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MENTAL DISORDERS AND FUNDAMENTAL SPACE TIME GEOMETRY AT PLANCK SCALE: A HYPOTHESIS

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SUMMARY

The cytoskeleton is a critical player in the neuronal structure and function determining the shape, structure, growth and function of neurons. Actin, microtubules and intermediate filaments are part of cytoskeleton. Microtubules consist of tubulin dimmers and have been shown to be associated with quantum computation. Since cytoskeleton is altered in mental disorders we have earlier proposed that the mental disorders are associated with altered quantum computation. This may lead to altered brain frequency which resonates with a world which has frequency different from that of the decohered world. We further propose that the world which resonates with the brain of a patient with the mental disorder is stabilized in the reference frame of the patient at the Planck scale. Further we discuss that there may be a thin line between epiphany (and creativity in general) and hallucinations/delusions and we propose a physical explanation for it.

INTRODUCTION

Synaptic plasticity, ion conductance and neurotransmitter vesicle transport/secretion are important membrane based neuronal input-output activities which are controlled by cytoskeleton. Cytoskeleton is an intra-neuronal network of filamentous protein polymers. Organisms which show sophisticated functions such as swimming, avoiding obstacles and predators, find food and engage in sex without the presence of synaptic connections. Cytoskeleton has been proposed to be the nervous system of paramecium [1].The cytoskeleton determines the shape, structure, growth and function of neurons. Cytoskeleton includes actin, microtubules and intermediate filaments. Rigid microtubules are interconnected by microtubule-associated proteins and immersed in actin form.

Thus a dynamic supporting network is formed.

The cytoskeleton plays a pivotal role in maintaining the structural polarity and asymmetrical shape of neurons. Cytoskeletal reorganization has an important role to play in neuritogenesis. In neurodegenerative diseases, there is impairment of neurotransmission due to abnormal assembly of

cytoskeleton. Abundant amyloid plaques and neurofibrillary tangles are the two major neuropathologic alterations present in the brain in Alzheimer's disease. Microtubule-associated protein tau constitutes nearly entire neurofibrillary tangles of paired helical filaments. Neuron structure and integrity is partly stabilized by binding of tau proteins to microtubules under normal conditions. Lewy bodies are another example of cytoskeletal abnormalities present in neurodegenerative disease and are considered as pathologic markers of Parkinson's disease. Tubulin, MAP1, and MAP2 constitute Lewy bodies. Schizophrenia is accompanied by loss of dendrites and spines, changes in neuronal shape and irregular distribution of neuronal elongation in brain of the patients. Accumulating evidence suggests that psychiatric illnesses and neurodegenerative diseases are associated with cytoskeletal alterations in neurons which lose the ability to transmit incoming axonal information to the somatodendritic domain as a consequence of alterations in synaptic connectivity. In fact cytoskeleton has been proposed to be a target of drug therapy as the neuronal cytoskeleton is disrupted in neurodegenerative and some psychiatric diseases. Besides evidence indicates that neuritogenesis through cytoskeletal rearrangements is promoted by melatonin, a hormone secreted by pineal gland [2].

Dendritic spines are mainly constituted of actin. Actin also exists throughout the rest of neuronal interior. With the polymerization of actin, the cell interior converts from an aqueous (sol) state to a gelatinous (gel) state. Neuronal microtubules self-assemble and along with actin are involved in growth of axons and dendrites. Motor proteins transport materials along microtubules to regulate and maintain synapses. The conformational states of MT subunits govern the direction and guidance of motor proteins and synaptic components. Microtubules are apparently involved in active guidance of the transport and appear to be well suited for information processing. Microtubules are comprised of 13 longitudinal protofilaments which are chains of the protein tubulin. Each tubulin molecule consists of two monomers known as alpha and beta tubulin. The dendritic cytoskeleton is unique in the sense that unlike axons and any other cells, in dendrites the microtubules are short, interrupted and mixed polarity. Microtubule associated proteins form the networks of equal mixtures of polarity [1].

Quantum computation in microtubules and consciousness

In conventional computers digital information is represented as binary bits of either 1 or 0. However in quantum computers quantum information can be represented as superpositions of both 1 and 0. Qubits interact with other qubits by nonlocal entanglement, allowing interactions to evolve [3] resulting in enormous speed and near infinite parallelism of computation. The tubulin dimmers in the microtubules also behave as qubits. Conformational states of tubulin protein subunits within dendritic microtubules interact with the neighbouring tubulin molecules. The tubulin molecules are linked to each other by dipole coupling. Thus microtubules process information in a manner analogous to cellular automata. Tubulin molecules may exist as superpositions of different conformational states and may act as qubits. When tubulin molecules are in superposition they compute by entanglement with the other tubulin qubits. These tubulin qubits may lie in the same microtubule, other microtubules in the same dendrite and microtubules in other dendrites which may be connected by gap junctions. The dendritic cytoplasm alternate between the sol (aqueous) and the (gel) gelatinous phase. In the sol phase the actin is depolymerized and microtubules communicate/process information in a classical fashion with the external world. As the actin polymerizes and the dendritic cytoplasm is converted to a gel phase, microtubules become isolated from environment. In the gel phase quantum states of tubulin/MTs are protected from environmental decoherence by biological

mechanisms such as topological quantum error correction, coherent pumping, Debye screening, ordered water and acting elation. During the gel phase MT tubulin qubits represent subconscious or unconscious experience. Preconscious tubulin (subconscious or unconscious) superpositions reach threshold for Penrose OR. A sequence of OR events give rise to our consciousness [1]. We propose that the processing of quantum information by microtubule automata contributes to the brain frequency described below.

The Brain frequency and the relationship between the brain and universe

The rhythmic activity of the brain is divided into bands by frequency. This activity is measured by EEG. Majority of the cerebral signal observed in the scalp EEG falls in the range of 1–20 Hz. The frequency range from 4 Hz to 7 Hz is known as theta. Theta can be seen in meditation [4]. Many relationships have been proposed between the physical properties of the human brain and earth as well as the entire universe [5]. For example the resonant frequency of the human brain (about 7Hz) matches approximately with the frequency range of the earth. It has been further proposed that (1) the human brain functions along a wavelength that is consistent with the wavelength of the entire universe (2) the brain may have access to a currently immaterial dimension, given appropriate electromagnetic circumstances would allow such information from a universal plane existing throughout time to emerge at an appropriate level of space and time familiarly perceivable to human beings [6]. The frequency of the brain in the patients with the mental disorder may be different from that of normal human beings. For example, Karson et al. [7] reported that the neural alpha frequency in the brains of patients with schizophrenia is considerably lower than in control groups composed of individuals without schizophrenia. Thus we have earlier proposed [8] that the quantum computation in patients with mental disorders may be altered due to altered neuroskeleton, which may lead to different brain frequencies. These altered brain frequencies may resonate with the frequency of the parallel universe which may lead to hallucinations. In this paper we further elaborate on this hypothesis.

Penrose has suggested [9,10] that quantum superposition is an actual separation in underlying reality at the level of fundamental space-time geometry at the Planck scale of 10^{-33} cm. Penrose further proposes that superposition can be envisaged as a blister, bubble or superposition in fundamental space-time geometry. This is somewhat similar to the multiple worlds view, however, according to Penrose the separations are unstable and they spontaneously self collapse due to an objective threshold in space time geometry. In this context we propose that within the reference frame of a schizophrenic patient, the separations in the fundamental space-time geometry may be stabilized and there may be a complete branching off of various worlds. The schizophrenic brain resonates with a world which is different from that of the world (produced due to decoherence) that is in resonance with the brain of a normal person. The patient remains in delusion till decoherence takes place.

What may be the difference between a delusion and an epiphany?

Epiphany has been defined as "a literary work or section of a work presenting, usually symbolically, such a moment of revelation and insight." We propose that this moment of revelation and insight is brought about when the separations in the fundamental space time geometry are stabilized within the reference frame of the observer and the brain resonates with a parallel world which resonates which has a frequency different from that of the decohered world. However we have proposed the same explanation for the hallucinations experienced by patients with mental disorders. The difference in both the states may be that, in the normal human beings the brain resonates with the frequency of a universe which is closer to the frequency of the decohered universe. However the delusions and

hallucinations may be experienced when the brain resonates with a frequency which is "quite different" from that of the decohered universe. Obviously there is a thin line between hallucinations/delusions and epiphany (or creativity in general).

It has been demonstrated that patients with schizophrenia or bipolar disorder and their relatives are overrepresented in creative occupations. This study has been validated with a large sample of patients (n = 1,173,763) to survey several psychiatric diagnoses and to validate previous findings. The authors conducted a nested case–control study using longitudinal Swedish total population registries. In this study the occurrence of creative occupations in patients and their non-diagnosed relatives was compared to that of matched population controls. Anxiety disorders, alcohol abuse, drug abuse, autism, ADHD, anorexia nervosa, completed suicide, schizophrenia, schizoaffective disorder, bipolar disorder, unipolar depression were the diagnoses included in this study .Creative professions included scientific and artistic occupations. It was concluded that, individuals with overall creative professions were more likely to suffer from bipolar disorder than controls. However, being an author was specifically associated with increased likelihood of unipolar depression, anxiety disorders, substance abuse suicide schizophrenia and bipolar disorder. Besides this, an association was found between creative professions and first-degree relatives of patients with bipolar disorder, anorexia nervosa, schizophrenia, and for siblings of patients with autism [11].

CONCLUSIONS

We have discussed the physical basis of differences in epiphany and delusions. We have proposed earlier that in patients with mental disorder the brain frequency is altered due to differences in the cytoskeleton and hence quantum computation in the brain. We further propose that this brain frequency resonates with the frequency of a parallel world. This parallel world is stabilized in the fundamental space time geometry within the reference frame of the patient. The epiphany (and creativity in general) may be due to same mechanism with the difference lying in the proximity of the frequency of the parallel world to the frequency of the 'normal' decohered world.

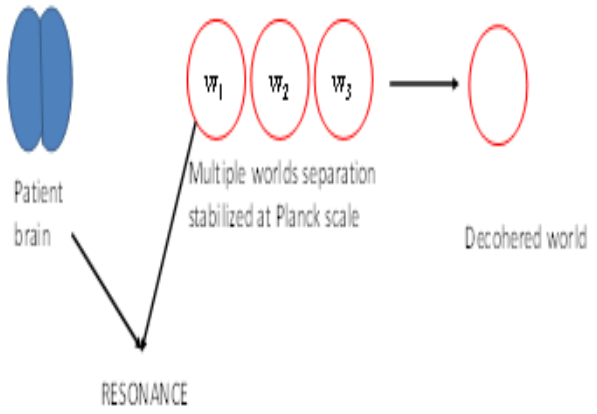

Fig.1a Events in the brain of patient with mental disorder leading to delusions and hallucinations

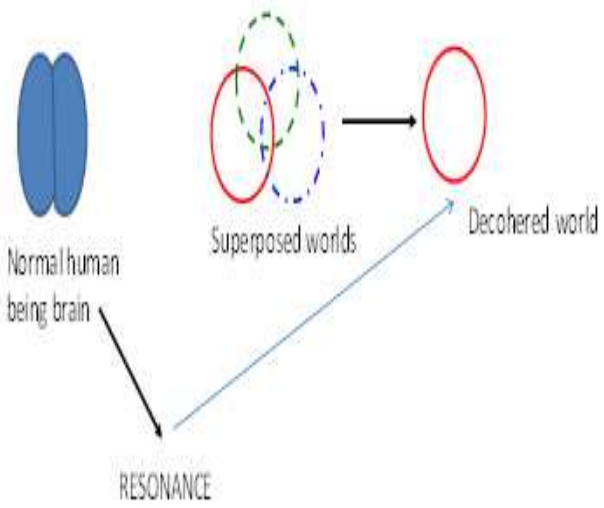

Fig. 1b Events in the brain of normal person in contrast to Fig. 1a

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