

A Review of the Relationship among Self, Mind and Brain in Functional Magnetic Resonance Imaging Study: Tree-Pattern Image of Semantic Map in Human Brain Viewed from the Ultron-Logotron Theory

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Abstract

The scientific relationship among self, mind and brain is still not clearly known. Self's subjective experience of perception and cognition of words, feelings, thoughts etc. is supported by the integrity of human brain. 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 is located in certain parts of the cortico-thalamic system. But it is not known specifically which parts of the human brain are involved in the human cognitive activity. In this study, the author proposed a tree-pattern architecture of the cerebral neural substrate in cognitive understanding of words, feelings, and thoughts on the basis of the author's hypothesis of the ultron-logotron theory to explain the neural correlate of consciousness.

Keywords

Consciousness, fMRI, Words Atlas of Brain, General Anesthesia, Confucian Philosophy, Jeong Yeok, Ultron-Logotron Theory

1. Introduction

The 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) is likely to be located in certain parts of the cortico-thalamic system. However, it is not 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) published 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 & 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 & Cohen, 2001; Greene et al., 2001; Ochsner et al., 2002; Schwartz, 1999; 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).

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.

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.

In the author's study, the relationship is investigated, and an attempt is made to explain it.

1) Findings and discoveries in modern science, quantum physics, string theory, especially entanglement in the arena of mind and matter are reviewed (Penrose, 2007; Penrose, Hameroff, & Kak, 2011; Griffiths, 2005; Stapp, 1999; 2011; Ochsner et al., 2002; Schwartz et al., 2005; Mitchell & Staretz, 2011; Close, 2011; Laszlo, 2007, 2008; Suplee, 1999; Capra, 1999; Hands, 2015).

2) Philosophical teachings of major religions, especially the Eastern Confucian philosophy are reviewed and compared with quantum physics. Confucian philosophy is described in the I Ching, the Book of Changes (William, 1967) and JeongYeok, the Book of Right Change (Kim, 1885; Yi, 1992; Chung, 2009, 2010).

1.2.1. "Ultron"

In Confucian philosophy, all things are created by power of the Creator, the Non-Ultimate, the Great Ultimate. The Great Ultimate created Two Forms, Yin and Yang, the two primary fundamental elementary particles that are represented by a solid line (—) and a broken line (– –). The author names Yin and Yang "yin-ultron" (U^-) and "yang-ultron" (U^+), respectively. All things of the universe are generated by movements of "ultrons" (Capra, 1999; Chung, 2009, 2014a, 2014b, 2015).

Table 1 shows comparison of characteristic aspects of the ultron-logotron theory and quantum physics. Basic elementary particles, ultrons would be analogous to strings of string theory. The ultrons are the building blocks of matter of the physical world. The yang- and yin-ultrons are positively and negatively charged, respectively.

If external force comes to a region of space, the regional space will be excited and pulsate, and then a hidden vertical pair of particle-antiparticle emerges in it, causing material actualization of real particle and antiparticle, creating matter.

The author infers that when a matter and antimatter collide and disappear, becoming virtual matter and antimatter, consciousness in the excited state superpositioning to each of the pair will disappear and become a virtual consciousness in the ground state. If the above is true, then it would imply that particles of matter would have a triple property of particle, wave and consciousness (Bohm, 2006; Nichol, 2006).

If a mental force is presumably created by the self, it will strike the regional space that could excite virtual consciousness in the ground state to become consciousness in the excited state, creating conscious mind (Chung, 2009, 2014a). Mind and matter are interrelated and interconnected (Capra, 1999; Chung, 2009, 2012, 2014a, 2015).

1.2.2. "Logotron"

Table 2 shows comparison of characteristic aspects of "ultrons" and "logotrons".

Table 1. Comparison of characteristic aspects of the “ultron”-“logotron” theory and quantum physics.

Characteristic aspects	The “ultron”-“logotron” theory	Quantum physics
Basic elementary particle	Yin- and yang-ultrons	Quarks and electrons
Form	A solid (-) and a broken (-) line	An open (~) and a closed (0) string
Movement	Join, movement, stillness, advance, retreat, expansion and contraction	Split, fission, break, pinch, join, spin and oscillation
Property	Triple: particle, wave and consciousness	Triple: particle, wave and consciousness
Energy	Yes	Yes
Force	Yes	Yes

Table 2. Comparison of postulated characteristic aspects of “ultrons” and “logotrons”.

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)	(Instant)

The author names “information” that is described by David Bohm in his quantum theory “logotron”. Logotrons in this study represent contents of consciousness of mind in humans such as thoughts, feelings, colors, sounds, concepts of

all things of the universe that may be expressed by words (Greek: logos).

1.2.3. Interaction between Ultron and Logotron

Figure 1 illustrates Feynman's space-time diagram of interactions between ultron and logotron. Mental-force-carrying "mentalon" exchanges between ultron and logotron, creating resonance-like effects, and perhaps exchanges between logotrons as graviton exchanges between ultrons of matter. The conscious mind of the inner self of an individual person has power to generate mentalon as well as logotrons with free will and free choice. Mentalon is virtual force like graviton; it has two states: the ground and excited states. The author infers that the quantum states result from the incoming neural stimulus in the neurons of human brain, then OR occurs (the quantum wave function collapses) when the physical self and the inner self have conscious perception through quantum computations in the microtubule automata (Penrose & Hameroff, 2011). In the quantum state of the prefrontal cortex of human brain, the quantum wave function collapses when the inner self who is an observer and does conscious cognitive action with free will and free choice, and with attention, efforts, thoughts and planning in the inner self's mind; then logotrons in the excited state are generated from the ground state, generating conscious cognition in the inner self's consciousness (**Figure 1(a)**) (Stapp, 1999; Stapp, 2013; Kafatos, Tanzi, & Chopra, 2011; Schwartz et al., 2005; Ochsner et al., 2002). The self (the true inner self) has power in the conscious mind to choose logotron in the excited state from its ground state, changing the quantum state of the logotron with free will, free choice, attention and intention, guiding actions (Stapp, 1999; Chung, 2012). Ultrons in the excited state are generated by mentalon originated from the inner self's conscious mind (**Figure 1(b)**) (Schwartz et al., 2005; Ochsner et al., 2002). **Figure 1(b)** illustrates processes at the interface between mind/consciousness and brain. Existence of mentalons can be empirically recognized by their effects in the external world resulting from interactions between mind and matter in the PFC of human brain. In this matter-mind process, mentalons participate in generation of conscious mind (**Figure 1(a)**) and vice versa (**Figure 1(b)**). M line shows its origin on the left side with an apparent slightly upward right direction but is actually horizontal and parallel to the space axis, indicating instantaneous speed in space-time (**Figure 1(a)** and **Figure 1(b)**) (Penrose, Hameroff, & Kak, 2011).

The author reviewed modern quantum physics and the Eastern Confucian philosophy. On the basis of the review and authors' personal experiences of valid precognitive dreams, the following theory is proposed (Chung, 2014a, 2017a):

(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.

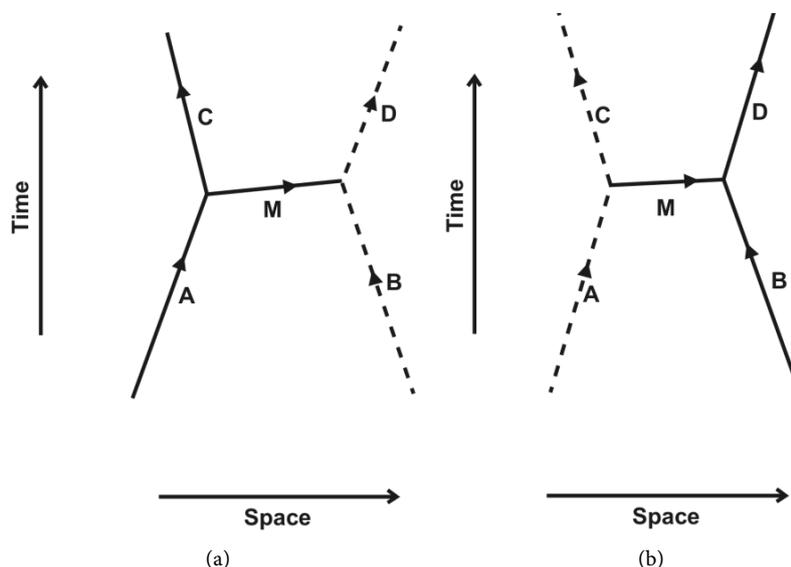


Figure 1. Feynman's spacetime diagram of interactions between "ultron" and "logotron". (a) A—Real ultron in the excited state in the neuron of the prefrontal cortex caused by incoming stimulus. C—Real ultron in the ground state after collapse of the quantum wave function when the self controls (observes).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

The energy, E_m , of mentalon creating the electron spin in the prefrontal cortex at quantum levels 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. Penrose-Hameroff Orch-OR Theory

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. When OR occurs, actual consciousness of subjective experiences occurs.

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_t , the number of microtubule tubulins that will collapse for time T . For $T = 25$ ms (e.g. 40 Hz oscillation), $N_t = 2 \times 10^{10}$ 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.

1.4. 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., 2014; Casarotto et al., 2016).

1.5. ZFH2 Gene

Six individuals of a peculiar Italian family display a pain insensitive phenotype that is characterized by hyposensitivity to noxious heat and painless bone fracture. This congenital hypoalgesia is a rare inherited disorder. A human pain insensitivity disorder is caused by a point mutation in ZFH2 gene (Habib et al., 2018). There is no peripheral neuropathy in the family. These findings may allow to develop new analgesic drugs.

Functional magnetic imaging has been used to study brain activities induced by specific sensory stimulation, motor or cognitive performance (Wise & Tracey, 2006; Leppä et al., 2006).

2. Materials and Methods

2.1. Materials

Wise and Tracey (2006) reported a functional magnetic imaging study (fMRI) on correlates of pain and human brain in normal subjects and patients. They described that pharmacological fMRI studies make contribution to development of new drugs. Leppä and his coworkers (2006) reported acute opioid effects on human brain as revealed by functional magnetic resonance imaging.

Paasonen et al. (2018) measured functional connectivity (FC) under six commonly used anesthesia protocols and compared the findings with data obtained from awake rats. The results demonstrated that each anesthesia uniquely modulated FC.

Bonhomme and his coworkers (2012) reported neural correlates of consciousness during general anesthesia (GA) using functional magnetic resonance imaging (fMRI). Uhrig, Dehaene and Jarraya (2014) published the cerebral mechanism of general anesthesia.

The meaning of language is represented in regions of the human cerebral cortex. However, the selectivity of most brain regions is unknown. Gallant and his coworkers recorded blood-oxygen-level-dependent (BOLD) responses by fMRI on seven subjects listening to more than two hours of narrative stories from *The Moth Radio Hours*. The BOLD response showed map semantic selectivity across the cerebral cortex with use of voxel-wise-modeling (VM). The semantic system is organized and consistent across individuals. They reported creation of novel, detailed semantic maps (“Words Atlas”) in human cerebral cortex (Huth et al., 2016).

The results reported in the above articles are used for analysis to find the relationship among self, mind and brain, and further to study the possible architecture of ultron- and logotron-complex.

2.2. Methods

Findings and data in recent fMRI researches in the fields of pain, analgesics, general anesthesia, auditory and visual words in perception and cognition in normal subjects and patients are reviewed, and the data are reexamined from the prospective of the author’s hypothesis of the ultron-logotron theory (ULT).

Reasoning, comparison, postulation, intuition and imagination are carried out to reasonably and possibly explain reported data in the field of mind and brain, consciousness and quantum physics in functional magnetic resonance imaging study.

3. Results

3.1. Pain and Analgesics

Noxious thermal stimuli, administered to the dorsum of left hand of seven volunteers, eliciting pain, produced a typical matrix of pain-related brain activity indicated by BOLD (blood-oxygen-level-dependent) responses in multiple brain areas, ROIs (regions of interest, voxels). Multiple regions of typical BOLD responses include anterior cingulate cortex, insular cortex, somatosensory cortex, thalamus and prefrontal cortex. The typical, pain-related functional brain activity revealed by BOLD response was modulated and reduced by intravenous administration of remifentanyl, μ -opioid analgesic. Activity in the visual cortex in response to a checkerboard stimulus was unaffected by the analgesic drug. The figure 4 of the article of Wise and Tracey (2006) clearly demonstrates the above described finding in fMRI study.

This finding strongly suggests that analgesia modulates the pain-related fMRI image that represents pain ultron-complex in the human brain, resulting in suppression of generation of matching painlogotron-complex that would give

rise to analgesia.

In Leppä and his coworkers' study, the fMRI revealed a specific neural functional activity indicated by BOLD responses in multiple voxels within the regions of interest (ROIs) of the corticothalamic system and limbic system, including fifteen areas during time course of intravenous administration of opioid, remifentanil and saline. This finding of detailed information is clearly demonstrated in the figure 2 of the article of [Leppä and his coworkers \(2006\)](#). The multiple brain areas include the cingulate, orbitofrontal, posterior parietal and insular cortices, prefrontal cortex and amygdala, which were clearly related to most subjective sensations of pain. The specific architecture of image strongly suggests a tree-like pattern of the neural process and activity in human mind and brain ([Figure 2](#)).

3.2. Anesthesia and Anesthetics

In experiments with rats, using fMRI, in awake state, the feedforward and feedback information flow are intact in the multiple brain regions. All anesthetics disrupt the functional connections (FC) in feedforward and feedback information exchange in the brain regions, including between the prefrontal region and multiple other brain regions of the cerebral hemispheres that might be

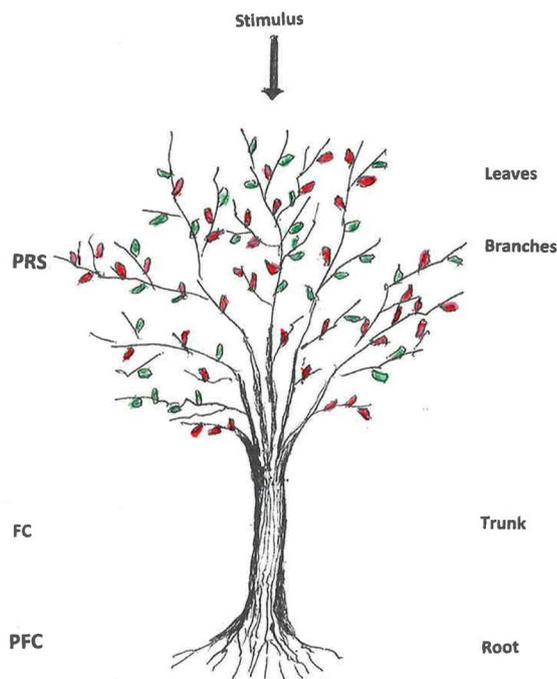


Figure 2. Tree-pattern image of ultron- and logotron-complex in human brain. Leaves represent cell bodies of neurons. The red leaves represent positive BOLD (blood-oxygen-level-dependent) response, and the green leaves negative BOLD response. Branches represent dendrites and axons of neurons, and the 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).

directly related to loss of consciousness. Depression of synaptic transmission results in loss of information and loss of consciousness (Paasonen et al., 2018).

In general anesthesia (GA) in humans, it is postulated that functional connections (FC) between the higher-order cortical regions and the lower-order primary brain areas are interrupted, resulting in loss of consciousness (Bonhomme et al., 2012; Uhrig et al., 2014). The anesthetic agents inhibit excitatory neurotransmitter that inhibit functional connectivity between the frontal cortex and the other brain areas (PRS) including the thalamocortical connectivity, resulting in unconsciousness in general anesthesia (Bonhomme et al., 2012).

3.3. Semantic Maps (“Words Atlas”) in Human Brain

The figures published by Gallant and his coworkers in their article show semantic maps (“Words Atlas”) of the cortex of bilateral cerebral hemisphere. BOLD responses in fMRI in multiple cortical areas of the parietal, frontal, temporal, occipital lobe and insula as well as the prefrontal cortex, up to 192 areas in the left hemisphere and 128 areas in the right, reveal specificity. Each word in the stories was projected into voxels within ROIs. The semantic system is organized and appears common across individual subjects. The results suggest that most areas within the semantic system represent information about specific semantic domains, or groups of related concepts (Huth et al., 2016). This study seems to provide a powerful and important means for mapping functional representations in the brain, and presumably to clarify the spatiotemporal, matching relationship between ultron- and logotron-complex.

Figures 1-12 of the article of Huth et al. (2016) clearly show the above described findings that are strongly suggestive of a tree-pattern architecture (pain matrix) of neural correlates of words, feelings, thoughts etc. in the human brain (Chung, 2017b), and further suggest a tree-like-pattern of the ultron-complex (Figure 2).

BOLD responses in fMRI are specifically involved in Brodmann’s areas 24/24’ and 32’ of the anterior cingulate cortex of ten normal subjects who performed cognitive task of attention to visual or auditory words stimulation. The words included animals, fruits, vegetables and people’s names (Davis et al., 1997).

Figure 2 illustrates a tree-like pattern of matrix image that schematically shows a fMRI architecture of neural activity (BOLD responses) in matrix network in the human cerebrum generated by any information such as sensory stimuli, words, feelings, thoughts etc., representing the ultron-complex. Stimulus information is transmitted to neurons of the multiple regions of the cerebral hemispheres behind the PFC (the author names these parts the prefrontal-rear system, “PRS” (leaves), then through neural pathways (branches and trunk) to the prefrontal cortex (PFC) (root). The self interacts with the PFC where a logotron-complex matching to the incoming ultron-complex arises from ground state to excited state, resulting in conscious cognition.

Figure 3 shows Feynman’s spatiotemporal diagram of ultron- and logotron-

complex that is postulated to illustrate the process between the incoming ultron-complex (A: excited state, C: ground state) and logotron-complex (B: in ground state, D: excited state) in the prefrontal cortex. M represents mentalon. Conscious cognition takes place in this process. There is one difference between **Figure 1** (one single line for ultron or logotron) and **Figure 3** (multiple lines for ultron-complex or logotron-complex). (see text with regard to **Figure 1**).

3.3.1. Relationship between Collapse Time (T) and Number of Tubulin (N_t) in Penrose-Hameroff Orch-OR Theory

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

$$E = aN_t \quad (3)$$

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

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

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

$$T = 5 \times 10^{11} / N_t \quad (5)$$

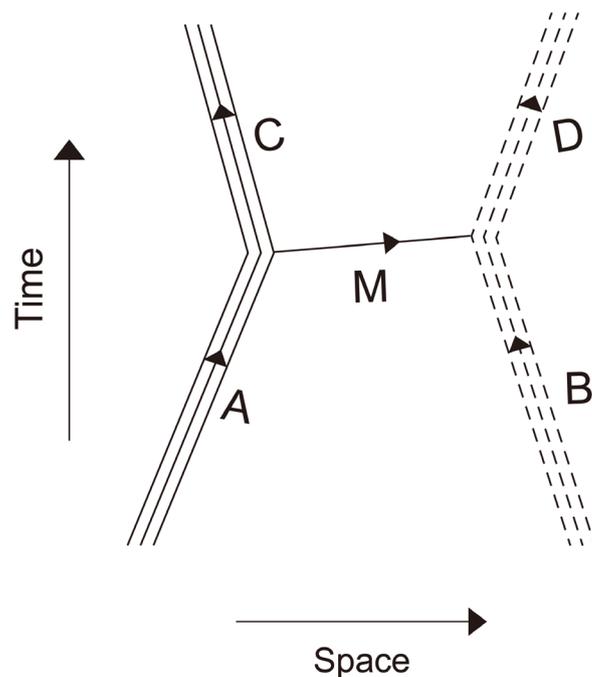


Figure 3. Feynman's space-time diagram of ultron- and logotron-complex in human brain. Each solid and dashed line represents ultron- and logotron unit, respectively. (A)—Real Ultron-complex in the excited state in the neurons of the prefrontal cortex-caused by incoming stimulus; (C)—Real ultron-complex 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.

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.

3.3.2. Relationship between Perturbational Complexity Index (PCI) and Collapse Time (T)

If Equation (2) and PCI values are valid, Equation (6) can be applicable.

$$E = iT \quad (6)$$

where i is assumed to represent intensity of ultron-complex.

$$PCI = bi \quad (7)$$

where b is a constant.

$$T = \hbar/iT$$

$$PCI = b\hbar/T^2 \quad (8)$$

$$b = PCI \times T^2/\hbar \quad (9)$$

$$PCI = (0.31 \times 25^2/\hbar) \times (\hbar/T^2) \quad (10)$$

$$PCI = 193.75/T^2 \quad (11)$$

Equation (11) expresses the PCI value as a function of the collapse time T in the cognitive process in the prefrontal cortex (PFC).

3.3.3. Relationship between Perturbational Complexity Index (PCI) and Number of Tubulin (N_t) in Penrose-Hameroff Orch-OR Theory

Equation (12) expresses the PCI value as a function of the number of tubulin (N_t) in the cognitive process in the prefrontal cortex (PFC).

$$PCI = 7.75 \times 10^{-22} \times N_t^2 \quad (12)$$

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 substrate (**Table 1** and **Table 2**). A tree-pattern architecture of logotron-complex is inferred to match and reflect a specific corresponding neuronal tree-like pattern architecture of ultron-complex of substrate of neurons in the self's cognition in the PFC. 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 2** and **Figure 3**).

Subjective conscious 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) (**Bushnell & Apka-**

rian, 2006). Specific tree-pattern images of ultron- or logotron-complex may correlate with different localizations and/or kinds of stimulation (Bushnell & Apkarian, 2006).

Noxious stimulus in tissue is transmitted through the neural pathway, the spinal cord to multiple regions of the brain, thalamus, the anterior cingulate cortex of the limbic system and other cerebral regions (the spinothalamocortical projections) (the author names these multiple neural connections prior to the PFC' the prefrontal-rear system, "PRS"), and finally to the PFC. Ultron-complex transmitted to the PFC generates a matching virtual logotron-complex transformed from the ground state to the excited state, and gives rise to perception as well as cognition of experience of subjective pain feeling in the self's mind (Dostrovsky & Craig, 2006). The tree-pattern image of ultron- and logotron-complex is postulated to be four dimensional and spatiotemporal as shown in **Figure 3**. The perception is of the fifth dimension and the cognition of the self's mind seems to be of greater than five dimensions.

Analgesics modulate the tree-pattern image of pain-ultron-complex and would not give rise to a matching pain-logotron-complex due to the distorted image pattern of pain-ultron-complex, resulting in analgesia (Davis et al., 1997; Farrell et al., 2005; Carter, 2014). Davis et al. (1997) reported that the typical, pain-related BOLD response in fMRI was specifically evoked in the Brodmann's areas 24 and 32 of the anterior cingulate cortex (ACC) in ten normal subjects who received painful median nerve stimulation by the transcutaneous electrical nerve stimulation (TENS). Reduction of chronic intractable cancer pain by surgical cingulotomy was reported by Bouckoms in 1989, and Pillay and Hassenbusch in 1992 (Davis et al., 1997). In adolescents with idiopathic musculoskeletal pain, the prefrontal cortex that is involved in the executive/emotional and pain-related system has abnormally increased sensitivity to pain stimulus, resulting in increased BOLD response and subjective experience of pain (Molina et al., 2017).

Valet et al. (2004) and Tracey (2008) (2002) Tracey showed that the pain-related BOLD response in the prefrontal-cingulate areas to painful stimulation is modulated and reduced by distracting attention, resulting in reduction of pain perception (Bushnell & Apkarian, 2006).

When lesions of injury, degeneration, abnormal excitement, suppression or chemical drug effects are present at the sense organ, the peripheral nervous pathway, the spinal cord, the "prefrontal-rear system", ("PRS") and/or the prefrontal cortex would cause clinical disorders and diseases such as aphasia, blindness, hearing loss, depression, bipolar disorder, amnesia, schizophrenia, hallucination, Alzheimer's disease, general anesthesia, coma etc. (Sapolsky, 2004; Molina et al., 2017; Wikipedia, 2018).

When neural connections between the prefrontal-rear system ("PRS") and the prefrontal cortex (PFC) are dissociated, consciousness vanishes in case of general anesthesia (GA) and coma due to anesthetics and injury (Uhrig et al., 2014; Bonhomme et al., 2012). The self interacts with the prefrontal cortex that is the

fundamental base of the self's consciousness. When there is no information arriving at and no elicited matching logotron-complex in the PFC, then no consciousness would arise in the self's mind. It seems to the author that unconsciousness is the normal, original, ground state of the self's mind as individual humans experience during dreamless deep sleep. Sleep state would possibly give rise to perception-related dreams associated with ultron-complexes stored in the "PRS".

Penfield and Boldrey (1937) reported that patients rarely experienced pain upon electrical stimulation of their exposed cerebral cortex during surgery to remove epileptic foci (Bushnell & Apkarian, 2006). Virtually single electrically-evoked focal brain response during neurosurgery is quite different from the pain-evoked brain response indicated in BOLD response, and consequently when transmitted to the PFC, it does not generate the matching pain-related logotron-complex, resulting in no subjective pain feeling by the patient. This finding in neurosurgery seems to provide an evidence for the mind-brain relation based on the ULT.

Acupuncture modulates the limbic system and the "PRS" as shown fMRI studies (Hui et al., 2000; Yan et al., 2005). A human pain insensitivity disorder caused by a point mutation of gene, ZFH2 suggests that abnormal protein in the pain-ultron-complex would modulate the tree-like architecture of pain-ultron-complex, resulting in suppression of generation of pain-logotron-complex in the brain that gives rise to pain insensitivity.

One of the most famous patient in the history of neuropsychology, Phineas Gage who was a railroad constructor damaged his prefrontal cortices in an explosive accident made neuroscientists find enormous valuable information on the prefrontal cortices for human knowledge (Sapolsky, 2004; 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 (McMillan, 2000; Sapolsky, 2004). It is inferred that Gage's inner true self was unable to interact with his prefrontal cortex, resulting in inability of controlling his physical self/body.

Researches in neurobiology and neuroscience revealed enormous reciprocal connections between the prefrontal cortex (PFC) and other cortical and subcortical brain structures including amygdala, hypothalamus, hippocampus, nucleus accumbens and cingulate cortex of limbic system, putamen, thalamus, substantia nigra etc. (the "prefrontal-rear system", "PRS") (Sapolsky, 2004; Schultz et al., 2000; Rilling & Insel, 1999; Herman et al., 2005). The animal's brain has less than 100 thousand neurons and in human brain there are 100 billion or more neurons (Miller & Cohen, 2001). The prefrontal cortex receives information from sites throughout the rest of cortex. The nucleus accumbens is involved in pleasure and reward, using neurotransmitter, dopamine signaling to the prefrontal cortex. The prefrontal cortex sends inhibitory signals to the limbic system, suppressing impulsive emotion and behavior (Sapolsky, 2004).

It is inferred that the self's original state is non-consciousness (unconscious-

ness), nothing in consciousness, that is inactive, ground state. The self's active, excited state is the wakefulness, awake state and creative state. If the PFC and the PRS are disconnected, no matching logotron-complex is generated, and no conscious perception nor cognition occurs in the self's mind.

It is postulated that immense number of virtual logotrons and ultrons in forms of unit and complex exist in space as well as in human brain as possibly suggested by presence of innumerable neutrinos in space and trillions of neutrinos passing through our body every second (*Time Blimp, 2018*). A cognition of the self's consciousness is analogous to a bubble of water at the surface of a vast ocean produced by winds (stimuli of the world). The water of the bubble is same as the water of the ocean. The self's consciousness is a minute part of the Cosmic Consciousness. If one thing in science is really true, it should be similarly true and valid in religion and philosophy, and vice versa.

Virtual logotrons are postulated to really exist. The physical world and the spiritual world coexist. The inner/super self's original, inactive state of non-consciousness (unconsciousness) seems to be serene and nothing in the self's mind but the self of the humanity in the active, excited state of consciousness is postulated to have potentially immense creative power and ability.

The fMRI studies in the fields discussed in this article would be continued so that more details and expansion in findings can be provided for the further research.

5. Conclusions

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 prospective of the author's hypothesis of the ultron-logotron theory (ULT):

A tree-pattern architecture of the cerebral neural substrate is proposed in cognitive understanding of words, feelings, and thoughts on the basis of the author's hypothesis of the ultron-logotron theory to explain the neural correlate of consciousness (*Figure 2*).

The semantic maps ("Words Atlas") in human cerebral cortex developed by Gallant and his coworkers are inferred to provide an evidence for tree-pattern, four-dimensional images (architectures) of ultron- and logotron-complex in human cognitive comprehension of words.

Cognition of stimulus from the external world is dependent upon the three 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") (leaves and branches in *Figure 2*).
- 2) The stimulus information is then transmitted through the functional connection, FC (trunk) 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 and diseases. The inner self interacts with the PFC and perceives and cognizes the incoming information with the matching logotron-complex.

Noxious stimuli produce a specific pain-related brain activity revealed by BOLD response in cerebral regions (voxels) of human brain, giving rise to pain feeling. Analgesics modulate the pain-related BOLD response in voxels of brain, disrupting the tree-pattern pain-ultron-complex, and suppressing generation of matching pain-logotron-complex.

Any injury, infection, degeneration and abnormal excitement or suppression state of certain parts of cerebral regions (ROIs or voxels) will result in clinical disorders and diseases such as aphasia, hearing loss, blindness, hallucination, amnesia, depression, bipolar disorder, Alzheimer’s disease, coma and so on due to modulation of the matrix pattern of the brain activity, resulting in a modulated ultron-complex that is transmitted to and/or within the prefrontal cortex (PFC), and subsequently giving rise to an abnormal logotron-complex, generating abnormal perception and cognition of the self’s conscious mind, and resulting in clinical disorders and diseases. Dissociation between the PFC and the PRS results in unconsciousness. Anesthetics suppress functional connections (FC) between the “PRS” and the PFC, resulting in unconsciousness. Sleep state would possibly give rise to perception-related dreams associated with ultron-complexes stored in the “PRS”.

The conclusive findings in the functional magnetic resonance imaging studies seem to provide evidence for 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 (Chung, 2018).

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

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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