

THE EMERGENT DUALISM VIEW OF QUANTUM PHYSICS AND CONSCIOUSNESS

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*“In our description of nature the purpose is not to disclose the real essence of phenomena but only to track down as far as possible relations between the multifold aspects of our **experience**.”* – Niels Bohr (1934, p.18)

*“The conception of the objective reality of the elementary particles has evaporated not into the cloud of some new reality concept, but into the transparent clarity of a mathematics that represents no longer the behavior of the particles but our **knowledge** of this behavior.”* – Werner Heisenberg (1958, p. 95.)

*“In short, orthodox quantum mechanics is Cartesian dualistic at the pragmatic/operational level, but **mentalistic** on the ontological level.”* – Henry Stapp (2009, p. 8).

Abstract: This paper introduces the ontology of Emergent Dualism, which takes the position that the elementary stuff of everything in the universe is energy, that this energy can become structured into a series of levels of emergent organization whose operating principles are not derivable from the previous levels, that one of these levels is the concatenations of neural processes called brains, that brains have some particular emergent process that gives rise to subjective experience from the internal viewpoint of that process, and that the private, subjective property of this emergent process entails a dualistic philosophical treatment of its analysis.

Keywords: Reality; Quantum physics; Philosophy of mind; Dualism; Monism; Emergence; Subjectivity; Consciousness; Energy; Mind/brain problem.

1. QUANTUM REALITY

The goal of this treatment is to develop a new philosophical position on the nature of reality, with an emphasis on the nature of the quantum realm as a whole. It has long been recognized that the quantum realm is somehow wrapped up with, or entangled with, the consciousness of the observer – the physicist conducting the quantal experiments. Therefore a theory of quantum reality has to take into account its relationship to the observer’s consciousness.

It seems, however, that this relationship has been widely misunderstood by physicists, perhaps stemming from the analysis of von Neumann (1932). The three header quotes, two from the originators of the core Copenhagen Interpretation of quantum phenomena, are chosen to emphasize the inability of this interpretation to access the underlying physical reality: “the purpose is not to disclose the real essence of phenomena” (Bohr); “The conception of the objective reality of the elementary particles has evaporated” (Heisenberg). These are very strong statements that are nevertheless ignored by almost all quantal ontologies. (See the website: https://en.wikipedia.org/wiki/Interpretations_of_quantum_mechanics).

If we disavow the possibility of knowing the underlying reality, what is this to be replaced with? For Bohr it was “relations between the multifold aspects of our **experience**”; for Heisenberg, it was “a mathematics that represents no longer the behavior of the particles but our **knowledge** of this behavior”. Thus, what are being described by the equations of the quantal mathematics are purely structures in the mind of the observer. The full force of this limitation is highlighted by Henry Stapp’s quote that “orthodox quantum mechanics is . . . **mentalist** on the ontological level”.

The term “ontology” refers to our understanding of the underlying reality of the experimental observations. Thus, all three of these quantum theorists are understanding the underlying reality of what the mathematics is describing as being the mentalistic knowledge of the experience of their observations of the physics experiments. The goal of this paper is to take this specification as literally as possible and elaborate it into a full philosophical position. (Note that Stapp, despite his quote, immediately reinserts an underlying physical reality, termed “process 3” to denote the underlying reality of “nature’s response to the [observer’s] probing action”. He does not, therefore follow the core implications of these three quotes, which are indeed all from his paper, Stapp, 2009.)

At this point, it is important to attempt a definition of what is meant by the term “mentalist”. This term is intended to refer to the domain of human thought, or the operational consciousness in which the propositions of physics and philosophy are formulated, incorporating knowledge and experience. These propositions are not

marks on a page, or even the functioning of a computer program, which carry no meaning unless interpreted by a human **consciousness**. As such, consciousness is conceived as an operational process, to be distinguished from simple **awareness**, which is the experience of the properties of something (known as **qualia**) without reaching the level of operational intentionality. On the other side, operational consciousness *per se* is to be distinguished from **self-consciousness**, which involves not just a functioning process, but one in which the self is incorporated as a component of the process. The corresponding term for non-intentional awareness is **self-awareness**, which may thus be distinguished as the awareness of the self as a component of the array of qualia, without operational manipulations being involved. An example would be the experience of oneself as a runner when long-distance running (as opposed to the experience of the environment passing as one progresses forward, which would be non-self awareness). Thus, according to this scheme both awareness and consciousness are experiential, involving qualia of some kind, but awareness is the basic state while consciousness is the intentional process of operating on mental entities. If the qualia involve some mental representation of the self, they are the ‘self-‘ variety of the respective experiences.

To clarify these distinctions, we may draw up a table in which we symbolize awareness by A* and consciousness by C* (where the * represents the quality of being an experiential process).

Table of Forms of Consciousness

	A*	C*	Self-A*	Self-C*
Experiential	√	√	√	√
Intentional		√		√
Reflexive			√	√

Each of these terms has been used in multiple different ways in the literature, including as synonyms for each other, but it seems illogical to compress them in such a manner when there is this set of distinctions that need to be made. This table is by no means exhaustive of all the consciousness terms that have been discussed, but is intended to define the usage of the most common terms for the purpose of the present paper.

2. EMERGENT DUALISM

In common with Quantum Physics, the ontology of Emergent Dualism¹ is a new philosophical approach that starts from the assumption is that the primary ‘material’ of the universe is energy, which of course can be manifested as kinetic energy, potential energy or matter. The flow of such energy throughout the universe may be considered to be of the form described by full elaboration of the Schrödinger Equation. This is the classic monistic position, but in order to account for the hierarchy of levels of organization of the realities with which we are familiar, we need to invoke the concept of **functional emergence**, under which the principles of each level of organization of this energy are entirely absent from the lower levels. (Thus, for example, the principles of organization of crystalline matter are entirely absent from the laws of the flow of electromagnetic energy through space, even though there is a continuity provided by the $E = mc^2$ relation.) It is generally believed that the lower level equations project continuously up to higher levels, as the Schrödinger Equation can predict the structure of the atoms of the Mendele’ev table of elements. In fact, the Schrödinger Equation not only cannot *predict* the structure of any atom, it cannot even be mathematically optimized even to describe the structure of any atom beyond helium (Mills, 2008).

This failure is an example of **functional emergence**, the property by which the principles of operation at a higher level are completely distinct from those at the lower level of a hierarchy. Another example is the emergence of a tornado from a steady wind. The wind is a laminar flow across a large region, but when it reaches a critical point it breaks into turbulent flow and generates the vortices that we call ‘tornados’. Once the tornado is formed, it constitutes a defined object with a location that changes over time, which is the path of the tornado. This trajectory is an emergent property with its own rules of operation that are not predictable from the laws that govern the laminar flow of the wind, because the turbulence that governs the formation of the tornado is well-known form of chaotic dynamics that is defined by the fact that its behavior is not predictable from the laws of laminar flow. (The term ‘functional emergence’ is used to avoid the implication of downward causation from the emergent level to levels below, which is attached to the established term ‘strong emergence’, while emphasizing the fundamental emergence of novel principles of operation beyond what is usually termed ‘weak emergence’.)

¹ This ontology has something in common with ‘Neutral Monism’, which sees mind and matter as two aspects of an underlying mode of existence, but Emergent Dualism differs in treating the underlying mode as energy rather than experience, and in allowing for multiple levels of functional emergence from the principles of operation of the basic physics of this energy.

Thus, functional emergence is a general principle of complex systems, such as the system of reality covered by the hierarchy of quantum physics, macro physics, chemistry, biology, neurophysiology, and the psychology and philosophy of consciousness. Each level is in many respects emergent from the previous level, with its own laws of operation that are not derivable from the lower level. In particular, the operational laws of consciousness can be seen to be distinct from those of the neurophysiology from which it derives. Neuronal activity consists predominantly of local field potential oscillations and millisecond spikes, but there is nothing (or very little) that resembles either the oscillation or the spikes in the conscious experience that is our evidence for its functioning. Conversely, a primary property of consciousness is its unified intentionality, the property of representing and understanding the flux of information about the world as unitary and meaningful entities. Centuries of studies in what we call cognitive science have not revealed how the mind encodes the causal relationships among events in the world that are our primary understanding of “how things work”. Conscious processing thus seems to be an emergent principle of operation over its non-representational neurophysiological substrate.

However, while necessary, this emergence alone is not sufficient to solve the Hard Problem of conscious awareness (Chalmers, 1995). As is made clear, emergence is a property of many levels of physical reality, whereas consciousness is unique in being the form that we, as humans, use as a mode of thinking, (i.e., the process that generates the form of behavior that generates the present document). What is it that makes this particular emergent process unique? It is not simply the complexity of its structure. The broiling infernos of the interactive processes that constitute the activity of the sun, for example, are enormously complex and highly structured, but we do not consider them to be conscious (or if we do so, we have no means of verifying whether this is the case). What makes consciousness unique is that it is the only process that we know from the **internal** perspective of what it is like to **be** that process.

It is this internal perspective that entails the hard dualism, since we cannot take the internal perspective of anything but our own brain processes. In principle, one could imagine that all neural activity gave rise to consciousness, so that it was not a special emergent property of neural activity but of neural activity in general. We would have understood the neural basis for consciousness. Nevertheless, consciousness would still be **private** in the sense that it was the experience arising from the process of neural activity, rather than any other process (such as the flow of the ocean currents or the workings of a computer). We can never know whether such non-neural processes might involve some form of consciousness because we cannot know what it is like to **be** any other process than the process of our brain. Thus it is the privacy or exclusivity of

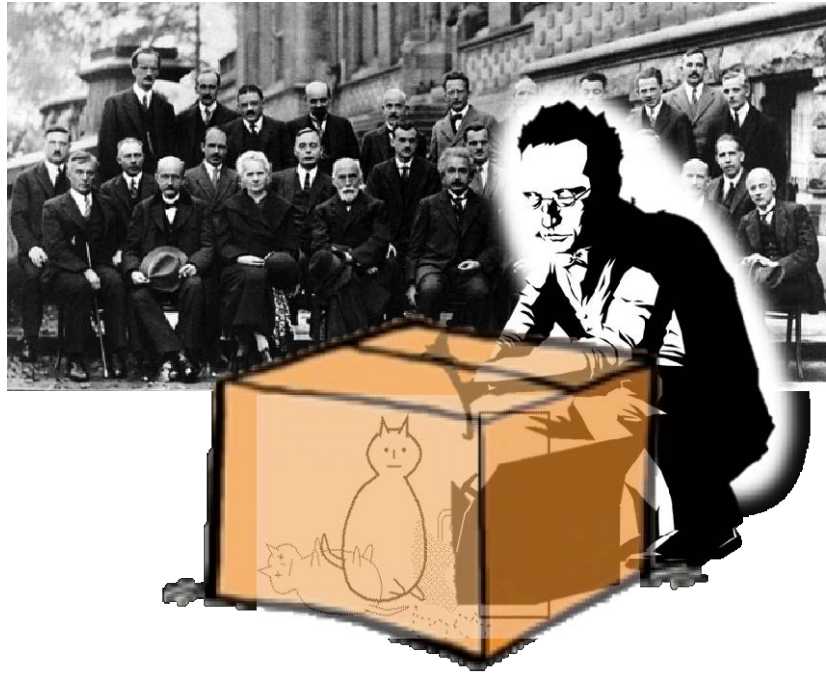
our brain process to our own personal **subjectivity** that constitutes the real hard problem.

In summary, then, emergent dualism takes the position that the elementary stuff of everything in the universe is energy, that this energy can become structured into a series of levels of emergent organization whose operating principles are not derivable from the previous levels, that one of these levels is the concatenations of neural processes called brains, that brains have some particular emergent process that gives rise to subjective experience from the internal viewpoint of that process, and that the private, subjective property of this emergent process entails a dualistic philosophical treatment of its analysis.

Notice that this form of philosophical dualism is very different from that of Descartes, which essentially treat the matter ‘stuff’ and mind ‘stuff’ (*res materia* and *res cogitans*) as separate operational domains, whereas in the present view they are very much two sides of the same coin, although the difference between the respective viewpoints (subjective vs objective) may entail very different descriptive properties of the observables. An example of such a difference is the **continuity** of the subjective impression of a light field such as the sky in contrast to the discrete **pixelation** of its objective neural encoding by the individual receptors of the retina and the visual cortex. Since the only information we get is from the discrete receptor axons, we are unaware of the sometimes large gaps between them. (Objective neurophysiology tells us that only ~10% of the photoreceptors are able to signal the blue of the sky, for example, yet we see it as a **continuous** blue field. Thus, the experience of continuous fields of color are emergent from the underlying operational principles of the **discrete sampling** by the photoreceptors.) This subjective/objective distinction is often accepted as being incorporated in the rubric of monistic materialism, but its inherently unresolvability in terms of principles of operation seems to require it to be maintained as a core dualism in its philosophical analysis. This view is amplified in relation the paradoxes of quantum physics in the next section.

3. EMERGENT CONSCIOUSNESS AND QUANTUM PHYSICS

As typified by the header quotes, the quantum physics of elementary particles has long been considered to be in some sense **entangled** with the properties of consciousness. Indeed, this view has been taken to such an extreme that many believe that human C* somehow derives from the collapse of superpositions at the quantum level (e.g., von Neumann, 1932; Penrose & Hameroff, 2011). It is thought that human decisions are ultimately attributable to these fundamental collapses, and that free will is derived from the quantum indeterminacy of Heisenberg.



At its core, this entanglement derives from the idea that the wavefunction defining the fundamental quantal energy state is a superposition of the possible detection states giving rise to its definition. Schrödinger's cat is simultaneously alive and dead until the superposition is resolved by an observation. The resolution of this superposition of states is fundamentally probabilistic, with the probabilities defined by the amplitude of the wavefunction that is accurately calculable (at least in principle) for the physical situation.

Emergent Dualism takes a very different position on these issues. Rather than assigning probability to the quantal realm, it takes note of the fact that a 'probability' is a form of answer to a question posed by a conscious scientist. In Heisenberg's (1963) indelible words, quantum physics is "nature exposed to our method of questioning". The answer is the wavefunction defining the probability of detection events. But this wavefunction is not known *a priori*. It has to be based on a history of observations cumulating the numbers of detection events in specific situations. The resultant wavefunction is by now very well known for simple cases but is still dependent on further observations for cases of any complexity (e.g., Studolna et al., 2010).

Thus, probability is not a physical energy. Probability is an operational concept that can be held by a conscious mind, a philosophical category that is distinct from physical energy. As this category, probability *per se* has the properties of incorporating a) the **superposition of states** and b) the **collapse** of this superposition once an observation is made. Probability, by its nature, implies the simultaneous existence of the states of existence and non-existence (or more complex combinations). The states are superposed with probabilities of p and $(1-p)$. Moreover, once an observation is made, this superposition collapses to one state or the other. As a mental construct, probability embodies the key paradoxes of quantum physics without reference to any physical situation. This parallelism should give us pause. Why should a mental concept that existed since the 18th century have the same properties as the physical reality discovered in the 20th century?

Thus, Emergent Dualism takes the position that the superposition of states and the collapse are properties of the “method of questioning” of quantum physics, which is the discrete detection probe of the detector array (such as the photographic film on which the light is projecting). Given a binary detection process, and an energy function, such as system would inherently have the properties of the quantal domain, superposition of the states of detection and non-detection with a probability defined by the wave function at any particular position, and the collapse of this probability wherever a detection is made. Note that this ontology provides an immediate resolution to the idea that the wavefunction collapse in the classic quantum ontology collapses simultaneously everywhere in the universe, although it is considered not to violate the Einsteinian constraint on information travelling no faster than the speed of light. If the collapse is attributed to the wavefunction as a physical entity, as usually seems to be the case, this provides an impenetrable conundrum that quantum physicists generally just accept with a shrug. If on the other hand, it is a collapse of the probability as a concept in the mind of the physicist, that collapse applies only to the detector in question, and the wavefunction remains in force in the rest of the universe, in agreement with the observations. (Indeed, proponents of the concept of the collapse of the physical wavefunction do not address how there could be simultaneous detection events at two detectors simultaneously, but this is not an issue for the probability account applied independently to each detector.)

The problem, of course, with the assignment of the probabilities to the mental realm is Einstein’s analysis of the photoelectric effect, which was considered to be absolute evidence for the quantization of the light energy, rather than the detection process, requiring the probabilities to be assigned to the physical system even in the absence of an observing mind. There is not space in the present treatment to develop

an analysis of the strength of the evidence for Einstein's interpretation. Here it will only be noted that a) abandoning this one interpretation resolves a large number of other paradoxes in quantum physics, and b) that several alternative analyses that do not require quantization of the light field have been published.

4. SUBJECTIVE OBJECTIVISM

The core property that entails the hard dualism is the **internal** perspective of our consciousness, since we cannot take the internal perspective of anything but our own brain processes. Taken to its logical conclusion, the implication is that mind processes are essentially experiential (subjective observables) while brain processes are essentially physiological (objective observables), even though both kinds of observables may derive from the same underlying processes. The subjective observables are essentially private, while the nature of the objective observables is that they may equivalently be experienced by indefinitely many other observers. It is this **subjective/ objective dehiscence** that enforces the **dualism** of the viewpoint adopted here. This dualistic divide between the subjective and object views of brain processes is fundamental, even though we spend much of our time inferring subjective states in others, and even though the objective observables of others' brains are ultimately filtered through the individual subjectivity of each observer. We can never really know for sure how another person feels, and our confidence in the reliability of objective scientific observations across laboratories is often shaken when we participate directly in another scientist's experiments.

Note that the assignment of probabilities to the mind of the observer in Emergent Dualism is not in the subjective form espoused by Quantum Bayesianism (or "QBism"). These approaches treat the mental probabilities as subjective estimates by individual observers that could take arbitrary values, depending on the individual's experience. Under the present approach, on the other hand, the probabilities are worked out as the **consensus analysis** of the physics community, and are thus as **objective** as physics can be made. If the physics were fully worked out, it would be absolutely applicable, and each human observer would be in the position of being able to say "I know that if I did any interference study, I would be able to predict its result within the accuracy of the calculated measurement error by applying the applicable formulas of physics to my experimental situation." That is, the individual observer would not subjectively know the specific outcome of the interference experiment before running the calculation, but would be one of the **community** of physicists who were able to do this, if the question arose, based on the body of accurate physical knowledge that is ultimately held in the subjectivity of the physics community.

The deference of the individual subjectivity to the physics (or other analytic) community is an important contribution of the Emergent Dualism framework to the quantum consciousness debate, because it highlights an implicit assumption in quantum physics, and in the philosophy of mind in general, that there is a Platonic **ideal** reality outside the individual subjectivity. Plato argues strenuously for the independent existence of pure forms (such as the circle and the triangle) beyond their conception in the individual mind. His forms are universals that transcend time, space and individual subjectivity. It is therefore the role of humans to discover these universal forms by philosophical investigation.

The Emergent Dualism view, on the other hand, is that all forms, ideas and universals are products of the **human mind**, and are essentially products of its limitations. An infinitely knowledgeable mind would understand every detail of all sense data in the universe **without** the need to simplify it into conceptual entities designated as ‘forms’. It is only the limitation of the mind that has to condense entities to their average or typical representatives. The infinitely knowledgeable mind has no need of such condensations as “universals”, since it would have total knowledge of all aspects of the situation.

In the same way, the laws of physics are considered under Emergent Dualism to be condensations of the infinite complexity of physical laws. Kepler’s laws, for example, give a second-order approximation to the planetary motions (the Pythagorean circular orbits being the first-order approximation). The actual planetary motions will be perturbed by many factors, such as the influences of nearby planets, fluctuations in the solar wind, asteroid impacts and so on. Every physical law has its limits beyond which it must be readjusted; they are just convenient approximations that hold over large domains. These laws are products of the physics community, subject to replacement with new knowledge, just as Newton’s laws were replaced by the laws of relativity. The laws of physics cannot, therefore, be held to be absolute truths independent of the existence of the physics community. Kuhn’s analysis of paradigm shifts ensures that this whole knowledge framework will have been replaced by totally different way of conceptualizing things in a millennium, or even a century.

Thus, even the most objective approaches to scientific knowledge are ultimately **subjective**, and there is no objective reality in a sense that is knowable to the human community. What knowledge there is, is embedded in the **minds** of the practitioners, aided by symbolic storage and manipulation in the form of books, the internet and scientific modeling. It remains to be seen whether we are on the threshold of the transfer of this subjectivity to the universe of electronic machines, but even then the largest scope of knowledge acquisition will remain subject to its operational limitations.

Objective knowledge will necessarily remain incomplete and subjective, even down to the most rigorous laws of physics.

5. THE NEURAL SUBSTRATE OF CONSCIOUSNESS

Within the Emergent Dualism concept of emergent consciousness (subject to the Hard Problem constraint_ there is nevertheless an assumption of the **psychophysiological parallelism** under which present-day neuroscience operates. All human neuroscience studies that perform analyses linking brain function to observer report or perceptual response are assuming psychophysiological parallelism, and few in the field doubt its validity. Moreover, there have been extensive recent efforts to identify what is known as the neural correlate of consciousness (NCC) in the functioning of the brain at various levels. This term has its limitations, in that a) it implies that consciousness is a state rather than a process, and b) even if interpreted as a process, it seems to embody an implicit dualism that there is a process called ‘consciousness’ and an array of neural functions that might correlate with it, as though they a running parallel in the way that the traffic runs parallel to the structure of the road. The Emergent Dualism position, on the other hand is that there is a unified **neural substrate** of conscious processing (NSCP) in the sense that the neural and the subjective aspects of conscious process are ‘internal’ and ‘external’ aspects of the SAME unitary process. That unitary process is functionally emergent from the basic neural process of firing in proportion to the summed inputs at each neural soma, but it is fundamentally still a neural process. The emergent property is a tenet of the theory, and has not yet been empirically established. The prerequisite for its establishment is a complex of correlatives between the subjective mental properties of consciousness and the objective properties of the emergent neural process sufficient to establish the NSCP.

In this sense, the Emergent Dualism is similar to the classical position in expecting to find neural correlates of consciousness. The difference is that, under Emergent Dualism, the correlates are sought across a multidimensional space of mental properties, and that they are considered as indicators of the true neural substrate of consciousness.

6. PROPERTIES OF CONSCIOUSNESS

Many thinkers have provided putative analyses of the properties of consciousness. To avoid the criticisms of untestability leveled against the 19th century phenomenologists, the goal of the Emergent Dualism approach is to identify the specific properties of consciousness that provide the foothold of empirical testability in physiological terms. Of course, the properties of consciousness are, of their nature, subjective, but they may gain a measure of objectivity by consensus agreement on their validity. Once an

appropriate set of properties is identified, such consensus will be sought among the community of interested scientists.

One interesting set of properties (or “constraints”) of consciousness was compiled by Metzinger (2000), as follows (with the explanations being his complete quotes):

1. Globality: Individual phenomenal contents are always bound into a global situational context, consisting of a conscious world model
2. Presentationality: The temporal immediacy of experience as such, that is embedded into a uni-directional flow. Especially the experience of ‘nowness’ such that every moment includes an immanent immediate past and presages a future
3. Transparency: The unavailability to attention of preconscious processing stages
4. Convolved holism: The structural feature of phenomenal states whereby we experience objects at once as being wholes and not merely sets of features, but at the same time as often being wholes constructed of parts
5. Dynamicity: Our conscious life emerges from integrated psychological moments, which are themselves integrated into the flow of subjective time
6. Perspectivalness: The reference of conscious contents to a subjective first-person perspective. In general, conscious mental life possesses a focus and comes from a point of view

Although a worthy first attempt, to this author several of these “constraints” seem mutually redundant, and unhelpful as criteria for identifying the psychophysiological basis of consciousness. In general, it is hard to see how they could be empirically testable because most of them are experiential rather than structural properties. Constraint 3 is not a property of consciousness *per se* but of unconscious mental processing. Constraints 1 and 4 seem largely redundant in the property of globality, while Constraints 2 and 5 both express the experiential integration of psychological moments into the flow of time. Constraint 4 seems self-contradictory, as it is difficult to understand how objects could be perceived simultaneously as both wholes and collections of parts. Sequentially, perhaps. Thus, Metzinger’s Constraints do not provide a firm basis for the identification of the NSCP.

One of the most recent and influential approaches to the properties of consciousness (C*) is a set of “axioms” or “self-evident truths about consciousness” proposed by Tononi (2008) and Oizumi, Albantakis & Tononi (2014) in the context of their Integrated Information Theory, which are endorsed by Koch (2012).

1. C* exists

2. C* is compositional (structured): each experience consists of multiple aspects in various combinations
3. C* is informative: each experience differs in its particular way from other possible experiences
4. C* is integrated: each experience is irreducible to non-interdependent components
5. C* is exclusive: each experience excludes all others.

Although these “axioms” represent the established intent of the author(s), to this author they again seem mutually contradictory, confusing and unhelpful as criteria for identifying the psychophysiological basis of consciousness. If each experience excludes all others (as in Axiom 5), how can it consist of the multiple aspects of Axiom 2? Are not the aspects “experiences”? How do the “aspects” differ from the “components” of Axiom 4? Indeed, the double negative of the Axiom 4 renders it largely uninterpretable. If the components to which it is reducible are interdependent, they seem contradictory to the recombinant aspects of Axiom 2. And the exclusive, integrated aspect/component structure of the experiences as specified in these axioms provides little in the way of properties that meet the criteria for physiological testability. They are more in the nature of phenomenological analysis of the contents of consciousness than testable properties for mind/brain assessment.

Thus, we seek a set of properties of consciousness (C*) that are distinct, mutually compatible, and testable as targets for assessing the NSCP. A list of ten such properties may be developed:

1. Unity
2. Interrogacy
3. Privacy
4. Extinguishability
5. Iterativity
6. Operability
7. Multifacetedness
8. Complex interconnectivity
9. Autosuppressivity
10. Self-referentiability

Expanding on these terms in more detail, although there is not space to survey the literature on them, in brief we have:

1. **Unity:** Under ordinary conditions, C* is experience as **unitary** at a given moment. We have one experience at a time, although we may be able to rapidly switch among multiple experiences over a short period of time. The NSCP must, accordingly, occur in a unified neural net of some kind rather than in multiple distinct brain sites.
2. **Interrogacy:** Though not widely recognized, a defining property of C* is the ability to generate **questions** and represent potential answers in an indeterminate superposition of probabilistic states. Other complex systems, such as galaxies and biological cells and the Internet, incorporate extensive interactions and consist of energy processes that undergo development and evolution. Although they can be said to process information, they cannot meaningfully be said to ask questions. It seems to be a unique property of a conscious system to ask questions, and something that gets switched on in humans at about the age of 1 year. As detailed in Section 5, this capability also entails (though perhaps not until a later age) the ability to envisage possible answers. In doing so C* incorporates the mental superposition of states of the array of possible answers envisaged, and hence their mental collapse into a defined state of the actual answer when resolved.
3. **Privacy:** One of the irreducible properties of C* is its **privacy**. *Pace* science fiction, as far as we know, there is no way to share our individual C* with anyone else. Verbal and non-verbal means of communication provide effective means of generating the illusion of sharing C*, but as too many lovers have found to their cost (!), this is only a superficial level of apparent sharing, not a direct experience of another's true internal experience. To meet this criterion, the NSCP must be brain-compatible and not allow for direct interbrain communication. In the context of quantal theories of C*, this means that the NSCP must not be based on non-local quantal effects. (Those who accept the non-locality of some superordinate cosmic C* will, of course, draw the opposite conclusion, but this is not the position of Emergent Dualism.)
4. **Extinguishability:** A primary property of C* is its lack of continuity. It is **extinguished** every time we fall asleep or are anesthetized and is rekindled when we awake (and also, in a somewhat restricted form, when we dream). The NSCP must therefore exhibit the same form of complete extinguishability at the same criterion levels, i.e., it must be dowsed during deep sleep but switched on

during dreaming. Although these states are deeply subjective, they can be attested in the form of memory marker of external events (such as our last memory of a radio program before dropping off or first memory of a wake-up alarm). Dreaming is well established as being objectively indexed by rapid eye movements while asleep (REM sleep).

5. **Iterativity:** Another well-established property of C* is its tendency to **iterate repeatedly** through similar states, both when there are problems to be solved (like anxiously reiterating a worrying scenario) and as a form of pleasure (like music, which reflects the C* of its listeners, and has continual repeats of phrases, themes and whole pieces on a wide range of time scales). The NSCP must equally exhibit such iterativity over this range time scales.
6. **Operationality:** The operational property is captured by the term “working” in the cognitive science concept of “**working memory**”. In other words, “memory” is the ability to store representations of aspects of the world as stable brain states. The remarkable property of such memories is that we are not conscious of the millions of them that are held in store most of the time. We only become conscious of them when they are accessed by C* for a brief time. There seem to be two forms of access, one that is well-described as “working memory”, to perform some operation on the stored information, and the other an inoperative access, that is usually included in the functional usage of “working memory” but does not involve any operational changes to the stored information. Various NSCP brain sites associated with working memory have been identified through fMRI studies, but their specific roles and dynamics in relation to the operational properties of experiential working memory are not well understood.
7. **Multifacetedness:** C*by its nature incorporates all **varieties of human experience**, from logical thought processes and imaginary journey planning through the irreducible qualia of direct sensory and indirect imagery experiences to the array of emotional experiences and primary internal states such as pain and orgasm. Although we still may not be able to envisage what it would mean for the NSCP to exhibit, or possess, such experiences, it is a core requirement of the theory that it would be able to do so. At least in the case of thought or journey planning, the NSCP should be able to exhibit the activation of the specific memory states representing the sequential stages of the specific thought or journey in question.
8. **Complex interconnectivity:** C* is experienced as complexly interconnected, in the sense that it can proceed along many paths from any one state to many others. This **interconnected flexibility** is part of its generative or creative

power. It is not like a finite state machine, one that typically proceeds sequentially from any one state to a defined following state. It is capable of exhibiting multiple connectivity from any facet to any other facet of human thoughts and feelings, unconstrained by logic. (Of course, in some cases well-trodden paths of thought do become established such that C* does operate analogously to a finite-state machine, but this is more the exception than the rule.) To be explanatory the NSCP should exhibit a similar variety of interconnectivity.

9. Autosuppressivity: One of the sources of the variety and creativity of C* is that it tends to exhibit the property of burning out at any one state, **inhibiting** the tendency to return to that state, thus impelling continuous movement to novelty. This is a well known property of attention across the visual field (inhibition of return), and also a rule of a good writing style, to avoid using the same term or phrase repeatedly. Once again, such autosuppressivity is a further property that can be identified in candidate mechanisms for the NSCP.
10. Self-referentiability: A final property of C* is its ability to represent **itself** as a component of the conscious field. This property harks back to Russell's Paradox as a seemingly impossible feat: the set of entities that includes itself as a member. But this is a common experience that we can be (acutely!) aware of ourself as a participant in the field of C*. Computationally, it is not difficult to achieve a program that includes itself as a component in its representation, a common feature of computer games known as a "avatar". It escapes Russell's Paradox by not being a full representation that actually contains itself. It is not so clear how the neural implementation of avatar could be achieved, but this is a further prerequisite of the NSCP.

6. CONCLUSION.

The philosophical position of Emergent Dualism is a concatenated monism that incorporates a fundamental dualism engendered by the functional emergence of conscious processes from the energetic backdrop of non-conscious processes, and by the fact that the entities (ourselves) posing the philosophical enquiry of the nature of their existence are necessarily doing so from the inherent perspective of being those emergent processes *per se*. It is this inherent perspective that enforces a functional dualism embedded within the axiomatic monism of its initial presumption.

Specifically, Emergent Dualism proposes that the elementary stuff of everything in the universe is energy, that this energy can become structured into a series of levels of emergent organization whose operating principles are not derivable from the previous levels, that one of these levels is the concatenations of neural processes called brains, that brains have some particular emergent process that gives rise to subjective

experience from the internal viewpoint of that process, and that the private, subjective property of this emergent process entails a dualistic philosophical treatment of its analysis.

The implications of Emergent Dualism for Quantum Theory are that the nature of physics is constrained to the probing of the energetic basis of reality by the emergent consciousness that is ourselves. It is inherent to its internal perspective that only such a process can ask questions of the nature of reality, and that therefore the accepted properties of quantum entanglement and the superposition of states are essential properties of the concept of ‘probability’ developed by the minds that are engaged in the probing rather than of the energetic basis of the underlying processes.

To extend the probing to the neural substrate of conscious processing (NSCP), a full specification of the properties of consciousness as subjectively experienced is provided in a form that is neuroscientifically testable.

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