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

Huping Hu* & Maoxin Wu

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 Pregolato 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 Pregnolato 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, Pregnolato 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 start 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**

<table>
<thead>
<tr>
<th>Year</th>
<th>Theorist(s)</th>
<th>Theory/Concept</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1902-1935</td>
<td>Niels Bohr</td>
<td>Copenhagen interpretation</td>
<td>II-O2-T6</td>
</tr>
<tr>
<td>1925</td>
<td>Alfred Lotka</td>
<td>Classical and non-classical consciousness</td>
<td>II-O3-T6</td>
</tr>
<tr>
<td>1932</td>
<td>John Von Neumann</td>
<td>Interactive Dualism</td>
<td>II-O2-T2,4</td>
</tr>
<tr>
<td>1939</td>
<td>Fritz London &amp; Edmond Bauer</td>
<td>Consciousness creates reality</td>
<td>II-O3-T4</td>
</tr>
</tbody>
</table>

**Table 2 Some Recent Theories**

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

**Table 3 Some Related Books (Publishers are given)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Fritjof Capra</td>
<td>The Tao of Physics</td>
<td>Shambhala</td>
</tr>
<tr>
<td>1985</td>
<td>Nick Herbert</td>
<td>Quantum Reality</td>
<td>Anchor</td>
</tr>
<tr>
<td>1987</td>
<td>F. David Peat</td>
<td>Synchronicity</td>
<td>Bantam</td>
</tr>
<tr>
<td>1989</td>
<td>Roger Penrose</td>
<td>The Emperor’s New Mind</td>
<td>Oxford Uni. Press</td>
</tr>
<tr>
<td>1991</td>
<td>Michael Lockwood</td>
<td>Mind, Brain and the Quantum</td>
<td>Blackwell Pub</td>
</tr>
<tr>
<td>1991</td>
<td>Michael Talbot</td>
<td>The Holographic Universe</td>
<td>Harper Perennial</td>
</tr>
<tr>
<td>1991</td>
<td>Danah Zohar</td>
<td>The Quantum Self</td>
<td>Harper Perennial</td>
</tr>
<tr>
<td>1992</td>
<td>Paul Davies</td>
<td>The Mind of God</td>
<td>Simon &amp; Schuster</td>
</tr>
<tr>
<td>1993</td>
<td>Amit Goswami</td>
<td>The Self-Aware Universe</td>
<td>Tarcher</td>
</tr>
<tr>
<td>1993</td>
<td>D. Bohm &amp; B. Hiley</td>
<td>The Undivided Universe</td>
<td>Routledge</td>
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</tbody>
</table>
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.
5. Sensed presence and altered state of consciousness under magnetic stimulations: Persinger e.t. al. (see, 1993, 2010a).
8. Non-local pattern in cognitive functions: e.g., Diederik Aerts et. al. (see 2000), Elio Conte et. al.(2003, 2010).


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
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(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**


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