Quantum Physics and Beyond

CONSCIOUSNESS AND QUANTUM MECHANICS: OPTING FROM ALTERNATIVES

by David E. Klemm and William H. Klink

Abstract. We present a model of a fundamental property of consciousness as the capacity of a system to opt among presented alternatives. Any system possessing this capacity is "conscious" in some degree, whether or not it has the higher capacity of reflecting on its opting. We argue that quantum systems, composed of microphysical particles, as studied by quantum mechanics, possess this quality in a protomental form. That is, such particles display the capacity to opt among alternatives, even though they lack the ability to experience or communicate their experiences. Human consciousness stands at the opposite end of the hierarchy of conscious life forms as the most sophisticated system of which we have direct acquaintance. We contend that it shares the common characteristic of a system capable of opting among alternatives. Because the fundamental property of consciousness is shared by human beings and the constituents of elementary matter in the universe, our model of consciousness can be considered as a modified form of panpsychism.

Keywords: freedom; hierarchy of matter; models of consciousness; opting from alternatives; panpsychism; quantum mechanics; Sartre and spontaneity; subjectivity

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In its widest connotation, *consciousness* "includes *all* experiences" (Husserl 1976, 113). To be conscious of something means to be immediately aware of it, in the sense of having direct acquaintance with it in one's own mind. Consciousness has a qualitative dimension, because immediate awareness

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involves more than passive reception of sensory data. Consciousness is active in its meaning-giving and meaning-receiving functions. In directing its "mental look" toward selected contents, which are uniquely "appreciated" or "valued" in their actuality, consciousness makes choices among possible alternatives (Husserl 1976, 117, 122–23). Consciousness also has a subjective dimension, because in becoming conscious of something I also am immediately aware that this act is "mine," that "I" am conscious of it.

In this essay we propose a model for a fundamental property of consciousness that can account for what David Chalmers has called the "hard problem" of consciousness, namely, the twofold problem of what consciousness is—its essential nature—and how it came to be (Chalmers 1997, 1).[1] On the first issue, we argue that the fundamental property of consciousness is the capacity of a system to opt among alternatives, such that the outcomes are neither determined (wholly predictable) nor random (although they may be given by probabilities). The capacity to opt among alternatives is presupposed by the meaning-giving, meaning-receiving function of consciousness, because every meaning in consciousness is the actualization of one potentiality among many. On the second issue, we claim that the fundamental property of consciousness is ingredient in elementary physical particles, the basic constituents of matter, from the beginning. Consequently, our model opens the possibility of explaining the origins of consciousness as the organic development of a potentiality already found in the deepest structure of matter. Moreover, our model points toward a way that avoids the opposition between ontological dualism and all forms of materialism or naturalism. Indeed, our model implies a modified form of panpsychism, one based on scientific rather than on metaphysical grounds (contra Griffin 1998, for example).

Our philosophical orientation in this essay is to modern European thought in the traditions of phenomenology that run from René Descartes and Immanuel Kant, Johann Gottlieb Fichte and G. W. F. Hegel, through Edmund Husserl and his immediate followers such as Jean-Paul Sartre, Maurice Merleau-Ponty, Paul Ricoeur, Emmanuel Levinas, and others. This broad tradition has defined itself as a study of consciousness in its peculiarly human manifestation as self-consciousness. The reason for this focus on consciousness is, as contemporary German philosopher Manfred Frank said in a 1994 lecture, that "modern thinkers again and again held self-consciousness to be an indubitable principle. It counted as the *fundamentum inconcussu* from which intelligibility one hoped to be able to deduce all other insights, step by step." In other words, modern European philosophy has grounded itself on the self-evident givenness of consciousness, which, as Descartes demonstrated, cannot be denied without being affirmed. In this tradition, consciousness is the meaning-constituting element in any possible experience or knowledge of the objective world and so should be the first topic of philosophical inquiry. Phenomenology is the philosophical effort to reflect rigorously on the first-person experiences of conscious states for the purpose of attending to phenomena in their modes of givenness. Its central question is: How does consciousness constitute objectivity by, in, and for consciousness?

Contravening this major tradition is the modern scientific view of the purely material universe, which operates strictly according to principles derived through induction from empirical observation. The modern scientific view has no need for either universal mentalism or dualism in philosophy.[2] Its explanations of phenomena (and all phenomena are, according to modern science, in principle physical phenomena) are entirely naturalistic. Consider Newtonian mechanics, through which the modern scientific view of the universe became compelling and dominant in the Western tradition, rendering the Cartesian line of thought an idiosyncratic branch of speculative philosophy that scientists can well ignore. In their initial reception, the principles of Newtonian mechanics seemed utterly universal and necessary. Their many successes raised the question: Do Newtonian principles exhaustively explain all of reality, including mental reality? If so, phenomenology and its domain—the first-person experience of conscious states—lose their viability. Instead, the prospect looms of a deterministic, utterly material universe, completely knowable and predictable by science.

We argue the contrary. In our view, consciousness in its subjective dimension remains an anomaly for the materialistic view of the world, even with the advent of neuroscience. Even if the scientific program that began with Newtonian mechanics could successfully be applied to such conscious activities as thinking and perceiving, reducing them to neuronal mechanisms, the felt experiences or qualia of thinking and perceiving would be left unexplained (see Chalmers 1997, 10). The reason for the inexplicability of experience is that the *I* of a conscious individual—the one who experiences sensations, emotions, thoughts, and the like—necessarily escapes scientific analysis, because the immediacy of first-person experience is not a sensibly observable object, even in the form of a neural process, but an "inner life" that accompanies these other activities of consciousness. This inner life is constituted by an awareness of "what it is like to be" a conscious organism (Nagel 1974). It is an immediate consciousness that "I" have of how it is with me. Any attempt to objectify my inner life misses the phenomenon, which recedes behind the effort to objectify it and thus systematically eludes objectification. Given this situation, we are left with the "hard problem" (Chalmers 1997, 11): "Why should physical processing give rise to a rich inner life at all?" The materialistic program seems incapable of resolving this anomaly of subjectivity.

Before continuing, let us clarify what we mean by the latter term. *Subjectivity* means the principle of the individualized origin point and owner of experiences as "mine." Every individual who says "I" uniquely reveals the phenomenon of subjectivity. Using Kant's terminology (1965, 329, 167–71), we say that subjectivity has both empirical and transcendental dimensions. The empirical subject is the immediate subject of first-order empirical experiences, in which "I" relate to things, other persons, my own mental states, or even reflective objects such as truth, goodness, or beauty. The transcendental subject is the subjective principle of the unity of consciousness over time in relating to its own first-order experiences. The transcendental *I* relates not to first-order things, persons, and so forth but rather as a second-order possibility to its own relations to things (for example, as theoretical, practical, or aesthetic relations). It is the condition of the possibility of unifying diverse conscious experiences into a continuous narrative account that is "mine."

Frank makes the point that subjectivity resists materialistic reductions of all kinds. He cited the linguistic example of the subjective use of the first-person pronoun *I*. When used, the indexical *I* necessarily discloses its referential object (me, myself, as subject), yet the reached *I* is not a possible object of scientific inquiry but the subject of any such activities as scientific inquiry. Frank's general claim is that the subjective perspective, the inner experience of the *I*, is irreplaceably necessary for any situating of the self in the world as origin point of practical interactions with the world. I would not know how meaningfully to use the indexical *I* apart from my own inner acquaintance with myself as the one denoted by the first-person pronoun. According to Frank, the materialist cannot even mount a refutation of the ontological irreducibility of subjectivity without situating herself in the world as an *I* and assuming responsibility as an *I* for the refutation. The refutation of subjectivity therefore entails the assertion of subjectivity, which makes the refutation self-contradictory.

Is the systematically elusive *I* necessarily immaterial? If the criterion for materiality is to be a possible object of scientific inquiry, the *I* as such is immaterial. Accordingly, Husserl conceives of phenomenology as "a science of concrete, transcendental subjectivity" (1960, 30) that is altogether different from the naturalistic science of psychology. Psychology is an objective science in that it limits itself to "worldly" subjectivity—that is, subjectivity that one encounters within the world. The transcendental subject, which is "phenomenology's sole theme," is extramundane individuality in that the *I* is neither simply a piece of the world (the person) nor a "universal subject" disembodied from the world. The transcendental subject combines these two elements: pure consciousness, which is "absolute in itself," comes into "empirical relation to the body," becoming "real in a human and animal sense, and only thereby does it win a place in Nature's space and time" (Husserl 1976, 164). This interweaving of pure, transcendental consciousness with corporeal being occurs in "apperception," with a twofold point of view: The apprehending glance both turns toward perceived objects and passes back "to the pure apprehending consciousness itself" (1976, 165–66).

The accomplishment of Husserl's phenomenology is to display the essential structures of consciousness for analysis. According to Husserl, consciousness has the structure of *intentionality*, which means that consciousness intends an object that is distinct from the activity of consciousness. Consciousness is always "a consciousness of something" (1976, 120). Hence, we have on one side the intentional act and on the other side the intentional object. Intentional objects are "unities of meaning" (p. 168) as "modally determined" (for example, as a natural object or as an object of value) (p. 367). The important point for our argument is that for Husserl all reality exists through the conferring of meaning, and the transcendental subject is the originating source of meaning-giving consciousness (Husserl 1960, 7–26; 1976, 168).

Husserlian phenomenology thereby has a solution to the "hard problem" of consciousness: Mental activities, such as thinking and perceiving, do not, strictly speaking, "give rise" to the elusive phenomenon of inner, conscious life; rather, both mental activities and the inner life that accompanies them (determinations of self-apperception, immediate self-consciousness) are grounded in and arise from transcendental subjectivity. There is a cost, however, for this answer. The phenomenological tradition thereby rests on the foundations of an otherworldly transcendental ego. Descartes' substance dualism, or, in an extreme interpretation, perhaps even Fichte's subjective idealism (universal mentalism) are corollaries of phenomenology. The rub for this tradition is that if transcendental subjectivity as the constituting origin of consciousness is an unnecessary theoretical construct, the phenomenological solution to the problem of consciousness evaporates.

We offer an alternative answer. We argue for a model of consciousness that preserves the experience of subjectivity and in this regard still stands in the tradition of phenomenology just outlined. But our model redefines subjectivity in terms of the capacity to opt among alternatives, which connects subjectivity to elemental properties of matter at the microphysical level. We speak of a minimal "subjectivity of opting," which abandons the foundational and constitutive role of the transcendental ego. The thought of Sartre—himself a phenomenologist who was profoundly critical of certain elements of Husserl's classical presentation of phenomenology—proves instrumental for us in this regard. As such, our model of consciousness breaks from classical phenomenological approaches by entailing neither dualism nor idealism. At the same time, by connecting to quantum mechanics through the subjective phenomenon of opting among alternatives, our model avoids all forms of materialism. As we shall explain, by virtue of its connection with quantum mechanics, our model instead implies a modified form of panpsychism, a third option in the current standoff between dualism and materialism.

Quantum Mechanics as a Theory of Alternatives

Quantum mechanics is one of the most successful physical theories ever created by human beings. Our society is dominated by devices whose structure and function is governed by quantum mechanics. Examples include almost all electronic devices that one can buy today, many devices in medical science such as PET scanners and magnetic resonance devices, and nuclear fusion and fission devices such as nuclear reactors. Were not quantum mechanics a fundamentally correct theory, these devices would not function properly. It is an incredibly successful theory, particularly in the areas of atomic, molecular, and solid state physics, where the interactions between the constituents (primarily electrons and nuclei) are electromagnetic interactions.

Still, there are many open and puzzling questions in quantum mechanics. These have primarily to do with nuclear and gravitational interactions, whose nature is not as well understood as electromagnetic ones. They also have to do with phenomena dealing with particles whose velocities are close to the speed of light, in which case Einstein's theory of relativity must be incorporated into the quantum mechanical framework. But in the domain of what is called nonrelativistic quantum mechanics, dealing with phenomena that are mediated by the electromagnetic interactions, theory and experiment are in excellent agreement.[3]

In spite of the spectacular successes of quantum mechanics, it is very difficult to be able to say what quantum mechanics really means—what it tells us about the nature and behavior of matter. Quantum mechanics is able to predict with uncanny accuracy what the observable quantities in an experiment will be and with what probabilities these observable quantities will occur, but it gives no insight as to why or how individual outcomes occur. The remarkable feature of quantum behavior is that unpredictable outcomes of individual systems between clear alternatives occur for microphysical systems, and the best that quantum mechanics can do is to predict probabilities. We propose that individual microphysical systems are making unpredictable "choices" between alternatives open to them. We use the word *opting* to denote these acts of "choosing" that are not individually predictable, even though they confirm the probabilities. Such opting at the microphysical level, we want to maintain, signifies the presence of protomental conscious life that underlies the phenomena explained by quantum theory. Thus, we are arguing for a way of understanding quantum theory that makes clear why the structure of quantum theory cannot in general deal with the behavior of individual quantum systems.

In this section we present arguments that quantum mechanics is a theory that specifies the alternatives that are open to a quantum system. The reason that quantum mechanics is unable to specify beyond probability why a quantum system opts for certain available outcomes is that these systems express a primitive property of consciousness, which is a fundamental aspect of the quantum world that cannot be reduced to any more basic category. In other words, quantum systems display the fundamental property that is characteristic of consciousness.

To spell out what this means and the implications it has for our model of consciousness, it is necessary to review some of the main tenets of quantum theory.[4] We begin with the idea of the state of a system and show how it is linked to the notion of *symmetry*. The further consequences of symmetry lead then to the peculiarities that arise in the evolution of states using the Schrödinger equation.

Quantum mechanics begins with the notion of the state of a system—that is, the maximum amount of information available about it. Quantum mechanics is not unique in beginning with states; all physical theories begin with some similar notion. For example, in classical Newtonian physics, the state of an object, such as a basketball, is given by specifying its position relative to some coordinate axis and its velocity.[5] Quantum mechanics differs from other physical theories such as Newtonian theory in delimiting what are possible states of a system. In particular, quantum mechanical states have the property that a quantum system cannot have both a well-defined position and velocity. It may have one or the other but not both. This deviation from classical mechanics is a consequence of the Heisenberg uncertainty relations.

When quantum mechanics was first developed in the 1920s, it was not always clear how the possible states of a quantum system should be specified. Pioneering work by Eugene Wigner provided a means for specifying what the possible set of states should be through the notion of symmetry. The word as it is used today in physics refers to transformations in the description of a system that entail no change in that system. A snowflake, when rotated through certain angles about its center, is transformed into itself. The set of all such symmetry transformations is called a symmetry group, or sometimes just a group. A sphere, such as a basketball with no markings on its cover, exhibits a larger symmetry than the snowflake symmetry in that there are many more transformations about the center of the sphere (in fact there are an infinite number) that leave the sphere unchanged.

What is important here is that theories also can exhibit symmetries. A theory exhibits symmetry if under the group of symmetry transformations the form of the theory remains unchanged. For example, the Newtonian equation $F=ma$ has the property that under transformations from one inertial frame to another its form does not change. Similarly, Einstein discovered that Maxwell's equations, which relate electric and magnetic fields to charged particles, have a symmetry different from Newtonian symmetry. This discovery led to the creation of the special theory of relativity.

Symmetry plays an even more important role in quantum mechanics than in classical mechanics, for the equations of quantum theory should have the property that probabilities expressed in one inertial frame are the same as in any other inertial frame. A first consequence of symmetry in quantum theory is that it generates the possible set of states of a system. That is, if the structure of quantum theory is to have the same form in all inertial reference frames, there is a unique way of specifying what the possible states of a system are, and the manifold of these states (called a Hilbert space) follows from the structure of the symmetry group.

A second and equally important consequence of symmetry in quantum mechanics is that it generates the quantities that are observable for a quantum system. These quantities are called operators because they operate in a definite manner on the possible states of the system and specify the alternatives open to it. The most important such operator is the energy operator. For a given quantum system, an important goal is to specify the energy operator and then extract from it the possible energy values (alternatives) open to the system.[6] One early success of quantum theory in the 1920s was computing the possible energy levels of the hydrogen atom and seeing that they agreed with the experimentally known levels.

Operators are of two types: those that are invariant (or unchanged) under transformations from one inertial frame to another, and those that are changed. The observables connected with operators that are invariant include the mass, spin, and charge of a given particle. For example, every electron in the universe has the same mass, spin, and charge; they have no alternatives open to them with regard to these observables. The values of these quantities identify an object as being an electron rather than a proton or a hydrogen atom (which is the bound state of an electron and proton). A proton has the same spin as an electron, but it differs in mass and charge, whereas all protons in the universe have the same mass, spin, and charge (as well as other intrinsic properties).

A third consequence of symmetry in quantum mechanics is that the set of states of composite systems (such as the hydrogen atom) are products of the set of states of their constituents. This consequence means that the set of states of composite systems is richer than the possible states of the individual particles making up the composite system. For example, the hydrogen atom is a composite system, made out of an electron and a proton. Its structure is richer than either the electron or proton in that it has many more invariant quantities associated with it than the electron or proton by itself. It has a ground and many higher-level (excited) energy states, with different possible spins, whereas the electron (or proton) has only one mass and spin. This principle—that composite systems are richer in invariant observables—continues in the hierarchy through atoms and molecules and up into biological systems. We will see that this has important consequences for our model of consciousness.

Besides the invariant operators generated by the symmetry group, there also are noninvariant operators, such as the position or velocity operators, whose form does change under transformations from one inertial frame to another. But the form of these operators also is given by the symmetry group, and the possible outcomes of measurements of observables related to such noninvariant operators is specified by the symmetry group. Although no alternatives are open to objects such as electrons as regards their mass, spin, and charge, the noninvariant operators, such as position, do provide observables for which there are alternatives. For composite systems such as the hydrogen atom, both the invariant and noninvariant operators provide alternatives that are open to the system, indicating a richer set of alternatives as compared with the fundamental objects making up the system.

To predict the outcomes from measuring some observables of a system, it is necessary in any scientific theory to know the state of the system before the measurement is made. In quantum measurements, an ensemble of identical systems is prepared in such a way that its state is known. For example, a beam of electrons is prepared so that its velocity is centered around a given prescribed value. Such is the case in electron accelerators, where the electron beams are then scattered off targets to learn something about the nature of the target particles. The velocity of an electron beam is a noninvariant property of electrons. Other electron beams may have different velocities, but all electron beams consist of electrons with the same mass and spin.

If the state of a system is known at some time, it may evolve into another state at a later time. The principle by which states of systems evolve in time is called the dynamics of the system and usually is specified by a differential equation. In Newtonian physics the dynamics of the system is governed by the differential equation $F=ma$. If the position and velocity of a basketball are known at some time, and the forces acting on the basketball are known (mostly gravitational and frictional forces), the state (position and velocity) of the basketball at a later time can be predicted. In quantum mechanics, by contrast, the evolution of states in time is governed by an equation called the time-dependent Schrödinger equation. It is deterministic in that if the state of a system is known at some time, the solution of the Schrödinger equation will specify the state of the system at a later time.

Precisely at this point in our summary of quantum mechanics a peculiar feature of quantum theory appears that raises the question of what quantum mechanics means. If a measurement is made on the system at a particular time using the Schrödinger equation, the theory predicts only the probabilities of outcomes of that measurement. Unlike the Newtonian example, where the position and velocity of the basketball at a later time are uniquely specified, quantum theory predicts only probabilities; it says nothing about the outcomes of individual occurrences. The prediction of probabilities of outcomes is tested by doing experiments on ensembles of identically prepared systems with different sets of alternatives. In all known cases, the experimentally measured outcomes agree with the probabilistic predictions of quantum mechanics with high precision.

To make this point more concrete, consider the following experiment. A beam of electrons impinges on a gas of hydrogen atoms that are assumed to be in their lowest energy state. An example would be a fluorescent light bulb in which the gas in the bulb is hydrogen. When the current is turned on, the electrons in the current interact electromagnetically with the hydrogen atoms, altering the velocities of the electrons and causing the hydrogen atoms to go to higher (excited) energy states. The excited atoms spontaneously drop to lower energy states by emitting light quanta called photons. This is what happens when the fluorescent bulb is turned on. The important point in this example is that only certain energies (alternatives) are open to the hydrogen atom. When an electron interacts with a hydrogen atom in its lowest energy state, quantum theory can accurately predict the probability of the hydrogen atom's going to some higher energy state. These probabilities are verified experimentally by counting the number of photons that are emitted from a given energy level of the atom. Yet quantum theory cannot predict the behavior of individual atoms.

In this experiment, a finite number of alternatives are open to the hydrogen atoms. Precisely this limited set of alternatives is seen experimentally, and no others. Moreover, other experiments proscribe different sets of alternatives. For example, in the two-slit experiment, a continuous range of alternatives is possible. Consider again a beam of electrons, not in this case interacting with hydrogen atoms but just passing through two slits and then impinging on a screen where their position is recorded. In this situation, the alternatives open to the electrons form a continuum, inasmuch as the electrons can impinge anywhere on the screen. Quantum theory predicts how the probability of an electron impinging on the screen varies from point to point. At some points on the screen the probability of finding an electron is almost zero; at other points it has some maximum value. The alternatives open to the electrons include all points on the screen, but the probabilities vary widely from point to point. Even when such experiments are carried out with different types of particles, such as neutrons or hydrogen atoms, the predicted probabilities always agree with experiment.

What are we to make of such behavior? Why is quantum theory mute with regard to the outcomes of individual events?

We argue that quantum theory is a theory of alternatives in that, for a given experiment in which an observable quantity (such as the energy) of a system is measured, it specifies the alternatives that are open to the system. For the example given of the hydrogen atom, only certain values of the energy are possible, and in an experiment measuring the energies of the atom, only these values are available.[7] No other alternatives are available to the hydrogen atom as far as the bound-state energy levels are concerned.

Quantum theory cannot account for why an individual atom opted for one energy state rather than another when it was measured. All quantum mechanics can say is that when the experiment is done repeatedly on an ensemble of identically prepared hydrogen atoms, the probabilities for outcomes of any of the alternatives open to the atoms are specified by the formula given in note 7.

Although the alternatives open to a system are calculated from the operators acting on the states of the system, the probabilities of outcomes are given by both the state of the system at the time of measurement and the projection operator related to a given alternative. This means that states of systems can be so prepared that, even though an alternative is in principle open to the system, the probability of finding a given alternative may be zero. This happens in the two-slit experiment; there are locations on the screen where the probability of finding an electron is essentially zero.

We argue that from a given set of alternatives specified by quantum theory, individual quantum systems spontaneously opt for one alternative rather than another, and that this opting is a primitive form of consciousness, not reducible to any more fundamental category. That is, matter at the quantum level exhibits not only material aspects such as the invariant properties of mass, spin, and charge but also protomental properties that are manifested in experiments in which matter opts from a set of alternatives specified by quantum theory.[8] Why we call such opting a manifestation of primitive consciousness is discussed in the next section.

Two further points must be made here. First, it is clear that many objects exhibit no form of consciousness even though they are made of electrons and nuclei. Rocks, chairs, and basketballs do not seem to exhibit any form of consciousness. Put differently, they do not have alternatives open to them from which they can opt, one over another. In order for our model to be coherent, we must be able to show why many systems in our everyday world exhibit no trace of consciousness. Second, many systems at the macroscopic level do exhibit various forms of consciousness. Relative to plants or other animals, it seems clear that there is hierarchy of matter, starting with basic constituents such as electrons and nuclei, through atoms such as the hydrogen atom (on the ground that composite quantum systems have more alternatives open to them than their constituents do), to molecules (such as the water molecule), and on to more and more complex systems (Schäfer 2006, 522). The higher the level in the hierarchy, the more alternatives are in principle open to the system.

Why, then, do many macroscopic systems not exhibit quantum behavior? Various answers have been given to this question. Probably it is fair to say that the quantum mechanics of macroscopic systems is not yet fully understood. (This does not affect our model of consciousness, because the reasons that macroscopic systems do or do not exhibit quantum properties are independent of any interpretation of quantum mechanics.) The reason usually given for quantum systems not exhibiting quantum behavior has to do with sizes and orders of magnitude. If one computes the interference pattern that should occur when basketballs are thrown at a wall containing two windows (the two-slit experiment), the spacing between maxima in the probability pattern is so small by orders of magnitude as to be forever immeasurable. Similarly, if one applies the rules of the Heisenberg uncertainty relation to the orbit of a thrown basketball, the uncertainty is so tiny that one can talk with certainty about the orbit of the thrown ball. But such answers do not seem to get at the heart of the matter. They seem only to indicate that the kinds of measurements made on quantum systems, such as electrons or hydrogen atoms, are not possible with macroscopic systems.

There are several possible explanations of why many macroscopic systems do not exhibit quantum behavior. The first involves the notion of decoherence. The basic idea is that macroscopic systems are never isolated systems; they are in constant contact with their environment. The environment is constantly and erratically fluctuating, thereby washing out any quantum behavior. Experiments involving electrons and hydrogen atoms succeed so spectacularly in showing quantum behavior precisely because the system is isolated from its surroundings. This condition is almost never met for macroscopic systems. Jitters from earthquakes, random variations of the wind, interactions of light with the system, and the like all contribute to minute fluctuations that wipe out quantum behavior. If an atomic two-slit experiment were not carefully isolated, the interference pattern would be completely washed out.

One may object that if electrons and hydrogen atoms can effectively be isolated from their surrounding environment, why can't basketballs or rocks? That is, under what conditions might macroscopic systems exhibit quantum behavior?

Several conditions are necessary, even when the system is well isolated from its environment. The most important is our second reason: The temperature of the system must be very low so that the thermal motion of the system does not wipe out the quantum effects being sought. As we rise in the hierarchy of matter to systems with more and more constituents, their internal structure accordingly becomes richer. At higher levels of complexity, the spacing between energy levels becomes smaller and smaller. With very small spacings between energy levels it becomes increasingly difficult to keep thermal agitations from eliminating any quantum effects, unless the temperature is very low (Greenstein and Zajonc 2006, 185–214).

Certain carefully constructed macroscopic systems, such as superconductors, do exhibit quantum behavior which satisfy the conditions just adduced. To the extent that such systems have alternatives open to them, they do indeed, in our model, exhibit primitive forms of consciousness.

Why do macroscopic systems such as cats or human beings exhibit consciousness? This question is related to the existence of brains and nervous systems, which seem necessary to produce consciousness of the sort that human beings have, including the rich inner life of experience. Here we simply say that protomental consciousness found in quantum systems is built up into more sophisticated forms of consciousness when the systems become complex enough to have brains and nervous systems. Like all other conscious beings, cats and human beings choose from the alternatives that are available to them. However, they manifest their consciousness in a more sophisticated way than the primitive consciousness found in simple quantum systems without nervous systems or memory.

So far in this essay we have argued for the existence of a protomental or primitive consciousness at the level of simple quantum systems, as indicated by the opting of such systems from a manifold of alternatives made available to them by a measuring device. Complex systems are made from simple quantum systems, and there is a hierarchy of more and more complex systems. We hold that these more complex systems split into two branches: the organic branch, whose systems continue to opt from alternatives, and the inorganic branch, whose systems do not. The organic branch has more and more complex alternatives open to it as systems move through simple organisms to ones such as cats and human beings, where brains and nervous systems play a key role. However, as we discuss in the next section, the fundamental property of consciousness is maintained through the whole of the organic hierarchy.

Sartre and the Spontaneity of Consciousness

In 1936, Sartre published a remarkable treatise on consciousness titled *The Transcendence of the Ego*. Sartre was himself firmly situated within the traditions of Husserlian phenomenology, yet he used Husserl's own version of Cartesian doubt to deliver a radical critique of the received doctrine of the transcendental subject as ultimate source of the meanings that unify experience. Sartre maintained the fundamental principle of phenomenology conceived as a descriptive science—thinking should orient itself "to the things themselves! (*zu den Sachen selbst!*)" Husserl employed this principle in conceiving the intentional structure of consciousness: Consciousness is always consciousness *of* something and thus has an intentional object.

Sartre continued to think of intentionality as the essential structure of consciousness. As mentioned earlier, however, in his later writings Husserl explained the intentional structure of consciousness with reference to the constituting activity of the transcendental ego. In Husserl's view, according to Sartre, "It is because all my perceptions and all my thoughts refer themselves back to this permanent seat that my consciousness is unified" (Sartre [1936] 1957, 37). On this point, Sartre objects to Husserl's highly theoretical explanation as a departure from his method of strict description. In *The Transcendence of the Ego* he refutes the later Husserl, arguing that it is not necessary to posit a constituting ego behind consciousness and somehow inhabiting it both materially (as empirical ego) and formally (as transcendental ego) (p. 31).

We find Sartre's analysis to be convincing and incorporate it into our model. Here we show what exactly we take from Sartre's philosophy of consciousness and how it connects to both the meaning of quantum mechanics and the proposal for a modified panpsychism.

Sartre's argument is based on rigorous description of what he calls *unreflected consciousness*, which refers to conscious acts and meanings in their immediate experiential and direct givenness. In his view, unreflected consciousness does exhibit the structure of intentionality, as Husserl set it forth, but with a crucial difference. According to Sartre, the essential nature of unreflected consciousness is that it transcends itself toward its object, and *thereby it finds its unity in the object* (p. 48). His description of consciousness thus contradicts the received model of consciousness as the act of a transcendental subject constituting the unity of its intentional object by conferring meaning on it. For him, unreflected consciousness is a sheer, spontaneous activity of being outside itself in presence to objects. Consciousness is like a sparkling (Sartre's term: *éclat*) onto the world, like a light focusing on and illuminating objects. In itself it is nothing; ontologically speaking, consciousness is "being-for-itself," which is contingent and dependent on "being-in-itself," toward which it erupts (Sartre 1992, 617, 681). In his view, there is no *I* in unreflected consciousness, inhabiting it and conferring meaning on its contents. For example,

> When I run after a streetcar, when I look at the time, when I am absorbed in contemplating a portrait, there is no *I*. There is consciousness *of the streetcar-having-to-be-overtaken*, etc., and non-positional consciousness of consciousness. In fact, I am then plunged into the world of objects; it is they which constitute the unity of my consciousnesses; it is they which present themselves with values; with attractive and repellant qualities—but *me*, I have disappeared; I have annihilated myself. There is no place for *me* on this level. And this is not a matter of chance, due to a momentary lapse of attention, but happens because of the very structure of consciousness. (Sartre [1936] 1957, 49)

Sartre is clear that unreflected consciousness is, strictly speaking, inaccessible to description. Any description of unreflected consciousness necessarily entails the intrusion of a different form of consciousness—reflecting consciousness—that turns the prior unreflected conscious acts and meanings into "reflected consciousness" ([1936] 1957, 44–48). Reflecting consciousness refers to conscious acts of bending back on prior acts of consciousness in order to understand their intrinsic structure—what any conscious act is and what it means. Unreflected consciousness is always reflected to some degree; hence, it is modified in the act of reflection. Even reflecting consciousness is, in its immediate givenness, a mode of unreflected consciousness that requires a new act of reflection to grasp it ([1936] 1957, 45). However, Sartre holds that in spite of this unavoidable structural limitation we can focus the mind on the immediacy of unreflected consciousness, using memory and imagination to recall the immediate experiences of unreflected consciousness. The intrusion of reflection does not render the intuitive givenness of unreflected consciousness inaccessible or distorted beyond understanding.

It is important to recognize that Sartre's position does not deny Descartes' irrefutable demonstration of the existence of the *I* in the *cogito, ergo sum*. In incorporating Sartre's view of unreflected consciousness into our model we are by no means embracing a postmodern deconstruction of the ego or a version of the narrative expressing the "end of the self." Sartre's point, with which we agree, is a different one: The *I* does not appear at the level of unreflected consciousness but appears only *through* the form of reflected consciousness as the source of consciousness ([1936] 1957, 51). In reflected analysis of unreflected conscious acts, we posit the *I* as source within the structure of intentionality. As such, the *I* is not given in immediate experience but is posited by reflection as an existent object that is transcendent to the unreflected consciousness (pp. 52–53).

In understanding human consciousness, it is crucial to understand the difference between the unreflected and reflected levels of consciousness. This distinction has long been known, but only Sartre recognized that the *I* formally appears only at the level of reflected consciousness. At the level of unreflected consciousness, subjectivity takes the form of immediate, nonthetic self-consciousness, by which he means an immediate awareness of or acquaintance with oneself that does not formally posit the *I* (pp. 46–47). The original field of conscious activity is "pre-personal," without an *I* (p. 36). Formal thinking of the *I* is always reflected consciousness, for which the *I* is a transcendent object conceived as the originating unity of states and actions (p. 70).

Most important for our argument, as we interpret and adapt Sartre, is that the essential feature of unreflected consciousness is "spontaneity" (pp. 41, 97–98). The spontaneity of consciousness is the capacity of *being* what one *does*; unreflected consciousness *is* what it *produces* through itself (p. 70). Through its spontaneity, consciousness introduces meaning, significance, differentiation, and purpose into being. But this spontaneity of consciousness has no other cause than itself in its freedom as an opting among alternatives. For example, I may say "I like chocolate ice cream but dislike vanilla," a statement that reflects an immediate, unreflected state of consciousness. This state has a subjectivity about it; in liking chocolate, there is immediate self-awareness of my own inner life as determined by the feeling. This subjectivity determines itself through its action—it is what it has opted for. Alternatives present themselves: repulsion, attraction, and indifference (not everyone likes chocolate)—but a choice is made spontaneously, based on nothing but the subjectivity of taste. The subjectivity of opting is grounded only on the individuality of being; all that reflection can say to justify the opting is that I am the person I am. Others may like vanilla, or even strawberry, but I like chocolate.

Reflection, of course, still has an important role to play in our model of consciousness. Through reflection on my acts of opting I may seek reasons to justify my specific acts of opting or I may resolve to change my behavior in the future. Reflection can and sometimes should intervene as a determinant of thought, action, and possibly even feeling. Furthermore, I may reflect on the general principles, concepts, and rules of taste or action, and thus I may develop a reflective discipline of aesthetics or ethics. Nonetheless, the phenomenological point is that my liking chocolate appears spontaneously and without reflection. It simply happens through the subjectivity of opting when I taste it. The event is neither random nor determined.

According to Sartre, unreflected consciousness has an ontological priority over reflected consciousness in that the latter is a secondary construction with regard to the former. We agree with this claim. Whatever I may think about my response to chocolate as an immediate state of unreflected consciousness, it remains a fact that at the spontaneous level chocolate attracts me (although it could be otherwise). Ultimately, no reasons can be given why I like chocolate and dislike vanilla; I just do. Psychologists can probably construct experiments according to which they can make accurate probabilistic predictions as to what percentage of people will be repelled, attracted, or indifferent to vanilla or chocolate, just as political scientists can predict voting behavior at election time. But in these cases, as in the case of quantum behavior, the opting behavior of individuals remains inscrutable. No one can predict with certainty how any one person will respond to different flavors.

Quantum Mechanics and Panpsychism

In this section we come to the perhaps surprising conclusion that our model may in fact be a modified version of panpsychism.[9] David Skribina defines panpsychism as follows: "All objects, or systems of objects, possess a singular inner experience of the world around them" (2005, 16). This definition characterizes the basic doctrine of panpsychism. It means that all objects, or systems of objects, have a mental or protomental quality internal to them that is manifest in a unitary experience or pattern of behavior. Our model is a *modified* version of panpsychism because, as already stated, not all objects in the world exhibit protoconsciousness according to our criterion of opting. Our modified version has scientific, not metaphysical, warrant. Nonetheless, the discovery of the same structural quality of opting in both higher organisms and the fundamental material constituents of the universe justifies our modified version of panpsychism.

In current discussions of mind, arguments sympathetic to a panpsychic form of consciousness have been given by Thomas Nagel, and more recently by William Seager, over against competing theories. In their pared-down forms, the alternatives are dualism, materialism, emergentism, and panpsychism. Dualism is strongly discredited today by philosophers, who point to metaphysical problems in relating mind and matter (among other questions), and by neuroscientists because it lacks scientific warrant. Nonetheless, many philosophers of mind, while rejecting dualism, resist the full-blown reduction of consciousness to material reality.

Emergentism is one possibility for avoiding both dualism and materialism. It holds that the property of consciousness emerges in biological organisms out of nonconscious biochemical constituents at some point in the history of evolution. The problem with emergentism was well expressed by W. K. Clifford in 1874:

> We cannot suppose that so enormous a jump from one creature to another should have occurred at any point in the process of evolution as the introduction of a fact entirely different and absolutely separate from the physical fact. It is impossible for anybody to point out the particular place in the line of descent where that event can be supposed to have taken place. (in Seager 1997, 277)

Panpsychism is the remaining possibility. Nagel's argument (1979, 181; 1986, 8; 2005, 230–31, 234) is that if consciousness is not reducible to configurations of matter, no matter how complex, and if there are no truly emergent properties, a primitive form of consciousness must have been present already in the simple forms of matter that make up the more complex configurations. To quote Seager, "Emergence is impossible, reduction is absurd—so elements of consciousness must be found in the basic construction materials of the universe" (1997, 277).

The main objection to panpsychism is called the combination problem. It is "the problem of explaining how the myriad elements of 'atomic consciousness' can be combined into a new, complex and rich consciousness such as that we possess" (Seager 1997, 278). The problem can be extended by asking why some macrosystems possess consciousness and others do not. But this is precisely the issue we addressed earlier in explaining why some systems such as rocks or chairs do not exhibit consciousness and others, such as organisms, do. We noted that certain conditions must be met for a macroscopic system to have alternatives. Most systems do not satisfy these conditions. Others, like superconductors or liquid helium, behave like quantum systems. They can be said to exhibit a primitive form of consciousness of the same kind as found in electrons or hydrogen atoms.

The harder part of this objection is the question of how atoms and molecules, when combined into complex configurations leading to organic systems, generate more complex forms of consciousness. Although we are not able to answer this question in any definitive way, there are hints as to how richer forms of consciousness might arise. Earlier we discussed decoherence, including the decoherence of systems in an energetic environment, as an important mechanism for wiping out quantum behavior. Some models have been proposed for explaining how quantum coherence may be maintained in organisms. Surely these models must include the emergence of nervous systems and memory storage devices (Hameroff and Penrose 1997, 177–96). Our point is that whatever the mechanism might be, the property of opting from a set of alternatives remains as a basic feature of consciousness, even at the level of human beings, as seen in the phenomenological analysis of Sartre.

Conclusion

In this essay we have presented a model of a fundamental property of consciousness, namely, the capacity to opt from a set of alternatives. We claim that this capacity of opting is common in the hierarchy from nuclei and atoms, governed by quantum mechanics, through simple organisms to higher-level organisms and finally to human beings. We also make a claim concerning how consciousness arises in the world, with respect to both physical conditions and its evolution into higher forms. Briefly, we argue that the fundamental property of consciousness as opting occurs already in the very nature of elemental matter. It continues to manifest itself in increasingly sophisticated and complex forms in organic life, including human beings.

Our proposal does not obviate the need for research now carried out in neurophysiology and neurobiology. It continues to be mysterious how consciousness as manifested in experience is generated on top of the fundamental property of opting from alternatives. We have argued that neural systems and brains are necessary to produce such further manifestations of consciousness, but how this actually comes about is unknown. The gulf between the protoconsciousness of nuclei and atoms and the consciousness of human beings is immense, and nowhere is this gulf clearer than in saying that atoms opt but human beings also can choose—that is, reflect on the alternatives available to them. Thus, if our model is correct, it has wide-ranging implications for new types of research.

Our model also has far-reaching implications for a number of areas traditionally associated with consciousness. An algorithmic device can never be conscious in our sense, simply because it has no alternatives open to it; an algorithm is by definition not open to alternatives. Hence, any device such as a computer that embodies the structure of a Turing machine can never be conscious. It may be able to simulate consciousness but can never properly embody it. Further, the Turing test for consciousness cannot be meaningful as originally proposed by Turing, because, even if the device behind the curtain appears to be conscious, if it is algorithmically driven, no matter how sophisticated it may be it can only simulate and never genuinely manifest consciousness.

We therefore basically agree with Searle's Chinese room example (Searle 1980, 417–24; 2004, 62–64, 69–72), which is intended to show the irreducibility of consciousness to programmable functions. The algorithmic aspects of the Chinese language may appear to incorporate meaning, but in principle they never can. More generally, translation devices may, over time, be more and more successful in translating from one language to another, but to the extent that they are algorithmically driven they can never capture the full meaning of statements in the richness of their contexts. Understanding meanings within a language always involves something more than following rules. Even learning machines cannot be said to be conscious if they are driven by higher-level algorithms. Introducing randomness into such machines also will not help, because there is a fundamental difference between devices that incorporate random elements and the spontaneity of opting. Devices that incorporate deterministic and random elements can merely simulate such opting.[10]

Finally, our model shows the inadequacy of Colin McGinn's mysterian position on the problem of consciousness. McGinn (1999, 5 and passim) argues that the human mind has so evolved that it is incapable of understanding the link between the brain as a material system and consciousness; evolution has structured the human brain so that it is well equipped to deal with scientific or mathematical problems, but the hard problem of consciousness is not a problem that the human brain can solve. In this article we have developed a model that shows at least in principle how dualism and materialism can be overcome. Our model points the way to a solution to the hard problem by connecting the phenomenon of opting in matter to the same phenomenon in human spontaneity. It may turn out that our model is wrong or too limited to fully explain consciousness, but the important point is that it *is* a model. McGinn underestimates the ability of human imagination to create new models for dealing with a wide variety of problems—even the hard problem of consciousness.[11]

NOTES

1. For an expanded account of what we mean by a "model," see Klemm and Klink 2003.
2. Dualism claims that the universe, and everything in it, consists of two interrelated principles of mind and matter. Universal mentalism holds that all reality, including material reality, can ultimately be reduced to ideas in human or divine consciousness.
3. In this article we deal only with nonrelativistic quantum mechanics. The reason is that, while quantum field theories such as quantum electrodynamics are in excellent agreement with experiment, the bound-state problem in quantum field theory is notoriously difficult, so it is difficult to talk about a hierarchy of matter in quantum field theory.
4. There are a number of ways of grounding nonrelativistic quantum mechanics, including the Feynman path integral approach and the Dirac Poisson bracket approach. We think that the symmetry approach used in this essay is the most conducive to seeing how quantum theory is a theory of alternatives.

5. In Newtonian theory, the state of a solid object is not specified just by its position and velocity, for it may also be spinning about some axis. Strictly speaking, only idealized point masses have states specified by just position and velocity.

6. Extracted are the eigenvalues of these operators, which then give the possible outcomes of measurements of the observable.

7. The formula that gives the probability of outcomes is given by the product of the state of the system at the time of measurement times a projection operator related to a possible given outcome; more technically it is given by $Tr\, p(t)P(k)$, where $p(t)$ is the state of the system at time t (p is called the density matrix), $P(k)$ is the projection operator for the observable value k, and Tr is the trace operation.

8. For important alternative views, see Stapp 1993 and Schäfer 2006.

9. On the issue of a panpsychism implied by quantum reality, with a critical perspective on Pierre Teilhard de Chardin's panpsychist vision of biological evolution, see Schäfer 2006.

10. The distinction we are making here can be further elucidated by considering the different ways in which probability arises. When one says that the probability of a thrown die giving the number 2 is 1/6, the probability arises from ignorance. In principle, if all the forces and initial conditions on the die were known, it would be possible to predict the appearance of the number 2. In quantum mechanics, probability does not arise from ignorance but seems absolute. However, Einstein (and others) tried to show that probability in quantum mechanics could also be understood as arising from ignorance. This is the hidden-variables theory of quantum mechanics. Various theorems, including Bell's theorem, severely reduce the possible class of hidden-variables theories to nonlocal theories. Bohm's hidden-variables theory is not ruled out by experiment because it is constructed to agree with the predictions of conventional quantum mechanics. But the Bohm theory is very nonlocal and has a number of other deficiencies.

11. The point we are making is that if the capacity to opt among given alternatives is a correct explanation of individual events at the level of microphysical particles, it can be connected all the way up the hierarchy of matter to organic beings and to human freedom. If, however, the hidden-variables interpretation of quantum mechanics is correct, so that the appearance of opting actually comes from some underlying determinism, our model could be falsified. We do not presume to demonstrate the correctness of our model, which, like all models, invites criticism through testing. We do propose that the evidence supporting our model is strong enough to deserve further testing.

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