TOWARD A SCIENCE OF
CONSCIOUSNESS
2015

TSC 2015: Pre-conference workshop & tutorials

Scientific Field Theories of Consciousness – Recent Developments. Pre-conference workshop

Time: 8th June 2015, 9 am - 1 pm
Place: University of Helsinki, Main Building (old side, Senate square), auditorium XIII

Presented by
Andrew Fingelkurts, BM-Science - Brain & Mind Technologies Research Center, Espoo,
Alexander Fingelkurts, BM-Science - Brain & Mind Technologies Research Center, Espoo,
Walter Freeman, University of California at Berkeley,
Giuseppe Vitiello, University of Salerno,
Robert Kozma, University of Memphis

This workshop will observe exclusively scientific field theories of consciousness concerning the everyday conscious experiences of individuals (including such sensations as colours, sounds, smells, tastes or somatosensation) and not the theories in which the word “field” is used to mean an abstract or esoteric entity.

The field theories of consciousness are theories that postulate that consciousness is identical with a field (or some aspect of it) in the general sense in which the term “field” is used in physics, i.e. a field in which the property that exists at each point in a particular region of the space-time continuum is objectively measurable. In other words, consciousness is seen as having not only temporal duration, but also extension in space.

It is a common consensus that in the 1930s and 40s the Gestalt theorist Wolfgang Köhler put forward the foundations for an electromagnetic field theory of consciousness. More specifically, in his work “field theory” (Köhler 1940) he referred to brain electric fields as cortical correlates of percepts. Latter, the proper neuroscientific formulations of the electromagnetic field theory of consciousness have been developed by Robert Charman (1997), Susan Pockett (1999, 2000), Johnjoe McFadden (2000, 2002), Roy John (2001), Andrew Fingelkurts and Alexander Fingelkurts (2001, 2005, 2008), Walter Freeman (2006, 2007), Paul Nunez (2006, 2007).

Some electromagnetic theories of consciousness are also quantum mind theories of consciousness. Examples include quantum brain dynamics (QBD) approaches of Mari Jibu and Kunio Yasue (1995) and of Giuseppe Vitiello (2001, 2002). The basic concept in QBD is that the electrical dipoles of the water molecules in the brain constitute a cortical field. The quanta of this field are described as corticons. QBD proposes that the cortical field not only interacts with, but also to a good extent controls the neuronal networks.

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Organizers:
Dr. Andrew Fingelkurts, Ph.D. (*BM-Science – Brain & Mind Technologies Research Centre, Espoo, Finland*)
Dr. Alexander Fingelkurts, Ph.D. (*BM-Science – Brain & Mind Technologies Research Centre, Espoo, Finland*)

Time-Table:

9:00 – 9:20 – ***Welcoming word***. Dr. Andrew Fingelkurts, Ph.D. (*BM-Science – Brain & Mind Technologies Research Centre, Espoo, Finland*).

9:20 – 9:50 – Prof. Walter Freeman, Ph.D. (*Division of Neurobiology, University of California at Berkeley, Berkeley, USA*). ***Consciousness as We Know it Began with a Hunter's Plan***.

9:50 – 10:00 – Questions and answers

10:00 – 10:30 – Prof. Giuseppe Vitiello, Ph.D. (*Department of Physics "E.R.Caianiello" and INFN, Fisciano (Salerno), Italy*). ***A Proposed Solution to the Mind-Brain Relationship***.

10:30 – 10:40 – Questions and answers

10:40 – 11:10 – Prof. Robert Kozma, Ph.D. (*Department of Mathematical Sciences, University of Memphis, USA*). ***A Field Level in Brain Functional Architecture – Is It the Phenomenal Consciousness***.

11:10 – 11:20 – Questions and answers

11:20 – 11:35 – Break

11:35 – 12:05 – Dr. Alexander Fingelkurts, Ph.D. (*BM-Science – Brain & Mind Technologies Research Centre, Espoo, Finland*). ***A Field Level in Brain Functional Architecture – Is It the Phenomenal Consciousness***.

12:05 – 12:15 – Questions and answers

12:15 – 12:45 – Dr. Andrew Fingelkurts, Ph.D. (*BM-Science – Brain & Mind Technologies Research Centre, Espoo, Finland*). ***Experimental Support to the Brain Operational Architectonics Theory of Phenomenal Consciousness***.

12:45 – 13:00 – General discussion.

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ABSTRACTS

Consciousness as we know it began with a hunter's plan *

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Animals search for food and shelter by locomotion through time and space. The elemental event is the action-perception cycle, which has three stages. In the first stage a volley of action potentials initiated by an act of search (sniff, saccade, etc.) triggers the formation of a macroscopic wave packet that caries a pattern of amplitude modulation (AM) that can be observed non-invasively from scalp EEGs of human volunteers perceiving stimuli. The first stage gives emotional awareness of the stimulus. The wave packet is filtered and sent to the entorhinal cortex, where it is combined with wave packets from all sensory systems. This triggers the second stage forming a concept as a multimodal flash memory that is passed through the hippocampal formation where it is assigned a place in the life-long memory of the subject. In the third stage the output of the entorhinal cortex triggers the formation of a global wave packet that synchronizes some oscillatory activity of most if not all of the cerebral cortex. Therefore I postulate that the global wave packet, the third stage in the cycle requiring ~0.2 seconds, expresses the global accommodation that culminates the action-perception cycle with a plan and a prediction for the next cycle. In humans each embodies a social contract for cooperation that requires prediction and understanding of others' minds.

* Adapted from Freeman WJ. (2014) pp. 140-148, Cosmos and History: The Journal of Natural and Social Philosophy, vol. 10, no. 1, 2014.

1. Freeman WJ. (2001) How Brains Make Up Their Minds. New York: Columbia UP.
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A proposed solution to the mind-brain relationship

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As shown by laboratory observations, the brain goes through a continuous flow of phase transitions, in a succession of amplitude modulated (AM) and phase modulated (PM) patterns (wave packets) correlated with categories of conditioned stimuli. These ordered patterns of coherently oscillating neuronal assemblies are described in the dissipative quantum model of brain (DQMB) by means of spontaneous breakdown of symmetry triggered by external stimulus. Their sequencing is associated to the non-unitary time evolution implied by dissipation. The brain

is indeed an open system in permanent interaction with the environment. In the DQMB the balance of energy and matter between the brain and the environment requires the doubling of the degrees of freedom of the brain. The environment, thus described by the doubled degrees of freedom as the time reversed image of the brain, appears then as the “Double” of the brain. The consciousness act is in the trade between the brain and its environment, in the permanent dialog between the brain and its Double. In this way, by updating of the meanings of the flows of information exchanged in its relation with the Double, the brain construct knowledge in its own world, builds its own mind. The complex system of the
Double, the brain and their relationship may describe the mind-brain dynamic relationship.

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3. Vitiello G. My Double Unveiled (John Benjamins, Amsterdam 2001).
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5. Freeman WJ. Current Opinion in Neurobiology 2015;31, in print.
6. Vitiello G. The use of many-body physics and thermodynamics to describe the dynamics of rhythmic generators in sensory cortices engaged in memory and learning. Current Opinion in Neurobiology 2015;31:7-12.

Experimental Evidences of the Phase Transition Models of Conscious Experience

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In this work, we introduce recent results of the analysis of ECoG data, identifying synchronization effects with sudden transitions in spatio-temporal neurodynamics, which are hypothesized to relate to conscious experience. Previous studies indicated that higher cognitive processing is manifested via cortical singularities [1-4]. In those works a hypothesis is outlined about the cognitive cycle. This work provides extensive analysis of the dynamics of spatio-temporal patterns of amplitude and frequency and postulates neural correlates of the cognitive cycle, in particular of the "aha" moment. The studies employ quantitative features including analytic amplitudes (AA) and instantaneous frequencies (IF) derived from Hilbert transforms, and pragmatic information (PI) indexes [5-9]. We describe the time evolution of the spatio-temporal dynamics through repeated phase transitions using mathematical models of large-scale networks [10]. The analyzed responses show significant nonlinear events characterizing the cognitive cycle

in the 1s window following stimuli as follows: (a) The initial “Awe” (0-0.1 s) period, which is due to the direct imprint of the sensory stimuli. (b) Chaotic Exploration (0.1-0.3 s) describing the brain as dynamical system searching through its reservoir of past experiences. (c) The “Aha” moment (0.3-0.45 s) corresponding to the link between the sensory stimulus and meaningful individual desires and experiences. (d) Chaotic Integration (0.45-0.6 s), when the new knowledge is incorporated in the brain dynamics, by adjusting its landscape if warranted. (e) Finally, a dramatic drop (0.6-0.9 s) indicates a return to background brain dynamics and unfolding a response. We discuss the implications of the results in understanding the development of human consciousness and the emergence of shared meaning in relationships with others. We conjecture that this analysis could eventually shed light on how to develop an ethical framework for decision making, considering and emphasizing the constructive aspects of intention and creativity in the context of universal values and behavioral responses, for the future benefit and the peaceful development of humanity [9, 11-13]. This is a joint work with W.J. Freeman, J.J. Davis, and G. Gillett.

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A Field Level in Brain Functional Architecture – Is It the Phenomenal Consciousness

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Phenomenal consciousness refers to a highest level of organization in the brain and captures all immediate and undeniable (from the first-person perspective) phenomena of subjective experiences (concerning hearing, seeing, touching, feeling, embodiment, moving, and thinking) that present to any person right now (subjective present) and right here (subjective space). It is a real and a natural phenomenon that is tightly anchored to a biological reality found in the human brain [1]. If it is so, then there must be a specific level of brain organization (and a specific spatial–temporal grain in it) that functions as the direct realization base of the phenomenal world. We propose that the brain operational architectonics (OA), centered on the notion of operation, is the only brain level that satisfies requirements needed for consciousness to emerge [2]. According to this view the simplest mental/cognitive operations (responsible for qualia or simple computations) are presented in the brain in the form of local 3D fields produced by transient functional neuronal assemblies, while complex operations (responsible for complex objects, images or thoughts) are brought into existence by joint simple operations (temporal coupling of local 3D fields by means of operational synchrony, OS) in the form of so-called operational modules (OM) of varied complexity [3]. Therefore, brain OA is presented as a highly structured and dynamic extracellular electric field nested in spatial and temporal domains and over a range of frequencies, thus forming a particular operational space–time (OST). OST level has emergent properties relatively independent from the neurophysiological (neuroanatomical) properties of the brain [4,5]. Phenomenal (subjective) level supervenes on the operational (OST) level with one-to-one correspondence and ontologically it is inseparable from it [4,5]. OST level is best captured by the electroencephalogram (EEG) measurement [2,3,4,5].

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Experimental Support to the Brain Operational Architectonics Theory of Phenomenal Consciousness

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Most neuroscientists agree that further understanding of phenomenal consciousness will rely upon the view according to which phenomenal consciousness is grounded to material carrier processes that take place in the brain [1]. According to the brain Operational Architectonics (OA) theory, such processes take place at the electromagnetic field produced by the brain, thus being the highest level of brain's functional organization [2]. Indeed, brain generates a highly structured and dynamic extracellular electric field nested in spatial and temporal domains and over a range of frequencies. This field exists within brain internal physical space–time (IPST) and is best captured by the electroencephalogram (EEG) measurement. Detailed analysis of the structure of EEG's complex hierarchical and nested architecture reveals a specific operational space–time (OST) which literally resides within the IPST and is isomorphic to phenomenal space–time (PST) [3]. Therefore such OST level may serve as the potential neurophysiological constituent of the phenomenal consciousness' architecture [4]. If it is true, change in circumstances when awareness expression is either weakened or lost completely should bring changes to the brain OA. Application of OA methodology to EEGs of patients who are in a permanent vegetative state (VS) or in a minimally conscious state (MCS) revels that when neuronal assemblies get very small, short-lived, highly unstable and do not communicate with each other, consciousness fades leading to complete unawareness of self and the environment [5,6]. Other experimental models of consciousness such as pure hypnosis [7] or sleep dreams [8] and manipulation of subjective awareness by TMS [9] revealed additional information supporting the view according to which it is an intact coordinated activity (operational synchrony) among relatively large, long-lived, and

stable neuronal assemblies within particular temporal scales that is important for enabling routine representational processes to be integrated within a coherent phenomenal world from the first-person perspective [5,6].

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