

Editorial

Current Landscape and Future Direction of Theoretical & Experimental Quantum Brain/Mind/Consciousness Research

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ABSTRACT

The issues surrounding quantum brain/mind/consciousness research are both confusing and complex. If one can manage to grasp these issues, one may find that the past of this field has been fruitful and its future is indeed very promising. The current landscape and past achievements in this field have already been discussed by our colleagues as pointed herein. This editorial mainly attempts to classify/clarify some of the major issues and discuss what are lying ahead. Whatever difficulties may still remain, recent experimental results by several groups including those of the authors' own make it very clear that quantum effects play important roles in brain functions despite of the denials and suspicions of the naysayer and skeptics.

Key Words: quantum brain, quantum mind, quantum consciousness, research, theoretical, experimental, current landscape, future direction.

1. The Current Landscape

The current landscape of quantum mind/brain research may be likened as the “Wild West” of old America. It is filled with a few larger-than-life characters whose theories and perceived/self-claimed authorities are attacked from the outside by the guards of the classical world and challenged within by competing researchers armed with their own theories/speculations and in some cases experimental results. Also notable are the new electronic journals organized and run by different groups which have created new outlets for publishing new thoughts and research results otherwise maybe being rejected or suppressed. Among these journals are NeuroQuantology (<http://neuroquantology.com>) run by Sultan Tarlaci since 2003, Mind and Matter (<http://mindmatter.de>) run by Harald Atmanspacher since 2003, AntiMatters (<http://anti-matters.org>) run by Ulrich J Mohrhoff since 2007 and Quantum Biosystems (<http://www.quantumbiosystems.org>) run by Massimo Pregnotato since 2007. The latest is the Journal of Consciousness Exploration & Research (JCER <http://jcer.com>) run by the herein authors since beginning of this year.

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In two recent articles entitled respectively “Why We Need Quantum Physics for Cognitive Neuroscience (Tarlaci, 2010a)” and “A Historical View of the Relation Between Quantum Mechanics and the Brain (Tarlaci, 2010b)”, Tarlaci, have surveyed the field of quantum brain/mind/consciousness research with respect to why quantum mechanics is needed and what have been done in the field since early 20th century. Massimo Pregolato has also written a guest editorial entitled “Time for Quantum Consciousness” for this issue of JCER assessing the field and discussing the future of quantum brain/mind research and the broader implications associated with quantum consciousness. In addition, Antonella Vannini (2008) in an article entitled “Quantum Models of Consciousness” summarized many of the existing theories and attempted a classification of the theories he mentioned. The herein authors agree to large extent with the surveys and assessments of their colleagues Tarlaci, Pregolato and Vannini and readers are encouraged to study all these four articles to learn about this field.

The issues surrounding quantum brain/mind/consciousness research are both confusing and complex. If one can manage to grasp these issues, one may find that the past of this field has been fruitful and its future is indeed very promising. This editorial mainly attempts to classify and/or clarify some of the major issues and discuss what are lying ahead.

2. Definitions & Classifications of Quantum Brain/Mind/Consciousness Research

The descriptive phrase for this field is quantum brain, quantum mind or quantum consciousness. As far as authors know, no one has attempted to make clear distinctions among these phrases. Therefore, for all practical purposes, they mean the same field of research.

So what is quantum mind/brain/consciousness research then? Well, it may mean different things to different people based on their particular backgrounds and perhaps “stages of enlightenment.”

In the narrow sense, it means:

Definition I: The theoretical and experimental study of whether a particular quantum effect such as quantum coherence or quantum entanglement in a particular neural location and/or substrate is occurring and, if occurring, whether it is involved in a particular brain/cognitive function (let’s call this the “Narrow Problem” of quantum mind research).

In the broad sense, it also includes:

Definition II: The theoretical and experimental study of the foundations of and the relationships and/or connections between quantum mechanics and consciousness such as the measurement problem (let’s call this the “Broad Problem” of quantum mind research).

The confusions and complexities starts with areas covered under Definition II since neither the foundational questions (the mysteries) of quantum mechanics nor those of consciousness are well settled. Indeed, there may be as many quantum physicists as interpretations and as many consciousness theorists as consciousness theories. Physicist Richard Feynman (1967) once lamented that “I think I can safely say that nobody understands quantum mechanics.” Philosopher David Chalmers (1995) once suggested that the reason for people wanting to connect consciousness with quantum mechanics is that “consciousness is mysterious and quantum mechanics is mysterious, so maybe the two mysteries have a common source.”

A. Classification based on ontology

From the perspective of ontology there are three categories of quantum brain/mind theories:

- O1: Materialistic theories which implicitly or explicitly treat consciousness as various types of emergent phenomena of the material world.
- O2: Dualistic theories which implicitly or explicitly treat consciousness as various types of mind-matter interactions.
- O3: Panpsychism (or pan-consciousness) based theories which treat consciousness as the foundation of reality.

B. Classification based on testability

From the perspective of testability there are six types of quantum brain/mind/consciousness theories:

- T1: Theories which involve concrete entities/variables and are testable with currently available technologies.
- T2: Theories which involve abstract entities/variables but contains predictions testable with currently available technologies.
- T3: Theories which involve concrete entities/variables and may become testable with future technologies.
- T4: Theories which involve abstract entities/variables but contain predictions maybe becoming testable with future technologies.
- T5: Theories which involve concrete entities/variables but in principle may not be testable.
- T6: Theories which involve abstract entities/variables and contain/make no testable predictions.

3. Tentative Classification of Some Existing Theories (Note: it is incomplete and dates and classification may not be accurate) plus a List of Some Existing Books

Table 1 Some Early Thoughts

1902-1935	Niels Bohr	Copenhagen interpretation	II-O2-T6
1925	Alfred Lotka	Classical and non-classical consciousness	II-O3-T6
1932	John Von Neumann	Interactive Dualism	II-O2-T2,4
1939	Fritz London & Edmond Bauer	Consciousness creates reality	II-O3-T4

Table 2 Some Recent Theories

1967	L.M. Riccardi & H. Umezawa	Quantum Field Theory	I-O1-T4,6
1968	Herbert Frölich	Long range coherence and energy storage	I-O1-T3,5
1970	Ewan H. Walker	Electron tunneling in synapses	I-O1-T3,5
1971	Karl Pribram	Holonomic model of mind	I-O1-T2
1980	David Bohm	Wholeness and the implicate order	II-O2-T4,6
1986	John Eccles	Quantum tunneling	I-O1-T3,5
1989	Ian Marshall	Bose-Einstein condensate	I-O1-T3,5
1989	Chris King	Dual-Time Supercausality	II-O2-T4,6
1991	Brian Josephson & F. Pallikari-Viras	Biological utilisation of quantum non-locality	II-O2-T4
1991	Michael Lockwood	Mind, Brain and the Quantum	II-O1-T4,6
1992	Stuart Hameroff & Roger Penrose	Objective reduction in microtubules	II-O1-T3,5
1993	Henry Stapp	Mind Matter and Quantum Mechanics	II-O2-T4,6
1998	Matti Pitkänen	TGD inspired theory of consciousness	II-O1-T4,6
2000	Giuseppe Vitiello	The dissipative brain	I-O1-T4,6
2000	Alex Kaivarainen	Hierarchic model of consciousness	I-O1-T4,6
2002	Huping Hu & Maixin Wu	Spin-mediated consciousness theory	II-O3-T1,3

Table 3 Some Related Books (Publishers are given)

1975	Fritjof Capra	The Tao of Physics	Shambhala
1985	Nick Herbert	Quantum Reality	Anchor
1987	F. David Peat	Synchronicity	Bantam
1989	Roger Penrose	The Emperor's New Mind	Oxford Uni. Press
1991	Michael Lockwood	Mind, Brain and the Quantum	Blackwell Pub
1991	Michael Talbot	The Holographic Universe	Harper Perennial
1991	Danah Zohar	The Quantum Self	Harper Perennial
1992	Paul Davies	The Mind of God	Simon & Schuster
1993	Amit Goswami	The Self-Aware Universe	Tarcher
1993	D. Bohm & B. Hiley	The Undivided Universe	Routledge

1994	Roger Penrose	Shadows of the Mind	Oxford Uni. Press
1995	Fred A. Wolf	The Dreaming Universe	Touchstone
2002	Jeffrey Satinover	The Quantum Brain	Wiley
2006	Bruce Rosenblum & Fred Kuttner	Quantum Enigma - Physics Encounters Consciousness	Oxford University Press
2006	Dean Radin	Entangled Minds	Paraview Pocket Books
2007	Henry P. Stapp	Mindful Universe	Springer
2008	Gregg Braden	The Divine Matrix	Hay House
2008	Ervin Laszlo	Quantum Shift in the Global Brain	Inner Traditions
2010	Graham Smetham	Quantum Buddhism	Shunyata Press

4. Experimental Results Supporting Quantum Brain/Mind/Consciousness

There are several types of experimental results supporting and/or being explainable based on quantum brain/mind/consciousness (the list is not complete):

1. Parapsychology: e.g., Rupert Sheldrake (see 2009), Dean Radin (see 2006).
2. Homeopathy (water memory): e.g., Jacques Benveniste (see Davenas et. al, 1988).
3. Remote effect of Human Intention: e.g., Robert Jahn & Brenna Dunne (see 2009), William Tiller (see 2007), Masaru Emoto? (see 2005), Uri Geller? (see 1999), various Qigong effects.
4. Non-local corrections of EEG: e.g., J. Grinberg-Zylberbaum (1987), Jiri Wackermann (see, 2004).
5. Sensed presence and altered state of consciousness under magnetic stimulations: Persinger e.t. al. (see, 1993, 2010a).
5. Non-local corrections of MRI signals: e.g., Jeanne Achterberg (2005).
6. Non-local correlations of EEG under magnetic stimulations: Michael Persinger, et. al.(2003, 2010b).
7. Non-local pattern in cognitive functions: e.g., Diederik Aerts et. al. (see 2000), Elio Conte et. al.(2003, 2010).
8. Light/environment-induced biological effects: e.g., Peter Gariaev (see, 1991), Bevan Reid (1989).
9. Consciousness collapse wave function: e.g., Dick J. Bierman (2003), also see Mark Germine? (1998).
10. Non-local effects of chemical substances on the Brain: Huping Hu & Maoxin Wu (2006a-c).

11. Non-local chemical, thermal and gravitational effects: Huping Hu & Maoxin Wu (2006d, 2007a-b).

12. Optical illusions: Efstratios Manousakis? (2007), Elio Conte et. al.(2009).

5. Tentative Conclusions from Existing Theories & Experimental Results

Based on the above list of existing theories and summary of experimental results, several tentative conclusions may be drawn as follows:

- (1) Materialistic theories alone without enlargement of ontology to O2 or O3 are likely invalid.
- (2) Quantum effects play important roles in brain and/or cognitive functions (that is, in consciousness).
- (3) Consciousness likely play important roles in quantum effects such as in wave function collapse.
- (4) Consciousness is likely outside spacetime and is the foundation of reality.
- (5) Unity of Mind (the binding problem) is likely achieved through quantum entanglement beyond the current forms of quantum mechanics.
- (6) Conscious intentions likely have physical effects on matter.
- (7) Neural substrates of consciousness (mind-pixels) are possibly nuclear/electronic spins.

6. Future Tasks/Directions of Quantum Brain/Mind/Consciousness Research

A. Most urgent and crucial are independent verifications/replications of existing experimental results.

B. Design and implement additional experiments to find out:

- Where are neural substrates of consciousness (“NCCs”) located at the cellular, molecular and sub-molecular levels?
- What are the NCCs: nuclear spin, Electron spin, and/or other entities in the brain such as ions?
- What are the roles of biophotons emitted from the brain in consciousness? (The authors’ own suggestions are: (1) Formation of quantum entanglement in the brain to achieve binding; (2) Transmission of quantum information from location to location in the brain; (3) Formation of collective consciousness

(entangled mind as Radin would say) through quantum entanglement and nonlocal information sharing.

C. Improve existing theories (develop new ones, if necessary) and do even more experiments to find out:

- How NCCs interact with the action potentials? In other word, how action potentials input information into NCCs and how NCCs associated with free will (human intention) output information into action potentials?
- How NCCs are connected to qualia and/or quantum information associated with qualia?
- How qualia are accommodated in O2/O3 type of theories?
- Whether O2 or O3 types of theories are the correct theories or more compete theories;
- How free will operate in O2/O3 types of theories?

Whatever difficulties may still remain, recent experimental results by several groups including those of the authors' own make it very clear that quantum effects play important roles in brain functions despite of the denials and suspicions of the naysayer and skeptics.

REFERENCE

Achterberg, J. et. al., Evidence for correlations between distant intentionality and brain function in recipients: A functional magnetic resonance imaging analysis. *J. Alternative & Complimentary Med.*, 2005; 11 (6): 965–971.

Aerts, D. et. al. The violation of bell inequalities in the macroworld. *Foundations of Physics*, 2000; 30(9): 1387-1414.

Bierman, J. B. Does consciousness collapse the wave-packet? *Mind & Matter*, 2003; 1(1): 45-77

Bohm, D. *Wholeness and the Implicate Order*, 1980. Routledge, Oxford.

Bohr, N. as described in McEvoy, P. *Niels Bohr: Reflections on Subject and Object*, 2001. MicroAnalytix.

Chalmers, D. Facing up to the problem of consciousness. *Journal of Consciousness Studies* 1995; 2(3):200-19.

Conte, E. et. al. A preliminary evidence of quantum like behavior in measurements of mental states. 2003; arXiv:quant-ph/0307201v1.

Conte, E. et. al. Mental states follow quantum mechanics during perception and cognition of ambiguous figures. *Open Systems and Information Dynamics*, 2009; 16(1): 85-100.

Conte, E. et. al. A Preliminary Experimental Verification of Violation of Bell Enequality in a Quantum Model of Jung Theory of Personality. JCER, 2010: 1(7): 831-849.

Davenas E, Beauvais F, Amara J, et al. Human basophil degranulation triggered by very dilute antiserum against IgE, Nature, 1988; 333 (6176): 816–8.

Eccles, J. *Evolution of the Brain*, 1989. Routledge, Oxford. Also see, Eccles, J.C., A unitary hypothesis of mind-brain interaction in the cerebral cortex. Proc. Roy Soc. London B 1990; 240: 433-451.

Emoto, M., *The Hidden Messages in Water*, 2005, Atria.

Feynman, R. *The Character of Physical Law*. MIT Press (1967).

Fröhlich, H, Long range coherence and energy storage in biological systems, Int. J. Quantum Chemistry, 1968; 2: 641-649.

Gariaev, P.P., et. al., Holographic Associative Memory of Biological Systems, Proceedings SPIE, Optical Memory and Neural Networks, 199; 1621: 280- 291.

Geller, U. et al., *Mind Medicine: The Secret Of Powerful Healing*, 1999, Element Books Ltd.

Germine, M. Experimental Model for Collapse of the Wavefunction. Dynamical Psychology, 1998: <http://www.goertzel.org/dynapsyc/1998/collapse.html>

Grinberg-Zylberbaum, J. & Ramos, J., Patterns of interhemispheric correlation during human communication. International Journal of Neuroscience, 1987; 36: 41–53.

Hameroff, S. R., Penrose, R., Orchestrated reduction of quantum coherence in brain microtubules: A model for consciousness. Neural Network World, 1995 5(5): 793-804.

Hu, H. & Wu, M. Spin-mediated consciousness theory. arXiv 2002; quant-ph/0208068. Also see Med. Hypotheses 2004a: 63: 633-646. Also see, Hu, H. & Wu, M. Spin as primordial self-referential process driving quantum mechanics, spacetime dynamics and consciousness. NeuroQuantology 2004b; 2:41-49.

Hu, H. & Wu, M. Photon induced non-local effect of general anesthetics on the brain. NeuroQuantology 2006a 4: 17-31. Also see Progress in Physics 2006b; v3: 20-26; Hu, H. & Wu, M. Thinking outside the box: the essence and implications of quantum entanglement. NeuroQuantology 2006c; 4: 5-16.

Hu, H. & Wu, M. Evidence of non-local physical, chemical and biological effects supports quantum brain. NeuroQuantology 2006d; 4: 291-306. Also see Progress in Physics 2007a; v2: 17-24. Also see Hu, H. & Wu, M. Thinking outside the box II: the origin, implications and applications of gravity and its role in consciousness. NeuroQuantology 2007b; 5: 190-196.

Jahn, R. G., Dunne, B. J., *Margins of Reality: The Role of Consciousness in the Physical World*, 2009, ICRL Press.

Josephson, B.D., Pallikari-Viras, F., Biological utilisation of quantum nonlocality, *Foundations of Physics*, 1991, 21: 197-207.

Kaivarainen, A. Elementary Act of Consciousness or Cycle of Mind, involving Distant and Nonlocal Interaction, 2000, arXiv:physics/0003045v1 [physics.gen-ph].

King, C. C., Dual-time supercausality, *Physics Essays*, 1989; 2(2): 128-151.

Lockwood, M., *Mind, Brain and the Quantum*, 1989, Basil Blackwell, Oxford.

London, F., Bauer, E. *La théorie de l'observation en mécanique quantique*, 1939. Hermann, Paris.

Lotka, A. J. *Elements of Physical Biology*, 1925. Williams & Wilkins Co, Baltimore.

Manousakis, E. Quantum formalism to describe binocular rivalry, 2007: arXiv:0709.4516v2 [q-bio.NC]; also see *Biosystems*, 2009; 98: 57-66.

Marshall, I., Consciousness and Bose-Einstein condensates, *New Ideas in Psychology*, 1989; 7: 73-85.

Von Neumann, J. *Mathematical Foundations of Quantum Mechanics*, 1932. Princeton Univ. Press.

Persinger, M. A., Vectorial cerebral hemisphericity as differential sources for the sensed presence, mystical experiences and religious conversions. *Psychological Reports*, 1993; 76: 915-930.

Persinger, M.A., Koren, S.A. & Tsang, E.W. Enhanced power within a specific band of theta activity in one person while another receives circumcerebral pulsed magnetic fields: a mechanism for cognitive influence at a distance? *Perceptual and Motor Skills*, 2003; 97: 877-894.

Persinger, M. A. et.al. The Electromagnetic Induction of Mystical and Altered States within the Laboratory, *JCER*, 2010a; 1(7): 808-830.

Persinger, M. A. & Lavalley, C. F., The Electromagnetic Induction of Mystical and Altered States within the Laboratory, *JCER*, 2010b; 1(7): 785-807.

Pitkänen, M., TGD inspired theory of consciousness, 1998. see, e.g., http://www.emergentmind.org/pitkanen_1.htm

Pregolato, M. Time for quantum consciousness. *JCER* 2010; 1(8): pp. 898-906

Pribram, K, *Languages of the Brain*, 1971. Prentice Hall, New Jersey.

Radin, D., *Entangled Minds: Extrasensory Experiences in a Quantum Reality*, 2006, Paraview Pocket Books.

Reid, B. L. On the nature of growth and new growth based on experiments designed to reveal a structure and function for laboratory space. *Medical Hypotheses*, 1989; 29: 105-127.

Ricciardi, L.M., Umezawa, H. Brain and physics of many body problems, *Biological Cybernetics*, 1967; 4(2): 44-48.

Sheldrake, R., *Morphic Resonance: The Nature of Formative Causation*, 2009, Park Street Press.

Stapp, H. P., *Mind Matter and Quantum Mechanics*, 1993, Springer-Verlag, Berlin.

Tarlaci, S. Why we need quantum physics for cognitive neuroscience. *NeuroQuantology* 2010a; 8(1): 66-76.

Tarlaci, S. A historical view of the relation between quantum mechanics and the brain. *NeuroQuantology* 2010b; 8(2): 120-136.

Tiller, W. A., *Psychoenergetic Science*, 2007, Pavior.

Wackermann, J., Dyadic correlations between brain functional states: present facts and future perspectives. *Mind and Matter*, 2004; 2(1): 105–122.

Walker, E., The nature of consciousness, *Mathematical BioSciences*, 1970; 7: 131-178.

Vannini, A. Quantum models of consciousness. *Quantum Biosystems* 2008; 1(2): 165-184.

Vitiello, G., *My Double Unveiled - The dissipative quantum model of brain*, 2001, Amsterdam: John Benjamins.