



Stream of consciousness: Quantum and biochemical assumptions regarding psychopathology



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ABSTRACT

The accepted paradigms of mainstream neuropsychiatry appear to be incompletely adequate and in various cases offer equivocal analyses. However, a growing number of new approaches are being proposed that suggest the emergence of paradigm shifts in this area. In particular, quantum theories of mind, brain and consciousness seem to offer a profound change to the current approaches. Unfortunately these quantum paradigms harbor at least two serious problems. First, they are simply models, theories, and assumptions, with no convincing experiments supporting their claims. Second, they deviate from contemporary mainstream views of psychiatric illness and do so in revolutionary ways. We suggest a possible way to integrate experimental neuroscience with quantum models in order to address outstanding issues in psychopathology. A key role is played by the phenomenon called the “stream of consciousness”, which can be linked to the so-called “Gamma Synchrony” (GS), which is clearly demonstrated by EEG data. In our novel proposal, a unipolar depressed patient could be seen as a subject with an altered stream of consciousness. In particular, some clues suggest that depression is linked to an “increased power” stream of consciousness. It is additionally suggested that such an approach to depression might be extended to psychopathology in general with potential benefits to diagnostics and therapeutics in neuropsychiatry.

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Introduction

Many current neuropsychiatric models seem to be inconsistent and sometimes lead to equivocal analyses. The mainstream state of the art in neuropsychiatry does not seem completely adequate. In particular, Mender shows several inconsistencies in the biopsychosocial paradigm of psychiatric disease [53]. Woolf et al. demonstrate that there are both equivocal and negative evidences for theories of “chemical imbalances” among neurotransmitters [93]. Globus argues that schizophrenia is just an example of how nonlinear dynamical brain model fails to explain neuropsychiatric illnesses [31]. He further proposes to change the definition itself of the different psychiatric pathologies because of the open “controversy” of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). DSM-V is in progress from 1999 and although it has been recently finalized, it is still subject to ongoing discussions. In general, DSM is related to dangerous rates of misdiagnosis [5,69]. It

leads to a situation where serious ethical problems come into light and cannot be neglected [44].

On the other hand, a growing number of alternative and sometimes controversial approaches are being developed. In particular, quantum theories of mind, brain and consciousness seem to offer a promising way to fundamentally reset the present approach. Currently, among the most notable departures from dogma, one should mention the Orchestrated Objective Reduction (Orch OR) model of Hameroff and Penrose ([38,39,62]) and the Thermofield Brain Dynamics (TBD) model [87–89,29,30] but many others should be taken into account. Even if these models seem very promising, we discern two main problems plaguing these approaches. First they remain simply theoretical and often very abstract models: at the moment there are no convincing experiments or empirical validations in support of them. Such models remain hypothetical. Second, the domain of psychiatric illness as understood today and the realm of quantum mind are mutually detached. Applications to psychiatry thus far have not been seriously considered by quantum physicists, at least in a theoretically systematic manner, nor have quantum models been taken into account by the main stream practitioners and thought leaders in psychiatry.

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To address these problems, we have attempted to study depression by integrating quantum models into experimental neuroscience. We have built a graph as a chain that, step by step, links different aspects of neuroscience, and have included a quantum model as just one of the nodes. Thus, an assumption made by the quantum model could be indirectly verified by its participation in the rest of the chain, that is the neuroscientific part, which can be made testable and measurable by practical methods.

A specific assumption we made, based on quantum methodology, is about the phenomenon of the stream of consciousness. This phenomenon was specifically selected in order to approach depression differently from traditional methodologies. This assumption offers a unique view point on unipolar depression but this approach could be applied to other psychopathologies as well. We shall first build this graphic chain, step by step, and then look at depression from the stream of consciousness point of view.

Experimental neuroscience and quantum models

Depression and the cell membrane

The cell membrane has been extensively studied recently to better understand psychopathologies and in order to find possible biomarkers. Different approaches have been proposed. Among the most important contributions made, a proposal focusing on the G-protein dynamics is especially noteworthy [1,24]. This research focuses on the dislocation of G-protein within its membrane lipid raft microdomain as a basic element conferring vulnerability in depression. Hence, investigating G-protein dislocation within the neuronal membrane or in peripheral tissue, such as platelets, can provide diagnostic markers for depression. (It should be noted that, at least for this kind of study, platelets seem to give the same results as brain cells. This is why platelets are known as “the neuron’s mirror” [19].

Another important approach comes from the authors of the present paper [13–18]. These researchers have investigated the fatty acid (FA) profile within the platelet membrane, comparing groups of depressive versus healthy subjects. One of the main results describes three FAs as the main actors in the onset and development of depression. These are palmitic, linoleic and arachidonic acids. The authors show that these three FAs suffice to recapitulate the entire cell membrane status, i.e. the full FA profile. In particular, depressive pathology seems to be correlated with a high level of arachidonic acid as well as a low level of palmitic acid, whereas linoleic acid seems to be involved as a “fine tuner” or a control parameter to use the language of phase transitions in physics.

Both the work on G-protein and on FAs shows ample evidence that the status of the cell membranes can be used to diagnose depression. Studies are in progress in order to understand whether the two effects (G-protein dislocation and FA composition) are expressions of the same underlying mechanism. In any case, what is to be noted here is that both research groups emphasize the status of the membrane, which is strongly linked to depression.

Cell membrane and the cytoskeleton

The cytoskeleton is an important structure inside living cells. It is a complex network of protein filaments composed of microtubules (MTs) and microtubule associated proteins (MAPs) as well as intermediate filaments and actin filaments with MTs being the most complicated and dynamical of these structures. MTs are hollow cylindrical structures consisting of tubulin subunits, which are 8 nm heterodimers. From 1981 to the present time, there has been an extensive literature produced giving evidence that the FA dynamics is linked to the dynamics of the cytoskeleton, in particu-

lar MTs and tubulins [6,28,42,50,56]. In the same way it is well known that G-Protein dynamics is linked to the cytoskeleton, specifically MTs and tubulins [46,68]. Thus there exists experimental support reported in the literature showing that the cell membrane status is deeply involved in the dynamics of cytoskeleton, MTs and tubulins [70,83,10,77].

Cytoskeleton and quantum consciousness

There have been many hypotheses put forward regarding consciousness formation. It is not possible or useful to consider all of them here, because they are very different from one another and there is insufficient space in this paper for an extensive review. They consider different brain regions and assume different kinds of communication among them. Some of them focus on a wide brain region, other investigate the microscopic sub-cellular level of analysis. However, considering the quantum models of brain, mind and consciousness, a common element seems to emerge, namely the cytoskeleton within the neuron cell. According to some authors, the cytoskeleton plays a leading role ([38,39,62,21,20,40]) while for others it is just one of the fundamental elements [87–89,29,30]. It cannot be convincingly demonstrated that consciousness formation takes place in the cytoskeleton. However, it is safe to say that the cytoskeleton has properties that appear favorable for quantum computation or for quantum events to take place due to its physical and biochemical features [71,3,41,22,21,20,64,84]. Therefore, in any molecular-level model it should be considered a very important basic structure for any possible quantum model regarding mind, brain and consciousness.

In the mid-nineties, Roger Penrose and Stuart Hameroff proposed the so called “Orch OR” or “Orchestrated Objective Reduction” model [38,39], which has been continually updated ever since ([62,40]). According to this well-known model but still highly controversial, one of the main sites involved in consciousness formation is the system of neuronal MTs whose fundamental building blocks are tubulin heterodimers. They are supposed to support both classical states (at least two depending on the association of GTP or GDP with beta tubulin) and a quantum superposition state (possibly even a quantum coherent state). In terms of the classical states supported by MTs, they can express information content as bits, while when in a superposition quantum state, they can express information as qubits. Thus both classical and quantum computation could take place in parallel.

It has been further hypothesized that once these tubulin assemblies find themselves in a quantum coherent state, a threshold can be reached which highlights, a wave function “collapse” from a quantum to a classical state (called “Objective Reduction – OR” by Penrose). This self-organized collapse to classical states is proposed to give rise to the “conscious event”, the “actual now”. The stream of consciousness would then conceivably be a discrete sequence of quantum “self-collapses” (ORs). Hameroff and Penrose suggested that differences in the sequence of ORs could be coupled with different “real life” situations, thus different streams of consciousness as showed in Fig. 1.

In other words, the stream of consciousness is meant to represent a chain of instantaneous conscious “now” moments, in quite the same way as Whitehead defines his “occasions of experience” [91,92] or Stroud described consciousness as discrete events, akin to frames in a motion picture in his “perceptual moment” theory [76]. In the Orch OR model view, the different state of consciousness (e.g.: normal, altered, dreaming, anesthesia, etc.) could be expressed by stream of consciousness with different physical quantities (such as different frequency, etc.). Moreover, according to the Orch OR model: the cytoskeleton, MTs and tubulins are the main actors for quantum consciousness and for the stream of consciousness.

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