening up discussion about possible ways of resolving some of the core limitations in the prevailing metaphysics. Readers are unlikely to abandon long-held views, but perhaps we can instill some doubt regarding views that previously were considered unassailable, and introduce the beginning of speculations about alternative promising approaches. Indeed, to be a true skeptic one must question not only those ideas towards which one is disinclined, but also those that are appealing. Toward this goal, we invite readers to reflect on the ideas presented here in light of the wonderful allegorical tale of *Flatland*, written by Edwin Abbott (1885) more than a century ago.

Flatland depicts a two-dimensional world that is visited by a three-dimensional being. The protagonist of the story is a square who has a dream in which he meets the king of a one-dimensional world ("lineland"). From his two-dimensional perspective the square is able to see right into the middle of the king, as well as all of the subjects to his right and left. The king, who can hear the square but not see him, is incapable of conceiving of the square's claim of the existence of another dimension. Later the square encounters an anomaly in his waking life: a circle that appears out of nowhere, grows, shrinks, and finally disappears. Although no longer visible, this anomalous being informs the square that he is a three-dimensional sphere who has just passed through flatland. The square is initially as disbelieving of the sphere's claims of three dimensions as the king of lineland had been of the existence of a second dimension. However, the sphere proceeds to pull the square out of flatland, providing him with a view that he never before could have imagined. Enthralled by his newfound understanding of the existence of a higher dimension, the square asks the sphere about the possible existence of yet a fourth dimension, exclaiming:

> But just as there was the realm of flatland, though that poor puny Lineland Monarch could neither turn to left nor right to discern it, and just as there was close at hand and touching my frame the land of Three Dimensions, though I, blind senseless wretch had no power to touch it, no eye in my interior to discern it, so of a surety there is a Fourth Dimension, which my Lord perceives with the inner eye of thought. … I ask therefore, is it, or is it not the fact that ere now your countrymen also have witnessed the descent of Beings of a higher order than their own, entering closed rooms, even as your Lordship entered mine. (p. 135–136)

Although confirming the square's conjecture that the inhabitants of his three-dimensional world had reported such sightings, the sphere dismisses them, observing:

> It is reported so. But men are divided in opinion as to the facts. And even granting the facts, they explain them in different ways. And in any case, however great may be the number of different explanations, no one has adopted or suggested a theory of the fourth dimension…. Most people say that these visions arose from the thought… from the brain; from the perturbed angularity of the Seer. (p. 137–138)

Following the square's persistent suggestion of the possibility of higher order dimensions, the Sphere becomes infuriated and throws the square back into flatland where he is promptly convicted of blasphemy.

The story of flatland offers a number of useful lessons for the present discussion. First it provides a powerful metaphor for thinking about the existence of additional dimensions of reality. Long preceding relativity theory, which treats time like a fourth dimension, or string theory, which currently posits the existence of up to seven additional spatial dimensions (Greene 2004), Abbot's tale introduces us to the concept of higher order dimensions. Flatland describes how additional dimensions can be both embedded in and yet simultaneously transcend what we know. Facts that seem anomalous in n dimensions may be entirely resolved in n + 1 dimension. The parallels to consciousness are striking. When the square moves to the third dimension he suddenly sees inside the objects of flatland. Like consciousness, movement in an additional dimension enables the perception of an inside where none could otherwise be possible. Like consciousness's relationship to reality, an additional dimension intersects with the lower dimensions and yet is distinct from them. And like the recognition of an additional dimension, positing consciousness as a fundamental feature of physical reality resolves anomalies that otherwise seem to be incapable of naturalization into the broader theoretical framework of modern physics.

In addition to the explicit demonstrations of how beings could be oblivious to the higher dimensions in which they are embedded, the story of flatland also includes more subtle insights about the relationship between dimensions that may be relevant to the present discussion. Although the beings in flatland had no concept of up/down, upon reflection they should have been able to infer it. This is because in order to have any existence at all they would have had to have a modicum of thickness in the up/down dimension. If they had no thickness at all, they wouldn't exist at all. Even if they were unable to move in this dimension, their very existence could have led to the inference that this dimension must exist. In principle, the same argument may hold for our experience of time. In order to experience time at all we must have some extent in it. In much the same way that the residents of flatland required another dimension of space to exist in the two dimensions of flatland, we and everything else may require another dimension of time to exist in time.

A further implication of the story of flatland comes from the similarity between the added perspective that the square provided to the monarch of Lineland, and that the sphere provided to the square from Flatland. The square infers, based on these parallels alone, that there must be a realm with dimensions even greater than that enjoyed by the sphere. In each of these cases, the higher order beings are able to perceive relationships between parts that the lower order beings were not. This depiction is strikingly reminiscent of the levels of consciousness suggested in this paper. The jump from micro-consciousness to macro-consciousness, or from macro-consciousness to unified experience is potentially similar to the realization of higher order dimensions.

The final critical parallel between flatland and discussions of consciousness is how the beings at every dimensional level respond to the suggestion that there

could be dimensions higher than their own. The monarch of lineland, the residents of flatland, and even the enlightened sphere of spaceland, all recoil at the suggestion of higher dimensions. These claims are viewed as preposterous, supernatural, and even blasphemous. The parallels to present views regarding consciousness are unmistakable. Just as the authorities of flatland viewed the notion of a third dimension that transcends the known principles of their two dimensional world as undeserving of consideration, so too the scientific establishment of our day often disdains the notion that consciousness might have any properties that transcend those ascribed to the third person perspective of material objects. The hubris that the beings of flatland evidenced in their assurance that nothing beyond the world as they construed it might exist characterizes well the prevailing physics and metaphysics of today.

Ultimately, the most important lesson from the allegory of flatland is the need to maintain humility regarding what is possible and what is impossible. Experiences or claims that may seem ludicrous or supernatural can, from a more informed perspective, turn out to be accurate. This has been demonstrated many times in the history of human thought. The realization of such truths may require a major shift in worldview but certainly not an abandonment of reason (Kuhn 1962/1996). In a very illuminating passage about meteorites – objects falling from space to Earth – we see the hubris that is present in all ages with respect to the prevailing understanding of nature (Krinov, quoted in Koestler 1978):

> During the period of vigorous scientific development which took place during the eighteenth century, scientists came to the conclusion that the falling of meteorites upon the Earth is impossible; all reports of such cases were declared to be absurd fiction…even the well-known chemist Lavoisier signed a memorandum in 1772 with scientists of the Paris Academy of Sciences, which concluded … that 'the falling of stones from the sky is physically impossible.' (p. 322)

Eventually, of course, the prevailing understanding of physics needed to be changed in order to accommodate the genuine existence of meteorites. Such accommodation may have been substantial but it did not require abandoning reason or the scientific method. Similarly, although the prevailing metaphysics is forced to treat subjectivity as inconsequential and the flow of time as illusory in order to reconcile them with scientific facts, this does not mean that all metaphysical frameworks must be so constrained. Ultimately, there may be ways to conceptualize extant and future scientific findings within a metaphysical framework that does not force us to ignore or abandon the subjectively self-evident facts that experience exists and time flows.

Afterword

As noted earlier, the Schoolers and Hunt differ on a number of central speculations in the second half of the paper. The following is a brief summary of a few of the key issues of contention, presented from the perspective of Hunt and the Schoolers in turn.

Hunt – I respectfully part ways with the Schoolers in the above treatment of time and information. I have fleshed out my views on time and information, which combine the ideas of subjective and objective time into a single dimension of time that is quantized at the most fundamental level, in Hunt 2010, in press. I am uncomfortable with the ontological dualism suggested by the Schoolers in their postulation of distinct subjective and objective realms, primarily due to the same problems that are raised by all dualist ontological theories, including Descartes' well-known dualism. That is, how do these distinct realms interact?

The difference in my view is that I do not distinguish between objective time and subjective time in an ontological sense. Rather, there is one ontological (objective) time that may be experienced at different rates by each subject, but this is merely an epistemological, not ontological, difference. The block universe concept, which leads to the problematic objective/subjective time dichotomy, arises primarily from Einsteinian relativistic physics. There is a broad consensus today that relativistic physics requires accepting a block universe because of the "relativity of simultaneity," as described in the body of this paper. However, the relativity of simultaneity is not a logical, philosophical or scientific necessity, as its proponents often suggest. Rather, there is a lengthy history of debate in this area in the philosophy of physics that demonstrates the feasibility – and from my point of view the desirability – of absolute simultaneity.

This alternative view, known as the "conventionality of simultaneity" argument, asserts that Einstein's special theory of relativity assumes a constant speed of light for all observers, as a stated postulate, but that this postulate is a mere "convention," as Einstein himself states. In other words, there are many other possible postulates regarding the speed of light that lead to the same empirical results. This is the case with Lorentz's "ether theory," a competitor to Einstein's theory of special relativity that Hendrik Lorentz, a Nobel Prize winner from Holland, developed in the early part of the twentieth century before Einstein's competing theory. Lorentz's ether theory asserts that the relativistic effects of length contraction and time dilation are caused by interaction with a non-material ether akin to Newton's absolute space. A key feature of Lorentz's view of time dilation, however, is that time dilation refers only to how clocks track time, which is independent of the background "absolute time."

The general view of physicists and philosophers today who track this debate is that the Einsteinian special relativity and Lorentzian relativity theories (Lorentz 1895, 1899) are empirically indistinguishable (they use the same mathematical formulas, known as the "Lorentz transformations") but that Einsteinian relativity is preferred because it is simpler. I disagree with this conclusion for a variety of reasons, not least because of the havoc Einsteinian relativity wreaks on the ontological validity of the passage of time and of free will, which leads to all the problems regarding the nature of consciousness and time that are described in the present paper. Many other philosophers and physicists have supported the "conventionality of simultaneity" arguments over the decades, including Hans Reichenbach, Adolf Grunbaum, Franco Selleri, and many others, as cited in Max Jammer's (2006) *Concepts of Simultaneity*, an excellent primer on these issues.

Moreover, beyond "mere" philosophical arguments regarding alternatives to Einsteinian relativity and the block universe view, we have the very compelling empirical results from various entanglement experiments in quantum physics. These experiments, led by Alain Aspect and his team in France in the 1980s (Aspect et al. 1982) and most recently with Daniel Salart's work in Switzerland in 2008, demonstrate that some kind of causal influence travels between particles far faster than the speed of light – at least 10,000 times the speed of light, according to Salart and his team. This evidence alone demonstrates the invalidity of Einsteinian relativity as a necessary statement about the ontology of the universe. The debate on the ultimate nature of time and free will is, accordingly, still very open.

With respect to information, I also view information as an epistemological concept and not an ontological concept. We can describe reality as particles, energy, etc., or we can describe reality as more fundamentally simply "information." And there are of course many other possibilities with respect to these and other concepts, which mean only what we choose them to mean (as Humpty Dumpty said so aptly). Regardless of our terminology, we are led to the same insights about reality – which is ultimately only the collection of sense-data each of us receives about the world "out there," and nothing more. But we can't use both sets of terminology at the same time. So, from my point of view, if we describe reality as consisting of information, then the same rules and philosophical considerations apply to this information-based reality as we would otherwise ascribe to a matter/energy-based reality. It's just terminology. Thus information has no ontological status above and beyond matter/energy.

A final note is warranted: though I part ways with the Schoolers in using "information" as something ontologically distinct from matter/energy (the physical universe), I do agree that there is more than just the four dimensions of space and time in the totality of reality. There is not space to flesh out this view here, but I have done so in my other works, detailing how the "new ether" or "ground of being" concept is a necessary concept in physics, psychology and spirituality. There is, thus, something beyond, behind, under or above the four dimensions of physical reality, which plays a key role in determining how each chronon and how each actual entity is instantiated. This may be described as ether, ground of being, *Brahman*, *apeiron,* or any of many other terms. As I and the Schoolers continue to flesh out our views on these highly interesting, complex and important ideas I believe we may re-converge in our views – as the creative advance works its magic.

The Schoolers respond: A key source of contention between our perspective and that of Hunt's is the age-old question of how to conceive of the divide between subjective and objective. We believe that both subjective and objective attributes of reality can be conceptualized within a single system, that they nevertheless represent fundamentally distinct aspects of reality. Hunt characterizes our view as essentially dualist, and therefore susceptible to the same criticisms that have haunted dualist perspectives since Descartes, namely, how it is that the two realms interact, if they are distinct. Critically, it is our claim that domains can be distinct and yet nevertheless interact in meaningful ways. As mentioned earlier we believe that the distinction between dimensions may mirror the relationship that consciousness may have

with physical space time. Just as objects possess distinct coordinates in space and time, so too may they have distinct coordinates in experienced information space. Similarly, just as matter and space are fundamentally different yet we can understand how matter moves through space, so too we can conceive of consciousness as distinct from physical space/time and yet still capable of moving through it. Like matter and space, consciousness and objective space/time may be qualitatively different in their properties yet nevertheless inseparable.

We concur with the perspective of the opening quote of Alan Watts in which he suggests that although objective and subjective aspects of everything are different that they nevertheless go together. Hunt also agrees with this sentiment, so it seems that the crux of the issue boils down to what "different" means. From our perspective all matter may indeed have both an outside form that it presents to others and an inside state that it experiences, but these two aspects, though necessarily interdependent, have distinct natures.

Consider for example the difference between matter/energy and information states. Admittedly, when one speaks about matter/energy we are necessarily referring to our informational states about matter/energy. Nevertheless we believe there remains a fundamental difference between the presumed physical states of an objective universe whose characteristics can only be inferred and the experienced informational states of conscious beings. To be sure, our knowledge of physical states exclusively entails our inferences about the characteristics of a physical world. Nevertheless, to the degree that we take the existence of a physical world seriously we can make a fundamental distinction between the presumed states of a physical world that we infer from our observations, and the known informational states that we consciously experience. In our view, the fact that we know information but can only infer the physical world illustrates the fundamental nature of their distinction.

A similar argument can be made for the distinction between objective and subjective time. Objective time corresponds to the time of clocks. It has a precise measurable quantity that can be defined in terms of physical events. Subjective time in contrast is defined exclusively with respect to the experience of the conscious observer. Both, however, carry comparably significant yet distinctly different meanings. While objective time can be physically measured, what is of value from the vantage of the experiencer is not how much time has actually passed, but how much time felt like it passed. Neither objective time nor subjective time can be dismissed, nor can either be reduced to the other, leading to the seemingly inevitable conclusion that they are fundamentally distinct constructs.

Hunt also takes issue with the notion of the block universe, and the related premise that consciousness can be thought of as a wave moving through physical time. He rejects the block universe notion in favor of absolute time and an ontologically real present. We think that the idea of absolute time has much to commend it as it offers a more meaningful way of conceptualizing the privileged present. From our view, however such a framework is not inconsistent with the notion of consciousness as wave. Rather, from this perspective the wave of consciousness would correspond to the cusp of the progression of absolute time moving through some type

of absolute ether. Of course all of these suggestions are highly speculative. Our point in offering them is not to necessarily be correct, but rather to encourage bolder speculations about alternative ways of conceptualizing the physical and the mental within a single overarching framework.

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