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From Quantum Physics to Quantum Hypnosis: *A Quantum Mind Perspective*

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ABSTRACT

A novel, heuristic model based upon chaotic complex systems theory and quantum mechanics is proposed to overcome the dichotomy between mind and body. The mind–body interface represents a chaotic system, ruled by the probability principle, as shown in quantum mechanics. Neuronal activity shows many patterns of chaotic behavior, and applications of chaotic patterns seem to be relevant for research regarding the mind–body relationship and the process of trance. A quantum consciousness theory has been proposed, largely controversial, since quantum physics applies to subatomic world and not to macrostructures, such as the brain. Quantum cognition is an emerging field that applies the formalism of quantum theory to model cognitive phenomena such as information processing by the human brain; it overcomes limits and shortcomings of cartesian dualism as well as quantum general theory. As hypnosis is a state of consciousness, it applies to hypnotic cognitive functioning rather than hypnotic structure.

INTRODUCTION

According to the American Psychological Association Division 30, hypnosis can be defined as a "state of consciousness involving focused attention and reduced peripheral awareness characterized by an enhanced capacity for response to suggestion" (Elkins et al., 2015). Despite an increasing body of evidence suggesting a rather discrete neuromatrix (i.e., activation/deactivation of discrete brain regions) for the hypnotic state and process (De Benedittis, 2015b), hypnosis and hypnotic responses are probably best explained by com- prehensive models that take into account factors from biological, psychological, and social domains (Jensen et al., 2015). These models suggest which main factors contribute to the hypnotic experience and responses, but to understand the nature of hypnosis it is necessary to address the problem of consciousness, its definition, and theories.

It has been suggested that we can know of the existence of consciousness in no other way than through our first-person feeling of awareness or the second-person reports of others (Chalmers, 1996). For example, "consciousness is one of the most challenging and hard issues in Science . . . There is nothing that we know better than a conscious experience, but at the same time there is nothing more difficult to explain" (Chalmers, 1996, p. 3).

Consciousness is defined as a "quality of mind that is generally associated with subjective experience, self-awareness, feeling, cognition, free will and perception of relationships

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between us and our environment" (Edelman, 2005, p. 8). In consciousness research, there are "easy" and "hard" problems (Chalmers, 1996). The easy problem refers to the main functions of consciousness, such as attention, awareness, perception, feeling, and so on. Neural studies (both electrophysiological and neuroimaging) have provided neural corre- lates of discrete components of conscious experience (Edelman, 2005). The hard problem of consciousness is to explain ontological consciousness in terms of neural correlates (Chalmers, 1996). In a nutshell, the hard problem is explaining how the biological brain generates the subjective, inner world of experience. It is impossible to explain consciousness purely in terms of its neural correlates (Chalmers, 1996).

According to Edelman (2005), we must distinguish "primary consciousness," which is the mental awareness of what is happening in the world, and "superior-order conscious- ness," which includes self-awareness or the consciousness of consciousness (self- consciousness), the exclusive domain of human species and of primates, to a certain extent. Neural correlates of primary consciousness may include: thalamo-cortical systems and projections (reticular n., intralaminar thalamic nn.); hippocampus; inhibitory circuits of basal ganglia; diffuse ascending systems (locus coeruleus, raphe magnus n., cholinergic, dopaminergic, histaminergic nn.; Edelman, 2005). Neural correlates of self-consciousness (or superior order consciousness) may include: thalamus and thalamo-cortical network, posterior cingulate cortex, precuneus, retrosplenial cortex, and projections and coupling between brain stem and cortex (Alkire & Miller, 2005; Vogt & Laureys, 2005).

Other important aspects refer to quantitative and qualitative content of consciousness that can be exemplified as level of arousal versus representational capacity (Laureys et al., 2005). Hypnosis generally shows low level of arousal as compared to high representational capacity of consciousness (similar to the dream state), though it may range from a deeply relaxed state to a very alert one with eyes open, during which the subject may be highly performing, such as in sports (Unestahl, 2018).

Qualitative aspects of consciousness are better expressed by the term "qualia," which represents mental states of "what it is like," (e.g., the percept of mental states such as feeling pain – painfulness – seeing the color red, smelling a rose, the wetness of water, etc.; Wilberg, 2004). Qualia can be defined as inexpressible, intrinsic, private, directly, and immediately apprehensible in consciousness (Dennett, 1992).

THEORIESOF CONSCIOUSNESS

Because the real essence of consciousness remains largely unknown, a number of competing theories have been developed and proposed in order to answer the hard question or problem. Limiting our review to recent times, a huge spectrum of epistemological approaches has been devised, none of which is heuristically effective in explaining con- sciousness (De Benedittis, 2015a).

Theoretical areas range from one extreme (i.e., mysterianism, or the impossibility reach- ing any explanation for this problem) to the other (i.e., reductionism, or the mind is what the brain does, and every mental state are only the result of neural correlates). Other intermediate theories focus on functional or phenomenological determinants of the con- scious experience (see review in McFadden et al., 2017). There are two main theories: 40 Hz theory and global workspace theory.

40 HZ THEORY

Francis Crick, physicist codiscoverer of the DNA double helix who became a brain scientist, was looking for the "awareness neuron." For him, our subjective experience – our con- sciousness – is nothing but the activity of such neurons. His book, *The Astonishing Hypothesis*, identifies that hypothesis in stating, "You, your feelings, your pain, your joys and sorrows, your memories, your ambitions, your sense of personal identity and your free will are nothing else that the behavior of a vast assembly of neurons and their associated

molecules" (Crick, 1995). According to his 40 Hz hypothesis, 40 Hz synchronization in thalamo-cortical networks gives rise to a conscious experience but does not explain how this can happen.

GLOBAL WORKSPACE THEORY

According to the global workspace theory by Stanislas Dehaene (2014), consciousness is a form of information processing. It occurs when sensory data from an experience go to a "global workspace" and are broadcast to other centers. The core of this process in the brain may be in the frontal cortex.

In studies of consciousness, reductionism (or the mind is what the brain does) argues that once the electrochemical neural correlates of consciousness are understood, there will be nothing left to explain (Changeux, 1997). This theory tells nothing about the essence and quality of a conscious experience and the mind–body interface.

NEUROCHAOS

Chaos theory is the field of study that investigates the behavior of dynamical systems that are highly sensitive to initial conditions (Boeing, 2016). Small differences in initial condi- tions yield widely diverging outcomes for such dynamical systems, rendering long-term prediction impossible in general (Kellert, 1993). This happens even though these systems are deterministic. In other words, the deterministic nature of these systems does not make them predictable. This behavior is known as "deterministic chaos," or simply chaos.

The view of the nervous system as a linear, computer-like machine performing classical, deterministic input-output or stimulus-response computations is still very popular in neuroscience. However, this view is challenged by experimental findings and theoretical analyses indicating that the nervous system is a nonlinear dynamical complex system (see Jedlicka, 2017, as review). There is increasing evidence that many activities in the CNS and in clinical conditions are ruled by chaotic patterns, according to the chaotic complex systems theory, with concomitant changes of entropy and negentropy (Korn & Faure, 2003).

The search for chaotic patterns has occupied numerous investigators in neuroscience. Although a convincing proof of chaos (as defined mathematically) has only been obtained at the level of axons, of single and coupled cells, convergent results can be interpreted as compatible with the notion that signals in the brain are distributed according to chaotic patterns at all levels of its various forms of hierarchy (Korn & Faure, 2003).

Modern trends in psychology and cognitive neuroscience suggest that applications of nonlinear dynamics, chaos, and self-organization seem to be particularly important for research on mind-brain relationship (Bob, 2007). Chaotic self-organization provides a unique theoretical and experimental tool for deeper understanding of dissociative phe- nomena (Bob, 2007).

Chaotic-like patterns (e.g., neural strange attractors) have been found in normal and abnormal EEGs, electrophysiological studies in the olfactory groove, epilepsy, some kinds of neuropathic pain, and dissociative phenomena (such as hypnosis; Bob, 2007).

Spectral entropy with EEG signal, despite possible artifacts and pitfalls, may be useful in distinguishing wakeful state from general anesthesia. Two convergent studies showed high entropy in the waking state and low entropy (or negentropy) under general anesthesia (Ellerkmann et al., 2006; Schwilden, 2006). These findings should be taken with caution, yet they suggest that waking state (i.e., consciousness) is characterized by chaotic patterns as opposed to anesthesia (i.e., unconsciousness). EEG analysis using permutationentropy (PeEn; Kreuzer et al., 2014) and/or multivariate empirical mode decomposition and multi- scale entropy (MSE; Liu et al., 2017) may overcome limitations related to this methodology. Brain dynamics nonlinear patterns show a domain between deterministic order and ran- domness (i.e., negentropy and entropy), which is complex. This is referred to as the “edge of chaos” (Bak, 1996). Accordingly, neurochaos seems to be the bridge between classical Newtonian and quantum-like world (Korn & Faure, 2003; Pessa & Vitiello, 1999).

FROM CARTESIAN STRUCTURAL DUALISM/REDUCTIONISM TO CHAOTIC COMPLEX SYSTEMS AND QUANTUM MECHANICS

A substantial body of evidence does not support the Cartesian dualistic model on both epistemological and clinical grounds (De Benedittis, 2012, 2015a). Moreover, neuroimaging and hypnosis studies have recently shown how elusive the borderline is between real and imagined percepts (De Benedittis, 2003, 2012; Derbyshire et al., 2004; Halligan et al., 2000; Rainville et al., 2005). As a consequence, the biomedical approach and the current taxon- omy seem unable to provide an adequate, descriptive and explanatory model of mind-body interface (De Benedittis, 2015a).

In order to overcome the old and inappropriate dichotomy between body and mind, a novel, heuristic model based upon chaotic complex systems theory (Prigogine, 1997) and quantum mechanics is proposed. The model postulates that brain activity and conscious- ness represent a chaotic complex system, ruled by the probability principle, as shown in subatomic physics and quantum mechanics, rather than by the deterministic principle of causality (e.g., somatogenic vs. psychogenic) (De Benedittis, 2008, 2015a).

QUANTUM PHYSICS

Classical or Newtonian mechanics is usually an excellent approximation for objects much larger than molecules, but it is only an approximation. The "Quantum Enigma" has challenged physicists for a century. Quantum theory postulates that atoms and molecules are not existing someplace until our observation creates them there. According to Heisenberg (1927), microscopic objects are somehow not physically real, they are just "potentialities." The magic world of Quanta is fascinating, mysterious, and counterintuitive but necessary to subatomic world (De Benedittis, 2015a). Its basic principles are:

(a) *Uncertainty principle* (Heisenberg, 1927) states that measurements of certain systems cannot be made without affecting the systems, that is, without changing something in a system (the so-called "observer effect").

(b) *Superposition principle* is the idea that a system is in all possible states at the same time until it is measured. After measurement, it then falls to one of the basic states that form the superposition, thus destroying the original configura- tion. The superposition principle explains the "quantum weirdness" observed with many experiments (such as the famous thought experiment by Schrödinger, 1935).

(c) *Tunneling* is a quantum mechanical effect. A tunneling current occurs when elec- trons move through a barrier that they classically should not be able to move through. As electrons have both wave and particle-like properties, tunneling is an effect of the wavelike nature.

(d) *Wave function collapse* is said to occur when a wave function – initially in a superposition of several states – appears to reduce to a single state due to interac- tion with the external world (the observer effect). Only when we observe can we "force" a wave function (electron) to become a localized particle (or to "collapse" toward a single, concrete possibility). The "coherence" becomes "decoherence" and the magical quantum world returns to the familiar classical world.

(e) *Quantum entanglement* is a physical phenomenon that occurs when pairs or groups of particles are generated, interact, or share spatial proximity, even when the particles are separated by a large distance. That means that particles can be in two or more locations at the same time and have distant connections.

(f) *Nonlocality* describes the apparent ability of objects to instantaneously know about each other's state, even when separated by large distances (potentially even billions of light years!; Mermin, 2014).

Instead of categories such as "structures" and "functions," "events" are the basic compo- nents of this complex, dualistic system made of particles and wave functions. Events can be wave functions whose morphofunctional configuration can change with time and according to probability differentials.

Quantum mechanics abolishes differences between structures and functions by concep- tualizing the universe as a chaotic complex network of mental and physical functions. Accordingly, light can be treated as waves or particles. Photons are quanta of light, whose energy is related to their wave frequency according to Plank's constant (Plank, 1900). Particles are energy quanta with wave-function propriety. As a consequence, the corpus- cular (photon) and waveform structure of the light represents two complementary aspects of the same reality (Bohr, 1913). When the particle is not observed (i.e., when consciousness is not present), it remains a wave (a probability wave), but upon being observed (i.e., when consciousness is present) it becomes a particle.

What turns a wave into a particle is observation. According to Eugene Wigner (Nobel Prize 1963), "It is not possible to formulate the laws of quantum mechanics . . . without reference to the consciousness" (Wigner, 1995, p. 262). It follows that consciousness creates reality. As quantum physics applies only to the subatomic world, classical physics and quantum physics seem incompatible with each other. However, theoretical attempts have been made to integrate these two worlds.

String, superstring, and loop quantum gravity theories potentially provide a unified description of gravity and particle physics, being a potential candidate for a theory of everything, a self-contained mathematical model that describes all fundamental forces and forms of matter (Mukhi, 1999; Rovelli, 2004). Despite much effort on these problems, it is not known to what extent these theories describe the real world and how it can really fill the gap between these two worlds.

The recently discovered gravitational waves (LIGO Scientific Collaboration and Virgo Collaboration, 2016), disturbances of spacetime curvature, generated by accelerated masses, predicted by Albert Einstein in 1916 on the basis of the general theory of relativity, may represent a new, theoretical, and promising attempt to integrate classical physics and quantum physics (Einstein, 1916). Though this research is still in its infancy, gravitational waves seem to have quantum-like characters (e.g., graviton), so as to be somehow physically related to quantum mechanics.

QUANTUM CONSCIOUSNESS

The "Quantum Enigma" and consciousness represent two mysteries: the first, the physical demonstration of the quantum enigma faces us with a fundamental mystery of the objective world "out there;" the second, conscious awareness, faces us with the fundamental mystery of the subjective, mental world "in here." Quantum mechanics might connect the two. In his rigorous book, *The Mathematical Foundations of Quantum Mechanics*, John Von Neumann (1955) showed that quantum theory makes physics' encounter with consciousness inevi- table. More recently, this idea had been shared by Eugene Wigner (1995). Consciousness, which is an emergent property of the brain, may be the bridge between the classical world and the quantum world (Baars & Edelman, 2012; Melo, 2012). Classical physics and reductionism are intrinsically incapable of explaining the holistic aspects of consciousness, whereas quantum mechanics can. The quantum mind or quantum consciousness hypoth- esis posits that quantum mechanical phenomena may play an importantpart in the brain's function and could form the basis of an explanation of consciousness.

Theoretical physicist Roger Penrose and anesthesiologist Stuart Hameroff collaborated to produce the theory known as orchestrated objective reduction (Orch-OR). The theory was reviewed and updated by the authors (Hameroff, 2013; Penrose, 1989, 1995; Penrose & Hameroff, 2011). Penrose (1995) proposes a physical quantum process that rapidly collapses macroscopic superpositions to actualities. This process collapses, or "reduces," the wave function objectively, that is even without an observer. Penrose (1995) calls this process "objective reduction" (OR), and speculates that OR occurs spontaneously whenever two space-time geometries, and therefore gravitational effects differ significantly. Hameroff (2013) postulates that consciousness is presumed to "emerge:" from complex neuronal computation and to have arisen during biological evolution as an adaptation of living systems and suggests how this process might occur in the brain. Two states of certain tubulins (proteins) that exist within neurons might display Penrose's OR on a time scale appropriate for neural functions. Penrose and Hameroff (2011) claim that superposition states and long-range quantum coherence might exist within a brain, even though it is in physical contact with the environment and that spontaneous ORs could regulate neural functions.

They suggest that neuronal microtubules would be suitable candidates for quantum-like behavior (Hameroff, 2014; Penrose & Hameroff, 2011). Further, they proposed that quan- tum-like behavior in one neuron could extend to many others via gap junctions between neurons forming a macroscopic quantum feature across an extended area of the brain. When the wave function of this extended condensate collapsed, this would ultimately lead to conscious experience. In 2014, Hameroff and Penrose announced the discovery of quantum vibrations in microtubules, thus confirming the hypothesis of the Orch-OR theory (Hameroff, 2014).

However, Orch-OR made numerous false biological predictions, and is considered by some to be an extremely poor model of brain physiology. The three bases of the Penrose- Hameroff theory – noncomputability, the involvement of quantum gravity, and the role of tubulins – are each controversial (McKemmish et al., 2009; Tegmark, 2000).

Other quantum-related theories of consciousness include Pribram's holonomic brain theory (based on quantum holography), invoking quantum mechanics to explain higher order processing by the mind (Pribram, 1993), and Stapp's model (2009) that quantum waves are reduced only when they interact with consciousness.

In conclusion, despite emerging ideas and concepts about quantum-like consciousness that challenge the mainstream reductionistic-deterministic view of the human brain, direct experimental evidence in favor of the quantum brain/mind hypothesis is still missing.

QUANTUM COGNITION

Quantum cognition is an emerging field that applies the mathematical formalism of quantum theory to model cognitive phenomena such as information processing by the human brain, decision making, human memory, concepts, human judgment, and perception (Pothos & Busemeyer, 2013). The field clearly distinguishes itself from the quantum brain as it is not reliant on the hypothesis that there is something micro-physical quantum mechanical about the brain. Quantum cognition is based on the quantum-like paradigm (Khrennikov, 2006) that information processing by complex systems such as the brain, taking into account contextual dependence of information and probabilistic reasoning, can be mathematically described in the framework of quantum information and quantum probability theory.

Since the use of a quantum-theoretic framework is for modeling purposes (i.e., cogni- tions and perceptions), the identification of quantum structures in cognitive phenomena does not presuppose the existence of microscopic quantum processes in the human brain (De Barros & Suppes, 2009).

Though circumstantial evidence suggests that several aspects of biological life might fit the principles of quantum mechanics (McFadden & Al-Khalili, 2016), overall the evidence in favor of quantum brain is still weak and controversial, and it is very likely that the nervous system is incompatible with macroscopic quantum behaviors such as quantum entanglement, superposition, or tunneling (Koch & Hepp, 2006).

The neural basic unit of information processing is a neuron. It is clear that a neuron cannot be in the superposition of two states: firing and nonfiring. Hence, it cannot produce superposition playing the basic role in the quantum information processing. Superpositions of mental states are instead created by classical complex neural networks of neurons. Quantum cognition postulates that the activity of such neural networks can produce effects that are formally described as interference (of probabilities) and entanglement. The quan- tum cognition project is based on the observation that various cognitive phenomena are more adequately described by quantum information theory and quantum probability than by the corresponding classical theories (Pothos & Busemeyer, 2013). Although the discrete neurophysiological mechanisms of the quantum-like representation of information in the brain are not known, general informational considerations can be done, supporting the idea that information processing in the brain matches with quantum information and probability.

Quantum-like model shows promise in addressing cognitive, perceptual, and psychoso- matic phenomena that have proven recalcitrant to modeling by means of classical prob- ability theory (Rakovic & Vasic, 2008). By and large, quantum cognition has drawn on quantum theory in different ways to model concepts (e.g., using quantum entanglement to model the semantics of concept combinations and quantum superposition to account for the emergence of a new concept when concepts are combined) (Pothos & Busemeyer, 2013).

MEMORY

Findings that are puzzling from a classical probability perspective exist in basic memory processes. One paradoxical phenomenon is called the episodic overdistribution effect, which can be explained using a simple quantum model involving the superposition of memory traces (Brainerd et al., 2013). Related to memory phenomena, Bruza et al. (2009) developed a quantum model to explain the entanglement-like behavior observed in human lexicon and word association.

PERCEPTION

Bistable perceptual phenomena is a fascinating topic in the area of perception. If a stimulus has an ambiguous interpretation, such as a Necker cube, the interpretation tends to oscillate across time behaving as quantum-like process (Kak, 2013). Quantum theory and an appropriate model have been developed by Conte et al. (2009) to account for interference effects obtained with measurement of ambiguous figures. Quantum theory has also been used for modeling Gestalt perception, as there are apparent similarities between Gestalt perception and quantum theory. In an article discussing the application of Gestalt to chemistry, Anton Amann (1993) writes, "Quantum mechanics does not explain Gestalt perception, of course, but in quantum mechanics and Gestalt psychology there exist almost isomorphic conceptions and problems."

According to quantum cognition paradigm, quantum cognition, but not quantum mechanics, may be the suitable candidate to explain consciousness better than Newtonian classical physics. A novel, heuristic biopsychophysical model is proposed that postulates that conscious states may be conceptualized as a *continuum* spectrum (De Benedittis, 2015a) (see Figure 1).

At one extreme of the spectrum, there is the superior order consciousness (i.e., self-consciousness), associated with self-awareness, arousal, and a strong, personal identity feeling, while at the other extreme there are other states of consciousness (e.g., hypnosis, meditative states), associated with effortless and focused attention, comfort, dissociation, and with primary consciousness in between. Any particular conscious state, including hypnosis, at a given time, is the expression of quantum probability differential and may shift from one extreme to the other.

Two world events (i.e., *exteroception*, body-oriented, and *interoception*, mind-oriented) are entangled and can shift, at a given moment, according to quantum probability differ- entials, from one to the other, collapsing a wavefunction into a real actuality (physical and/ or subjective; see Figure 2).

After the Tao of Physics (Capra, 2010), quantum cognition may open a new Tao of consciousness, providing exciting perspectives in exploring the universe of human experi- ence, including hypnosis (De Benedittis, 2015a).

QUANTUM HYPNOSIS

From an epistemological point of view, Eastern philosophies come closer to quantum physics than their Western counterparts (Facco, 2017; Facco et al., 2017). So, we may need to provide a theoretical framework that can overcome the limits and flaws of the Cartesian dualism or monism. Quantum cognition can provide this framework.

Similar to quantum-like consciousness, the same biopsychophysical model can apply to hypnotic process and responses, with quantum cognition being the functional quantum-like analog link between the hypnotic brain and the hypnotic mind. Quantum-like hypnosis is a novel, heuristic approach to hypnotic cognition and responses. It overcomes limits and shortcomings of Cartesian dualism as well as quantum general theory. It applies to hypnotic cognitive functioning (i.e., hypnotic mind) rather than to hypnotic structure (i.e., hypnotic brain).

Quantum cognition and quantum chaos approaches can apply to a wide variety of hypnotic phenomena and responses, such as analgesia, dissociation, amnesia, time-space distortion, etc. (Bob, 2007). We can also use quantum superposition and entanglement to account for the emergence of a new concept when concepts are combined, such as in associations of ideas in trance states. Quantum-like theory can also be used for cognitive modulation of perception (such as pain). Not only does quantum cognition better explain hypnotic processes and phenomena but it can deeply and positively affect therapeutic suggestions and hypnotic responses in diverse clinical conditions.

Quantum-like basic principles can be applied isomorphically to quantum-like hypnotic experience and process and utilized as translational techniques in clinical practice according to quantum cognition paradigm:

(1) Chaotic cognitive patterns can be translated into confusion techniques.
(2) Time/space continuum can turn into spatio-temporal dissociation/distortion
(3) Mind-body continuum experience can be induced by mind/body dissociation and reassociation. This translational approach can be particularly suitable for psychoso- matic patients and conditions (e.g., pain, IBS).

(4) Superposition can be induced by suggesting multilocation and multitemporal experi- ence in a sort of a multiverse (Everett, 1957).
(5) Tunneling can be induced by means of space/time tunneling or going through space and time barriers.
(6) Entanglement can be induced by distant spatio-temporal correlation and no-locality.
(7) Coherence/decoherence can be experienced as unconscious mind/unconscious body interaction and collapse mediated by the hypnotic observer.

CLINICAL IMPLICATIONS AND FUTURE DIRECTIONS

Quantum-like paradigm opens new perspectives in conceptualizing heuristically hypnotic processes and responses, but it also offers a new insight of hypnotic techniques, such as, for instance, indirect Ericksonian techniques (Erickson & Rossi, 1981). Some of these techni- ques (e.g., confusion, dissemination, time distortion, dissociation) incorporate basic prin- ciples of quantum cognition, which can at least partially explain their clinical efficacy, particularly in resistant patients (Rossi & Rossi, 2016).

It is premature to predict whether this epistemological approach may have a significant impact on clinical practice. Clinical experiences are in their infancy (Wang et al., 2013) but seem promising in psychosomatic and, with some caution, in borderline/psychotic patients, possibly because quantum cognition offers a far greater cognitive flexibility than classical techniques in modeling hypnotic experiences and responses.

Research is needed to empirically test quantum-like hypnotic procedures, including:

a) elucidating neurophysiological correlates and functional mechanisms underpinning quantum-like hypnosis as compared with default hypnosis; b) exploring the quantum-like hypnotic experience (e.g., *Consciousness Inventory* by Pekala, 1991); c) changing and/or maximizing hypnotizability and hypnotic responding as compared with classical hypnotic induction; d) comparing quantum-like induction procedure versus

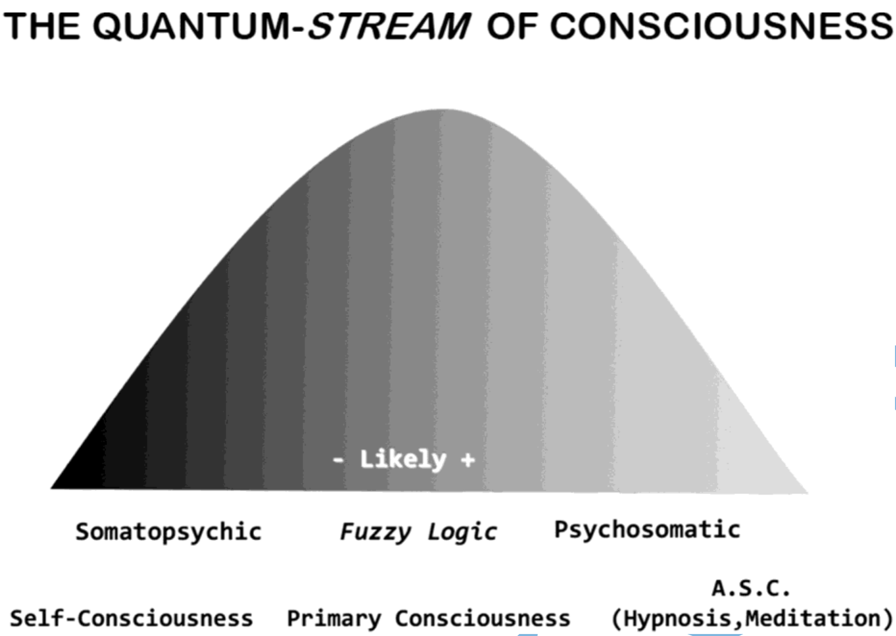

Figure 1. Quantum Biopsychophysical Model

Conscious states may be conceptualized as a *continuum* spectrum (De Benedittis, 2015a). At one extremity of the spectrum, there is the superior order consciousness (i.e. self-consciousness) associated with self-awareness, arousal, and a strong personal identity feeling, while at the other extremity there are altered states of consciousness (ASC) (e.g. hypnosis, meditative states) associated with dissociation, comfort, and effortless attention with primary consciousness in between. Any particular conscious state, including hypnosis, at a given time is the expression of quantum probability differential and may shift from one extreme to the other according to the principle of fuzzy logic.

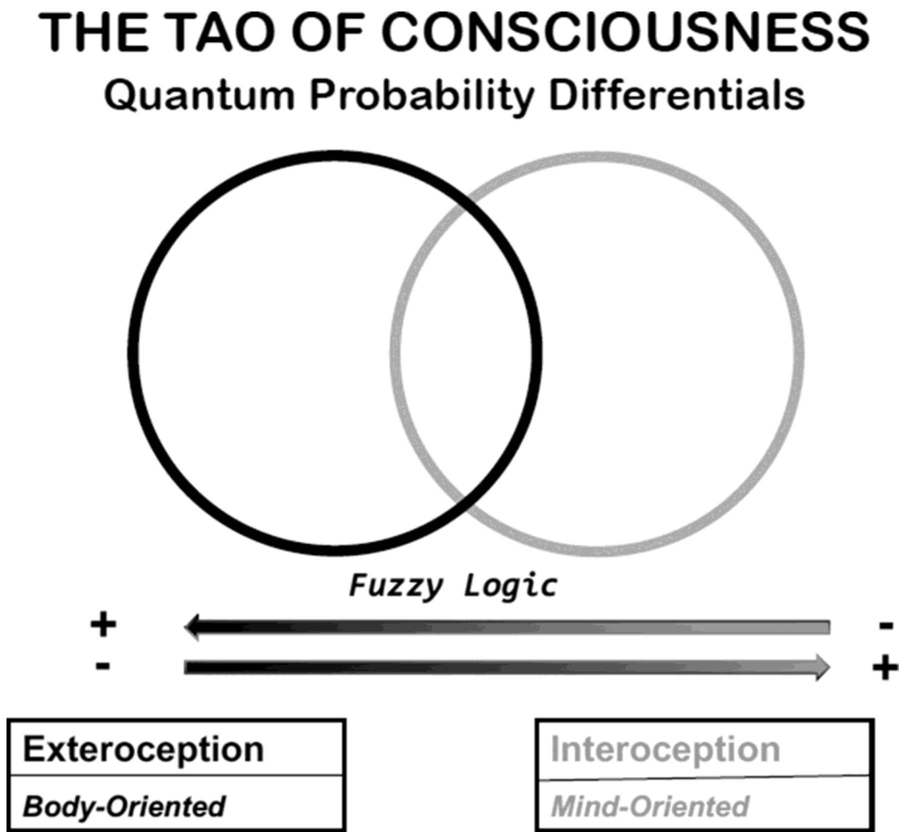

Figure 2. The Tao of Consciousness

Two world events (i.e. *exteroception*, body-oriented, and *interoception*, mind-oriented) are entangled and can shift, at a given moment, according to quantum probability differentials, from one to the other, collapsing a wavefunction into a real actuality (physical and/or subjective).

classical induction procedure; e) evaluating clinical efficacy in diverse medical and psychological conditions by means of controlled studies. Appendix A illustrates a transcript for potential "quantum-like trance-mutation."

CONCLUSIONS

A substantial body of evidence does not support the mind-body dualistic model on both epistemological and clinical grounds. As a consequence, the biomedical approach and the current taxonomy seem unable to provide an adequate, descriptive, and explanatory model of somatic and psychic domains (such, as for instance, pain) (De

Benedittis, 2008, 2015a).

In order to overcome the old and inappropriate dichotomy between mind and body, a novel, heuristic model based on chaotic complex systems theory and quantum mechanics is proposed (De Benedittis, 2015a). The model postulates that mind–body interface, and possibly consciousness, represent a chaotic complex system, ruled by the probability principle, as shown in subatomic physics and quantum mechanics, rather than by the deterministic principle of causality (e.g., somatogenic vs. psychogenic). Accordingly, instead of categories such as “structures” and “functions,” “events” are the basic compo- nents of this complex system. Events can be wave functions, whose morphofunctional configuration can change with time and according to probability differentials. Quantum mechanics abolishes differences between structures and functions by conceptualizing the universe as a chaotic complex network of mental and physical functions.

From various experiments, it has been well established that neuronal activity and EEG recordings show many patterns of chaotic behavior (Korn & Faure, 2003; Pessa & Vitiello, 1999). New trends in psychology and cognitive neuroscience suggest that applications of chaotic patterns seem to be particularly important for research of some fundamental problems regarding the mind–brain relationship and the process of trance (Bob, 2007).

A quantum consciousness theory (Penrose & Hameroff, 2011) has been proposed and supported by weak, circumstantial evidence. As quantum physics applies to subatomic world and not to macrostructures, such as the brain, the theory has been much criticized and remains largely controversial.

Quantum cognition is an emerging field that applies the mathematical formalism of quantum theory to model cognitive phenomena such as information processing by the human brain. Quantum cognition is based on the quantum-like paradigm that information processing by complex systems such as the brain can be described in the framework of quantum information and quantum probability theory (Pothos & Busemeyer, 2013). It overcomes the limits and shortcomings of Cartesian dualism as well as quantum general theory. As hypnosis is a state of consciousness, it applies to hypnotic cognitive functioning rather than to hypnotic structure.

This novel paradigm postulates that mind-body interface may be conceptualized as a continuum spectrum. At one extremity of the spectrum, we might assume the pure somatogenic event (i.e., exteroception), while at the other extremity there is the pure psychogenic or mental event (i.e., interoception) (De Benedittis, 2015a). Any particular event at a given time is the expression of quantum probability differential, with most of the events being under the Gaussian curve. This new quantum-like Tao of hypnosis opens exciting perspectives in exploring a new healing field and its effects on both somatic and mental disorders.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

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Von der Quantenphysik zur Quantenhypnose: Eine Quanten Geist Perspektive

Giuseppe De Benedittis

Zusammenfassung: Es wird ein neuartiges heuristisches Modell vorgeschlagen, basierend auf der chaotisch komplexen Systemtheorie und der Quantenmechanik, um die Körper-Geist Dichotomie zu überwinden. Die Schnittstelle zwischen Körper und Geist stellt ein chaotisches System dar, bestimmt von Wahrscheinlichkeitsprinzipien, wie in der Quantenmechanik darges- tellt. Die neuronale Aktivität zeigt viele Muster chaotischen Verhaltens und die Anwendung chaotischer Muster scheint relevant zu sein zur Erforschung der Körper-Geist Beziehung und des Trance-Prozesses. Es wurde eine reichlich umstrittene Quantentheorie des Bewusstseins vorges- chlagen, da ja die Quantenphysik sich auf die subatomare Welt bezieht und nicht auf Makrostrukturen wie das Gehirn. Quanten-Kognition ist ein neues Gebiet, in welchem der Formalismus der Quantentheorie verwendet wird, um kognitive Phänomene darzustellen wie die Informationsverarbeitung des menschlichen Gehirns. So werden die Grenzen und Unzulänglichkeiten des cartesianischen Dualismus überwunden und ebenso die allgemeine Quantentheorie. Da Hypnose ein Bewusstseinszustand ist, betrifft sie eher die kognitive Funktion als die hypnotische Struktur.

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De la physique quantique à l'hypnose quantique: une perspective de l'esprit quantique

Giuseppe De Benedittis

Résumé: Un nouveau modèle heuristique basé sur la théorie des systèmes complexes chao- tiques et la mécanique quantique est proposé pour surmonter la dichotomie entre l'esprit et le corps. L'interface esprit-corps représente un système chaotique, régi par le principe de probabilité, comme le montre la mécanique quantique. L'activité neuronale montre de nombreux modèles de comportement chaotique, et les applications des modèles chaotiques semblent être pertinentes pour la recherche concernant la relation corps-esprit et le pro- cessus de transe. Une théorie de la conscience quantique a été proposée, largement controversée, car la physique quantique s'applique au monde subatomique et non aux macrostructures, comme le cerveau. La cognition quantique est un domaine émergent qui applique le formalisme de la théorie quantique pour modéliser des phénomènes cognitifs tels que le traitement de l'information par le cerveau humain; il surmonte les limites et les lacunes du dualisme cartésien ainsi que de la théorie générale quantique. L'hypnose étant un état de conscience, elle s'applique au fonctionnement cognitif hypnotique plutôt qu'à la structure hypnotique.

Gerard Fitoussi, M.D.

Président of the European Society of Hypnosis

De la física cuàntica a la hipnosis cuàntica: Una perspectiva cuàntica de la mente.

Resumen: Se provee un modelo novedoso heurístico, basado en la teoría de sistemas caóticos complejos y la mecánica cuántica, para superar la dicotomía entre la mente y el cuerpo. La interfase mente-cuerpo representa un sistema caótico, regido por el principio de probabilidad, como se muestra en la mecánica cuántica. La actividad neuronal muestra muchos patrones de un comportamiento caótico y la aplicación de patrones caóticos parecen ser relevantes para la investigación sobre la relación mente-cuerpo y el proceso de trance. Se ha propuesto una teoría cuántica de la conciencia que es muy controversial, ya que la física cuántica aplica el mundo subatómico, pero no para macroestructuras como el cerebro. La cognición cuántica es un campo emergente que aplica el formalismo de la teoría cuántica para modelar fenómenos cognitivos como el procesamiento de información por el cerebro humano. Además, sobrepasa las

limitaciones y del dualismo cartesiano y la teoría general cuántica. Ya que la hipnosis es un estado de conciencia, la cognición cuántica es aplicable al funcionamiento cognitivo hipnótico más que a una estructura hipnótica.

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APPENDIX A: QUANTUM-LIKE TRANCE-MUTATION

The following script represents a quantum-like hypnotic induction procedure:

Let my voice bring some order and a bit of confusion into you, so that confusion feeds your order and order feeds your confusion.

[Inducing confusion]

And you don't even have to ask yourself if you prefer order to confusion or confusion to order, because one is the other side of the other, and there is no order without some confusion, as there is no confusion without a bit of order.

[Suggesting gravitational waves effect and space/time dissociation]

Now, I would like you to imagine a secret and safe time in a space that resembles you, where both time and space expand and shrink at will as if you were jumping on an elastic net on which to bounce nicely. Up and down! Down and up! And it is so pleasant not to know the difference between the high and the low, the plus and the minus, the alpha and the omega.

[Inducing superposition]

And now that you jump on this magic network made of space and time that ripples and bounces with your weight, you can watch yourself as you turn from one position to another, from one second to another, as if you were simultaneously in several different positions and in different times. Without space and time constraints. Finally free!

[Tunneling and mind/body dissociation and reassociation]

So free and powerful that you can pass through spaces made of matter and materials made of spaces, like in a large luminous tunnel to go through or to be traveled at the speed of light.

And as this happens, and time plays to hide with space, part of your body turns into thoughts and emotions, while thoughts and emotions are embodied into your body. And it is so pleasant and natural this transmutation that takes place within you between body and mind, like the one that takes place in the external world, that every moment is at the same time corpuscle and energy, energy and corpuscle. So, you could discover the thrill of breathing underwater or flying in the blue of the sky. All the time and all the space you want. Finally free!

[Suggesting waveform collapse by observation and entanglement]

There is nothing that should happen, but only pleasant and stimulating experiences that can happen. If you want it and the eye of your unconscious mind gazes at them. Magically.

And yet wherever you go, wherever you decide to go or stay (which is the same thing!).

Whenever that happens, you know that every part of you is and will always be connected to the whole. As well as everything, you will be able to recognize it and find it in every tiny part of you.

[Inducing mind–body interaction and no-locality]

And all this can happen and it happens without you having to know it, because your unconscious mind is the reflection of your unconscious body, and one is the dream of the other and vice versa. And you will never know where one ends and the other begins and if there is a border between one and the other. Because, after all, the borders are also just passages, transitions from one state to another, in a time out of time and in an empty and full space at the same time.

And when, in a few spaces/instants, I'll wake you up from the trance counting from 10 to 1, it will be like you see yourself awaken with the eye of your unconscious mind and go back to being what you were not before you entered this trance, and not whether you remember the past experience or the future one, you will remember it in whole or in part.

Because, basically, even memories can surface or sink at the same time. Yet they are always there. Somewhere, sometime.