Chapter 14
The Quantum Human Central Neural System

Athanasios Alexiou and John Rekkas

Abstract In this chapter we present Excess Entropy Production for human aging system as the sum of their respective subsystems and electrophysiological status. Additionally, we support the hypothesis of human brain and central neural system quantumness and we strongly suggest the theoretical and philosophical status of human brain as one of the unknown natural Dirac magnetic monopoles placed in the center of a Riemann sphere.

Keywords Frailty • Human brain • Central neural system • Excess entropy production • Magnetic monopole • Dirac string • Quantum information • Nonlinear mirror • Riemann sphere • Weak quantum theory • Complementarity • Entanglement

14.1 Introduction

The use of term frailty meets an increasing interest among the geriatricians and the medical doctors that treats elderly population (mainly aged over 65) and as a syndrome can be defined as a state of vulnerability to stressors resulting from a decrease in functional reserve across multiple systems and compromising an individual's capacity to maintain homeostasis [1]. Obviously frailty is a multiparametric clinical condition associated with a large scale of symptoms such as social and demographic factors, physical function, cognitive status and other social, environmental, and behavioral factors. While our knowledge concerning aging and systems biology is rapidly increasing, mathematical and biophysical modeling of frailty remains yet an open problem. The use of thermodynamics principles for irreversible processes has to be adjusted in a new way of studying geriatrics frailty.

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Additionally, nowadays several studies are under way concerning the analytically mapping of human brain, the modeling of all the subcellular processes and the way that cognition's disorders could be manipulated and treated in an effective way.

A latest research concerning the rapid way of human brain to process images and direct the eyes to their next target, conducted by neuroscientists at the Massachusetts Institute of Technology, seems to support our presented hypothesis theory [2]. During this clinical study, a series of 6 or 12 pictures presented at between 13 ms and 80 ms per picture to individuals, with no interstimulus interval and the results were consistent with feed-forward models [2]. As the authors concluded, a possible role for such rapid visual understanding would be to provide nearly instantaneous conceptual activation that enables immediate action when necessary, without waiting to refine understanding by reentrant processing or by the kind of conscious reflection that requires a stable recurrent network [2]. It is obvious that this two-way human brain processing must be operated in a simultaneous manner, almost synchronized, and be formalized by quantum and not classic information.

In this chapter we support that the application of the synchronistic theory [3], the modeling of synchronistic phenomena as entanglement correlations [4, 5], and the notation of complementarity in cognitive studies [6] through the formalisms of the Weak Quantum Theory (WQT) [7] are the necessary general framework for the establishment of a holistic human brain theory.

14.2 Measuring Frailty with Human Entropy

While the term "frail elderly" as a Medical Subject Heading term is defined as "older adults or aged individuals who are lacking in general strength and are unusually susceptible to disease or to other infirmity," we derived to a different formulation of the Hershey's original Excess Entropy Production (EEP) equation [8]. By taking into consideration the latest geriatrics clinical surveys, we propose a more complex system, for the representation of human aging, unlike the simple daily protein equilibrium that is the protein consumption minus the protein required [8].

Based on the Canadian Study of Health and Aging (CSHA) [9], we characterize human health as a dynamic system where frailty's progression depends on the overall human entropy. Categorizing the 70-item of the (CSHA) Frailty Index, we defined seven main groups of risk factors such as psychological, genetic, environmental, cardiovascular diseases, aging, comorbidities, and neurodegenerative lesions, where its subsystem entropy contributes to the overall system, often resulting to irreversibility even with a small accident or a symptom's presence. Increased entropy in any of the frailty subsystems may not lead immediately to a specific chronic disease or a case of morbidity. There is a chaotic combination of several factors, which have to be examined, in an individualized level, in order to calculate non-reversible healthy conditions.

Let us recall the basic equations for the internal entropy production for a chemical reaction system [10]:

$$\frac{\mathrm{d}S}{\mathrm{d}T} = \frac{Ar}{T}$$

where S is the internal entropy content; A is the chemical affinity, a chemical driving force; r is the reaction velocity, a chemical flow; T is temperature; t is time; and its general formulation is

$$\sigma(S) = \frac{\mathrm{d}S}{\mathrm{d}t} = \sum_{j=1}^{n} J_j X_j$$

where $a(S)$ is the internal entropy production at any time t, J_j is a flow for the component j, and X_j is a driving force for component j.

According to Hershey and Lee [11] EEP approaches a minimum or zero as the system approaches an equilibrium or stationary state and EEP describes the rate of approach of excess entropy (EE) to the final state, where

$$\mathrm{EEP} = \frac{\mathrm{dEE}}{\mathrm{d}t} = \frac{\mathrm{d}\left(\delta^2 S\right)}{\mathrm{d}t} = 2\sum_{j=1}^{n} \delta J_j \delta X_j$$

and

$$\mathrm{EE} = S - S^0 = \frac{1}{2}\delta^2 S$$

where S_0 is the entropy of the system in the reference state, δS is the first entropy deviation from the reference state, $\delta^2 S$ is the second entropy deviation from the reference state, and $\delta S = 0$ if the reference state is an equilibrium or stationary state of maximum entropy [12].

We analyzed the EEP equation of Hershey and Lee [8] and replace the [*Protein*] factor with the personalized [*Frailty*] value, where

$$Frailty = \sum_{i=1}^{n} a_i E_i, \qquad i = 1 \ldots 7$$

a_i is the energy coefficient and E_i corresponds to the i frailty's subsystem, expressed as an energy value. Therefore EEP can be rewritten as follows:

$$\mathrm{EEP} \cong \frac{(\delta[Frailty])^2}{[Frailty]}$$

where [*Frailty*] is the linear combination of the overall human quantum information of being healthy or not, that is,

$$|f\rangle = nh|0\rangle + h|1\rangle,$$

where $|nh|^2$ is the probability that elderly is not healthy, $|h|^2$ is the probability that elderly is healthy, $|nh|^2 + |nh|^2 = 1$, and $\delta[Frailty]$ is the daily total energy charge that human body produces in subcellular level minus the minimum energy required to result in a global irreversible process.

14.3 Signals Quantum Transmission in Human Body

We will start this third section with some basic mathematical terminology [13–16] based on the assumption of modeling the central nervous system (CNS) as a Riemann sphere with two states. One such system is described by the two-dimensional complex Hilbert space H^2.

We assume state $|\uparrow\rangle$ as the (1,0) and state $|\downarrow\rangle$ as the (0,1). While these two states are orthogonal we obtain $\langle\uparrow|\downarrow\rangle = 0$ and after their normalization we get $\langle\uparrow|\uparrow\rangle = 1 = \langle\downarrow|\downarrow\rangle$.

The overall system state results from the linear combination of the basis states $(\psi, \varphi) = \psi \cdot |\uparrow\rangle + \varphi \cdot |\downarrow\rangle$. The inner product of the general state $(a, b) = a \cdot |\uparrow\rangle + b \cdot |\downarrow\rangle$ will be computed from the $\langle (a, b)|(\psi, \varphi)\rangle = \overline{\alpha} \cdot \psi + \overline{b} \cdot \varphi$.

We assume also the following projective Hilbert space PH^2 where $\psi \cdot |\uparrow\rangle + \varphi \cdot |\downarrow\rangle = |\nearrow\rangle$ (Fig. 14.1).

According to the above, a synapse between a presynaptic neuron and a postsynaptic cell, for the transmission of an electrical or chemical signal will be equal to

$$\text{(True) or (1) for } |\nearrow\rangle$$
$$\text{(False) or (0) for } \langle\swarrow|$$

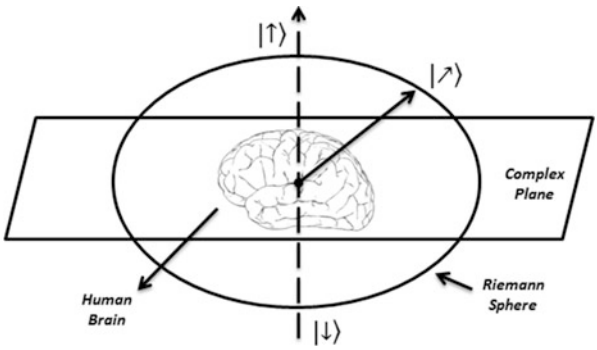

Fig. 14.1 The quantum brain in the center of a Riemann sphere

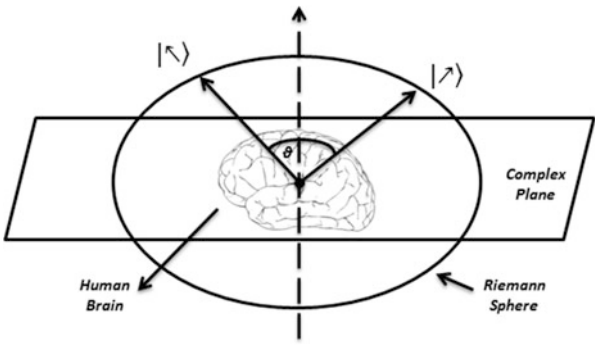

Fig. 14.2 The probability of measuring initial $|\nwarrow\rangle$ to a different direction $|\nearrow\rangle$

Assuming state $|\nearrow\rangle$, the probability of (True) during measure ($M\nearrow$) will be

$$\text{Prob} = \frac{|\psi|^2}{(|\psi^2| + |\varphi^2|)}$$

If we have a random state in the original direction $\langle\nwarrow|$ and measure the possibility of its existence in another direction $|\nearrow\rangle$ then the likelihood of (True) results from the relation

$$\text{Pr} = \frac{1}{2}(1 + \cos\theta),$$

where θ is the angle between $\langle\swarrow|$ and $|\nearrow\rangle$ in the three-dimensional Euclidean space (Fig. 14.2).

The Laplace operator in two dimensions of Euclidean space is given by $\nabla^2 = \partial^2/\partial x^2 + \partial^2/\partial y^2$, and must be transformed in curled metric as $\mathrm{d}S^2 = g_{ab}\mathrm{d}x^a\,\mathrm{d}x^b = \mathrm{d}\theta^2 + \sin^2\theta \cdot \mathrm{d}\varphi^2$ with spherical coordinates (θ, φ).

The Cartesian coordinates in the three-dimensional space can be presented in the form

$$\begin{aligned} x &= \sin\theta \cdot \cos\varphi \\ y &= \sin\theta \cdot \sin\varphi \\ z &= \cos\theta \end{aligned}$$

Additionally, Laplacian operator with partial derivative is given by

$$\nabla^2 = g^{ab}\nabla_a\nabla_b = \frac{\partial^2}{\partial\theta^2} + \frac{\cos\theta}{\sin\theta}\cdot\frac{\partial}{\partial\theta} + \frac{1}{\sin^2\theta}\cdot\frac{\partial^2}{\partial\varphi^2}$$

and ∇^2 Eigenvalues are

$$\nabla^2\Phi = -l \cdot (l+1) \cdot \Phi$$

where Φ the correspondence Eigenfunction with values $l = 0, 1, 2, \ldots$

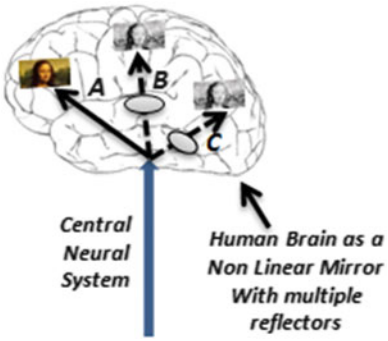

Fig. 14.3 Human brain as a nonlinear mirror with multiple reflectors

Given the complexity and randomness of energy production pathways, mainly by the activation of specific proteins and the quality of the mitochondrial dynamics, we conclude that any signal transmission requires energy production through non-conventional sources and non-discrete steps.

We therefore support that the human brain behaves like a nonlinear mirror, capable of generating and diffusing the incident signals from the CNS at different points, by moving forward and back in space and time, without creating actual copies of memories or reality's shots. Generated information behaves as if it is reflected by a spatial and temporal mirror and corresponds to authentic confirmation signals (without damage or distortion) in acknowledgment to the different brain subsystems receivers, acting as copies of the original signals (Fig. 14.3).

It is obvious that human brain does not create exact copies of the environmental reality i.e. optical images are derived inverted in the brain. In fact via quantum entanglement, a quantum state can be moved from one point of the nervous system to the brain and vice versa. While entanglement correlations cannot be used for transmitting signals or controllable causal influences [4, 5], Jung and Pauli [3] established the synchronicity theory in order to describe the so-called paranormal phenomena, not as results of any causal influence of mind on matter or other minds but as "meaningful coincidences" or correlations mediated by correspondences of sense and meaning [17]. Quantum information must be safety transferred in human body and shared equally with the past and to the future. Therefore the assumptions of weak quantum theory (WQT) [7] through the terms of complementarity and entanglement [6] can give us the necessary theoretical framework of explaining brain functionality and the conjunction between CNS and human brain parts.

14.4 CNS as a Dirac String

Our main objective is to establish the idea of a human brain isolated magnetic monopole existence [18–21], in order to pull electrons carriers' signals from the CNS. We use the initial Schrödinger wave equation $(\partial + M^2) \cdot \psi = 0$, which can be transformed to $(\partial + iM) \cdot \psi = 0$ for electron, using the Dirac operator.

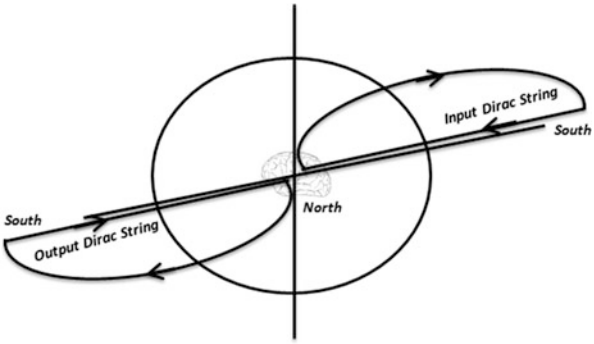

Fig. 14.4 Dirac strings across the CNS

The wave functions satisfying the Dirac equation will also satisfy the wave equation for particles with rest mass $\hbar \cdot M$. The Dirac equation might take the form of a Schrödinger equation:

$$i\hbar \cdot \frac{\partial \psi}{\partial t} = (i \cdot \hbar \cdot \gamma_0 \cdot \gamma \cdot \nabla + \gamma_0 \cdot \mu) \cdot \psi$$

where the parenthesis is the Hamiltonian operator; using the Hamiltonian, we express the interactions of the electron with the electromagnetic field generated by the magnetic monopole brain.

$$\text{Neural Cells} \xleftrightarrow{\text{synapses and electrons}} \text{Human Brain}$$

Therefore many Dirac strings are created for every neural pathway from one point of the CNS to another and to the brain, which are operated independently and often lead to undesirable side effects. These Dirac "brain bridges" give to the CNS the capability of accelerate synchronistic phenomena due to external stimuli or tissues-organs requests. As a conclusion the following theorem is resulting:

Theorem 1. Brain Magnetic Monopole (BMM) The magnetic power of the brain magnetic monopole is inversely proportional to the value of the electric charge flowing in each nervous Dirac string. The electric charge needs quantisation and must be equal to an integral multiple of a specific value of the electron charge.

This brain magnetic power will be given by the equation

$$P_{\mathrm{B}} = \frac{A}{|q|} = \frac{A}{N \cdot |q_{\mathrm{e}}|}$$

where $N = 1, 2, 3, \ldots$, $|q_{\mathrm{e}}| = 1.6 \times 10^{-19} C$, A is a physical constant expressed in $\frac{C \cdot J}{s}$ and depends on brain reflectance and its ability to act as a nonlinear mirror, creating evidence of information transference and countertransference as well as producing synchronistic phenomena through entanglement correlations (Fig. 14.4).

Conclusion

While new and extremely challenging evidences on brain ability to react on different environmental stimuli are published, in this chapter we propose a multiple formulation of human brain as a Dirac magnetic monopole, of CNS as Dirac string and of frailty evaluation as a thermodynamic problem. Merging biology with modern physics and mathematics, we support the hypothesis of the quantumness of CNS signals, through the formulation of human brain into a Riemann sphere in order to support the efforts of human brain mapping through a general and integrated theory.

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