Quantum Misuse in Psychic Literature

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ABSTRACT: In this paper, we address an unfortunate growing trend involving misuse of quantum physics in psychic and healing literature, including literature on near-death experiences. After a brief introduction to quantum physics, we provide examples and explanations of misuse. Such misuse encourages undue skepticism of what might otherwise be valuable reading. We conclude with recommendations to authors and publishers about how to guard against this problem.

KEY WORDS: quantum misuse, quantum collapse, entanglement, psi, consciousness

A substantial literature addresses psychic phenomena such as near-death experiences (NDEs), out-of-body experiences (OBEs), telepathy, and mind-over-body healing. In a growing trend, authors of this literature often refer to modern physics, specifically to quantum physics, to buttress their arguments. Their works are replete with terms like

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"quantum mind," "quantum synchronicity," "quantum soul," "quantum healing," and "quantum fields of possibility" (e.g. Chopra, 1993; Dispenza, 2014; Goswami, 1993; Schwartz, 2017).

Reference to quantum physics in psychic literature is perhaps not surprising. At the present time, quantum physics (Dicke & Wittke, 1960; Penrose, 2004) provides the most successful theory in physics, predicting a wide range of phenomena with unequalled accuracy. Nevertheless, quantum physics defies common sense with its baffling wave-particle duality, suggestions of a mysterious role of the observer in experiments, and "spooky action at a distance" (Einstein, in Born, 2005, p. 155) at speeds faster than the speed of light. Many authors have been tempted to invoke such baffling quantum physics concepts to explain equally baffling psychic phenomena. Unfortunately, only a small fraction of either the audience or the authors of psychic literature possesses in-depth understanding of quantum physics, with the result that well-established principles of quantum physics have often been misinterpreted and misused.

In this article we describe relevant principles of quantum physics and then give examples of significant errors in the literature. Although we are by no means the first authors to raise concerns about such pseudoscience (e. g. Carroll, 2016; Hobson, 2013; Park, 2000; Rosenblum & Kuttner, 2011), our article brings the discussion up-to-date with both recent as well as older examples. Our goal is to encourage authors to avoid augmenting their discussions with improper references to physics and also to call for better pre-publication vetting and educational dialogue with mutual respect. We take no position in this paper on the validity or invalidity of specific psychic phenomena.

A note about our explanations: In order to convey complex ideas in a form understandable to most laypersons who are relatively less versed in quantum physics, we have sometimes presented concepts in a way that some experts in quantum physics may find objectionable. In these cases, we provide parenthetical material beginning with the phrase "For the expert." Lay readers may wish to skim over or disregard this material to avoid complexities not germane to the main points of this article.

Quantum Physics

Before the 20th century, classical physics based on Newton and Maxwell's equations was widely accepted and very successful in explaining ordinary *macroscopic* phenomena. However, as scientists probed into the *microscopic* world of atoms, they discovered major discrepancies with classical physics requiring a radically new theory.

Quantum mechanics (Dicke & Wittke, 1960; Penrose, 2004) was first introduced in 1926 by Born, Heisenberg, and Jordan (1926) and by Schrödinger (1926). The theory was soon extended to cover both matter and radiation. It was further developed over the last century into a quantum field theory that underlies the so-called Standard Model, to date the most complete—though not yet fully complete—and successful theory of everything (Quigg, 2006). In what follows, we use the term *quantum physics* to subsume the original concepts of quantum mechanics, the extensive further developments of quantum field theory, and their experimental manifestations.

Wavefunction and Quantization

Quantum physicists conceptualize the universe as comprised of discrete entities such as photons, electrons, and protons—which are themselves made up of quarks, and of their combinations. Originally, Bohr (1913) envisioned atoms as comprised of solid particles, electrons, circulating around the nucleus like planets circulating around the sun. This concept has now been discredited and replaced. Rather than describing such entities in the classical way as solid particles, quantum physicists now describe them, and their evolution in time, in terms of a mathematical function, the Schrödinger wavefunction, which effectively smears out the entity's exact position. The wavefunction in any given case—such as an electron in an atom or a photon in a box—along with its evolution in time, are determined by the famous Schrödinger equation (1926).

The wavefunction of a single quantum entity ascribes an amplitude and a phase to every point in three dimensional space. In other words, the wavefunction is analogous, at least in two dimensions, to a water wave: At every point on the water's surface, a wave has an amplitude/height as well as a phase/timing of its oscillations. (For the expert, more technically, if there are N entities, their joint wavefunction assigns the amplitude and phase to every point in a 3N-dimensional "configuration space" consisting of all their possible positions.)

However, in quantum physics one must think of the wavefunction in *three*-dimensional space; depending on the particular case, the wavefunction can be either extended or concentrated in a small region of these three dimensions, and it can change—move or spread out—or be stationary. The result is that a quantum entity is more easily vi-

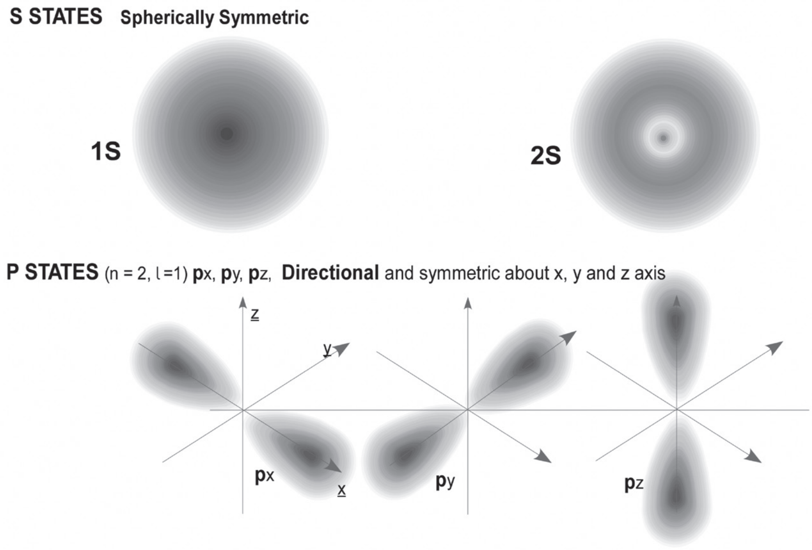

Figure 1. Several of the lowest energy wavefunctions or states, called 1S, 2S, and 2P, of an electron in a hydrogen atom (one electron and one proton). The proton lies in each diagram's center. Such states around a central nucleus are also called orbitals. Gray and black intensities represent wavefunction amplitude, often interpreted as the probability of finding an electron.

sualized as a cloud with varying local density that corresponds to the wavefunction's amplitude—the significance of which will be explained in the next section.

For example, when Schrödinger's equation is solved for the hydrogen atom—a single electron around a proton—one finds a discrete set of *possible* electron wavefunctions called orbitals, some of which are shown schematically in Figure 1, looking like clouds around the central proton (Dicke & Wittke, 1960). This picture is in sharp contrast to what Bohr (1913) originally envisioned.

More generally, such wavefunctions are called "quantum eigenstates," or simply "states," and with each state is associated an energy. A direct result of solving the Schrödinger equation is that the number of states in cases like the hydrogen atom is not continuous but discrete and countable, though still infinite (such as the integers 1,2,3 . . .). In other words, the states are said to be "quantized." This, then, is the origin of the term "quantum."

Entities like electrons, protons, and photons are said to "occupy" one of these possible quantum eigenstates. They can also jump from one state to another when excited, for example, by a photon or "quantum" of light energy. And, most remarkable of all, they can occupy multiple states *simultaneously*—meaning that the total wavefunction can be a mixture or "superposition" of the different eigenstate wavefunctions.

In practice, the utility of the wavefunction is to calculate the expected result of a measurement, and it does so spectacularly well. But *between* measurements—when no one is looking, as it were—the interpretation of the wavefunction—whether it is "real" or not—is still highly controversial. Many physicists have considered the wavefunction to be merely a mathematical description or calculational device (Becker, 2018; Herbert, 1985; Rosenblum & Kuttner, 2011), though some (Carroll, 2016; Einstein, Podolosky, & Rosen, 1935; Penrose, 2004) have considered it to be real, at least in some sense.

Whether real or not, the notion that entities comprising the universe are described by waves is counterintuitive to most people, who, like the ancient Greeks, most naturally think of solid particles as the basic building blocks of reality. Describing them as waves makes them seem mysterious, otherworldly. Authors of psychic literature have often seized on this fundamentally new concept as a scientific starting point for a paradigm in which, as in Buddhism, the external world is considered an illusion (Chopra, 1993; Goswami, 1993).

Observation and Quantum Collapse

As if these concepts aren't strange enough, the next key element of quantum physics is even more baffling: quantum collapse, also known as wavefunction "reduction" (Dicke & Wittke, 1960; Penrose, 2004). When a measurement or observation is made, for example of an electron's location, standard quantum physics postulates that its wavefunction "collapses," effectively instantaneously, to a localized spot—and, indeed, observation results in finding the electron in just one spot. What is more, it collapses *randomly*: The probability with which it ends up in any given spot is determined, according to the "Born rule" (Born, 1926), from the square of the wavefunction's amplitude at that spot. Thus, in the electron cloud surrounding an atom's nucleus, relatively lighter or darker locations in the cloud represent, respectively, relatively lower or higher probabilities that upon measurement the electron will be found at those locations. (Again, for the expert: More generally, if a wavefunction is in a mixed, superposed state, it can collapse on measurement to any one of the constituent eigenstates with a probability determined by the square of the weighting of that particular state in the original superposed wavefunction.)

The fact that measuring a quantum entity's location collapses the spread-out wavefunction into a localized form is partly what gives rise to the weird notion of "wave-particle duality." *Between* measurements, the entity looks like a wave, but *as a result of the measurement*—at least when location is being measured—it looks like a particle. *After* the measurement, the entity is once again described by a wavefunction, just a more spatially localized one that usually spreads out in time.

A revealing example of wavefunction collapse is the two-slit experiment shown in Figure 2b. Consider a single electron wave traveling from the left and passing through the two slits. Then, in the same way that water waves interfere with each other, the portions of the electron wave emanating in all directions from each of the two slits interfere with each other, creating an oscillatory pattern as they impinge on the detector screen to the right.

However, as predicted by the wavefunction collapse principle, when only a single electron wave is involved, only a *single* spot or pixel is activated on the detector screen. And, even more amazing, when *many* electrons are tested this way, the *net* pattern of detected spots reveals the interference pattern as shown in Figure 2b, with intensities as predicted by the Born rule. This is another example of quantum weirdness: *If the electron were actually just a single localized particle during its passage to the target, there would be no way to understand these experimental results.*

(Again, for the expert: In one modification of quantum physics, called the pilot-wave theory, the quantum entity is described as *both* a particle *and* a wave, *simultaneously* [Bohm, 1952]. Although consistent with experimental results, this theory is not widely accepted because of its extra complexity and because of some misunderstanding of an early disproof of such "hidden variable" theories by von Neumann [1932/2018]. Norsen [2017] explained the problem with von Neumann's disproof and showed that the pilot-wave theory is in fact alive and well.)

When a wave encounters a sharp edge or single slit, as in Figure 2a, the resulting pattern is called diffraction; when multiple slits are encountered, as in Figure 2b, the resulting pattern is called interference. However, both are the result of the same fundamental process of a wave scattering off an obstacle.

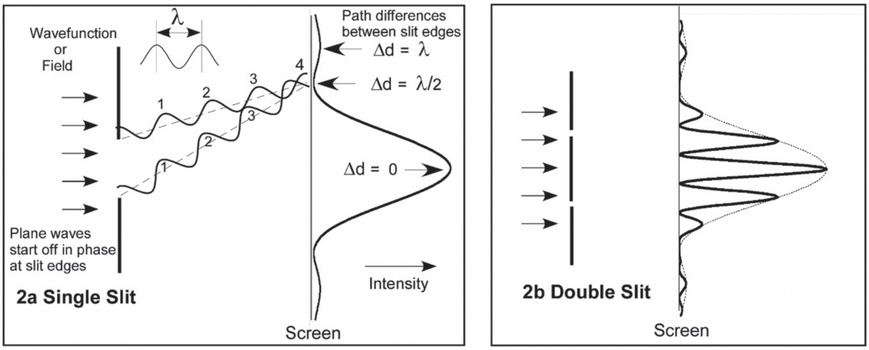

Figure 2. Schematic of the intensity of the *net* diffraction and interference patterns on a detector screen, for many electron plane waves passing through one (2a) or two (2b) slits. In 2a, the slit width is exaggerated to show the diffraction or interference effect. In both cases, the effect of a *single* electron plane wave is to register at only a single pixel of the detector screen.

Because the probability of measuring a given result is determined by the square of the wavefunction amplitude, a natural and widely used interpretation of the wavefunction is as a *probability wave*. Strictly speaking, it can be considered a probability wave only at the moment of measurement. (For the expert: Of course, the wavefunction is much more than just a probability wave because it also contains a phase that gives rise to its unique interference behavior.) And because the total wavefunction can consist of a superposition of multiple eigenstates, any one of which can emerge as the result of a measurement, these pre-measurement eigenstates are sometimes referred to as *potential* states of the quantum entity, or as states "*in potentia*" (Goswami, 1993).

Authors of psychic healing literature have applied this idea of potential states, sometimes also called "quantum fields of possibility" (Goswami, 1993), to the possible health states of an entire human being (Chopra, 1993). The suggestion is that through an appropriate "mental" measurement or observation, a person could "collapse" one's potential health states to a specific and hopefully desirable one (Chopra, 1993; Dispenza, 2014).

Unfortunately, one flaw in this line of reasoning is that it is not generally possible to extrapolate such microscopic "collapse" phenomena to the macroscopic level; we discuss this point further below. Another major flaw is that quantum physics predicts the result of such a collapse to be *random*, preventing a person from choosing or intending a particular desirable outcome. (For the expert: Regarding this last point, Stapp [2017] pointed out that in certain cases, increasing measurement frequency can enhance the likelihood of an otherwise random result, a phenomenon called the Quantum Zeno Effect. He suggested this mechanism could underlie free will. However, this interpretation is not widely accepted [Williams, 2017, p. 49]).

There has long been ambiguity in quantum physics about what constitutes a measurement and whether it is ultimately "observation" made by a *conscious* observer (Becker, 2018; Herbert, 1985; Penrose, 2004). Does the resulting quantum collapse occur right at a physical detector or in the conscious brain?

The conscious observer interpretation, first introduced by John von Neumann (1932/2018), has been adopted enthusiastically in psychic literature (Chopra, 1993; Dispenza, 2014; Stapp, 2017), whereby conscious observation is seen as turning an otherworldly "unreal" wavefunction into a physical, "real," particle. In effect, conscious observation is seen as *creating* physical reality. This idea resonates with the Buddhist idea of external reality as illusion and consciousness as the transcendent reality. However, this interpretation has not been proven and is not generally accepted by quantum physicists (Becker, 2018; Herbert, 1985; Penrose, 2004). Sean Carroll (2016), a theoretical physicist at the California Institute of Technology, wrote that "almost no modern physicist thinks that consciousness has anything whatsoever to do with quantum mechanics" (p. 166).

According to the relatively recent "decoherence" theory (Schlosshauer, 2005), interaction of a wavefunction with the environment or with a macroscopic object like a detector destroys its phase coherence which is responsible for most unique quantum interference effects, and this decoherence always happens *before* any conscious observation. Indeed, some scientists have even hypothesized that collapse or wavefunction reduction can occur spontaneously, *without any measurement, environmental interaction, or conscious observation at all* (Ghirardi, Rimini, & Weber, 1986; Penrose, 1995)!

Entanglement and Quantum Nonlocality

One other quantum weirdness should be mentioned because it has also stimulated much speculation in psychic literature: entanglement and the often resulting "quantum nonlocality" (Becker, 2018; Herbert, 1985; Penrose, 2004). When *multiple* quantum entities such as electrons or photons interact, they can become "entangled" into a joint quantum state. Even if these entities later fly apart, their entangled state is maintained even at large distances, and when their random properties are independently measured, quantum physics predicts a remarkable correlation between the results. [For the expert: In the case of two spin ½ entities in an entangled net spin singlet state, the correlation is a perfect *anti-correlation*—one spin up, the other down when they are measured along the same axis; however for the case of two entangled photons, the correlation is a perfect *positive correlation* when the two photons' polarizations are measured along the same axis (Norsen, 2017).]

These perfectly correlated properties manifest even when the timing and separation of the two measurements are such that, for the entities to communicate, signals would have to travel faster than the speed of light—a process that defies Einstein's laws of relativity (Becker, 2018; Herbert, 1985; Penrose, 2004). This amazing phenomenon is called quantum nonlocality, or, as Einstein (in Born, 2005, p. 155) put it, "spooky action at a distance," and it has been confirmed conclusively in the famous experiments of Clauser and Shimony (1978); Aspect, Grangier, and Roger (1982); and many others (Hensen et al., 2015).

The idea of quantum nonlocality and apparent communication at speeds faster than light has been enthusiastically adopted in psychic literature in an attempt to explain telepathy and other psychic phenomena. Actually, a No Communication Theorem has been established, confirming that communication of *useful* information through the instantaneous connection of quantum nonlocality is impossible (Eberhard, 1978; Eberhard & Ross, 1989; Ghirardi, Grassi, Rimini, & Weber, 1988).

Quantum nonlocality has given rise to an even more extreme concept, at least in some interpretations, that the entire universe might be totally interconnected at speeds *faster* than light (Penrose, 2004). Events in one corner of the universe could in principle manifest simultaneously in those of another. This notion has been picked up in the psychic literature in relation to the possibility of universal consciousness (Goswami, 1993; Stapp, 2017). In practice, however, the proposed interconnection remains theoretical: No actual phenomena reflecting universal quantum entanglement and collapse have ever been detected. Of course, scientific observations do not deny an assumed metaphysical universal consciousness, but science should not be used as justification for a metaphysical consciousness considered to be outside science's domain.

Microscopic or Macroscopic?

Weird quantum phenomena like interference in the double slit experiment or spooky action at a distance in entangled particles have been observed mostly in microscopic systems of only one or a very small number of quantum entities—and only when they are totally isolated from environmental disturbance. Such disturbance can arise, for example, from a profusion of photons or gas atoms impinging from outside, and isolation may require high vacuum or very low temperatures.

As mentioned earlier, environmental disturbance can destroy the condition, generally called "quantum coherence," required for observing characteristic quantum phenomena. Loss of coherence, or "decoherence," is now a well-established phenomenon in quantum physics and occurs faster in bigger systems, at higher temperatures, and with stronger environmental interaction (Penrose, 2004; Schlosshauer, 2005). This finding means that it is exceedingly difficult, if not impossible, to observe quantum phenomena at the macroscopic level.

Recently, one team reported detecting coherent quantum behavior at room temperature in the internal vibrations of two entangled millimeter-sized diamond crystals (Lee et al., 2011). To date, this system is by far the largest in which quantum coherent behavior has been seen at room temperature, but the diamonds decohered—lost their quantum behavior—in 7 picoseconds, whereby a picosecond is a miniscule 1/1,000,000,000,000th of a second! This result was enabled by the unique hardness of diamond, making its internal vibration frequencies high compared to frequencies corresponding to room temperature. Thus quantum coherence is actually a very fragile phenomenon that occurs at the microscopic level usually only very briefly under extremely controlled conditions. Extrapolating such quantum phenomena to the macroscopic level usually far exceeds what quantum physics would predict.

Authors of psychic literature have been interested in the possibility of such coherent quantum phenomena *in the human brain* (Chopra, 1993; Goswami, 1993). As a stepping stone in this direction, "nontrivial" quantum effects *have* been detected in biological photo or olfactory receptors (Jedlicka, 2017; Marais, 2018), giving rise to a new field of quantum biology. And multiple *theories* have been proposed. For example, Stuart Hameroff and Roger Penrose (2014) speculated on microtubules in neuron cytoskeletons sustaining room-temperature quantum behavior connected with consciousness. Schwartz, Stapp, and Beauregard (2005) and Stapp (2017) suggested that quantum-smeared calcium ions in ion channels critical to synaptic function, combined with the Quantum Zeno Effect, might enable mental control of behavior. However, conditions in the human brain are generally considerably less favorable for maintaining macroscopic quantum coherence than those in the diamond vibration experiment or even in biological receptors, and such quantum brain coherence is not yet supported by experiment.

Examples of Quantum Misuse in Psychic Literature

Physicists have a working theory of quantum physics, but how to interpret what is *really* going on is still in debate. Similarly, people know intuitively what it means to be conscious—but still don't know how it *really* works. And along with consciousness come the many psychic phenomena that also cry out for explanation. The mind-bending nature of quantum physics makes it an attractive target for explaining phenomena such as NDEs and other psychic and healing events. As we illustrate below, many authors have tried to use quantum physics for support or even proof. But as Rosenblum and Kuttner (2011) have pointed out, combining two mysteries for an explanation usually does not result in real science.

A first problem is outright error, which is no surprise when people untrained in quantum physics attempt to apply it to their ideas. More serious is the uncritical misapplication of quantum physics concepts to macroscopic situations in which weird quantum phenomena are known to be implausible in practice. There is nothing wrong with using ideas from quantum physics as *hypotheses* or suggestions for new concepts, but, in our view, suggesting that such concepts are justified by quantum physics undermines the very arguments authors of psychic and healing literature are trying to make. In the following discussion, we identify statements from five books that are either completely mistaken or make assumptions that go well beyond what is accepted in quantum physics.

van Lommel (2010)

We turn our attention first to Pim van Lommel's 2010 book, *Consciousness Beyond Life: The Science of the Near Death Experience.*

van Lommel is a Dutch cardiologist interested in reports of NDEs, OBEs and other psi phenomena including telepathy, clairvoyance, and epigenetics. In his book he explained how he was compelled from these reported experiences, in which consciousness appeared to operate in ways that exceeded known capacities of brain function, to formulate the idea of a nonlocal consciousness and its communication with a brain localized in the physical body. We found his material to be reasonable and interesting until he started explaining his ideas using quantum physics.

The first problem is that although van Lommel (2010) obviously knew all the words used in quantum physics, his use of them was often incorrect. For example, he wrote: “Experiments with isolated photons show that a photon sometimes behaves like a wave, which means that it is entangled with itself” (p. 227). As discussed earlier, entanglement in quantum physics refers to *two or more* photons or electrons, not just one. van Lommel went on to write that “entanglement . . . is known as the superposition of wave functions, whereby a wave should no longer be seen as a real wave but as a probability wave, as this quantum phenomenon is called” (p. 227). Actually, superposition is *not* the same as entanglement; it is the concept that even a single photon or electron can be in multiple states at the same time, each with a different probability. Also, superposition is not required for a wavefunction to “be seen . . . as a probability wave”; for example, even a *single* orbital quantum state (an eigenstate) of an electron in a hydrogen atom is described by a wavefunction interpretable as a probability wave.

A more serious problem is van Lommel’s (2010) proposal of information transfer from nonlocal consciousness to the brain. This concept is central to his explanation of the apparent communication in NDEs and other psychic phenomena. He wrote:

> Alain Aspect’s experiment, which provided definitive proof of nonlocal entanglement, also drew on magnetic influence and measurement of the spin direction of a “first” particle, instantaneously . . . revealing the spin direction of the “second,” the remote particle. The reciprocal information transfer between nonlocal consciousness in nonlocal space and the brain (the interface) could also rest on quantum spin coherence. (p. 275)

van Lommel was apparently unaware of the No Communication Theorem, which, as mentioned earlier, proves that in quantum nonlocality, such transfer of useful information is impossible. A minor additional point is that van Lommel's statements reveal an inaccurate understanding of Aspect et al.'s (1982) experiment in which photons rather than quantum spins were involved. There is a quantum spin version of the experiment, but it was proposed and explored by others (Penrose, 2004).

Part of the problem in the above quote and others is van Lommel's (2010) failure to define nonlocality and nonlocal space. There are at least three possible definitions:

- First, nonlocality could mean simply "not just in one place." This definition refers to spatial separation or the spread of a wave in "conventional" space—which could be three-dimensional or include Einstein's relativistic space-time; in this sense, *every* quantum wavefunction, including the wavefunction of a single entity, is nonlocal, except at the moment of collapse.
- The second definition refers to the special quantum nonlocality of multiple entangled entities that can show correlations even when they are far separated; this phenomenon still occurs in conventional space while the entangled wavefunction is described in a multi-dimensional "configuration space."
- The third definition refers to an assumed metaphysical nonlocality in a limitless "spirit" space or some other non-physical "dimensions" that many people believe are where all psychic phenomena operate.

van Lommel (2010) first brought up nonlocality, without definition, on page 225 of his chapter on Quantum Physics and Consciousness; we surmise he was talking mostly about the metaphysical definition, but as in the quote above, he often mixed the second and third definitions. Citing no reference, he appeared to have confused metaphysical nonlocal space with the conventional or configuration space in which quarks, electrons, and other quantum entities exist: "Another possible name for nonlocal space can be absolute or true vacuum; it is timeless, has no structure and is empty space in which quarks, electrons, gravity and electricity have become one and as such no longer exist" (p. 228). As another example, he wrote:

> All matter, including all of our body's cells, molecules, and atoms, is made up of 99.999 percent emptiness or vacuum, and this vacuum is filled with energy and information that originates in nonlocal space, just as the universe around us is saturated with information and energy. (p. 291)

The notion that all matter including atoms is made up of 99.999% emptiness or vacuum appears to derive from Bohr's (1913) original quantum theory in which tiny electrons orbit in a vacuum around a central nucleus. As we will illustrate with more examples below, this idea has propagated in psychic literature for a long time with varying numbers of decimals. However, it bears no relation to modern quantum physics in which the wavefunction *fills* space—as illustrated for the hydrogen atom case in Figure 1—except at the moment of quantum collapse in a location measurement. van Lommel's (2010) mention of "energy and information that originates in nonlocal space" is also not explained and lacks a reference.

In contrast to the above critiques, the following statement avoids problems by at least making clear, with the words "appear" and "similar," that van Lommel (2010) was referring only to an *analogy* with quantum entanglement: "Everything appears to be connected to everything else, an interconnection similar to what in quantum mechanics is called entanglement; everything is one" (p. 224). We believe he would have done better to state explicitly that he was talking about a *metaphysical* nonlocal space.

Chopra (1993)

Next we consider Deepak Chopra's 1993 book *Ageless Body, Timeless Mind*, *Quantum Alternative to Growing Old.* This is one of the early books to introduce quantum physics into psychic literature, in this case to promote healing by mental control of the aging process. Chopra, an MD, introduced 10 "assumptions." The first was: "The physical world, including our bodies, is a response of the observer. We create our bodies as we create the experience of our world" (p. 5). He then stated:

> These are vast assumptions, the makings of a new reality, yet all are grounded in the discoveries of quantum physics made almost a hundred years ago. The seeds of this new paradigm were planted by Einstein, Bohr, Heisenberg, and the other pioneers of quantum physics, who realized that the accepted way of viewing the physical world was false. Although things "out there" appear to be real, there is no proof of reality apart from the observer. (p. 7)

Unfortunately, Chopra (1993) gave no further details on how his assumptions were "grounded in . . . quantum physics," and the book has no references to any quantum physics sources. To deconstruct his thinking, we surmise that his notion of the physical world being "a response of the observer" stems from (a) the quantum physics interpretation that observation by a conscious observer precipitates quantum collapse of a wavefunction, and (b) the interpretation that the wavefunction is unphysical whereas the result of quantum collapse is physical. As discussed earlier, these interpretations are highly speculative and now discounted by many quantum physicists. The result of quantum collapse is still a wavefunction, albeit a more localized one. What is reality and what is mathematical construct is a largely philosophical question with no impact on practical application of the theory.

The next notion, that "we create our bodies as we create the experience of our world," is even more dubious, because Chopra (1993) was apparently applying the *microscopic* collapse phenomenon to the *macroscopic* physical world, "including our bodies." As we discussed above, the coherence underlying quantum phenomena has been demonstrated at the microscopic level but not (at least not yet) at the level of a macroscopic entity such as the human body. *Microscopic* and *macroscopic* are all too easily conflated in much of psychic quantum literature.

Chopra (1993) proceeded:

> Your body appears to be composed of solid matter that can be broken down into molecules and atoms, but quantum physics tells us that every atom is more than 99.9999 percent empty space, and subatomic particles moving at lightning speed through this space are actually bundles of vibrating energy. These vibrations aren't random and meaningless, however; they carry information. (p. 14)

He then asserted: "The essential stuff of the universe, including your body, is non-stuff, but it isn't ordinary non-stuff. It is thinking non-stuff. The void inside every atom is pulsating with unseen intelligence" (p. 14).

We have already explained in our section on van Lommel the error of Chopra's (1993) notion that "every atom is more than 99.9999 percent empty space." Furthermore, quantum physics provides no support to the idea of "unseen intelligence" inside every atom. Yes, the wavefunction provides amplitude and phase *information* at every point inside of every atom, but this information is a far cry from "intelligence."

In an apparent effort to make his book seem more scientific, and regardless of how inappropriate it may have been, Chopra (1993) used the prefix "quantum" liberally, preceding terms like: *healing*, *alternative*, *world view*, *exchanges*, *space*, *level*, *force*, *terms*, *dance*, *depths*, *standards*, *field*, and *reality*. The profusion of such language makes this book one of the more egregious examples of quantum misuse.

Dispenza (2014)

We next consider Joe Dispenza's 2014 book, *You are the Placebo: Making your Mind Matter.* In it, Dispenza, a doctor of chiropractic with postdoctoral training in fields like neuroscience and cellular biology—

but not quantum physics—also addressed mental control of health. After a good description of the placebo effect well known in medicine, he ran into trouble as he addressed mind-body interaction in the context of quantum physics.

In his Chapter 8 on "Quantum Mind," Dispenza (2014) provided only two references. The first was the over-100-year-old reference to Bohr's (1913) particle picture of the atom, which was later superseded by the wavefunction picture. Citing the second reference by Popp (1998), Dispenza wrote: "Research confirms that most interactions between cells happen faster than the speed of light—and since the limit of this physical reality is the speed of light, that means the cells must communicate via the quantum field" (p. 192). Checking this amazing statement, we found it incorrect. Popp's (1998) only estimates of cell communication speeds are on page 13 of his article, and these fall well below the speed of light.

Dispenza (2014) wrote:

> When quantum physicists began to look at [the space inside atoms, they found that atoms . . .] appear to be 99.999999999999 percent empty space. But that space isn't really empty. It's actually filled with energy. More specifically, it's made up of a vast array of energy frequencies that form a kind of invisible interconnected field of information. So if every atom is 99.999999999999 percent energy or information, that means that our known universe and everything in it—no matter how solid that matter may appear to us—is essentially just energy and information. That's a scientific fact. (p. 182)

The similarity of this paragraph to van Lommel's (2010) and Chopra's (1993) is unmistakable, though Dispenza (2014) increased the number of decimals in the percentage of empty space far beyond the other authors' numbers and also made the glaring assertion: "That's a scientific fact." Again, quantum physics theory describes the space around an atom as filled with a wavefunction, which does represent information about amplitude and phase and which has an energy associated with it. But to extrapolate this picture to the entire universe and to say that "everything in it . . . is . . . just energy and information," and to exclude matter, is certainly not scientific fact.

Another example is a statement we find bizarre, lacking a reference and corresponding to nothing we can identify in quantum physics:

> Matter is constantly transforming, oscillating between manifesting into matter and disappearing into energy, about 7.8 times per second as a matter of fact. And so, because the human mind is then intimately connected to the appearance of matter you could say mind over matter is a quantum reality. (Dispenza, 2014, p. 183)

Further on, Dispenza (2014) wrote: “Since the quantum field is an invisible field of information . . . that all things material come from, and is made of consciousness and energy, then everything physical in the universe is unified within and connected to this field” (p. 197). Here he has extrapolated the idea of energy and the field of information into consciousness. This extrapolation led to his vision of “consciousness to all things” (p. 197). Dispenza has in effect morphed the concept of the quantum physicist’s wavefunction all the way into consciousness, while implying this extrapolation is scientific fact. Again, this is a fundamental distortion of quantum physics.

In a final example, Dispenza (2014) wrote: “It’s only when an observer focuses attention on any one location of an electron that the electron actually appears in that place. Look away and the subatomic matter disappears back into energy” (p. 183). Later he applied this concept to mental control of body processes. This sentence reveals perhaps Dispenza’s most fundamental error. He is clearly taking off on the concept of wavefunction collapse stimulated by the conscious observer. But according to the Born (1926) rule, any observation gives rise to a *random* result, not a specific one that the conscious observer wants. The electron does not appear in a location that “an observer focuses attention on.” In other words, the observer can’t *control* the appearance of an electron at a particular location but can only wait until it happens *by chance*.

In their interpretations of quantum physics, many modern authors have discarded altogether the active role of the conscious observer (Becker, 2018; Carroll, 2016; Penrose, 2004; Rosenblum & Kuttner, 2011). As mentioned earlier, Schwartz et al. (2005) have proposed a rather complex theory to get around the randomness problem, but this interpretation is highly speculative and not widely accepted (Williams, 2017, p. 49). We hasten to add that none of our comments are intended to deny the power of mind-body interaction. But it is a major error for Dispenza (2014) to claim that his mind-over-matter concept for the body can be explained in terms of quantum physics.

Goswami (1993)

We next turn our attention to Amit Goswami’s 1993 book, *Physics of the Soul: The Quantum Book of Living, Dying, Reincarnation and Immortality*. This book is one of the most ambitious efforts to apply quantum physics to consciousness and other psychic phenomena. The author is a PhD physicist familiar with quantum physics, which raised our hopes for a serious and scientific effort. Goswami's use of quantum concepts has already been critiqued by other authors such as Poynton (2003), who stated under a heading entitled ALARM BELLS, "one might feel discomfort . . . at Goswami's extravagant extrapolations from quantum physics" (p. 153).

Goswami's (1993) language is somewhat unconventional but still maps with a bit of imagination onto the conscious observer collapse interpretation: "Quantum waves are possibility waves in transcendent potentia, and it takes consciousness to collapse possibility into actuality, which it does by exercising its freedom of choice" (p. 28). Goswami's further claims should be identified as hypotheses, because they go well beyond accepted science. The first, similar to Chopra, is to apply quantum collapse, observed in microscopic systems, unhesitatingly to macroscopic ones: "In an act of observation, a quantum measurement, consciousness not only collapses the possibility wave of the object, but also the possibility wave of the brain" (p. 30).

Goswami (1993) extended this concept, writing of life choices as "potentia" that can be chosen (collapsed) by consciousness. And then he stated, "we have physical, vital, mental and supramental worlds of existence in potentia, and the manifestation of physical, vital, mental and supramental bodies occurs only with quantum collapse" (p. 118). He also introduced the term "quantum monad (now looked upon as the conglomerate of the supramental intellect, mental and vital bodies)" (p. 115), and he asserted that "to circumvent dualism, we must recognize the quantum nature of the monad" (p. 115).

This is undeniably creative thinking at work, and with all his references to "quantum collapse," "quantum monad," "quantum mind," "quantum memory," even "quantum book," Goswami (1993), similar to the aforementioned authors, made these ideas all sound trendily scientific. However, as in the cases of those authors, his assertions must be recognized as little more than hypotheses in apparent contradiction to accepted quantum physics.

One other puzzling oversight for a PhD physicist is the notion that consciousness "chooses." What is it choosing? In one interpretation, consciousness chooses to do an experiment, or make an observation, but in quantum physics, as discussed above, consciousness does not choose the result, which is *random*, following the Born (1926) probability rule. Goswami (1993) never mentioned randomness until later in the book when he introduced his strange concept of quantum memory. Once again we mention in this connection the work of Schwartz et al. (2005), who have proposed a rather complex theory to get around the randomness problem, but Goswami obviously could not have been aware of this later and still speculative theory.

Goswami (1993) introduced quantum nonlocality with a largely correct description of the Aspect experiment but then jumped to apply this concept to macroscopic systems, again a major assumption. What began as "similarity" soon became fact: "The striking similarity between the correlated brains and the correlated photons is clear . . . " and "two brains act as a non-locally correlated quantum system" (p. 37).

Goswami (1993) even went so far as to assert that "the nonlocality of correlated photons . . . cannot be used to transfer information . . . but in the case of the correlated brains, since consciousness is involved in establishing and maintaining the correlation . . . message transfer is not forbidden" (p. 39). Notice the logical fallacy here: Trying to justify brain correlation on the basis of Aspect's photon correlation, he undermined his own argument by claiming photons and brains differ fundamentally in their ability to transfer information. At least he did acknowledge here the idea of the No Communication Theorem.

We offer one final speculation. Some similarity between the ideas of Dispenza (2014) and Goswami (1993) may stem from the fact that both are on the faculty of the Quantum University in Honolulu, Hawaii.

Schwartz (2017)

Next we consider Gary Schwartz's 2017 book, *Super Synchronicity: Where Science and Spirit Meet*. Schwartz is a psychologist and professor in Consciousness and Health at the University of Arizona. In his book he described amazing serial coincidences, far beyond chance, mainly experienced by Schwartz himself, which he defined as "super synchronicities." Throughout the book he attributed these coincidences to "the apparent involvement of the One Mind—i.e. the Source, the Great Spirit, the Universal Intelligence, the Supermind, Infinite, the Sacred, the Divine or what many people simply call God" (p. 294).

The problems arise in the chapter he titled, "Introduction to Quantum Synchronicity Theory (QST)," in which he repeatedly argued that the single slit quantum experiment shows particle properties, whereas the double slit shows wave-like properties. As we explained in connection with Figure 2, this assertion is incorrect: Neither electrons nor photons change their wave nature depending on the number of slits, although interference effects are more easily observed when two slits are used instead of one.

Schwartz (2017) continued,

> What QST does is encourage us to discover the many parallels between quantum physics and synchronicity—we have reviewed a possible parallel to wave-particle duality here . . . QST inspires us to expand our conception of quantum physics and psychology by opening our minds to the possibility that replicable and meaningful patterns of sequences of events can occur, not only in a double-slit experiment, but in the laboratory of our daily lives. (p. 258)

At least Schwartz was on safer conceptual ground here in referring to "parallels" between quantum physics and synchronicity rather than to a direct relationship between the two phenomena. However, we consider the title of the chapter, *Introduction to Quantum Synchronicity Theory,* to still be inappropriate because it implies that something about quantum theory may explain the serial coincidences that underlie synchronicity.

Exception to the Pattern of Misuse

We would like to point out that certainly some researchers of psychic phenomena have mentioned the possible role of quantum physics in psychic phenomena but avoided the most obvious pitfalls by stressing the analogy or metaphorical similarity with these phenomena *without claiming scientific explanation.* An example is Dean Radin's 1997 book *The Conscious Universe.*

A less clear example is Edward F. Kelly's (2007) chapter, "Toward a Psychology for the 21st Century" in the book *Irreducible Mind.* All of Kelly's references to quantum physics are based on the theories and interpretations of Henry Stapp (2017), a reputable quantum physicist whose views are controversial. Thus we do not find any direct quantum misuse in this source. However, as we've stated previously, Stapp's ideas have not garnered wide acceptance among quantum physicists (Williams, 2017, p. 49), primarily because they are speculative and, so far, lack direct experimental support. A thorough examination of this matter would be of value but is beyond the scope of this article.

Discussion

Proper science follows an established path to credibility and acceptance in the community: (a) in the case of experimental studies, repeated corroborating tests under scientifically accepted standards, and in the case of theoretical explanations, a clear statement of assumptions and logical analysis, (b) proper referencing, and (c) publication in peer-reviewed articles or books. By contrast, reports of psychic phenomena are mostly subjective and anecdotal, making vetting difficult, and books on such phenomena, unlike journal papers, are rarely submitted for detailed review.

Readers of psychic literature who are versed in science show clear annoyance with incorrect references to established science. One has only to look through amazon.com reviews of Dispenza's (2014) or Chopra's (1993) books or to conduct an online search of the term "quantum misuse." We quote a few other opinions to illustrate the point:

> We physicists are disturbed, and sometimes embarrassed, by the misuse of quantum ideas, as for example a basis of certain medical or psychological therapies . . . A touchstone test for misuse is the presentation of these ideas implying that they are derived from quantum physics rather than merely analogies suggested by it. (Rosenblum & Kuttner, 2011, p. 252)
>
> In a world that cries out for general scientific literacy, quantum-inspired pseudoscience has become dangerous to science and society. *What the Bleep Do We Know,* a popular 2004 film, won several film awards and grossed $10 million; its central tenet is that we create our own reality through consciousness and quantum mechanics. (Hobson, 2013, p. 211)
>
> No theory in the history of science has been more abused by cranks and charlatans—and misunderstood by people struggling in good faith with difficult ideas—than quantum mechanics. (Carroll, 2016, p. 160)

It is clear that quantum terminology conveys a mystique and enormous power to impress, and this power is sometimes misused or abused. Seeing all the misuses, one cannot help but speculate why the authors engage in this practice. It seems that many authors, through a combination of misunderstanding and wishful thinking—and perhaps in some cases as a strategy to enhance recognition, seminar attendance, or publication sales—see evidence of connections that support their arguments but that do not actually exist.

Conclusions

We have found that in a broad range of psychic literature, invocations of quantum physics have often been confusing, misleading, or outright wrong—even reckless. This situation is regrettable because, rather than supporting psychic studies, such invocations can have the opposite effect. Although many people find enough evidence to believe in psychic phenomena, others do not. This is particularly a problem for studies of NDEs, which generally rely on anecdotal reports frequently collected long after the event took place. To establish such phenomena on a more scientific basis is expensive, and when research budgets are controlled by skeptical scientists, erroneous invocations of science do not help.

Finally, to mitigate future misuses of physics, we urge authors of psychic literature who lack in-depth physics understanding, but delve into scientific discourse, to submit their books or papers for qualified audit. Publishers should do the same and refrain from publishing such literature unless it passes qualified review.

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