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PARALLELS BETWEEN THE TREE-PATTERN ARCHITECTURE OF BRAIN AND MIND ACTIVITY IN THE ULTRONLOGOTRON THEORY AND THE OPERATIONAL ARCHITECTONICS OF BRAIN-MIND RELATION IN THE QUANTITATIVE ELECTROENCEPHALOGRAPHY STUDY: A VIEW OF INTERACTION BETWEEN SELF AND BRAIN.

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Abstract

The relationship among self, mind and brain is not clearly known. Self's subjective experience of perception and cognition of words, feeling, thoughts etc. is supported by the integrity of human brain. The relationship between the self and human brain activity is not explicitly understood. Recent experimental evidence suggests that the neural correlate of consciousness is located in certain parts of the cortico-thalamic system. However, it is not clearly known specifically which parts of the human brain are involved in the human cognitive activity. Functional magnetic resonance imaging (fMRI) and quantitative electroencephalography (qEEG) have been used in the study of normalcy, psychiatric disorders and brain injuries. FMRI and qEEG are applied in diagnosis and clinical drug treatment of psychiatric disorders and brain injuries. In this study, the author analyzed results of published articles related to the above described fields to find the relationship among self, mind and brain, and proposed the mechanism involved in the self, mind and brain in normalcy, psychiatric disorders and brain injuries, and further the interaction between self and brain. Results of analysis reveal remarkable parallels between the author's tree-pattern architecture of brain and mind activity in the ultron-logotoron theory (ULT) and the operational architectonics (OA) of brain-mind relation in qEEG study reported by Fingelkurts and his coworkers.

Keywords:- *Consciousness, Selfhood, fMRI, qEEG, Psychiatric Disorders, Brain Injury, Confucian Philosophy, Jeong Yeok, Ultron-Logotoron Theory, Theory of Everything, Probacent Model.*

1. INTRODUCTION

The scientific relationship among self, mind and brain in humans is not clearly known. Self's subjective experience of perception and cognition is supported by the integrity of human brain (Tononi et al. 2016). Consequently, neuroscientists, psychologists, psychiatrists, physicists and philosophers have been investigating to find the scientific relationship between mind and brain, consciousness and quantum physics.

Recent experimental evidence suggests that the neural correlate of consciousness (NCC) are likely to be located in certain parts of the cortico-thalamic system. However, it is not explicitly known specifically which cortical areas, layers or neural populations are involved (Tononi, 2012; Tononi et al., 2016; Molina et al., 2017).

1. 1. The Theory of Self, Mind and Body

The author (Chung 2012, 2015a) published a hypothesis of a theory regarding the scientific relationship among self, mind and body based on that a human individual, the self is composed of the inner true self (spirit) and the physical false self that would fade and disappear at death of the body. The inner self has free will, will power, cognition, reason, morality, conscience, creative power, mathematical computation, future plan and high goals, behavior control, emotion regulation, and memory retrieval, supervising the physical self/body that senses through sensory organ systems and responds to the external world. The inner true self is the independent and indestructible spirit in an individual. The physical self is dependent upon and associated with the brain and body, and is impulsive, behaving for pleasure-desire and instinct for living (Joseph, 2011a; 2011b). The inner self controls the physical self/body by interacting with the prefrontal cortex of human brain (Rilling and Insel, 1999).

Recent researches in neuroscience using functional magnetic resonance imaging (fMRI) discovered that the prefrontal cortex (PFC) of the human brain performs cognitive control, emotion regulation, moral self-control, control of impulsive behavior and guiding brain activities with future goals and rules (Miller and Cohen 2001; Greene et al. 2001; Ochsner et al. 2002; Schwartz, 1999, McGonigal, 2012; Joseph, 2001, Carter, 2014).

McClure and his collaborators (2004) demonstrated in their fMRI study that one of the two systems of the brain involving subject's decision making, the dopaminergic limbic system is activated by decision involving immediate available rewards and that the other system, the prefrontal cortex is associated with subject's preferred choice. The immediate rewards correspond to pleasure-desire of the physical self/body, and the preferred choice corresponds to free choice and reasoning of the self. The PFC is involved in the executive and higher cognitive function of the brain with which the self-interacts in the ultron-logotron theory (Chung, 2012, 2015a).

The physical self has consciousness associated with the brain and stimuli coming from the external world. However, it lacks mind, and has no free will nor free choice. In contrast, the inner self has perception and cognition of stimuli coming from the external world and conscious mind with free will and free choice.

The theory of self, mind and body was developed in the author's study to find a general mathematical formula, the "probacent" model of "probacent"-probability equation that would be applicable to express relationships among intensity of stimulus, duration of exposure and response in biomedical phenomena (Chung, 1960, 1995, 2007, 2013, 2018d).

1. 2. Ultron-Logotron Theory

Interactions between self and consciousness: mind and matter are not clearly understood in science. There seem to be, to my knowledge, no articles in the literature that clearly explain the relationship between self and consciousness: mind and matter.

The author reviewed modern quantum physics (Bohm, 2006; Nichol, 2006) and the Eastern Confucian philosophy (Capra, 1999, Chung, 2009). On the basis of the review and author's personal experiences of valid precognitive dreams, the following theory is proposed (Chung, 2014a):

(1) The "ultrons" are the building blocks of matter of the universe. The "logotrons" are the building blocks of consciousness of human mind. The "logotrons" are virtual particles. The "ultrons" and "logotrons" interact each other with mental-force-carrying "mentalon" in neurons of human brain. Mentalon exchanges between logotron and logotron or logotron of self's consciousness and logotron of consciousness superpositioned to particles of matter (Table 1 and Figure 1).

(2) Entanglement could be explained by mental-force-carrying mentalon that exchanges between two entangled virtual quantum logotrons in particles or logotron in conscious mind and logotron in particles of matter at quantum levels.

(3) There seem to be parallels between the "ultron"- "logotron" theory and quantum physics from the ontological perspective, and a close agreement between the "ultron"- "logotron" theory and the Penrose-Hameroff's Orch-OR theory (Penrose and Hameroff, 2011) or the von Neumann-Heisenberg's orthodox quantum mechanics (Stapp, 1999, 2011) that seem to be correct descriptions and applicable to both the inner self and the physical self/body of humanity, respectively on the basis of the human individual self that is composed of two selves, one, the inner self and one, the physical self.

The physical world, the consciousness world and the spiritual world of our universe coexist in superposition and represent the macro-cosmos of the Creator God. The superpositioned worlds, the macro-cosmos of the Creator of our universe, the Self, seem to be analogous to the physical body, the conscious mind and the inner spiritual self in superposition that represent the microcosmos of the co-creator, the self of the humanity. The spiritual world is invisible but real. The spiritual world and the human world would unite in the coming kingdom of heaven on Earth where

goodness will be boundless according to Jeong Yeok, the Book of Right Change (Kim, 1885; Chung, 2010; Yi, 1992) of Confucian philosophy as the Bible predicts it. Virtual particles are in essence virtual logotrons (information) that are the archetype of real particles. Annihilation and creation of ultrons (matter) are secondary to action of underlying virtual logotrons in the Cosmic Consciousness (mind). This seems to suggest that the ultron-logotron theory possibly leads to the Theory of Everything (ToE).

The ultron-logotron-associated mental force, mentalon, is postulated to act on space in four different, undetermined ways, resulting in and generating four physical forces, gravitational force, electromagnetic force, and strong and weak nuclear forces. The four physical forces could be four different manifestations of the ultron-logotron-associated mentalon that would result in four differently distorted or shaped space of undetermined patterns.

Kak (2009) presented in his article the case of the existence of a separate principle of consciousness to complement physical law. Information of consciousness of the self, the observer, in cognition described by Kak seems to be analogous to logotrons of the ultron-logotron theory, and there appears to be a virtual agreement between the Kak's propositions and the author's hypothesis of the ultron-logotron theory.

Table 1. Comparison of postulated characteristic aspects of ultron and logotron.

Characteristic aspects	Ultrons	Logotrons
Element of	Physical matter	Conscious mind
Nature	Physical	Conscious (spiritual)
Creation	Created by the Creator	Created by the Creator and co-creator
Property	Triple: particle, wave and consciousness	Triple: particle, wave and consciousness
State	Real and virtual	Virtual
Interaction between themselves	Graviton, electromagnetic force, weak and strong nuclear forces	Mental-force carrying mentalon
(Speed of transmission)	(Maximum speed of light)	(Instantaneous)

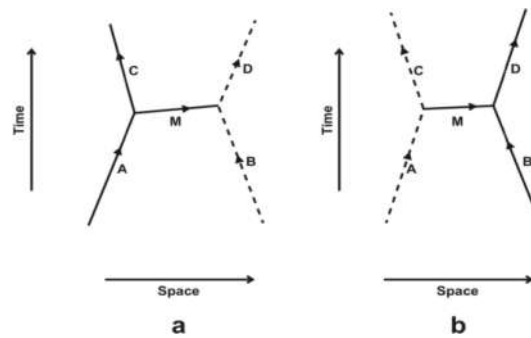


Figure 1. Feynman's spacetime diagram of interactions between "ultron" and "logotron". a: A – Real ultron in the excited state in the neuron of the prefrontal cortex caused by incoming stimulus. C – Real ultron in the ground state after collapse of the quantum wave function when the self-controls (observes). B – Virtual logotron in the ground state in the neuron of the prefrontal cortex.

D – Virtual logotron in the excited state when the self observes and cognizes. M – mental-forcecarrying "mentalon" exchanging between ultron and logotron. b: A – Virtual logotron in the excited state in the self's conscious mind in the neuron of the prefrontal cortex. C – Virtual logotron in the ground state after exchanging "mentalon" between the logotron and ultron in the neuron. B – Real ultron in the ground state in the neuron of the prefrontal cortex. D - Real ultron in the excited state in the neuron after exchanging "mentalon" between logotron and ultron. M – "mentalon". (see text).

1. 3. Functional Magnetic Resonance Imaging (fMRI) Study in Neuroscience (Chung, 2018a, 2018b, 2018e)

On the basis of review of findings and data reported in recent functional magnetic resonance imaging (fMRI) studies, the following conclusion is proposed from the perspective of the author's hypothesis of the ultron-logotron theory (ULT):

- [1]. The semantic map ('Words Atlas') in human cerebral cortex developed by Gallant and his coworkers is inferred to provide an evidence of tree-pattern, four-dimensional images (architectures) of ultron- and logotron-complex in human cognitive comprehension of words (Figures 2 and 3).
- [2]. Any injury, infection, degeneration and abnormal excitement or suppression state of certain parts of cerebral regions (ROI, voxel) will result in clinical disorders such as aphasia, hearing loss, blindness, hallucination, amnesia, depression and so on due to dissociation, suppression of connections between the prefrontal cortex (PFC) and the other cortico-thalamic system and the limbic system, the prefrontal-rear system ('PRS'), fundamentally due to blocking connections between ultron-complex and logotron-complex. The unconscious mind is inferred to be due to dissociation between the PFC and the 'PRS' (Figure 2).
- [3]. Noxious stimuli are related to specific cerebral regions (ROIs, voxels) of human brain, giving rise to pain feeling (Bushnell and Apkarian, 2006; Davis et al, 1997; Farrell et al, 2005).
- [4]. Analgesics modulate the pain-related voxels of brain, actually the tree-pattern ultron-complex, suppressing generation of matching pain-logotron-complex.
- [5]. Cognition of stimulus from the external world is dependent upon the processes as follows:
 1. A stimulus coming from the external world via the corresponding sense organ is transmitted through the peripheral nerve, the spinal cord and reach multiple regions of the prefrontal-rear system ('PRS').
 2. The stimulus information is then transmitted through the 'functional connections' (FC) that is the neural path connecting the 'PRS' and PFC to the prefrontal cortex.
 3. The PFC receives the incoming stimulus information from the 'PRS'. The PFC seems to correspond to the root of the tree-pattern image. Any damage or distortion in any parts of the above processing of information would result in clinical disorders (Figure 2).
 4. Anesthetics suppress functional connections (FC) between the 'PRS' and the PFC, resulting in unconsciousness (Bonhomme et al, 2012; Paasonen et al, 2018)
 5. Sleep state would possibly give rise to perception-related dreams associated with ultroncomplexes stored in the 'PRS'. Dreams represent conscious perception of the physical self superpositioned to the brain without the interacting inner true self during sleep.
 6. The inner self interacts with the PFC, and perceives and cognizes the incoming information with the matching logotron-complex.
 7. The conclusive findings in the functional magnetic resonance imaging (fMRI) studies seem to provide evidence of the ultron-logotron theory applicable to the relationship between mind and brain, consciousness and matter, and further dualistic existence of self and non-self in human individuals.
 8. There seems to be a considerable agreement and mutual support between the UltronLogotron Theory (ULT) and the Integrated Information Theory (IIT) of Tononi (2012).

On the basis of modern quantum physics and the ultron-logotron theory, the possible deeper structure of leptons and quarks is proposed (Chung, 2015b). A neutrino is composed of an equal number of yin-ultron and yang-ultron, and postulated to be composed of one yin-ultron and one yang-ultron. Yin- or yang-ultron mass is 0.16 eV. Electric charge of yin-ultron is $-1.602176565 \times 10^{-19} \text{ C} / (3.19 \times 10^6 \cdot 2k)$; that of yang-ultron is $1.602176565 \times 10^{-19} \text{ C} / (3.19 \times 10^6 \cdot 2k)$.

C denotes coulomb and k a number of neutrinos in a lepton. An electron is composed of two parts: one neutral part consisting of yin- and yang-ultrons and one electrical part of negative charge consisting of yin-ultrons.

Lehman & Persinger (2015) described in their article that the author integrated aspects of quantum physics with Confucian philosophy (Chung, 2015b).

It has been recently discovered that electrons split into two separate parts: a spinon carrying its spin (a neutral magnet behaving as a tiny compass needle) and an orbiton carrying its electron motion (negative electrical charge) around the nucleus (Palus, 2017; Paul Scherrer Institute, 2012; Piazza, 2014). The spinon and orbiton seem to correspond to the neutral part of yin- and yangultrons composite and the negative part of yin-ultron predicted in the ultron-logotron theory, respectively (Chung, 2015b). Yin- and yang-ultrons in a spinon are postulated to line up in a tiny series magnet arrangement with a south and a north pole in one direction that can generate spin (Chung, 2015, 2017a; Shee, 2017).

This substructure of electron suggests that a quark in a proton is likewise composed of two separable particles, a magnetic particle of yin- and yang-ultrons composite and an electrical particle of yin- or yang-ultrons, further that a proton made of three quarks would have its spin potentially from the quark spins and its electrical charge of the sum of the quark electrical charges. David Gross, Nobel Laureate in Physics, describes in his Theory of Everything that "the electron is not a fundamental, point-like particle. It must have structure to provide its dipole magnetic field. There must be orbital motion of charges within the electron..." "The most collapsed form of matter is the neutrino, which has a vanishingly small mass. However, the neutrino must contain all of the charges required to form two particles- a particle and its antiparticle." "The same model applies to the proton and the neutron. This model satisfies Einstein's view that there must be some lower level of structure in matter to cause resonant quantum effects" (Gross, 2005). There seems to be an agreement among the recent findings in electrons, the Theory of Everything of Gross and the ultron-logotron theory.

1. 3. 1. Spin-Mediated Consciousness Theory of Hu and Wu (2011)

The author infers that the primordial spin-mediated consciousness theory of Hu and Wu (2011) is applicable to mind-brain interactions in the prefrontal cortex (PFC) of human brain with which the self-interacts. Self's conscious mind is postulated to have inherent power to generate mental force and energy, "mentalon", as well as logotrons with free will and free choice, changing logotrons from ground state to excited state (Chung, 2014a).

Logotron-associated mentalon ("quantum information" called by Hu and Wu) is assumed to cause spin in an electron within protein molecules of neuronal structures at quantum levels in the quantum entanglement domain of pre-spacetime (the consciousness world) as described by Hu and Wu. Electron spin is also associated with the emission of photon (Emery, 2007). Both electron spin and emission of photon are involved in the mind-brain interaction.

The author postulates that the electron with spin becomes a spinning charged magnetic dipole (Griffiths, 2005). The magnetic dipole acts on electron clouds in atoms of protein molecules of the neuronal structure, and this effect softens, temporarily cancels out electric repulsion between two protein molecules. Then, London force, weak van der Waals' force emerges and begins to act and attract the two protein molecules, resulting in superposition and collapse of wave function (decoherence from coherence) at quantum levels (Penrose and Hameroff, 2011). This process is associated with consciousness of conscious cognition of the inner self in PFC as well as conscious perception of the physical self in PFC because of interconnections between PFC and other cerebral cortex regions and basal ganglia.

The energy, E_m , of mentalon creating the electron spin in the prefrontal cortex with which the self-interacts is assumed to be expressed by Equation (1).

$$E_m = n \cdot \hbar \quad (1)$$

Where \hbar is the reduced Planck constant energy, n is integers. The reduced Planck constant energy \hbar is postulated to be a minimum unit amount of mentalon energy in mind-matter interactions.

1. 3. 2... Penrose-Hameroff Orch-OR Theory (Penrose, 2007; Penrose and Hameroff, 2011; Penrose, Hameroff and Kak, 2011)

Penrose and Hameroff (2011) proposed the orchestrated objective reduction, Orch-OR theory. The theory describes that a form of quantum computation occurs in microtubules – cylindrical protein lattices within the brain's neurons in information transmission. In the Orch-OR theory, reduction of microtubule superposition (OR) occurs due to quantum gravity (London force) with instability in Planck-scale separation. When OR occurs, actual consciousness of subjective experiences (SE), occurs. Taking a modern panpsychist view, protoconscious experiences (PE), are embedded in Planck-scale spin networks.

PE and SE are embedded in Planck-scale spin network described by Penrose and Hameroff (2011) seem to be analogous to logotrons in ground state and excited state in consciousness in the mindbrain system of the ultron-logotron theory.

The author infers that the Penrose-Hameroff Orch-OR theory is applicable to conscious perceptions occurring in the cerebral cortex and the basal ganglia that includes the PFC. Electron spin and photon emission seem to be involved in the quantum computation.

The threshold for the Orch-OR is given by his indeterminacy principle of Equation (2), $T = \hbar/E$, where T is the coherence time until OR self-collapse. E is the gravitational self-energy or degree of spacetime separation given by the superpositioned mass; \hbar is the reduced Planck constant. E may be expressed as N_i , the number of microtubule tubulins that will collapse for time T . For $T=25$ ms (e.g. 40 Hz oscillation), $N_i = 2 \times 10^{10}$ tubulins (Penrose-Hameroff, 2011).

$$T = \hbar/E \quad (2)$$

Thus, the greater the mass energy of the object, the faster it will undergo OR, and vice versa. When collapse of wave function occurs, conscious perceptions occur in the self's consciousness.

1. 3. 3. Von Neumann-Heisenberg Orthodox Quantum Theory (Stapp, 1999, 2011)

The author infers that both the Penrose-Hameroff Orch-OR theory and the von Neumann-Heisenberg orthodox quantum theory are applicable to mind-brain interactions in the prefrontal cortex of human brain. When Orch-OR (the wave function collapses and decoherence from coherence quantum state takes place) occurs at the moment of interaction between consciousness and brain at quantum levels in the cerebral neurons in general, then conscious perception occurs. Consciousness of both physical and inner selves coexists in superposition in quantum states of neurons of the PFC. Conscious perception and cognition occur in the inner self in the neurons of the PFC. In the PFC where the conscious mind of the physical self is controlled by the inner self, the physical self would perceive the object, for example, an apple in a possibly genetically determined way or for pleasure and instinct for living without free choice (a fruit and appetite) at quantum levels. In contrast to the above, the inner self independently intervenes and probes in the way of probably limitless concepts (logotrons) in scientific, biological or philosophical meanings etc. (a fruit, nutritional, good diet and even Newton's discovery of gravity etc.) and chooses a conscious mind (logotrons) with free choice at quantum levels and controls the physical self's consciousness.

The author infers that both the Penrose-Hameroff Orch-OR theory and the von Neumann-Heisenberg orthodox quantum theory are correct descriptions regarding relationships between self and consciousness: mind and matter because the human self is inferred to be composed of two selves, i.e. the inner self and the physical self/body (Chung 2012). Therefore, relationships and interactions between self and consciousness in the brain seem to be non-dualistic with Orch-OR theory in the human brain in general and also dualistic with the von Neumann-Heisenberg quantum theory in the prefrontal cortex. If Orch-OR dysfunction occurs, then the perceptive and cognitive impairments and apparent loss of consciousness would occur (Penrose & Hameroff, 2011; Stapp, 1999; 2011).

This seemingly dualistic reality in the prefrontal cortex of human brain is analogous to driving a car in which the driver is the inner self and the car (the steering wheel, engine and body) is the physical self/body. The driver drives and guides the car with free will and free choice, and the car corresponding to the brain-body that was made operates, obeying physical laws of classic physics corresponding to the physical self's consciousness without freedom but under the control of the driver. The inner self that knows the physical laws and has power of making a car controls the physical self/body at the quantum level.

1. 3. 4. Lehman and Persinger's Physical Support for Teilhard de Chardin's Philosophy

Concerning the Human Species and Evolutionary Consciousness (Dotta and Persinger, 2015) Generation of photons from human brains by cognition, particularly visual imagination of white light (thought) coupled with photon emissions is experimentally confirmed by Dotta and Persinger (Dotta & Persinger, 2011a, 2015; Dotta et al., 2012; Hu & Wu, 2006). The energy of photon emission caused by imagination of white light (conscious concept) is within the range of about 10^{12} Watts (Joules per second) per meter squared. This study seems to support the electron-spin-mediated hypothesis of Hu and Wu for the origin of consciousness. Dotta and Persinger include detailed physical and mathematical analysis at quantum levels in their study (Dotta and Persinger, 2012).

Mentalon is qualitatively different from photon but once converted into photon in quantum entanglement, it becomes qualitatively same as the physical photon that would be created in the body with the mentalon. Both photons are qualitatively same but may be quantitatively different. Mentalon is conjectured to have inherent power to act on and react to the geomagnetic field. It seems to have been experimentally proven that all things of Earth are interconnected with the geomagnetic field (Dotta and Persinger, 2012; Karbowski et al., 2015).

A minimum unit of mental force-energy, mentalon, is postulated to be the range of the reduced Planck constant energy, $\hbar = 1.05457 \times 10^{-34}$ J·s in this study. The energy associated with an idea, thought of white light is a range of 10^{-12} watt·s (Lehman & Persinger, 2015; Dotta, Saroka & Persinger, 2012b). It is suggested from a calculation that there seems to be an enormous amplification in the processes from an initial primordial spin-mediated consciousness to a final photon emission in the human brain. The amplification seems to be a close range of Avogadro's number (6.02×10^{23} mole⁻¹):

$$\text{Range of } 10^{-12} / (1.05457 \times 10^{-34}) \approx \text{close range of } 10^{23}$$

The above calculation also suggests involvement of enormous number of qubits in quantum computation as well as multiple physical, electrical and chemical processes.

1. 3. 5. Perturbational Complexity Index (PCI)

Casali and his coworkers (2013) introduced a theory of the perturbational complexity index (PCI). PCI is measured by transcranial magnetic stimulation (TMS). They found a marker of consciousness level of PCI value greater than 0.31. The PCI value in unconscious patients in general anesthesia induced by anesthetics and in coma (vegetable state) was less than 0.31 (Casali et al. 2013; Perri et al. #4 2014; Casarotto et al. 2016).

1. 3. 6. Integrated Information Theory (IIT) of Tononi

Consciousness is subjective experience such as perceiving a scene, thinking, enduring pain etc. Consciousness vanishes in dreamless sleep. Consciousness depends on the integrity of certain brain regions, and particular contents of experiences depend on activity of neurons in parts of the cerebral cortex (Tononi et al. 2016). It is not known why the cerebral cortex supports consciousness but the cerebellum does not. Tononi proposed the integrated information theory

(IIT) to explain the relationship between consciousness and brain (Tononi, 2012; Tononi et al., 2016). It postulates that the physical substrate of consciousness (PSC) supports consciousness. The PSC is constituted of some neural elements, time scale and activity states as the neural basis of consciousness". The integrated information structure of consciousness is postulated to be specific, and geometrical and temporal, matching the stimulus-related PSC (Tononi, 2012). There seems to be a considerable agreement between the IIT and the ULT.

1. 3. 7. Relationship between collapse time (T) and number of tubulin in Penrose-Hameroff Orch-OR Theory

If Equation (2) is valid and E may be expressed as N_t , Equation (3) can be applicable.

$$E = aNt \tag{3}$$

Where a is a constant. For the collapse time $T=25ms$, $N_t=2 \times 10^{10}$ according to Penrose-Hameroff, Equation (4) is derived.

$$25 = \hbar / (a \times 2 \times 10^{10}) \tag{4}$$

$$a = \hbar / (50 \times 10^{10})$$

$$T = 5 \times 10^{11} / Nt \tag{5}$$

Equation (5) expresses the collapse time T as a function of the number of tubulin N_t involved in positive BOLD response in the cognitive process in the PFC.

3. 4. 2. Relationship between perturbational complexity index (PCI) and collapse time (T) If Equation (4) and PCI values are valid, Equation (6) can be applicable.

$$E = iT \tag{6}$$

represent intensity of ultron-complex.

$$PCI = bi \tag{7}$$

where b is a constant.

$$T = \hbar / iT$$

$$PCI = b\hbar / T^2 \tag{8}$$

$$b = PCI \times T^2 / \hbar$$

$$PCI = (0.31 \times 25^2 / \hbar) \times (\hbar / T^2) \tag{9}$$

Equation (9) expresses the PCI value as a function of the collapse time T in the cognitive process in the prefrontal cortex (PFC)

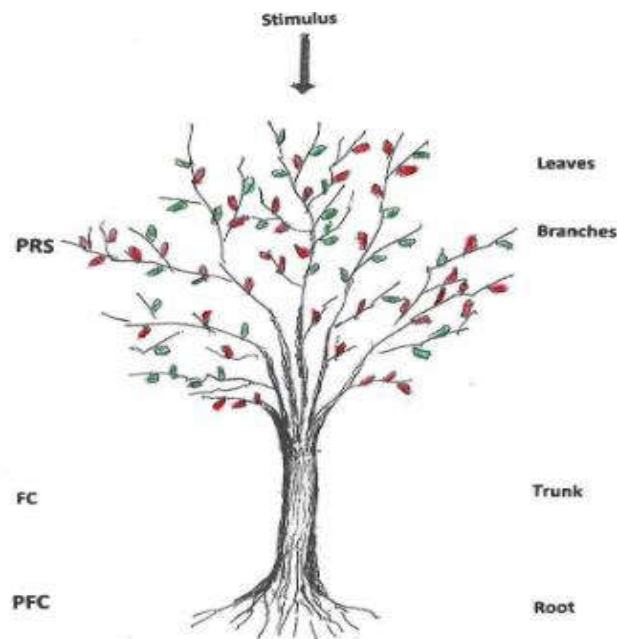


Figure 2. Tree-pattern image of ultron- and logotron-complex in human brain. Leaves represent cell bodies of neurons, branches dendrites and axons of neurons, and the trunk neural connections (functional connections, FC) between the prefrontal cortex (PFC) and the other brain areas (the author names the areas ‘the prefrontal-rear system, PRS’), respectively. The root represents the prefrontal cortex (PFC). (see text).

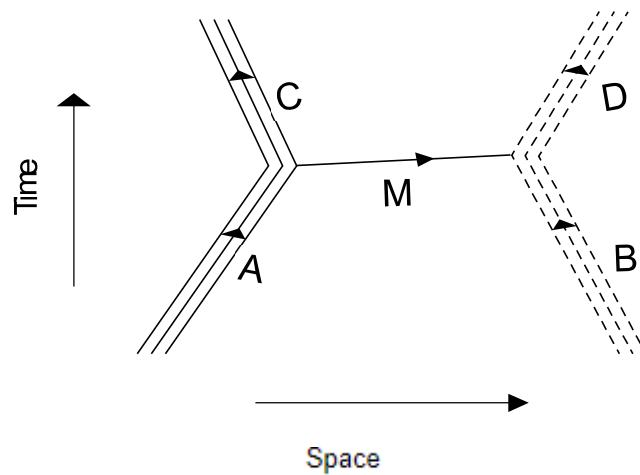


Figure 3. Feynman's space-time diagram of ultron- and logotron-complex in human brain. Each solid and dashed line represents ultron- and logotron unit, respectively. A – Real ultron-complex in the excited state in the neurons of the prefrontal cortex caused by incoming stimulus. C – Real ultron-complex in the ground state after collapse of the quantum wave function when the self controls (observes). B – Virtual logotron-complex in the ground state in the neurons of the prefrontal cortex. D – Virtual logotron-complex in the excited state when the self observes and cognizes. M – mental-force-carrying 'mentalon' exchanging between ultron- and logotron-complex.

1. 4. Brain-Mind Relation in Quantitative Electroencephalography (qEEG) Study

"For a long time, the topic of self-consciousness (or self-awareness) was the exclusive domain of philosophy and only recently has it begun to take a more prominent place in the cognitive neuroscience and neuroimaging studies (Musholt, 2013) and quantitative electroencephalography (qEEG) studies" (Fingelkurts et al, 2010, 2012, 2018; Fingelkurts and Fingelkurts, 2017).

Substantial empirical evidence for coordination of mind processes in space and time has been recently reported. "Neurons in different brain parts oscillate at different frequencies forming transient neuronal assemblies". "These neuronal assemblies are selectively coupled or bound together into a coherent network each time when a person attends, perceives, memorizes, imagines, thinks, plans and acts" (Fingelkurts et al. 2010).

There seem to be, to my knowledge, no neuroscience articles in the literature that clearly explain the interaction between self and brain. In this study, the author compared findings in qEEG studies on brain-mind relation of Fingelkurts et al with the author's hypothesis of the ultron-logotron theory (ULT) related to the tree-pattern architecture of brain and mind activity.

2. Materilas and Methods

2. 1. Materials

2. 1. 1. The Operational Architectonics (OA) of Mind-Brain Relation in Meditation Fingelkurts and his coworkers (2016, 2018) reported specific qEEG findings during a resting state, pre- and post-meditation in controls, experienced and training-stage persons. The operational synchrony of default mode network (DMN) modules are presented in different states.

2. 1. 2. The Operational Architectonics (OA) of Mind-Brain Relation in Vegetative State (VS) and Minimally Conscious State (MCS)

Fingelkurts and his coworkers (2012) reported the default mode network (DMN) operational synchrony relating to self-consciousness as evidence from patients in vegetative and minimally conscious state (VS and MCS).

2. 1.3. The Operational Architectonics (OA) of Mind-Brain Relation in a Patient with Severe Traumatic Brain Injury

Andrew Fingelkurts and Alexander Fingelkurts (2017) reported a qEEG case study of longitudinal dynamics of 3-dimensional components of selfhood in a 21-year old male after severe traumatic brain injury sustained in a traffic accident. The patient received advanced life support and was subsequently hospitalized. He was in coma. He underwent surgical procedures: subdural hematoma evacuation. MRI revealed damage to various parts of the brain (see the original article, 2017). After 2.5 weeks of hospitalization, the patient was reclassified as a vegetative state (VS). The patient was discharged home having minimally conscious state (MCS) after 11 months of hospitalization. At home, the patient continued on an intensive rehabilitation program.

Starting at 2 years after the injury, he underwent multiple EEG evaluations within 6 following years. During this period, the patient recovered cognitive, motor, speech, and consciousness functions.

The results reported in the above described articles are used for analysis to find the relationship among self, mind and brain, and further a possible mechanism of interaction between self and brain. In addition, possible existence of parallels between the tree-pattern architecture of brain and mind activity described in the ultron-logotron theory (ULT), and the operational architectonics (OA) of brain-mind relation in quantitative EEG presented by Fingelkurts and his collaborators (2017).

2. 2. Method

Findings and data in recent qEEG and fMRI studies in the field of brain-mind relation in normal subjects, pre-and post-meditation subjects and subjects in vegetative state (VS) and minimally conscious state (MCS), and a case of severe traumatic brain injury are reviewed and reexamined from the perspective of the ultron-logotron theory.

Comparison, reasoning, postulation, intuition and imagination are carried out to reasonably and possibly explain reported data in the fields of the self and brain activity in qEEG (electromagnetic field) study. In addition, it is attempted to find a possible existence of parallels between the treepattern architecture of brain and mind activity in the ULT and the operational architectonics (OA) of brain-mind relation.

3. Results

A significant increase is observed in the strength of EEG operational synchrony in the frontal DMN operational module (OM) after meditation in the experienced meditation group and significant decrease in the strength of EEG operational synchrony in the posterior DMN OM after meditation (Figure 1 of the article, Fingelkurts et al, 2016a, 2016b).

In the ultron-logotron theory, the self (the inner true self) interacts with the prefrontal cortex (PFC) subjectively perceives and cognizes the tree-pattern architecture of ultron-complex generated by the incoming information, and controls (suppresses) the physical self/body. This processes seem to correspond to the above findings in qEEG in meditation.

The above results strongly suggest that qEEG of the frontal DMN module primarily involves and expresses the activity of the PFC, and qEEG of the posterior DMN module represents and expresses primarily more the activity of the PRS.

EEG DMN operational synchrony in all three (alpha, beta 1 and beta 2) frequency bands in the frontal OM was highest in fully self-conscious subjects, lower or even absent in vegetative state (VS) patients, and intermediate in minimally conscious state (MCS) patients. VS patients who lacked self-consciousness could be differentiated from MCS patients who had partially preserved operational connectivity architecture of DMN.

The Figure 2 of Fingelkurts and Fingelkurts (2017) clearly reveals progressive improvement in integrity of all 3 self-referential frontal DMN module in qEEG in the case of a patient with severe traumatic brain injury. This was paralleled by marked improvement in the main 3 aspects, "Self", "me" and "I" of selfhood. This unique case study seems to provide important empirical evidence for interaction between self and brain, in addition, evidence for regeneration of the brain substance including neurons.

4. Discussion

Perception is postulated to be associated with the aroused consciousness of the physical self that is inherent as one of triple properties of ultrons in the brain substance (Table 1). A tree-pattern architecture of logotron-complex is inferred to match a specific corresponding neuronal treepattern architecture of ultron-complex of substrate of neurons in the PFC in the self's cognition. If both ultron- and logotron-complexes do not match, there would be no transformation of the logotron-complex from the ground state to the excited state nor aroused consciousness in the self's mind (Figure 1, 2 and 3).

Subjective consciousness experiences of painful feeling involve the cognitive and emotional aspects of the self's mind that interacts with the prefrontal cortex (PFC) and the anterior cingulate cortex (ACC) of the limbic system and other brain regions connected to the PFC, including multiple cortical and subcortical brain regions, the most commonly, primary somatosensory area (SI), secondary somatosensory area (SII), anterior cingulate cortex (ACC), thalamus (Th), insular cortex (IC), prefrontal cortex (PFC) and cerebellum (CB).

In deep meditation of experienced meditators, the self-consciousness of the inner self intensifies and is accompanied by increase in the operational synchrony of qEEG signals (alpha and beta waves). The physical self that is primarily associated with the PRS is controlled and suppressed by the inner self, is revealed by the decrease in the strength of qEEG signals in the posterior OM. The self's consciousness in deep meditation is accompanied by diminution of ego border, loss of bodily perception, peaceful state of mind, loving kindness and compassion, all-oneness (Fingelkurts et al, 2016b), and "the selfless self" in Buddhist teaching (Knitter, 2009).

The self (the inner true self, spirit) of human individuals is speculated to be blocked with an unknown "veil" so that the self is unable to directly perceive and cognize the external physical world and the coexisting spiritual world. The basic default state of the inner self-consciousness is unconsciousness, "non-consciousness", like unconscious state in deep sleep, in general anesthesia, coma or vegetative state (VS). There is no memory in these cases, such as surgery or severe brain injury and subsequent hospitalization.

In near-death-experience (NDE) or out-of-body-experience (OBE), the blocking "veil" seems to be transiently removed, so that the inner self would perceive and cognize the external physical world, most-likely through logotron-complexes mediated by ultron-complexes superpositioned to the physical world. The inner self that is independent and indestructible would probably cognize the physical world and the spiritual world after death of the body, being freed from the blocking "veil" (Chung, 2018b).

The physical self (the physical false self) perceives the false physical world stored in the brain just like in a dream, correlating to as seeing a movie scene of a false physical world. There is no self-awareness experience. The self (the inner true self) cognizes the real physical world by interacting with the prefrontal cortex (PFC). There is self-awareness experience in this context. Unconsciousness state is the self consciousness in ground state; manifest consciousness is the self's consciousness in excited state. Consciousness in ground state is postulated to be transformed from ground

state to excited state by the process of interaction between ultron-complex and logotron-complex in the brain, arousing self-awareness experience and vice versa. The self is life that is independent from the brain and indestructible.

The case of the patient in this study who suffered severe traumatic brain injury seems to be closely comparable to the case of Phineas Gage, one of the most famous patient in the history of neuropsychology. Phineas Gage who was a railroad constructor, damaged his prefrontal cortex in an explosive accident made neuroscientists find enormous valuable information on the prefrontal cortices for human knowledge (Gusnard, 2009). The selective destruction of the Gage's prefrontal cortex transformed Gage from a taciturn, reliable foreman in a railroad construction crew to a coarse, disinhibited, unstable individual who was never able to work (McMilan, 2000; Gusnard, 2009).

The case of the patient who suffered severe traumatic brain injury was treated and monitored until his recovery with qEEG and clinical observations for 6 years after the accident. There seems to be a remarkable similarity between both cases with regard to the brain-mind relation. Both cases seem to provide evidence for the self-interacting with the prefrontal cortex.

5. Conclusion

On the basis of review of the recent qEEG studies of Fingelkurts and his coworkers, and the author's previous publications (Chung, 2014a, 2014b, 2017b, 2018a, 2018b), the following conclusion is proposed:

- (1) The "ultrons" are the building blocks of matter of the physical world, and the "logotrons" are the building blocks, the fundamental virtual particles of consciousness of human mind at quantum levels, and probably of the spiritual world.
- (2) Findings in qEEG study (Fingelkurts et al., 2010, 2012, 2017, 2018) reveal a close correlation between qEEG changes and the self-conscious processing and clinical observations.
- (3) qEEG of the frontal DMN module is postulated to primarily involve and express the activity of the prefrontal cortex (PFC); qEEG of the posterior DMN module seems to represent and express the activity of multiple brain regions other than the PFC (PRS).
- (4) There seem to be remarkable parallels between the tree-pattern architecture of ultron and logotron complex in brain and mind activity based on the author's hypothesis of the ultron-logotron theory (ULT) and the operational architectonics (OA) of brain-mind relation in the theory proposed by Fingelkurts and his coworkers.
- (5) A possible mechanism of interaction between self and brain in human individuals is presented in this study (Chung, 2018b, 2018e)
- (6) The case of a patient with severe traumatic brain injury provides evidence for regeneration of the brain substance including neurons.

Further research would be needed for verification of the above described conclusion.

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