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# The extended Dual-Aspect Monism framework: Segregation and integration of information, hard problem, and the critical test for the inseparability between aspects

Ram Lakhan Pandey Vimal\*

Vision Research Institute, 25 Rita Street, Lowell, MA 01854 USA

Email: [rlpvimal@yahoo.co.in](mailto:rlpvimal@yahoo.co.in)

\*Corresponding author

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## Abstract

In **prior work**, we reported the followings:

- (i) There are about forty meanings attributed to the term consciousness. They were identified and categorized according to whether they were principally about *function* or about *experience*.
- (ii) The frameworks for consciousness that are based on materialism, idealism, and dualism have serious problems.
- (iii) An extended Dual-Aspect Monism (eDAM) framework was proposed for consciousness. This has the least number of problems compared to all other frameworks. It required a novel feature that the *potentiality* of primary irreducible subjective experiences exists in Nature. This is currently missing in science.

The **main new features** of the eDAM framework in the current article are as follows.

- (i) The Integrated Information Theory (IIT) was based on problematic materialism's identity theory and to some extent a version of panpsychism. The IIT is interpreted in terms of the least problematic eDAM framework.
- (ii) The eDAM framework attempts to address the hard problem of consciousness.
- (iii) It is shown that its hypothesis of *inseparability* of physical and non-physical aspects can be tested scientifically.

The **conclusions** are as follows:

- (i) If IIT is grounded on materialism, it is unable to resolve the hard problem of consciousness.
- (ii) If IIT is based on a version of panpsychism, it leads to serious problems.
- (iii) If IIT is re-interpreted in terms of the eDAM framework, it has the least number of problems.
- (iv) The eDAM can address the hard problem of consciousness successfully.
- (v) The inseparability hypothesis holds because none of the empirical fMRI/EEG data show separability between aspects.

**Keywords:** Metaphysics, materialism, idealism, Cartesian interactive substance dualism, Sāṅkhya non-interactive substance dualism, dual-aspect monism, consciousness, hard problem, segregation and integration (or binding) of information, necessary conditions of consciousness, experiential, cognitive, qualitative, and functional sub-aspects of non-physical and physical aspects, inter-dependently co-arising, causality, lack of inherent existence.

### **List of abbreviations**

1pp: First person perspective  
3pp: Third person perspective  
 $\Phi$ : Amount of integrated information  
CEI: Cause-effect information  
CR: Cause repertoire  
DAM: Dual-Aspect Monism  
eDAM: extended Dual-Aspect Monism  
EI: Effective information  
FB: Feedback signals  
FF: Feed-forward signals  
H: Entropy  
 $H_{\max}$ : maximum entropy  
I(X): Integration of system X  
IIT: Integrated Information Theory  
JND: Just noticeable differences  
MI: Mutual information  
MIB: Minimum information bipartition  
MIP: Minimum information partition ()

MT: Middle temporal area for motion in monkey

NCC: Neural correlate(s) of consciousness

NN: Neural network

NPB: Neural-physical basis

PEs: Proto-experiences

Q: Qualia

SE: Subjective experience

SEs: Subjective experiences

V4: Visual area 4 for color in monkey

V5: Visual area 5 for motion

V8: Visual area 8 for color in human

VO: Ventral occipital area for color in human

## 1. Introduction

There are about forty meanings attributed to the term ‘consciousness’, which were identified and categorized according to whether they were principally about *function* or about *experience* (Vimal, 2009b). *Materialism may explain functions but cannot explain experiences.* The *optimal* definition (that has the least number of problems) of consciousness is: *consciousness is the mental aspect of a state of the brain-mind system or a brain-mind process, which has two sub-aspects: conscious function and conscious experience from the first person perspective* (Vimal, 2010b). In other words, consciousness (a) has functional and experiential aspects and (b) includes functions and subjective experiences (SEs) (including feelings, emotion- and thought-related experiences).

We propose an extended version of dual-aspect monism metaphysics (eDAM) framework for consciousness, which attempts to address the hard problem of consciousness (Chalmers, 1995). The eDAM is a monist framework and is different from interactive substance dualism and quantum interactive dualism. This framework is an alternative to a materialism based framework for consciousness (Crick & Koch, 2003). Materialism does not address the hard problem because of the explanatory gap problem (Levine, 1983). Furthermore, Koch is sympathetic to a version of dual-aspect theory (Koch, 2012) that involves *integrated information* formulated by Tononi (Tononi, 2004, 2008, 2012). Tononi and Koch (Tononi & Koch, 2014) are sympathetic to panpsychism, but has serious problems (Vimal, 2010b). The eDAM framework tries to address this hard problem in Section 2.7.

The new and original idea is the eDAM framework ((Vimal, 2008, 2010a, 2013, 2014b) and Sections 1.2-1.5, 2-2.7) that has the least number of problems compared to all other frameworks. The main new features of the current article are as follows.

- (i) The problematic materialism's identity theory ((Tononi, 2004, 2008, 2012) and (Balduzzi & Tononi, 2008, 2009)) and to some extent a version of panpsychism (Tononi & Koch, 2014) based integrated information theory (IIT) is interpreted in terms of the eDAM framework (Sections 2-2.6).
- (ii) An attempt is made to address the hard problem of consciousness (Section 2.7).
- (iii) In addition, a scientific test is provided to test the eDAM framework (Section 3.2).

### **1.1. Hard problem and metaphysics**

Chalmers categorized the problems into tractable problems of science as 'easy problems' and non-tractable problems of consciousness as 'hard problem' (how to explain the experiential aspect of consciousness) (Chalmers, 1995). One could argue that functions and experiences fall under easy and hard problems, respectively (Cottam & Ranson, 2013; Vimal, 2009b, 2010b). For addressing the hard problem, we need to start at foundational level (the root/metaphysics). There are four major metaphysics: materialism, idealism, interactive substance dualism, and dual-aspect monism.<sup>1</sup> The first three metaphysics have serious problems as elaborated in (Vimal, 2010b, 2013). The fourth metaphysics, the dual-aspect monism, has fewer problems compared to other metaphysics, but not well developed. Therefore, an extended version of dual-aspect monism (eDAM) metaphysics is proposed to address the 'hard' problem.

The eDAM framework has five components; the first three components of the eDAM are well-developed in (Vimal, 2008, 2010a, 2013), the fifth component is well-developed in (Vimal, 2014b); they are concisely elaborated in Section 1.2-1.5. The fourth component of the eDAM framework is the *segregation and integration of information*, which is developed in Sections 2.1-2.6. The eDAM framework is summarized in (Vimal, 2015a, 2015b; Vimal & Bhardwaj, 2015; Vimal, Bókkon, Császár, Vas, & Szóke, 2015). A solution of the hard problem, attempted by the eDAM framework, is discussed by an example in Section 2.7 for which all five components of the eDAM are needed. Critical discussion is given in Section 3 and conclusion in Section 4.

### **1.2. The four major metaphysics, definition of consciousness, and hard problem**

#### **1.2.1. The four Metaphysics**

Chalmers categorized the problems into tractable problems of science as 'easy problems' and non-tractable problems of consciousness as 'hard problem' (how to explain the experiential aspect of consciousness) (Chalmers, 1995). For addressing the hard problem, we need to start at foundational level (the root), which is metaphysics.

This section is adapted from (Vimal, 2013). An entity is a general term used for a substrate, a field, a particle, a wave, a fermion, a boson, a composite of fermions and bosons such as

a classical object including a gene, a cell, a neuron, a neural-network (NN), a brain, a subject, a family, a society, a city, a country, the whole universe or anything; an entity has one or more properties. One could categorize all the properties of all entities of our universe into two categories from western perspective: physical properties from 3<sup>rd</sup> person perspective (3pp) and non-physical properties from 1<sup>st</sup> person perspective (1pp). The physical properties are, for example, mass, charge, and spin of elementary particles (fermions and bosons). A **physical** property is represented by P and is included in physical aspect of a state of an entity. A **non-physical** property is represented by NP and is included in the non-physical aspect of the state of the entity. The non-physical properties are, for example, (a) subjective experiences (SEs) and self (experiencer) as experiential sub-aspect of the non-physical aspect, cognitive sub-aspect such as thoughts, attention, intention, and memory, qualitative sub-aspect such as patterns/forms, and functional sub-aspect such as functions. The cognitive and experiential sub-aspects together are called mental sub-aspect. In other words, there are 4 sub-aspects of non-physical and physical aspects.

This categorization entails four major philosophical positions:

**(I) Materialism:** NP from P (P is primitive/fundamental), which includes materialistic frameworks, such as the naturalistic/physicalistic/materialistic nondual monism, physicalism, materialism, reductionism, non-reductive physicalism, naturalism, or *Cārvāka/Lokāyata* (800-500 BCE: (Bhattacharya, 2013; Raju, 1985; Singh, 2002; Vimal, 2012b)).<sup>2</sup> In terms of causality, P causes NP.

In terms of Nāgārjuna's dependent co-origination (DC) or inter-dependence co-arising (IC) and inherent existence, if primitive/fundamental P is the physical unified information/energy field (PUIEF) or quantum vacuum at unmanifested state, then DC/IC will suggest that PUIEF is the only primal entity that inherently exists and all manifested entities manifested entities inter-dependently co-arise.

**(II) Idealism:** P from NP (NP is primitive), which includes idealistic frameworks, such as the idealism, mentalistic nondual monism, or *Advaita* (788-820 AD: (Radhakrishnan, 1960; Vimal, 2012b)). In terms of causality, NP causes P.

In terms of Nāgārjuna's DC/IC and inherent existence, if primitive/fundamental NP is the non-physical universal potential consciousness informational energy field (UPCIEF) at unmanifested state, then DC/IC will suggest that UPCIEF is the only primal entity that inherently exists and all manifested entities inter-dependently co-arise.

**(IIIa) Western interactive substance dualism:** P and NP substances are independent (from western perspective). However, they can interact (both P and NP substances are equally primitive) as in the interactive substance dualism. The western Cartesian substance



dualism, where the mind (NP) and matter (P) actively interact until death; this can be called the 'interactive substance dualism' (ISD) or simply 'substance dualism'; they will be interchangeably used in this article. In terms of causality, P and NP entities are independent and they do not cause each other, but they can interact.

In terms of Nāgārjuna's DC/IC and inherent existence, if there are two primitive/fundamental entities, namely, PUIEF and UPCIEF at unmanifested state, then DC/IC suggests that PUIEF and UPCIEF are the only primal entities that inherently exist and all other manifested entities inter-dependently co-arise.

**(IIIb) Sāṅkhya:** The eastern substance dualism metaphysics is called *Sāṅkhya* (1000–600 BCE or even before *Gīta*) or *Gīta* (3000 BCE) (Vimal, 2012b) and (Radhakrishnan, 1960). Here, *Prakṛti* and *Puruṣa* two independent substances; *Puruṣa* simply is an eye-witness experiencer; it does not actively interact with *Prakṛti*; it 'shines' the processes of *Prakṛti* (that has causal and astral bodies like a mind/cognition and physical bodies like the matter) to experience it but does not interfere the process.

If we would like to compare with ISD, the ISD's NP can be further divided into three groups of non-physical entities: astral bodies  $NP_a$ , causal bodies  $NP_c$ , and the experiencer body  $NP_e$ . The *Prakṛti* is composed of P,  $NP_a$ , and  $NP_c$ , whereas *Puruṣa* is simply  $NP_e$ . Thus, there are two kinds of dualism. In terms of causality, *Prakṛti* and *Puruṣa* are independent and they do not cause each other and they do not interact; however,  $NP_c$  causes  $NP_a$ , which causes P

In terms of Nāgārjuna's DC/IC and inherent existence, if there are two primitive/fundamental entities, namely, *Moola-Prakṛti* at unmanifested state and *Puruṣa* (eternally manifested experiencer) then DC/IC suggests that *Moola-Prakṛti* and *Puruṣa* are the only primal entities that inherently exist and all other manifested entities inter-dependently co-arise.

**(IV) The extended Dual-Aspect Monism (eDAM):** P and NP are two *inseparable* aspects of a state of an entity, which includes dual-aspect monistic frameworks, such as the extended Dual-Aspect Monism (**eDAM, *Dvi-Pakṣa Advaita***/द्विपक्षाद्वैत, or *Ubhayādvaita*/उभयाद्वैत). There are other aspect-monism framework, such has Triple Aspect Monism at conscious state, Neutral Monism, Kashmir Shaivism (860–925 AD) and *cit-acit Viśiṣṭādvaita* (Ramānujāchārya: 1017-1137 AD: mind (*cit*) and matter (*acit*) are adjectives/aspects of *Brahman*), see (Radhakrishnan, 1960; Vimal, 2012b)). In Triple Aspect Monism, P is physical aspect-1; NP can be further divided into non-conscious informational NP aspect-2 and conscious NP aspect-3.

In terms of Nāgārjuna's DC/IC and inherent existence, in the eDAM, if primitive/fundamental entity is the unified information/energy field (UIEF) with UPCIEF as non-physical aspect and PUIEF as physical aspect at dual-aspect unmanifested state, then DC/IC suggests that UIEF at dual-aspect unmanifested state is the only primal entity-state that inherently exists and all other manifested dual-aspect states of all entities inter-dependently co-arise.

To sum up, there are four major metaphysics: materialism, idealism, interactive substance dualism, and dual-aspect monism. The first three of them have serious problems as elaborated in (Vimal, 2010b, 2013). The fourth metaphysics, the dual-aspect monism, has the least number of problems compared to other metaphysics, but not well developed. Therefore, an extended version of dual-aspect monism (eDAM) metaphysics was proposed to address the 'hard' problem.

### 1.2.2. Consciousness

There are about forty meanings attributed to the term 'consciousness', which were identified and categorized according to whether they were principally about a *function* or about an *experience* (Vimal, 2009b). An immediate advantage of this categorization is that it makes clear what materialism can do and what it cannot do. *Materialism may explain functions but cannot explain experiences*. In other words, this categorization sets the clear-cut limit for materialism.

A *general* definition of consciousness (that accommodates most views) may be: Consciousness is the non-physical aspect of a beable ontological dual-aspect state of the mind-brain-system or a mind-brain-process, which has four sub-aspects: a conscious experience (experiential sub-aspect), a conscious cognition (cognitive sub-aspect), a conscious quality (qualitative sub-aspect), a conscious function (functional sub-aspect), or first two to four sub-aspects depending on the context from the 1<sup>st</sup> person perspective (1pp), where the term 'context' refers to metaphysical views, constraints, specific aims, and so on. The experiential and cognitive sub-aspects are also called mental sub-aspect. In (Vimal, 2010b), cognition, quality, and function are combined in function and was called functional sub-aspect.

The *optimal* definition (that has the least number of problems) of consciousness is: Consciousness is the non-physical aspect of a beable ontological dual-aspect state of a mind-brain-system or a mind-brain-process, which has four sub-aspects: a conscious experience (experiential sub-aspect), conscious cognition (cognitive sub-aspect), conscious qualities (qualitative sub-aspect), and a conscious function (functional sub-aspect) from the 1<sup>st</sup> person perspective; see also (Vimal, 2010b).

In other words, consciousness has experiential, cognitive, qualitative (patterns/forms), and functional sub-aspects and includes (a) experiencer (SE related to self), (b) subjective experiences (SEs) of objects, emotions, and thoughts, and (c) *Samādhi* state experiences. This *special* beable ontological dual-aspect state has specific consciousness (1pp-non-physical aspect) when ‘viewed’ from the 1<sup>st</sup> person perspective (1pp) and has its *inseparable* physical aspect (correlated specific NN and its activities) when the same “effective” information is ‘viewed’ from the 3<sup>rd</sup> person perspective (3pp). Furthermore, this state is selected after matching the stimulus-dependent feed forward (FF) signal with cognitive feedback (FB) signals from the related long-term memory (LTM); if stimulus is novel then the related beable ontic state is selected and experienced and stored in the LTM if the stimulus is salient. The following necessary conditions must be satisfied for the selection of the related beable ontic state: the formation of the related neural-network, wakefulness, reentry, attention for the *access* (reportable) consciousness, information segregation and integration, working memory, stimulus contrast at or above a threshold, potential experiences embedded in neural network and so on (see Section 1.3.6).

Attention is not necessary for the *phenomenal* (non-reportable) consciousness. Here, a beable ontological dual-aspect state is defined as the dual-aspect state of a mind-brain-system or a mind-brain-process that really exist and we can empirically measure it using psychophysical methods (for the 1pp-nonphysical aspect) and neurophysiological methods such as fMRI/EEG (for the 3pp-physical aspect).

### **1.3. Extended Dual-Aspect Monism (eDAM)**

This section is adapted from (Vimal, 2017). The extended dual-aspect monism (eDAM, *Dvi-Pakṣa Advaita Vedānta*) is a middle way (between materialism and idealism/dualism) framework. The eDAM is elaborated in (Vimal, 2008, 2010a, 2013, 2015d, 2016c) and summarized in (Vimal, 2016b), an e-book (Vimal, 2012b) for Hinduism and another e-book (Vimal, 2012a) for other religions.

The eDAM is based on two sources of robust, highly reproducible, empirical data, which is called dual-source theory; this is interpreted in terms of the eDAM; from the discussion with Baars (November 19-22, 2015), my working hypothesis evolved to be as follows: The “effective” information is the same in both two sources (1pp and 3pp) for the same conscious event within the critical spatiotemporal-spectral interval threshold at a beable ontological (conscious) state of our mind-brain system. They appear different because perspectives (1pp and 3pp) of “viewing” are different (1pp: 1<sup>st</sup> person perspective; 3pp: 3<sup>rd</sup> person perspective). I assume that these two sources are two inseparable aspects of the same conscious state of the same mind-brain system to address from the association problem of separability in dualism.

The consciousness has experiential, cognitive, qualitative, and functional sub-aspects (Vimal, 2009b), which attempts to address the hard problem of consciousness (Chalmers, 1995). The eDAM is a monist framework and is different from interactive substance dualism and quantum interactive dualism. This framework is an alternative to a materialism based framework for consciousness (Crick & Koch, 2003) that does not address the hard problem because the explanatory gap problem (Levine, 1983) still remains. As per Crick and Koch, the hard problem of consciousness is the most difficult problem; it is “fruitless to approach this problem head-on”; instead, it will be useful first to find “the neural correlate(s) of consciousness (NCC)” and then try to explain it in causal terms; this will hopefully tell us how to address the hard problem (Crick & Koch, 2003). This strategy might have lead Koch towards dual-aspect monism in (Koch, 2012), but it certainly led me to the eDAM framework ((Vimal, 2008, 2010a, 2013, 2015d, 2016c) and Section 2.2) that tries to solve the hard problem.

The eDAM framework is consistent with psychophysical, biological, and physical laws and the principle of ‘dependent co-origination’<sup>3</sup>. The eDAM attempts to address the ‘hard’ problem of consciousness (how to explain subjective experiences) as elaborated in (Vimal, 2015d). In addition, this framework can be tested scientifically. For example, if the *separability* between the non-physical and physical aspects of a conscious brain-mind state is found under a single condition, the hypothesis of inseparability will be rejected; then the eDAM framework needs major modification; this is elaborated in (Vimal, 2015d).

### 1.3.1. The postulates of the eDAM

Some of the postulates of the extended Dual-Aspect Monism (eDAM) are as follows.

#### 1. Definitions

The physical attributes (properties) of an elementary particle (fermion or boson) are mass, charge, and spin, which are included in the physical aspect of a state of an entity. In other words, all 12 fermions, 5 bosons, and 1 hypothetical boson graviton are all [elementary particles](#) and hence they are all physical entities.

The attributes that are not physical are categorized as non-physical attributes, which are included in the non-physical aspect of the same state of the same entity. There are four sub-aspects of both non-physical and inseparable physical aspects, namely, experiential, cognitive, qualitative, and functional sub-aspects. The non-physical properties are, for example, (a) subjective experiences (SEs: including affective emotions/feelings) and self (experiencer) as experiential sub-aspect of the non-physical aspect, (b) cognitive sub-aspect such as thoughts, attention, intention, and memory, (c) qualitative sub-aspect such as patterns/forms, and (d) functional sub-aspect such as functions (including enaction/action). The cognitive and experiential sub-aspects together can be called mental

sub-aspect. Each of the sub-aspects of non-physical aspect has corresponding inseparable physical aspect.

A dual-aspect quantum (template) state (also called wavefunction) of a quantum particle (such as an elementary particle) is composed of the superposition of all possible/potential innumerable beable ontic dual-aspect states as the basis states in the eDAM's Hilbert space. A specific beable ontic dual-aspect state is realized/actualized thru the collapse of these superposed dual-aspect states to it.

The term 'latent' means unmanifested/hidden (not absent). For example, the experiential and cognitive sub-aspects of both aspects of a state of a stone are latent. However, if the elementary particles of a stone are re-organized (technically almost impossible) to human brain with the help of other elementary particles (that are not in the stone but necessary in the formation of a human brain), then those latent/unmanifested experiential and cognitive sub-aspects can be manifested. Presumably, the evolution has done this job, but it took over billions of years. Materialists might claim that these latent sub-aspects are absent in inert entities. However, if they were absent, how is it possible that we have them?

These definitions are only for the eDAM, i.e., when empirical subjective and objective data are interpreted in terms of the eDAM. It should be noted that all subjective and objectives data are based on our subjective experience (SEs), which are ineffable. When we use our own words during a speech or write them, they are nothing but our own interpretations based on some framework in which we are raised or developed since we are born in terms of some language: why? This is because all SEs are private and personal and are ineffable. We agree because we have the similar systems and we disagree if our systems are different. For example, trichromats will experience redness when they look at a ripe tomato, but achromats will not; instead, they experience dark grayness.

There are four major groups of frameworks: materialism, dualism/Sāṅkhya, idealism, and aspect-monism (such as eDAM, Triple Aspect Monism (TAM), and Relational Holon theory (RHT): each has its own definitions and postulates). We must not mix interpretations; otherwise, confusion will arise. For example, the eDAM categorizes patterns/forms and functions as non-physical aspects based on the above definitions (see below for further justification), but Sāṅkhya and materialism consider them as a part of physical aspect; for Sāṅkhya, only the experiencer/Puruṣa is non-physical separable aspect; for materialism there is no non-physical aspect, rather it arises from the physical aspect; for idealism, only non-physical aspect exists, matter is nothing but condensed/congealed consciousness (SEs). Some consider them as them evidence in place of interpretation, but they are all interpretations in the eDAM's point of view. Why? This is because the so-called evidence is also based on ineffable SEs. The eDAM uses 'inter-dependent co-arising' (IC) of aspects instead of causality. This is because entities lack inherent existence, which clearly shows

that they (patterns/forms and functions) are not caused by and not created by the matter, and the eDAM can logically argue for these (qualitative and functional) sub-aspects being categorized in the non-physical aspect and each of them has corresponding inseparable physical aspect.

### ***Physical vs. non-physical***

What is physical? If a state of an entity has properties such as (a) mass, charge, and spin, and (b) experiencer, experiences, cognition, patterns/forms, and functions. How do we categorize these properties? One could argue that the categorization of properties into physical and [non-physical](#) depends on a framework. There are four major groups of frameworks: materialism, dualism, idealism, and the aspect-monism (such as the eDAM). For materialism-based frameworks, all are physical; for idealism, all are non-physical; for dualistic Sāṅkhya, only Puruṣa (experiencer) is non-physical and the rest is physical; and for Cartesian dualism, properties (a) is physical and properties (b) is non-physical. The eDAM categorizes properties (a) under physical aspect and (b) under the inseparable non-physical aspect of the same state of the same entity. Which one is preferred? Whichever has the least number of problems should be preferred.

The eDAM is a middle way framework between materialism and idealism (at the two opposite poles) and tries to make a bridge them. It tries to honor some of the concepts from both.

In other words, consider the following properties of entities and their states: (a) mass, charge, and spin of fermions and bosons that constitute whole physical universe and (b) patterns/forms, functions, cognition, and subjective experiences of objects, and (c) the self (SE of subject) as the experiencer.

Let us examine how the four major groups of frameworks have categorized them.

Materialism: all (a) to (c) are physical.

Idealism : all (a) to (c) are non-physical.

Sāṅkhya-Dualism: (a) and (b) are physical; (c) is non-physical.

Cartesian-Dualism: (a) is physical<sup>4</sup>; (b) and (c) are non-physical; separability holds.

The eDAM: (a) is physical; (b) and (c) are non-physical; inseparability holds. It seems that the eDAM follows Cartesian-Dualism's classification (except inseparability between the two aspects) to honor some of the concepts of dualism towards bringing them (materialism, idealism, and dualism) closer.

How do we decide which classification is preferred?

For this purpose, we need to have some framework selection criteria. I propose the following criteria: (I) Occam razor parsimony, (II) the number of authentic problems, and (III) subjective and objective evidence based on empirical data.

(I) Occam razor parsimony =  $1/(\text{number of free parameters})$ :

1:1:1:0.5::materialism:idealism:eDAM:dualism.

(II) Number of unresolvable authentic problems:

1:1:0:13::materialism:idealism:eDAM:dualism. If the eDAM is correctly understood then it has no authentic problems.

(III) Subjective and objective evidence based on empirical data: all four groups of framework try to explain the empirical data in their own ways; it is unclear which explains the best. Therefore, it does not seem to be useful criterion.

Therefore, based on (I) and (II) the eDAM should be the preferred framework.

## 2. Inseparability hypothesis

We all are puzzled on how and where from a subjective experience (SE: SE of the subject as self or SE of objects) arise in our mundane conscious life. We can assume two possible primal sources: (i) cosmic consciousness (CC) in top-down approach (**TDA**) and (ii) universal potential consciousness informational energy field (UPCIEF) as non-physical aspect of the unmanifested state of unified informational energy field (UIEF) and Physical UIEF (quantum vacuum) as its inseparable physical aspect in the eDAM that follows bottom-up approach (**BUA**). Monistic Vedanta is underlying metaphysics for non-interactive dualistic Sankhya in TDA, which I do not follow because it leads to 13 unresolvable problems that have consensus for a long time (Vimal, 2012b). Therefore, I will briefly discuss only BUA-based eDAM.

In the eDAM, the dual-aspect unmanifested state of the UIEF is composed of the superposition of innumerable possible/potential beable ontic states as basis state of Hilbert space. A specific beable ontic dual-aspect state (out of innumerable superposed states) is actualized/manifested when its necessary conditions are satisfied thru interdependent co-arising (**IC**). This means that it's both aspects also co-manifested. For example, let this specific state is the ground state of an electron. Then the mass, charge, and spin of the electron as its physical aspect and its function and pattern/form as its inseparable non-physical aspect are co-manifested. Similarly, we can argue for other 17 elementary particles (or more if new elementary particles are discovered). In other words, I have assumed that the 18 dual-aspect elementary particles are the necessary building blocks of the universe

including us as science assumes. If in future, new elementary particles are discovered then we can easily include them. It should be noted that the eDAM has introduced the non-physical aspect in the current physics without violating it. It is like re-arranging the attributes of elementary particles. The patterns/forms, as also the properties of elementary particles, are implicitly already present in terms of wave-particle duality and their respective functions for building their composites such as atoms, molecules, and classical objects in physics and living entities (including us) with cognition and experiences as new (non-physical) properties in neurobiology. However, what happens to other unmanifested innumerable superposed beable ontic states after the manifestation of all elementary particles? A short answer is they are in superposed form in each state of each elementary particle. This needs a little more unpacking.

Let us take an example of electrons. Electrons are in all NNs (such as related to vision, auditory, taste, smell, touch etc) and almost in all composite living and non-living entities. Therefore, it is easy to think that they contribute thru some physical and biological laws. For example, they are five sensory systems in us. Each sensory system (also called modes in the eDAM as in Section 2.3) has many sub-systems (sub-modes) such as color, motion, shape etc in vision. Each sub-mode has many dimensions, such as red, green, blue etc for color sub-mode. Similarly, we can argue for the other elementary particles. Let us consider a redness-related beable ontic dual-aspect conscious state that has SE redness as experiential sub-aspect of non-physical aspect and redness-related V8-NN and its activities as its inseparable physical aspect. If the necessary conditions of this beable ontic state are satisfied, then it is manifested. When it is realized/manifested, it's both aspects are also co-manifested thru IC.

Why do we need the inseparability hypothesis? What is its purpose? Does it explain why SEs occur in the brain? Under what condition can we relax it? These queries are addressed as follows.

There is inseparability between physical and non-physical aspects. It has both subjective and objective pieces of evidence. For example, at wakeful conscious state, there are 100s of subjective (psychophysical) and objective (fMRI/EEG) reports that are consistent with inseparability between aspects because none of the reports show separability. It must be noted that science only rejects a hypothesis and does not prove it. Therefore, the inseparability hypothesis can be rejected only when experiments clearly show that aspects are separable. In addition, I have proposed a few experiments to test the eDAM. If separability is found in the experiments proposed in Section 3.2, then the monistic frameworks such as the eDAM will certainly be rejected.

If the eDAM is understood *correctly*, both aspects of a beable ontic state of an entity always go together, i.e., both aspects must manifest simultaneously and equally and hence the



inseparability between aspects are always maintained in all conditions and at all levels. If anyone finds a single case of clear-cut separability under a single condition at any level at any time at any location **within CSTSI (critical spatiotemporal-spectral interval)**, then the eDAM will be rejected. This search for separability is a challenge to all researchers.

The highest state of *ineffable* Samadhi SE has been interpreted by three of the six sub-schools of Vedanta that are consistent with dual-aspect view. These three sub-schools of Vedanta are *Cit*(non-physical aspect)-*acit*(physical aspect) *Viśiṣṭādvaita* (qualified non-dualism), *Dvaitādvaita*, and *Achintya-Bheda-Abheda* (inconceivable oneness and difference).

In the eDAM framework, there is no separate sub-substrate of each aspect; physical aspect (or non-physical aspect) does not manifest from the physical aspect (or non-physical aspect) of its precursor. Instead, both aspects of a beable ontic state of an entity interdependently co-arise together simultaneously when the beable ontic state of the entity is actualized when all necessary conditions are satisfied for its co-arising.

Similarly, if Sāṅkhya is interpreted in the eDAM framework, Puruṣa (or Prakṛti) does not have separate substrate in the formless, attributeless aspectless symmetric dual-aspect primal substrate Brahman or “unus mundus” (“nothingness”/“emptiness”). Instead, Puruṣa and Prakṛti inter-dependently co-arise from the Brahman simultaneously when all necessary conditions are satisfied for their co-arising. Here, “causality” is not used because IC (interdependent co-arising) here explains better in my view.

### ***The justifications for the inseparability***

The eight justifications for the inseparability between non-physical and physical aspects are as follows:

- (i) The original source of a dual-aspect entity is the primal dual-aspect substrate/structure such as unified informational energy field (UIEF).
- (ii) The source of “effective” information is the stimulus: physical information of the stimulus is transformed into neural-physical information by the photoreceptors, retinal, LGN, and cortical neurons.
- (iii) The “effective” information is the same in both aspects.
- (iv) If we change the information in one aspect, the information in the other aspect also changes correspondingly. This implies a 1:1 bidirectional relationship between aspects.
- (v) There is no evidence of separability between aspects in all empirical data.
- (vi) The ecosystem ecology also supports inseparability.

- (vii) It solves the serious unresolvable association problem of dualism, where the separability between the two aspects is postulated.
- (viii) There are robust and highly reproducible two sources (1pp and 3pp) of subjective and objective data, which support inseparability and rejects separability.

***Nunn (10/17/18)***

All may be inseparable prior to the symmetry break, but not after. Think weak force and e-m force for instance. They were originally unified but now do not appear remotely alike. Water and steam are a bit less dissimilar but convey the same message.

***Vimal (10/17/18)***

In eDAM, a state of the whole is an inseparable dual-aspect state; a state of a part of the whole is also inseparable dual-aspect state. In your example, all are manifested entities:

- (i) Whole: A state of electroweak force/entity (unified force as the whole) has inseparable physical and non-physical aspects.
- (ii) Part1: A state of weak force/entity (Part1) has inseparable physical and non-physical aspects.
- (iii) Part2: A state of e-m force/entity (Part2) has inseparable physical and non-physical aspects.

For example, the pattern/form of a force (electroweak, weak, or e-m) is the qualitative sub-aspect of non-physical aspects of a state of a force/entity and the related energy is the qualitative sub-aspect of physical aspects of the same state of the same force/entity. Can we separate the pattern/form from the related energy? Of course, not; therefore, the inseparability holds. This is consistent with the John Kineman's Relational Holon Theory (RHT) as well, where the relationship is 1-1 between aspects and inseparability is true.

Perhaps, you are asking about the relationship (a) between whole and parts before symmetry breaking or (b) between parts after symmetry breaking: are they this 1-1 and inseparable? This has nothing to do with the eDAM's inseparability. Please note the inseparability is between aspects of a specific state of a specific entity. Since entities and their states are different, inseparability is not expected. This is where the confusion is. Since the weak force is a different entity from the e-m force and has different states, and they are not aspects. Parts of the whole are not aspects of the whole. Aspects are for states of entities. Thus, inseparability is irrelevant for these cases. I hope that I have clarified.

### 3. Four sub-aspects and inseparability

There are at least four sub-aspects of each of the non-physical and physical aspects of a state of an entity related to (a) subjective experiences (SEs, including affective emotions/feelings: SE of all types of sensation and emotions), (b) cognition (including knowing: logical-mathematical thinking, attention, learning, memory, planning, moral judgment, decision making, intelligence<sup>5</sup>, and perception), (c) functions (including enaction/action) (Pereira Jr., 2019), and (d) patterns/forms. In other words, the non-physical aspect has four sub-aspects: experiential/affective, cognitive, functional/enactive/‘action-related’, and qualitative (patterns/forms) sub-aspects. Similarly, the physical aspect also has corresponding respective four sub-aspects related to respective neural-physical basis (NPB). There is no separate and independent mental or physical state; a state is always inseparable dual-aspect state.

For example, the redness-related beable ontic conscious dual-aspect state of a subject’s mind-brain system has (i) a specific subjective experience (SE) redness as the experiential sub-aspect of the non-physical aspect from the subject’s 1pp, and (ii) the redness-related NN and its activities (neural-physical basis, NPB) as the experiential sub-aspect of the physical aspect from the subject’s 3pp (but it is the 3<sup>rd</sup> person-viewer’s 1pp). Similarly, we could argue for other three sub-aspects for this beable ontic state of the subject’s mind-brain system. This beable ontic conscious state of the subject’s mind-brain system has the full manifestation of all four sub-aspects. If we arbitrarily assign the degree of manifestation of a sub-aspect as 25%, then the total will be 100%: 25% for experiential + 25% cognitive + 25% qualitative + 25% functional of **each** of both aspects, then the total will be 100% degree of manifestation of both aspects. In other words, the degree of manifestation of the experiential sub-aspect of the non-physical aspect is 25% and that of the experiential sub-aspect of the inseparable physical aspect is also 25%; similar argument is applicable for other three sub-aspects. Thus, a specific sub-aspect of physical and non-physical aspects are equally manifested, which clarifies the inseparability of the aspects. However, this arbitrary method will raise a query: what is that beable ontic state which has 100% experience-related non-physical aspect and the related inseparable 100% physical aspect? Thus, this arbitrary method of assignment will create confusion. Therefore, we can try another method of assignment: assign 100% to this sub-aspect because it is indeed fully manifested beable ontic conscious state. If we do that then what is that beable ontic state that has the degree of manifestation of 25% or between 0 to 100%? Can we assign 0% to deep sleep beable ontic state and 100% to the highest state of samādhi beable state? What would be degrees of manifestation of sub-aspects of both aspects of mokshic (liberated) state of a soul (if it really exists!). To answer these questions, we need to do careful calibration, need to attain these 7 (or more) states of consciousness, and need to measure them thru fMRI/EEG or more advance equipment and need further research. Conceptually, there are 4 sub-aspects so divide 100 by 4, which is 25% for each

sub-aspect. If only cognitive sub-aspect is manifested then it should have physical basis as well, which is 25% in both aspects compared to when all 4 sub-aspects are manifested (100%) as in us in this wakeful conscious state. In other words, if only the experiential and cognitive sub-aspects are manifested then, the degree of manifestation of both sub-aspects of each aspect is  $25+25=50\%$  compared to when all four sub-aspects are manifested.

Similarly, the qualitative (patterns/forms) and functional sub-aspects of the non-physical aspect of a state of any entity should correspond to the qualitative and functional sub-aspects of the physical aspect of the same state of the same entity. For example, I can experience from my 1pp that I am raising my hand (that has pattern/form and function) to pick a cup of tea. If you look at it then you will also experience the same from my 3pp, but it would be from your 1pp. In these cases, your and my observation would be the same for these two sub-aspects. Therefore, qualitative and functional sub-aspects are grouped under the non-physical aspect of a beable ontic state of my hand; this state has inseparable qualitative and functional sub-aspects of the physical aspect (NN and its activities). Again why? This is because of the definition and because of the observation from 1pp and from my 3pp (but from your 1pp) are the same. This is one of the reasons why qualitative and functional sub-aspects related to inert entities are grouped under the non-physical aspect of a beable ontic state of an inert entity, but this state also has qualitative and functional sub-aspects of physical aspect (material constituents are elementary particles; each of them has mass, charge, and spin) in the eDAM framework. This is how the eDAM maintains uniformity and consistency of inseparability and manifestation of both aspects together for all living and non-living/inert entities, which include the unmanifested state of the primal substrate thru extrapolation.

In other words, my hand has form/pattern and function. Thus, there are 1pp-qualitative and 1pp-functional sub-aspects of the non-physical aspect of a state of my hand. In addition, there are corresponding respective 3pp-qualitative and 3pp-functional sub-aspects of the physical aspect of the same state of my hand as NPB from my 3pp. The patterns/forms (qualitative sub-aspect) and functions (functional sub-aspect) are usually on the surface of the entity (such as hand). They are usually invariant across subjects, i.e., I am raising/extending my hand to pick up a cup of tea; you see its patterns/forms and functions or I see it; it would be the same. This is very little chance of making any error. It is this property and their definition; I have categorized them under 1pp-non-physical aspect even though we would never know the 1pp of an entity (such as other's hand or stone).

Similarly, we can explain for the cognitive sub-aspect (such as thinking, decision-making, attention etc) of both aspects of a beable conscious state of a mind-brain system.

Some readers get confused between aspects and perspectives. Aspects are for a state of an entity and perspectives are for the self (subject)'s point of view looking the same "effective

information. I have my neural-network and its activities inside my brain, which I cannot see them and it is physical; this is what I mean by from my 3pp; fMRI and EEG can record them (no need for you to see it from your 1pp). Of course, when you see the fMRI/EEG analyzed data using some software then it would always be your 1pp. We all experience from our 1pp, that is why the SE is private, person, and ineffable. However, 1pp and 3pp data look entirely different when we look at for example a ripe tomato: 1pp-data is SE redness, but 3pp-data is grey and white color grey and white matter of NN and activities are neural signals (electrochemical) and physical signals such as hydro-ionic waves; there is no redness in 3pp-data. The mind-body problem is the find the relationship between two entirely different looking 1pp and 3pp experiential data.

In other words, the eDAM will argue that there are four sub-aspects of the non-physical aspect and respective inseparable four sub-aspects of the physical aspect of a state of an entity.<sup>6</sup>

Let us take another example of an inert entity such as a stone. Why do the states of inert entities not show experiential and cognitive sub-aspects of the non-physical aspect? This is because the corresponding experiential and cognitive sub-aspects of the physical aspect of the same state of the same inert entity are not manifested. Why? This is because beable ontic states of inert entities do not have them (absent vs. latent). Why? This is because their necessary conditions are not satisfied. This does not mean that inseparability is rejected. Why? This is because they have qualitative and functional sub-aspects that are manifested in the beable ontic states of inert entities such as a stone. In other words, a stone has qualitative and functional sub-aspects, but its experiential and cognitive sub-aspects are unmanifested (latent). Therefore, the degree of manifestation of both sub-aspects of each aspect is  $25+25=50\%$  compared to when all four sub-aspects are manifested as in the wakeful conscious state. If a conscious robot is able to satisfy the necessary conditions of experiences, then it will be robotic type experiences.

In other words, in the beable ontic states of inert entities (such as a stone), the qualitative and functional sub-aspects of the non-physical aspects are manifested because their necessary conditions are satisfied. However, experiential and cognitive sub-aspects are latent/hidden/unmanifested because their necessary conditions are NOT satisfied. In all beable ontic states of all entities, both non-physical and physical aspects are always present inseparably in manifested or unmanifested (latent) form. In other words, the qualitative sub-aspect of non-physical aspect and the related the qualitative sub-aspect of the physical aspect of a state of an inert entity is manifested together. The experiential sub-aspect of non-physical aspect and the related the experiential sub-aspect of the physical aspect of a state of an inert entity is still unmanifested (latent). Similarly, we should examine the inseparability for other sub-aspects. To sum up, the inseparability is not

violated at any level. Therefore, co-ness (co-manifestation, manifestation together) and inseparability is always maintained.

To sum up, there are four sub-aspects of each of the physical and non-physical aspects of a state of an entity: experiential, cognitive, qualitative (patterns/forms), and functional sub-aspects. We can re-write the above as the physical aspect has four sub-aspects and the non-physical aspect has the same respective four sub-aspects. This makes four pairs for each of the four sub-aspects):

- (i) Experiential sub-aspect: the inseparability is between (a) non-physical aspect (such as redness) for a subjective experience (SE) and (b) physical aspect (such as redness-related V8-NN) for the same SE.
- (ii) Cognitive sub-aspect: the inseparability is between (a) non-physical aspect (such as a thought) for a cognitive element and (b) physical aspect (such as thought-related NN) for the same cognitive element.
- (iii) Qualitative sub-aspect: the inseparability is between (a) non-physical aspect (such as a pattern/form) for a statue and (b) physical aspect (such as material clay) for the same statue.
- (iv) Functional sub-aspect: the inseparability is between (a) non-physical aspect (such as a function) for a statue and (b) physical aspect (such as material clay) for the same statue.

#### **4. Inter-dependent co-arising (IC) and unus mundus**

**Sehgal:** I have four queries related to Inter-dependent co-arising (IC):

1. At the primordial stages, when there was no entity or manifested aspects, how will the mechanism of IC of entities/aspects kick in for the manifestation of very early entities?
2. When both the aspects were unmanifested, in what form the early necessary conditions existed?
3. How or who fulfilled the necessary conditions for the manifestation of the earlier entities?
4. When both the aspects were un-manifested, one aspect will take the lead and manifest first and then the other aspect will follow that and manifest in terms of IC. After all, IC is not a perpetual process. At the primordial stages, IC mechanism starts and when IC mechanism will take a start, there is no way out but one aspect to manifest first and then the other aspect to manifest in IC. When we walk, our both steps move in IC in some synchronous move. However, when we start the walk from the rest position, both the steps do not come out in one go. First, either left or right step comes out and then the second step comes out in one go. So when creation starts from the rest

position, which aspects -- physical or mental manifests first. As explained in the analogy above, both the steps cannot manifest “in one go” or simultaneously. (Pereira Jr., Vimal, & Pregnoloato, 2016)

**Vimal: 1.** *How does the manifestation of aspects start from the unmanifested state of the entity-less aspectless primal entity thru IC?* (Sehgal): The unified informational energy field (UIEF) can be considered as unus mundus (primal entity, Brahman); see also (Pereira Jr. et al., 2016) and (Pereira Jr., Nunn, Pregnoloato, & Nixon, 2018) for energy and (Pepperell, 2018) and references therein for energy and information as complementary processes. The mechanism of Inter-dependent Co-arising (IC) of entities/aspects kicks in thru the quantum fluctuations (QFs) in physical aspect reflected as consciousness fluctuations (CFs) in the inseparable non-physical aspect as follows. In our conventional reality, the manifested entities and their states lack inherent existence. The neutral primal entity is fundamental dual-aspect Brahman/‘unified informational energy field (UIEF)’/Śūnyatā/emptiness; so it has inherent existence, therefore, it does not dependently co-arise because it already inherently exists. One should not think that Śūnyatā/emptiness is literally “nothing”; it *appears* nothing because both aspects are latent; its physical aspect of the unmanifested state has QFs in quantum vacuum/emptiness. It should be noted that whatever (such as QFs) goes on in the physical aspect is automatically and immediately reflected in non-physical aspect (such as corresponding fluctuations in potential consciousness CFs: see cosmology as elaborated in *Brhadāraṇyaka Upaniṣad* (Vimal, 2012b).

The unmanifested state of UIEF has ‘physical UIEF’ (PUIEF) as the physical aspect and the ‘universal potential consciousness informational energy field’ (UPCIEF) as the inseparable non-physical aspect. The quantum fluctuations (QFs) in quantum vacuum are included in PUIEF. The unmanifested state is composed of the superposition of all possible innumerable beable ontic states in the past, present and future as basis states in the Hilbert space. The IC starts the manifestation thru for example Big Bang because of the many interdependent interactions between QFs/CFs in the dual-aspect UIEF generate enough pressure to break the symmetry related to physical and non-physical aspects. The Big Bang model (BBM) is one of 28 cosmological models (Vaas, 2004) (see Appendix A) and there is no consensus on any model, but BBM dominates.

A manifested beable ontic dual-aspect state with its inseparable aspects interdependently co-arise from the unmanifested state when necessary conditions are satisfied because manifested states of entities lack inherent existence.

**2.** *In what form the early necessary conditions existed when both the aspects were unmanifested?* (Sehgal): The early necessary conditions were (a) random QFs/CFs, (b) interactions between many QFs/CFs, which generate (c) enough pressure to break the

aspect-related symmetry of *unus mundus*. This led to Big Bang and further manifestations/realization of dual-aspect beable ontic states of entities. The realization/actualization of a specific beable ontic dual-aspect state is thru the collapse of the superposed innumerable beable ontic dual-aspect basis states.

**3.** *How or who fulfilled the necessary conditions for the manifestation of the earlier entities?* (Sehgal): The necessary conditions might be fulfilled by the *unus mundus* which has the potentiality of self-awareness (as the extrapolation of introspection and self-consciousness of a conscious state in our mundane life), self-organization, self-manifestation, autopoiesis (self-producing: extrapolation of our reductive system), self-referring dual-aspect system. There is no external agent (such as God or manifested cosmic consciousness) because it is a self-sufficient closed system.

(Poznanski et al., 2018) argues that the NCC and the unidirectional (from matter to mind) proposal leads to externalism/dualism. In place of NCC, one can argue for NPB (neural/physical basis). They argue that experiences arise from it (i.e., experiences are brain-based so they seem to argue for internalism. However, NCC can be interpreted in terms of all frameworks in their own ways. The unidirectional information transfer (from matter to mind) is just an assumption, without any empirical evidence. Intention and attention (both are parts of cognition) do affect neural activities. Therefore, on what basis are they rejecting externalism?

To reject external agent (such as CC, God etc), one has to show that the system is closed, i.e., the system can do everything without any external help. This means that the '*unus mundus*' must have potentiality at least for self-awareness and self-organization with QFs/CFs for breaking the aspect-related symmetry. Then only external agent (such as God or manifested cosmic consciousness) is not needed because the system (our universe) is a self-sufficient closed system.

**4.** *How are both aspects manifested together for the first time?* (Sehgal): The aspects were latent at unmanifested state of the primal entity. The QFs/CFs thru the interdependent co-arising led to the Cosmic Fire (Big Bang), which broke the aspect-related symmetry of *unus mundus* and both aspects emerged. This is how both aspects were manifested together for the first time.

## **5. Variation of the degree of manifestation**

The degree of manifestation of a pair of sub-aspects of non-physical and physical aspects varies depending on the states of beable ontic entities, levels, and the context. Both aspects manifest equally in a synchronous order under all set of circumstances and conditions as justified later. For example, a pair could be (i) the experiential sub-aspect of non-physical aspect and (ii) the experiential sub-aspect of physical aspect, which must be



manifested/realized together synchronously thru the IC. There are more than ample pieces of evidence in a conscious state (100s of fMRI/EEG reports) and also altered states (such as various levels of samādhi states). If astral entities exist (so far, there is no scientific evidence) then the states of their aspects are still dual-aspect with neural-physical basis (NPB) as physical aspect (or astral-physical aspect) at astral/subtle level. If moksha state exists, then there it should also have NPB (or mokshic-physical aspect) at mokshic level. We do not have any scientific evidence that there is a soul, which goes out of body or life-after-death and rebirth. If the existence of a soul is scientifically evident in future then its state will be beable ontic dual-aspect state. At any rate, in all conditions, the inseparability and all postulates of the eDAM must remain valid. It should be noted that all states must be beable ontic states of beable ontic entities. The term “beable ontic” means entities and their states must really exist in the universe out there; they should not be fictitious, imaginary, or probabilistic. The template state of quantum entities before a measurement is not a beable ontic state; it is an observable state. A template/quantum state of a quantum particle is composed of the superposition of beable ontic states as basis states in the Hilbert space, which is an abstract mathematical space we use to store all possible/potential beable ontic states as basis states for building models.

## **6. Necessary conditions**

A beable ontic dual-aspect state will manifest only when its necessary conditions of manifestation are satisfied. For example, the necessary conditions of conscious state are briefly summarized in Section 1.3.6.

## **7. Summary**

**1.** The eDAM postulates that fundamental substrate in the formless, attributeless aspectless symmetric dual-aspect primal substrate or ‘unus mundus’ (many names such as Brahman, nothingness, emptiness, or unified informational energy field, UIEF). This aspectless ‘unus mundus’ (primal entity) is symmetric with respect to the physical and non-physical aspects of a state of an entity, i.e., the aspects are latent in the unmanifested state of the primal entity; this symmetry needs to be broken for aspects to interdependently co-arise.

**2.** In all cases, the inseparability between aspects is maintained; so far, it has never been violated. If one, more, or all of the four sub-aspects of inseparable aspects are manifested, the co-manifestation and inseparability are still maintained for each of the respective sub-aspect of non-physical and physical aspects. Thus, there is no intrinsic contradiction between eDAM’s postulates if understood correctly. The concepts of uniformity and consistency throughout across all levels, all conditions, and all contexts are essential for a viable framework, which must not change according to their own convenience; otherwise, contradiction and problems will arise. For example, some models change from monism to dualism because at the highest state of samādhi subject-object division is abolished

whereas at the mundane level this division is essential to survive. The eDAM explains nicely this fact without violating monism because inseparability/monism is specific to a state of an entity.

**3.** If the eDAM is understood *correctly*, both aspects of a beable ontic state of an entity always go together, i.e., the co-ness (going together) and the inseparability between aspects are always maintained in all conditions and at all levels. If anyone finds a single case of clear-cut separability under a single condition at any level at any time at any location, then the eDAM will be rejected. This search for separability is a challenge to all researchers.

**4.** The eDAM does not break any existing laws of physics; it simply extends the physics. In other words, the physical aspect (such as mass, charge, and spin of elementary particles, which are the constituents of our physical universe) of a state of an entity is already well developed in physics. The eDAM adds the inseparable non-physical aspect to the same state of the entity. Therefore, energy conservation law is preserved in the eDAM.

**5.** If we can find a single case of clear-cut separability under any condition at any level at any time at any location, then the eDAM will be rejected.

**6.** The eDAM is a scientifically testable framework. So far, 100s of fMRI/EEG reports do not find any separability between aspects and hence consistent with the eDAM. As we know, science does not prove any hypothesis, it only rejects if it finds any contradiction.

**7.** I have also proposed some novel critical experiments in Section 3.2 to test the eDAM further. If these experiments cannot find separability to reject the eDAM then it will remain.

**8.** In inert entities, obtaining evidence for the **latent** mental (experiential + cognitive) sub-aspects of the non-physical aspect is NOT necessary to test the eDAM. It is more efficient and useful to understand that qualitative and functional sub-aspects of the non-physical aspect of a state of an inert entity exist and explicitly has more than enough evidence in our mundane life. Thus, the non-physical aspect is well established in both living and non-living entities and is inseparable from the related physical aspect. The major obstacle in understanding this fact may be the view that they are created by the structure as in materialism or Prakṛti part of Sāṅkhya. Well, you can argue for this view and is fine with me. However, the main problem is **as follows**: are we going to accept materialism and Sāṅkhya if we clearly understand that both have serious unresolvable problems that have consensus over many years? Or would you prefer to consider the eDAM that has no such problems?

### 1.3.2. The first component of the eDAM framework: Dual-Aspect Monism

This is elaborated in (Vimal, 2008) and summarized in (Vimal, 2015a, 2015b, 2016a). Briefly, it was hypothesized that a state of an entity has *inseparable* physical and non-physical aspects (Section 1.3.1.1). This involves the *doctrine of inseparability*, which is our one of postulates (Section 1.3.1.2). Each aspect has experiential, cognitive, functional, and qualitative sub-aspect (Section 1.3.1.3).

The **two perspectives** for viewing the same “effective” information are from (i) the 1<sup>st</sup> person perspective (1pp) of a subject and (ii) the 3<sup>rd</sup> person perspective (3pp) of the subject. In living entities, experiential and cognitive sub-aspects are from the 1pp and are subjective. The physical aspect (includes a neural network of a brain and its activities) is from the 3pp and is objective. The qualitative (Section 5.5 of Chapter 5 of (Vimal, 2017)) and functional sub-aspects could be from 1pp or 3pp. For example, when I extend my hand to pick up a cup of tea, both I from 1pp and you from my 3pp (but from you 1pp) can see the pattern/form of hand and its function.

The degree of manifestation of non-physical aspect and that of the physical aspect *interdependently co-arise* (Nāgārjuna & Garfield, 1995) and Section 3.1.1.4, co-evolve, co-develop, and sensorimotor co-tuned; this entails the *inseparability* between both aspects.

There is a state related to the engrams (memory traces) of long-term memory (LTM) of cognitive feedback system for the experiential sub-aspect of the non-physical aspect. This state consists of the superposition of all possible *potential* beable ontic states stored in the LTM as basis states related to the *potential* primary irreducible SEs representing the existence of the *potentiality* of experiences for living-system and/or conscious artifacts.

Similarly, the state related to the qualitative sub-aspect consists of superposed *potential* basis states related to forms/*rūpa*, patterns of distribution of matter/energy in space and time, and/or patterns of vibrations for both living and non-living systems (Pereira Jr. et al., 2016).

The qualitative sub-aspect can be from 1pp and/or from 3pp. For example, the qualitative sub-aspect can be from 1pp for us (as subjects). For example, suppose we (as trichromatic-subjects from our 1pp) look at a ripe tomato (its 3pp-physical aspect). The form/pattern of the tomato is oval in shape and reflects long wavelength light, which are the qualitative sub-aspects of the 3pp-physical aspect of the ripe state of the tomato. We, as the subjects from our 1pp, experience ovalness and redness. In this sense, it is consistent with eastern metaphysics *Sāṅkhya* because *rūpa* (visual form and pattern) is one of the five *tanmātras* (subtle-matter: *rūpa*/form, *śabda*/sound, *sparsā*/touch, *rasa*/taste, and *gandha*/smell), which are the parts of the *Prakṛti* (physical aspect) of *Sāṅkhya*.

The 3pp-physical aspect also includes the matter-in-itself. Strictly speaking, matter-in-itself, being an entity of ‘mind-independent reality’ (MIR), is unknown, but we try our best to know it by making models using our minds as in physics.

We have assumed that, in Nature, the subjective experiences (experiential sub-aspect) *potentially co-exist* (another postulate) with its *inseparable* physical aspect of a state of an entity. The unmanifested state of the primal entity consists of the *superposition* of the all possible/potential beable ontological (or ontic) dual-aspect basis states (or eigenstates). In other words, the non-physical aspect of a beable ontic basis state *inseparably co-exists* with its physical aspect. For example, a state related to the fundamental irreducible subjective experience redness (a primary color experience) (experiential sub-aspect) and its neural-physical basis (physical aspect) is a beable ontic basis state (also called eigenstate).

The superposition of multiple possible experiential states is motivated by the hypothesis: *the non-physical aspect of wave-state is wave-like and is a function of experiences*. This is based on the assumption that a state of matter (wave/particle) has *inseparable non-physical* and physical aspects. As per the principle of superposition,  $\psi = \sum_i a_i \phi_i$ , where  $\psi$  is a state of an entity and  $a_i$  is the probability amplitude of  $i^{\text{th}}$  basis or eigenstate  $\phi_i$ . Furthermore, the development of specificity of a subjective experience in a specific neural network (such as color in V8/V4/VO area) is detailed in (Vimal, 2008).

### 1.3.3. The second component of the eDAM framework: the dual mode and conjugate matching and selection mechanisms

This is well developed in (Vimal, 2010a). Briefly, the *potentialities* (possibilities) of subjective experiences (SEs: experiential sub-aspect) are *actualized* if all the necessary conditions of consciousness such as the formation of neural-networks, memory, attention and so on (Section 1.3.6 below) are satisfied,<sup>8</sup> and a specific subjective experience related beable ontic state is selected by the ‘self’ via a *matching* process through the interactions of two modes. The two modes are:

- (1) The *non-tilde mode* is related to a dual-aspect state of cognition (such as memory-engrams and attention) and the self; the related feedback (FB) signals in a neural-network (that includes self-related areas such as cortical and sub-cortical midline structures) of the brain represent the cognitive nearest past approaching towards present; and
- (2) The *tilde mode* is related to a dual-aspect state of the stimulus-dependent feed forward (FF) signals due to external environmental input and/or internal endogenous input; this represents the nearest future approaching towards present; it is the entropy/time reversed representation of the non-tilde mode.

Furthermore, one could argue that there are quantum (such as dendritic-dendritic microtubule) and non-quantum (such as classical axonal-dendritic neural and astroglial, hydro-ionic) sub-pathways in each of the feed forward and the feedback pathways for information processing/transfer in the brain dynamics. We propose that:

- (i) The *quantum-conjugate matching* (between *experiences* in the experiential sub-aspect of the non-physical aspect of the tilde mode and that of the non-tilde mode) is related more to the non-physical aspect of a state of the quantum sub-pathway and less to that of the non-quantum sub-pathways.
- (ii) The classical *matching* between *experiences* in the experiential sub-aspect of the non-physical aspect of a state of the tilde mode and that of the non-tilde mode is related to the non-physical aspect of a state of the non-quantum sub-pathways.

In all cases, a specific SE is selected by the self (*not* by any homunculus) (a) if the tilde mode interacts with the non-tilde mode to *match* for a specific SE, and (b) if the *necessary* conditions of SEs (Section 1.3.6) are satisfied. If the conjugate match is made between the two modes, *the world-presence (Now)* is disclosed; its content is the SE of subject (self), the SE of objects, and the content of SEs. The self is the experiential sub-aspect of the non-physical aspect of the self-related state of a subject's mind-brain system. The experiential sub-aspect of the inseparable physical aspect is the self-related neural network (such as cortical and sub-cortical midline structures) and its activities that is a part of reentrant feedback system.

Let us take an example of “looking at a ripe-tomato” to experience its color; the long-wavelength light is reflected from it and enters the eyes of a trichomat and process thru the redness related NN (neural network). The neural signals in the tilde mode and that in the non-tilde mode are matched to select a specific beable ontic dual-aspect state related to a specific SE (such as redness of a ripe-tomato) and experienced by the self. If there is no match then it is a novel stimulus; in this case, the beable ontic state related to stimulus-dependent-FF signal is selected and experienced; if the stimulus is salient then related engram is stored in the long-term memory (LTM) for future encounters. This selected specific beable ontic state has four sub-aspects: functional (detection and discrimination of redness from other colors), qualitative (long wavelength pattern/form/rūpa), cognitive (relevant cognition such as memory, attention, thoughts), and experiential (SE redness) sub-aspects of non-physical aspect from the subject's 1pp and inseparable physical aspect (structure: redness related V8-NN) from the subject's 3pp. In all cases, the *inseparability* (1-1 relationship) between respective sub-aspects of non-physical and physical aspects is maintained within a critical spatiotemporal interval.<sup>9</sup>

As per (Vimal, 2015a):

- The two modes are stimulus-dependent-feed-forward-signals-related-mode and cognitive-feedback-signals-related-mode. They interact for conjugate matching and then the selection of a specific subjective experience occurs and experienced by the self (Bruzzo & Vimal, 2007).
- For experiencing a specific SE, there are three major interacting signals: (i) stimulus-dependent feed forward (FF) signals, (ii) stimuli-related-memory-dependent cognitive feedback (FB) signals, and (iii) self-related signal that is a part of reentrant FB signals.
- The self can be defined as follows: (a) The self is the SE of subject (Bruzzo & Vimal, 2007). (b) The self consists of proto-self, core-self, and autobiographical-self (Damasio, 2010) as active dynamic self (ADS), and invariant passive self (PIS). And (c) the self is the 1pp experiential sub-aspect of the non-physical aspect of a state of 'self-related neural network (such as cortical and sub-cortical midline structures: (Northoff & Bermpohl, 2004)) and its activities'.
- The matching/interaction is between FF and FB signals; then the self-related signals interact with the resultant signal representing the matching between stimulus-related FF signal and cognitive FB signals; thus, there are interactions between the three major signals; this interactive process can be called as 'the specific SE is selected and experienced by the self'.

To sum up, in the eDAM, a dual-aspect FB-related state is composed of the superposition of many beable ontic dual-aspect states, which can be included as basis states in the Hilbert space. Each LTM-engram/trace related state is a dual-aspect basis state. For example, a color related LTM-engram/trace state is composed of the superposition of many beable ontic color related dual-aspect states, which are stored in color area (V8/V4/V8 NN) LTM.

In the eDAM, interactions are mandatory, so interactionism is a valid concept. For example, matching involves interaction between stimulus-related feed-forward (FF) and cognitive (LTM) feedback (FB) reentrant signals. Then, the self-related signals (from cortical and sub-cortical midline structures) must interact with the matched resultant signals to select a specific beable ontic dual-aspect state (such as redness-related state when the subject looks at a ripe-tomato) and then the "self" experiences it.

Sampling (Block, 2018)<sup>10</sup> is equivalent to collapse of superposed states of all orientations into a specific state of vertical orientation. Both sampling and collapse processes seem related to the matching and selection mechanisms for selecting a beable ontic state that has specific SE as experiential sub-aspect of the non-physical aspect and its NCC/NPB as the physical aspect in the eDAM framework.

### 1.3.4. The third component of the eDAM framework: the concept of the varying degrees of the manifestation of aspects depending on entities and their states

The third component of the eDAM is the varying degrees of manifestation (appearance/strength) of four sub-aspects of physical and non-physical aspects of a state of an entity depending on the states/levels of entities and contexts, where contexts include entity-state, environment, background, surround, and so on. This is well developed in (Vimal, 2013). It should be clearly noted that the physical and *inseparable* non-physical aspects of a specific sub-aspect are always manifested simultaneously (not sequentially one after another) thru interdependent co-arising within a critical spatiotemporal interval; this is the requirement of inseparability. At each level, the manifestation of aspects is through dependent co-origination (Nāgārjuna & Garfield, 1995), i.e., through co-evolution, co-adaptation, natural selection, co-development and sensorimotor co-tuning. For example, the degree of manifestation of the *experiential* sub-aspect of the physical and non-physical aspects of a beable ontic state of a non-living (inert) non-conscious entity is zero (latent, unmanifested), but that of a beable ontic awake-conscious state of a human mind-brain system is high.

The degrees ( $\check{d}$ ) of manifestation of four pairs of sub-aspects of physical (p) and non-physical (np) aspects of a beable ontic wakeful conscious state of a mind-brain system are equally high. The pairs are (i)  $\check{d}_{ep}$  and  $\check{d}_{enp}$ , (ii)  $\check{d}_{cp}$  and  $\check{d}_{cnp}$ , (iii)  $\check{d}_{qp}$  and  $\check{d}_{qnp}$ , (iv)  $\check{d}_{fp}$  and  $\check{d}_{fnp}$ , where subscripts e, c, q, f are for experiential, cognitive, qualitative, and functional sub-aspects. If we arbitrarily assign 25% as degree of manifestation for each sub-aspect, then sum of all four sub-aspects are 100%.

In a non-living (inert) system, such as a statue, the degrees of manifestation of two pairs of sub-aspects (qualitative and functional) of physical and non-physical aspects of a beable ontic state of the statue system are equally high. However, other two pairs (experiential and cognitive) sub-aspects are latent. In other words, (i)  $\check{d}_{ep} = \check{d}_{enp} = 0$  (latent, unmanifested) (ii)  $\check{d}_{cp} = \check{d}_{cnp} = 0$ , (iii)  $\check{d}_{qp} = \check{d}_{qnp} = 25\%$ , (iv)  $\check{d}_{fp} = \check{d}_{fnp} = 25\%$ ; then sum of all four sub-aspects are 50%, which is half of the degrees of manifestation of our conscious state.

The degrees of manifestation of the experiential and cognitive sub-aspects of the physical and non-physical aspects of a state of an inert entity are latent (or unmanifested or apparently absent). This led materialists to assume matter (physical aspect) is the only fundamental reality that leads to serious problems such as the well-known explanatory gap problem (Levine, 1983): how experiences can arise from matter.

My **working hypothesis** is as follows: The unmanifested state of the primal entity (*Brahman, unus mundus*) had all four sub-aspects of both *inseparable* physical and non-physical aspects latent before manifestation. After Big Bang, first, its qualitative and

functional sub-aspects of physical and non-physical aspects were co-manifested/co-arisen, but its experiential and cognitive sub-aspects of the physical and non-physical aspects were not yet manifested, i.e., the degrees of the manifestation of the experiential and cognitive sub-aspects were still latent/hidden/unmanifested. This is because experiences and cognition are unique property of living systems, whereas patterns/forms (qualitative sub-aspect) and functions are properties of both living and non-living systems. In other words, the qualitative and functional sub-aspects of physical and non-physical aspects co-manifested (i.e., co-arose, co-evolved, co-developed, and sensori-motor co-tuned) with high degrees. This is consistent with the Buddhist interdependent co-arising (also called dependent co-origination) (Nāgārjuna & Garfield, 1995). Eventually the degree of manifestation of all four sub-aspects of physical and non-physical aspects of a beable ontic state of a mind-brain system become high in us when we are awake conscious. Similarly, we can argue for degrees of manifestation of sub-aspects of aspects at *samādhi* state of mind-brain system.

The two postulates of the eDAM imply that the *inseparable* qualitative and functional sub-aspects of physical and non-physical aspects of various states of various inert entities co-evolved and co-arose over 10 billion years after Big Bang. We know what happened to the functional sub-aspect (and to some extent qualitative sub-aspect) of the physical and non-physical aspects of the states of galaxies, stars, planets and all non-living and living entities because they all have structure and function. However, the cognitive and experiential sub-aspects of the physical and non-physical aspects during co-evolution remain latent or hidden to us and needs further elaboration and research.

First, let us first clarify a term *proto-experience* (PE). A proto-experience is defined as the precursor of a *potential* subjective experience (SE). The experiential and cognitive sub-aspects of the physical and non-physical aspects co-evolved with their *inseparable* physical aspects from one entity to another during the formation of galaxies, stars, planets, etc. and eventually us.

For example, the innumerable beable-ontological states (such as a redness related state) can be introduced in the Hilbert space as basis states, which are superposed in a quantum state of an elementary particle; see also ('t Hooft, 2015). Each state has *inseparable* non-physical and physical aspects. When the relevant elementary particles are combined appropriately to form, for example, an atomic proton, the remaining (other than *realized* state related to the proton) superposed beable-ontological states of elementary particles are appropriately transferred as the superposed beable-ontological states into a state of proton. Similarly, one could argue for molecules and other aggregates. They are elaborated in Sections 3.14 and 3.15, especially 3.14.101.[1].10.[A], of (Vimal, 2016b)).



To sum up, the cognitive and experiential sub-aspects of the physical and non-physical aspect of a state of an inert entity remained latent to us. However, its patterns/forms (qualitative sub-aspect) and functions have higher degree of manifestation so they are not latent to us. Over 10 billion years after Big Bang or about 3.8 billion years ago, when life started, the degrees of manifestation of cognitive and experiential sub-aspects of the physical and non-physical aspects of the states of living entities started increasing from *latent* to higher level. Eventually in us, in conscious states, after 3.8 billion years of co-evolution (13.8 billion years after Cosmic Fire or Big Bang), the degrees of manifestation of cognitive and experiential sub-aspects of non-physical and physical aspects are equally high.

We perceive (from our 1pp) the forms/patterns/vibrations of distribution of matter/energy in space and time on non-living and living entities. This entails the existence of the qualitative sub-aspect of the 3pp-physical aspect of a state of an entity; this can be called as 3pp-qualitative sub-aspect of the physical aspect of the state of the entity. In other words, the 1pp-*qualitative* sub-aspect of the non-physical aspect of a state of a living or non-living entity, such as forms and patterns, can be perceived or implicitly *inferred* from its 3pp. Therefore, the degrees ( $\bar{d}_{qp}$  and  $\bar{d}_{qnp}$ ) of manifestation of qualitative sub-aspect of physical and non-physical aspects of an entity are always high. The same argument can be made for the functional sub-aspect.

However, the experiential and cognitive sub-aspects of the physical and non-physical aspects of a state of a non-living system are 'latent'/unmanifested/hidden to us. In other words, in inert (non-living) entities at classical level, such as molecule, the related degrees  $\bar{d}_{ep}$  and  $\bar{d}_{cp}$  (for physical aspect),  $\bar{d}_{enp}$  and  $\bar{d}_{cnp}$  (for non-physical aspect) for experiential and cognitive sub-aspects are zero (latent). This does not mean that nonliving systems have consciousness like us that is hidden from us. Instead, a state of an inert entity consists of the superposition of the beable ontic basis states that have experiential and cognitive sub-aspects, which are still unmanifested.

Biological organisms can be conscious if the evolutionary development of organisms is sufficiently developed or complex and the necessary conditions of consciousness are satisfied (Section 1.3.6). In living systems, at human level, when we are awake and conscious, all four sub-aspects of both aspects are equally manifested. In other words, inert nonliving matter, proteins, neurotransmitters, and neuromodulators including all those entities, which do not satisfy the necessary conditions of consciousness, will not be conscious.

This does not mean that quantum consciousness is not supported; it is supported as long as it is interpreted in terms of the eDAM. In quantum dendritic-dendritic mechanism, quantum Orch OR is hypothesized to occur in microtubule-network (Hameroff & Penrose,

1998), but its metaphysics is Neutral Monism, which has problem: how physical and non-physical aspect can be derived from a neutral entity that has none of them. If the Neutral Monism is interpreted in the eDAM that both physical and non-physical aspects of the unmanifested state of neutral entity are latent; then the problem is resolved because the degree of manifestation varies with level/state of an entity and the context as elaborated above. Here, a specific SE say *redness* is selected from potential SEs embedded in brain's spacetime geometry by objective reduction (the collapse used by Orch OR) of *potential* SEs (or PEs); the related beable ontic basis states are superposed in a state of microtubule-neural-network.

It is only at the neural-network level (in *living* systems), a specific SE (such as *redness*) will occur in a specific neural network (such as the red-green V8/V4/VO-neural-network) if (a) the *necessary* conditions (including biological laws) of SEs are satisfied (Section 1.3.6), and (b) if the self selects the specific SE via the matching process (Section 1.3.3). If there is no matching between feedforward (FF) and memory engram based cognitive feedback (FB) signals then it is a **novel stimulus**. Then the 'self' selects the related beable ontic state, experiences it, and stores in the LTM is it is a salient stimulus. Even the retina is not privileged to have SEs because it does not satisfy the essential conditions of consciousness, although retina is essential for vision. The retinal opponent and non-opponent networks include red-green and yellow-blue opponent cells, luminance non-opponent cells, and related visual channels. These networks will have higher specificity (higher degrees  $\bar{d}_{\text{enp}}$  and  $\bar{d}_{\text{ep}}$  of experiential sub-aspect of the non-physical and physical aspects) for SEs than cones and rods. The cones and rods will have higher specificity for SEs than molecules, atoms, and electrons; specificity is elaborated in (Vimal, 2008).

Let us examine the degrees of manifestation  $\bar{d}_{\text{fp}}$ ,  $\bar{d}_{\text{qp}}$ ,  $\bar{d}_{\text{cp}}$ , and  $\bar{d}_{\text{ep}}$  for the physical aspect and  $\bar{d}_{\text{fnp}}$ ,  $\bar{d}_{\text{qnp}}$ ,  $\bar{d}_{\text{cnp}}$ , and  $\bar{d}_{\text{enp}}$  for non-physical aspect of the functional, qualitative, cognitive, and experiential sub-aspects, respectively from humans to classical inert entities to quantum entities. We postulate that a state of 'entity-in-itself' has *inseparable* dual (non-physical and physical) aspects. This implies that a state of 'human-in-herself' has 3pp-physical aspect (such as body-brain system and its activities) and inseparable 1pp non-physical aspect with equally high degrees of manifestation at conscious state. In other words, the degrees of manifestation  $\bar{d}_{\text{fp}}$ ,  $\bar{d}_{\text{qp}}$ ,  $\bar{d}_{\text{cp}}$ , and  $\bar{d}_{\text{ep}}$  for the physical aspect and  $\bar{d}_{\text{fnp}}$ ,  $\bar{d}_{\text{qnp}}$ ,  $\bar{d}_{\text{cnp}}$ , and  $\bar{d}_{\text{enp}}$  for non-physical aspect are high. The four sub-aspects are (i) functions in the functional sub-aspect; (ii) the qualitative sub-aspect; (iii) thoughts, intentions, self, attention, and other cognitions in the cognitive sub-aspect; and (iv) SEs in the experiential sub-aspect.

The states of animals and birds have the degrees of manifestations of fours sub-aspects seem to be of different (mostly lower) degree compared to humans. The states of plants have physical aspects such as their roots to branches and activities and non-physical aspects such as functions and patterns/forms. However, it is unclear if they have experiences, self, attention, and other human-like cognitions; they may have plant-type proto-experiences, which are latent to us. Therefore, the degrees of manifestations of functional and qualitative

sub-aspects are high, but that of their cognitive and experiential sub-aspects are lower than animals.

The states of dead bodies (of human, animals, birds, and plants), inert entities, and other classical macroscopic and quantum microscopic (such as elementary particles) entities have high degrees of manifestation for functional and qualitative sub-aspects, but that of the cognitive and experiential sub-aspects are zero (meaning latent, hidden, unexpressed, invisible, recessive (in analogy to recessive gene), or unmanifested).

The degrees of manifestation of the four sub-aspects need further clarification: we are puzzled on the degrees of manifestation of four sub-aspects because we are unable to visualize and we depend on our models and indirect effects. On top of this, there are over 47 interpretations of quantum mechanics (QM). We will never know what quantum entities experience and think (if any!); so, the experiential and cognitive sub-aspects of the physical and non-physical aspects of a state of a quantum entity are hidden for us. Therefore, we propose that a state of a quantum entity has a sort of high  $\mathfrak{d}_{fp}$ ,  $\mathfrak{d}_{fnp}$ ,  $\mathfrak{d}_{qp}$ , and  $\mathfrak{d}_{qnp}$  and latent  $\mathfrak{d}_{cp}$ ,  $\mathfrak{d}_{cnp}$ ,  $\mathfrak{d}_{ep}$ , and  $\mathfrak{d}_{enp}$ , somewhat similar to classical inert objects. Quantum physicist Stapp argues for Global Mind and mindlike quantum entities (Stapp, 2009a, 2009b, 2013). However, quantum non-physical aspect is not like human mind; rather, the quantum mindlike non-physical aspect has to co-evolve with its *inseparable* physical aspect over billions of years, and the end product is human mind (non-physical aspect) and *inseparable* human brain (physical aspect), respectively. The above clearly elaborates the difference between living and nonliving systems.

### 1.3.5. The fourth component of the eDAM framework: Segregation and integration of information

This is discussed in (Vimal, 2015d). Briefly, there are two steps: (i) the segregation of information for the analysis of specific stimulus attributes (related to dimension such as redness, sub-mode such as color, and mode such as vision), and then (ii) the integration of information for the synthesis of all attributes, which results unified consciousness. In other words, the first stage of processing is the segregation of information (such as the information related to physical and conceptual attributes), which are analyzed and processed for preciseness and specificity in different specialized neurons of related brain areas. Then, the second stage of processing is the integration of information (or binding of attributes) (related to different functions, concepts, experiences and so on) in various neural-network-complexes, which results unified consciousness. The term ‘differentiation’ signifies that there are a large number of possible functions and *potential* experiences; this leads to higher effective information (Tononi, 2004).

I proposed three justifications in favor of the eDAM and its inseparability:

- (i) The original source is dual-aspect primal structure (dual-aspect Brahman),
- (ii) The “effective” information (see below) from the same stimulus source to both aspects, and
- (iii) The critical test should show separability (if it exists).

The ontology of both aspects starts from the ontology of primal dual-aspect structure with the **effective information** between aspects. Here, let us use the term “effective information” instead of information to avoid confusion related to the form of information, information loss during transduction, during information conversion, and during transfer, and passive information not used in the active information. The “effective information” is defined as the information that has the same effect in both aspects, i.e., if there is a change in the information in the 3pp-physical aspect (as in the information in neural signals related to stimulus’ neural representation), it should have corresponding change in the inseparable information in the 1pp non-physical aspect and vice versa.<sup>11</sup>

Since effective information is proposed to be the same (i.e., has the same effect) in both aspects at all levels, both aspects should be inseparable. Whatever goes on in one aspect is reflected in the other aspect. The contents of aspects look different because the perspectives of viewing are different. For example, physical (light) information (in the form of long wavelength and intensity of light) reflected from a ripe-tomato is transduced into electrochemical signal in retina (same effective information but in the form of neural signal), which travels towards cortex. Then the matching and selection mechanisms select a specific SE redness (which is the same effective information but in psychological form) and the “self” experiences it. For convenience, we can propose as follows: The effective information in the external light in physical form = effective physical information in neural form = common effective information in both aspects in abstract physical and non-physical form = non-physical effective information in experiential/psychological form.

The integrated information theory (IIT) of consciousness (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) is based on the materialistic identity theory (consciousness is integrated information) or to some extent panpsychism (Tononi & Koch, 2014). However, both materialism and panpsychism have serious problems (Vimal, 2010b, 2013). Therefore, the IIT is re-interpreted in terms of more efficient metaphysics, such as the eDAM framework in (Vimal, 2015d), which has the least number of problems; here, an information is a dual-aspect entity.

In the eDAM framework, consciousness [experiential (experiences/experiencer) and cognitive sub-aspects as defined in (Vimal, 2010b) and Section 1.3.1.4] is the 1pp non-physical aspect of a state of related neural network that has high amount of integrated non-physical information  $\Phi_{np}$ . Consciousness has two sub-aspects: (a) the *experiential* sub-

aspect of the non-physical aspect, such as SEs including feelings, emotion- and thought-related experiences and (b) the *cognitive* sub-aspect of the non-physical aspect, such as related to cognition. The 3pp-physical aspect (for each sub-aspect) of this state is the correlated neural-network (such as thalamocortical main complex) and its activity as its neural substrate that has high amount of integrated physical-information  $\Phi_p$  (for each sub-aspect), which is close to the term ‘integrated information’  $\Phi$  (for each sub-aspect) used in (Tononi, 2004, 2008, 2012) and (Balduzzi & Tononi, 2009). Since 1pp non-physical and 3pp-physical aspects are *inseparable*, ‘non-physical’ and ‘physical’ information related to the same brain-mind state are also *inseparable*, which is called “effective” information common to both aspects.

### 1.3.6. The fifth component of the eDAM framework: Necessary and Sufficient Conditions of consciousness

This Section is adapted from (Vimal, 2016c). The criterion for the selection of *necessary conditions* is that if any of them is missing, we will not have consciousness (SEs of objects), i.e., the necessary conditions are those conditions that must be satisfied in order to have consciousness. The *sufficient conditions* for consciousness are conditions, if satisfied, guarantee that the entity is conscious. Consciousness can be either *access* (reportable) or *phenomenal* (non-reportable) consciousness (Block, 2005; Lamme, 2003). For *access* consciousness, the interactions are between feed forward stimulus dependent signals and fronto-parietal feedback attentional signals. The *necessary* conditions for *access* (reportable) consciousness are:

- (i) Formation of neural-networks,
- (ii) Wakefulness,
- (iii) Reentrant interactions among neural populations,
- (iv) Fronto-parietal and thalamic-reticular-nucleus attentional signals that modulate consciousness,
- (v) Working memory that retains information for consciousness,
- (vi) Information integration in ‘complex’ of neural-network, such as thalamocortical complexes with critical spatiotemporal ‘grain-size’ (Tononi, 2004, 2008, 2012),<sup>12</sup>
- (vii) Stimulus contrast at or above the threshold level, and
- (viii) Neural-network potential proto-experiences (PEs) that are precursors of subjective experiences (SEs) embedded in a neural network.

One could further argue for other necessary conditions, such as (ix) higher-order thoughts, (x) executive functions, (xi) neural synchrony, (xii) intrinsic activity (Northoff, 2014), (xiii) active dynamic self (ADS) that is composed of proto-self, core-self and autobiographical self, (xiv) passive invariant self (PIS), (xv) feature and binding, and so on.

Certain neural-network or brain complex (such as thalamocortical ‘complex’) comparatively has very high integrated information ( $\Phi$ ). Therefore, it is a privileged area for consciousness. Attention and the ability to report are not necessary for *phenomenal* consciousness. Therefore, the necessary conditions for the phenomenal consciousness are the same as that for the access consciousness except the fourth condition related to attention. Further research is needed to address if the above *necessary* conditions of consciousness are also *sufficient*.

The eDAM framework (a) is parsimonious and has the least number of problems compared to all other frameworks (Vimal, 2015a), (b) is consistent with psychophysical, biological, and physical laws, and (c) attempts to address the ‘hard’ problem of consciousness (how to explain SEs) (Vimal, 2015d) and Section 2.7.

## **2. Segregation, differentiation, integration, hard problem, and the eDAM framework**

The models and results for the fourth component of the eDAM framework are related to the segregation and differentiation of information (Section 2.5) and then the integration of information (Section 2.6). The model and result for the solution of hard problem are given in Section 2.7.

### **2.1. Test-hypotheses and specific aims**

Our hypotheses and specific aims for this article are as follows:

- (1) The re-interpretation of the materialism and to some extent a version of panpsychism based Tononi-Balduzzi-Koch’s Integrated Information Theory (IIT) of Consciousness ((Tononi, 2004, 2008, 2012), (Balduzzi & Tononi, 2008, 2009), and (Tononi & Koch, 2014)) in the eDAM framework (Sections 1.3) leads to fewer problems.
- (2) The *inseparability* of 1pp non-physical aspect (experiential and/or functional sub-aspects of consciousness) and 3pp-physical aspect can be tested.
- (3) The ‘hard’ problem of consciousness can be better addressed by the eDAM framework.

### **2.2. Dual-aspect information**

There are two major categories of information<sup>13</sup>:

- (1) Shannon-Wiener information is [signal transmission theory](#) and is independent of meaning/semantic, organization and its material instantiation (Logan, 2012). “Shannon ... information is the amount of uncertainty in a message (a sequence of data) measured through probabilistic analysis of its elements” (Pepperell, 2018).
- (2) MacKay-Bateson meaningful information, also called biotic or instructional information: information is “a difference that makes a difference” (Bateson, 1979). “The integrated information theory of consciousness (IIT) proposed by Tononi and

colleagues provides an alternative, non-Shannonian, definition of information as ‘a form in cause-effect space’ (Tononi, Boly, Massimini, & Koch, 2016). [...] Information ... as a measure of the way energetic processes are organized, that is, their degree of differentiation and integration” (Pepperell, 2018).

**Shannon-information vs. IIT-information:** Shannon-information is extrinsic information without any meaning and is from 3pp. On the other hand, IIT-information is intrinsic information with a specific meaning and is from 1pp. The circuits (neural-networks) that “generate meaning originate, develop, and refine through a long process of evolution, neural development, and learning, under the selective pressure of a complex environment” (Supporting Information S3 of (Oizumi, Albantakis, & Tononi, 2014)). This intrinsic information with a specific ‘meaning’ is related to a specific subjective experience (**SE**), such as redness. However, it is unclear where from such a specific SE comes. In the eDAM framework, the source of such primary irreducible SEs *potentially* co-exist with its inseparable physical aspect in the Nature such as in the universal potential consciousness informational energy field (**UPCIEF**) with random eternal consciousness fluctuations (**CFs**). This is the non-physical aspect of the unmanifested state of the primal unified informational energy field (**UIEF**). The inseparable physical aspect of this unmanifested state is physical UIEF (**PUIEF**, quantum vacuum) with random eternal quantum fluctuations (QFs). The UIEF has many names such as emptiness with CFs/QFs, unus mundus, and Brahman. The QFs and CFs have the same common ‘effective’ information and are inseparable.

As per (Logan, 2012), “Data are the pure and simple facts without any particular structure or organization, the basic atoms of information ... Information is structured data, which adds more meaning to the data and gives them greater context and significance ... Knowledge is the ability to use information strategically to achieve one’s objectives”.

As per (Pepperell, 2018), “the governing principle of the brain at the neural level is not information processing but energy processing. [...] Cause-effect space, according to [(Tononi et al., 2016)], contains a “conceptual structure”— a constellation of related concepts — that is specified by the “physical substrate of consciousness” (PSC), this being the precise complexes of neural activation involved in any experience. Each conscious experience is identical with this “form”, denoted  $\Phi_{max}$  when maximally integrated. But while IIT is presented as a theory of integrated information, it could just as well serve as a theory of how energetic processing is organized since the PSC consists in the causally interrelated patterns of neural firing that are identical with the conscious experience. [...] (Logan, 2012) ... defines ‘biotic information’ as the organization of the exchange of energy and matter between organism and environment.” This is consistent with the eDAM’s unified informational energy field (UIEF) at primal level.

As per Chalmers (Chalmers, 1995).(p.216), “information ... has two basic aspects, a physical aspect and a phenomenal aspect”. Information is in (or related to) an entity, but an entity can have many states. Therefore, ‘the physical or non-physical aspect of information’ means ‘the physical or non-physical aspect of a state of an entity’. The physical aspect of information is embodied in physical processing. However, experiences arise through the phenomenal (non-physical) aspect of information. In other words, information remains the *same* in both perspectives (3pp and 1pp). It is just ‘looking’ the same information in two different perspectives that are as follows:

1. Objective 3pp-physical aspect (such as anatomical structure and related activities) of a NN of brain-mind state, and
2. Subjective 1pp non-physical aspect of the same state, such as experiential and cognitive sub-aspect of consciousness (Vimal, 2009b, 2010b) (see also Section 1.3.1.3).

In this article, information (a) related to 3pp-physical aspect is called ‘physical information’ and (b) that related to 1pp non-physical aspect is called ‘non-physical information’. Both aspects have the same “effective” information.

### 2.3. Steps for unified experience

In the eDAM framework, the following steps are necessary for unified experience  $\mathcal{E}$  across space-time assuming the necessary conditions of consciousness (Vimal, 2014b) are satisfied:

- (i) The segregation of information occurs in spatiotemporal stimulus dependent feed-forward signals  $FF(x, y, z, t; i, j, k)$  related to  
 A specific dimension ( $i$ : redness, greenness, blueness etc.) of  
 A specific submode ( $j$ : submodes of visual mode, such as color, motion, shape etc.) of  
 A specific mode ( $k$ : vision, audition, pain, etc.) at a specific space-time  $(x, y, z, t)$  for a specific analysis in related brain areas. For example, these areas are ‘visual area 8’ (V8), ‘visual area 4’ (V4), or ‘ventral occipital area’ (VO) i.e., V8/V4/VO for color and ‘visual area 5’ (V5) and ‘middle temporal area’ (MT) for motion.
- (ii) During matching process, feed-forward signals  $FF(x, y, z, t; i, j, k)$  interact with cognitive feedback signals  $FB(x, y, z, t; i, j, k)$  and integration (binding, synthesis) of information takes place in a related neural-network ‘complex’ over dimensions ( $i$ ), submodes ( $j$ ), modes ( $k$ ), and space-time resolution  $(\Delta x, \Delta y, \Delta z, \Delta t)$ .
- (iii) After matching and information integration, the selection of a specific experience  $\mathcal{E}(\Delta x, \Delta y, \Delta z, \Delta t)$  related to a specific dimension of a specific submode of a specific mode for a specific space-time *critical interval* occurs. Many such SEs (micro-



consciousness: (Zeki & Bartels, 1999)) are then used in binding processes for a unified consciousness/experience as elaborated in Section 3.10 of (Vimal, 2010a).

**(iv)** For the selection of specific experience, interaction with self-related signals (a part of feedback system) takes place, i.e., selected and experienced by the self. There is spatiotemporal critical grain size  $(\Delta x, \Delta y, \Delta z, \Delta t)$  for conscious experiences to occur/arise. Therefore,  $\mathcal{E}(\Delta x, \Delta y, \Delta z, \Delta t)$  is more appropriate than point-wise instantaneous experiences  $\mathcal{E}(x, y, z, t)$ . Moreover the concept of ‘point’ has the problem of singularity; rather, instead a string of Planck-length does not have such problems (Greene, 1999). In other words, in both space and time, there is ‘grain size’ at which information integration ( $\Phi$ ) reaches a maximum. This is related to consciousness, i.e., there is a spatiotemporal critical threshold (grain size) for conscious experiences to occur/arise (Tononi, 2004)).

#### **2.4. Segregation, differentiation, integration, hard problem, and the eDAM framework**

(Tononi, Sporns, & Edelman, 1996) proposed, “functional segregation within a neural system in terms of the relative statistical independence of small subsets of the system and functional integration in terms of significant deviations from independence of large subsets”. This is consistent with metastability (Kelso, 2012). This involves a balance between segregation and its complement integration<sup>14</sup> (Tononi, Sporns, & Edelman, 1994). In addition, metastability (Kelso, 2012) is an expression of brain-complexity that reach a maximum when the necessary balance is attained (Tononi et al., 1994). Furthermore, Tononi proposed an integrated information theory of consciousness, where “consciousness corresponds to the capacity of a system to integrate information” (Tononi, 2004). In addition, the experiential aspect of consciousness has two key properties (Tononi, 2004):

- (i) The *differentiation*, which is the availability of a very large number of micro conscious SEs and
- (ii) *Integration*, which is the unity of such experiences.

From the above, to address the hard problems of consciousness in rigorous manner, we also need the fourth component of the eDAM framework that includes:

- (i) The segregation of information for the analysis of specific stimulus attribute (Section 2.5) and then
- (ii) The integration for synthesis of all attributes (related to dimension, sub-mode, and mode) for unified consciousness (Section 2.6).

In other words, the first stage of processing is the segregation of information (such as physical attributes and conceptual attributes). These segregated attributes are analyzed and processed for preciseness and specificity in different specialized neurons in brain areas. Then, the second stage of processing is the integration (or binding) of information

related to different functions, concepts, and experiences, which are in various neural-network-complexes. They are integrated for unified consciousness.

Furthermore, as per (Tononi & Koch, 2014), “IIT was not developed with panpsychism in mind (*sic*). However, in line with the central intuitions of panpsychism, IIT treats consciousness as an intrinsic, fundamental property of reality.” It appears that IIT (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) involves both materialistic identity theory and a version of panpsychism. However, both have serious problems such as the explanatory gap problem in materialism and the combination problem in panpsychism. Other related problems are elaborated in (Vimal, 2010b, 2013). Materialistic identity theory explains only the objective 3pp-physical aspect of a brain-mind state. This is because it cannot explain how experiences (1pp-experiential sub-aspect of non-physical aspect) arise from non-experiential matter, such as brain.

Therefore, it is justified to develop IIT in the eDAM framework in such a way that it can also explain the 1pp non-physical aspect of brain-mind states such as experiential and cognitive aspect of consciousness (Vimal, 2009b, 2010b).

## **2.5. Segregation and Differentiation of Information**

### **2.5.1. Segregation**

In our daily lives, our receptors transduce signals related to external stimuli of various modalities such as visual, auditory, somatosensory, taste, and smell. Then, each modal signal (such as visual) further segregates into sub-modal signals such as color and motion of visual mode. After that, each sub-modal signal (such as color) further segregates into different dimensions (such as red, green and blue) for more specific and precise analysis related to function and experience. This process is called segregation related to functions and experiences. The segregated areas are for cognitive and experiential specialization, such as, V8/V4/VO neural network (NN) for color, and V5/MT NN for motion.

There are two contradictory appearing views on experiences and brain functions (Tononi et al., 1994):

1. *Localizationist views* that stress the specificity and modularity of brain organization: This entails the experiential and functional segregation of different brain regions for different stimulus attributes. For example, visual areas V8 and V5 are specialized for color and motion visual modes, respectively.
2. *Holist views* that emphasize mass action, global functions and experiences, and Gestalt phenomena: This implies integration in perception and in behavior. Furthermore, neural complexity is a measure of consciousness. It is low when “the components of a system are either completely independent (segregated) or completely

dependent (integrated)” (Tononi et al., 1994). It is high when “segregation coexists with integration” (Tononi et al., 1994).

### 2.5.2. Differentiation

The term ‘differentiation’ means that there are a large number of possible functions (functional sub-aspect) and *potential* experiences, which leads to higher effective information; each of these is capable of *realization* (Tononi, 2004). Since photodiode has only two states (ON or OFF), it corresponds to 1 bit of information; and hence its repertoire is minimally differentiated. We are able to differentiate among a very large number of states and we have innumerable brain-mind states, so we have large number of bits of information and our repertoire is enormously differentiated (Tononi, 2004). This concept of differentiation fits in very well with the superposition of many basis-states giving a dual-aspect mind-brain state as elaborated in Section 1.3; each basis-state corresponds to a possible/*potential* experience, cognition, pattern/form (qualitative sub-aspect), and function. In other words, we have the ability to differentiate a specific state out of a very large number of states, i.e., we can select one specific state (such as detecting a light) out of many states. We propose that this is done by the matching and selection mechanisms as elaborated in the second component (Section 1.3.3) of the eDAM framework.

### 2.6. Integration of Information

The integrated information theory (IIT) of consciousness (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) is based on the identity theory (consciousness is integrated information) of materialism. However, materialism has serious problems (Vimal, 2010b, 2013). Therefore, IIT needs to be interpreted in terms of the least problematic eDAM framework (Section 1.2-1.5), where information is a dual-aspect entity. Consciousness includes experiences (such as self, feelings, emotion- and thought-related experiences). In the eDAM framework, consciousness is the 1pp non-physical aspect of a state of related neural network (such as thalamocortical main complex) with high amount of integrated mental-information  $\Phi_{\text{mental}}$ . The 3pp-physical aspect of this state is this neural-network and its activity as its neural substrate with high amount of integrated physical-information  $\Phi_{\text{physical}}$ . This is close to the term ‘integrated information’  $\Phi$  used in (Tononi, 2004, 2008, 2012) and (Balduzzi & Tononi, 2009). There are four sub-aspects of each of the aspects, which imply four (experiential, cognitive, functional and qualitative) pairs of physical and non-physical aspects. The physical and non-physical aspects of each pair are *inseparable*. Therefore, the ‘non-physical’ and ‘physical’ information related to the same brain-mind state are *inseparable*, which implies the “effective” information between physical and non-physical aspects are the same.

The *quantity* of consciousness is related to the amount of information integrated through the matching/non-matching mechanism (Section 1.3.3), which involves the interaction

between feed-forward (FF) and feedback (FB) signals in a complex of elements. The word ‘non-matching’ entails for a novel stimulus, where there is no matching between FF and FB signals. This quantity is above and beyond the parts or elements of the complex. The *quality* of consciousness is determined by the set of all the informational relationships generated by the matching/non-matching and selection mechanisms (Section 1.3.3). In the eDAM framework (Sections 1.3), the observer (self: (Bruzzo & Vimal, 2007)) is the 1pp non-physical aspect of the state of self-related integrated information, and the observed experience (SE of object) is the 1pp non-physical aspect of the state of object-related integrated information.

### 2.6.1. Stationary systems: Derivation of an expression for integrated 3pp-physical information $\Phi(S)$ for consciousness in the eDAM framework

*Motivation:* As elaborated above, integrated information theory (IIT) of consciousness (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) claims that consciousness is integrated information, which is based on problematic materialism. In the least problematic eDAM framework, information is a dual-aspect (3pp-physical and 1pp non-physical aspects) entity.

To derive an expression of 3pp-physical integrated information  $\Phi$ , the following information theoretic terms and related expressions are needed (Tononi, 2004):

- (a) Entropy  $H$  as defined in Eqs. (1) and (2),
- (b) Mutual information (MI) that needs entropy and is defined in Eqs. (3) and (4),
- (c) Integration  $I(X)$  that needs entropy and is defined in Eq. (5) (Tononi et al., 1994),
- (d) Effective information (EI) that needs MI and is defined in Eqs. (6) and (8),
- (e) Maximum information capacity that needs maximum entropy and is defined in Eq. (7),
- (f) Minimum information bipartition  $^{MIB}A \leftrightarrow B$  that uses EI and  $H$ , and
- (g) Integrated information ( $\Phi$ ) that uses EI and  $^{MIB}A \leftrightarrow B$  as in Eqs. (9)-(14) (Tononi, 2008).

These information theoretic terms and related expressions are detailed below.

*Information* is defined as “reduction of uncertainty [or entropy] among a number of alternatives outcomes when one of them occurs” (Tononi, 2004).

As per [Wikipedia](#), “If  $\mathbb{X}$  is the set of all messages  $\{x_1, \dots, x_n\}$  that  $X$  could be, and  $p(x)$  is the probability of some  $x \in \mathbb{X}$ , then the entropy,  $H$ , of  $X$  is defined:

$$H(X) = E_X [I(x)] = - \sum_{x \in \mathbb{X}} p(x) \log p(x)$$

(Here,  $I(x)$  is the [self-information](#), which is the entropy contribution of an individual message, and  $\mathbb{E}_X$  is the [expected value](#).)”

Subjectivists can argue that uncertainties and probabilities are because of our ignorance, so they are subjective. However, objectivists can argue for objective probability; for example, quantum fluctuations, uncertainty principle and objective probability are essential in string theory (Greene, 1999). In the eDAM framework, information is a dual-aspect entity. The following development of IIT (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) is interpreted as the development of the physical information (3pp-physical aspect of information) for stationary systems. Since 3pp-physical and 1pp non-physical aspects are *inseparable*, the following development also holds for mental information.

*Entropy*  $H$  can be measured by the entropy function, which is the weighted sum of the logarithm of the probability ( $p$ ) of alternative outcomes ( $i$ ), and is defined (Tononi, 2004) as:

$$H = -\sum p_i \log_2 p_i, \quad (1)$$

where,  $p_i$  is the probability of  $i^{\text{th}}$  outcome. If outcomes are equally probable,  $p_i = 1/n_p$ , where  $n_p$  is the number of possible alternatives. If  $n$  is the number of bits, then  $n_p = 2^n$ .

The alternative outcomes in the definition of entropy are various possible *potential* 1pp subjective experiences (SEs), such as redness, greenness, blueness, etc. embedded in the related 3pp color-related V4/V8/VO neural-network in visual area. The matching mechanism (Section 1.3 and (Vimal, 2010a)) of the eDAM framework matches the stimulus-dependent feed-forward signals with cognitive feedback signals (either in 3pp-physical or 1pp non-physical aspect). Then its selection mechanism selects the matched specific SE (such as the redness of a ripe-tomato) out of all *potential* possible SEs. This specific SE is then experienced by the subject.

Let  $S$  is a subset of system  $X$  and divide  $S$  into parts  $A$  and  $B$ . The joint entropy  $H(AB)$  is the measure how much entropy is contained in a joint system of two random variables  $A$  and  $B$ . Then entropy for  $A$  and  $B$ , and joint entropy for  $AB$  can be written as:

$$H(A) = -\sum_i p_i \log_2 p_i; H(B) = -\sum_j p_j \log_2 p_j; \text{ and } H(AB) = -\sum_i \sum_j p_{ij} \log_2 p_{ij} \quad (2)$$

where  $i$  and  $j$  are particular values of  $A$  and  $B$ , respectively; and  $p_{ij}$  is the joint probability of these values occurring together.

*Mutual information* (MI) is a measure of the entropy or information shared between a source ( $A$ ) and a target ( $B$ ) (Tononi, 2004):

$$MI(A;B) = H(A) + H(B) - H(AB). \quad (3)$$

As per Tononi et al. (Tononi et al., 1994), for “a bipartition of the system X into a jth subset  $X_j^k$  composed of k components and its complement  $X-X_j^k$ ”, the mutual information (MI) between  $X_j^k$  and  $X-X_j^k$  is:

$$MI(X_j^k;X-X_j^k) = H(X_j^k) + H(X-X_j^k) - H(X). \quad (4)$$

*Integration*  $I(X)$  is defined as the difference between the sum of the entropies of all individual components ( $x_i$ ) considered independently ( $i$  varies from 1 to N components) and the entropy of X considered as a whole (Tononi et al., 1994):

$$I(X) = \sum_i H(x_i) - H(X). \quad (5)$$

The *effective information* (EI) between A and B is defined as (Tononi, 2004):

$$EI(A \rightarrow B) = MI(A^{H_{max}};B) = H(A^{H_{max}}) + H(B) - H(A^{H_{max}}B), \quad (6)$$

Where  $A^{H_{max}}$  is the source A with maximum entropy to the outputs, B is the target, and  $H(A^{H_{max}})$  is maximum entropy to the outputs from source A (Tononi, 2004). The arrow  $\rightarrow$  in  $A \rightarrow B$  represents that the source is A and the target is B; all possible effects of A on B are measured by  $EI(A \rightarrow B)$ . If the connections between A and B are specialized and strong,  $EI(A \rightarrow B)$  will be high. The value of  $EI(A \rightarrow B)$  is bounded by  $A^{H_{max}}$  and  $B^{H_{max}}$ , whichever is less. In general,  $EI(A \rightarrow B)$  and  $EI(B \rightarrow A)$  are not symmetric.

Maximum information capacity for each bipartition is:

$$H^{max}(A \leftrightarrow B) = \min[H^{max}(A); H^{max}(B)]. \quad (7)$$

The repertoire of possible causal effects of A on B and of B on A is measured as:

$$EI(A \leftrightarrow B) = EI(A \rightarrow B) + EI(B \rightarrow A). \quad (8)$$

The *minimum information bipartition* (Tononi, 2004)  $MIB_{A \leftrightarrow B}$  of subset S is its bipartition for which the normalized effective information reaches a minimum, corresponding to  $\min[EI(A \leftrightarrow B)/H^{max}(A \leftrightarrow B)]$ .

As per Tononi, *integrated information* ( $\Phi$ ) is defined as “the amount of information generated by a complex of elements, above and beyond the information generated by its parts” (Tononi, 2008). The information integration for subset S, or  $\Phi(S)$ , is simply the (non-normalized) value of effective information  $EI(A \leftrightarrow B)$  for the minimum information bipartition:

$$\Phi(S) = EI^{(MIBA \leftrightarrow B)}, \quad (9)$$

where  $\Phi(S)$  is the integrated information for subset  $S$  (i.e., the degree/amount of integrated information) and is the value of effective information for their minimum information bipartition. The effective information (EI) between  $A$  and  $B$  measures the repertoire of possible causal effects of  $A$  on  $B$  and of  $B$  on  $A$ . EI is the mutual information (MI) between  $A^{H_{max}}$  and  $B$ . MI is a measure of the entropy or information shared between a source ( $A$ ) and a target ( $B$ ). We can rewrite Eq.(9) as:

$$\begin{aligned} \Phi(S) = \Phi(A \leftrightarrow B) &= EI^{(MIBA \leftrightarrow B)} = EI^{(MIBA \rightarrow B)} + EI^{(MIBB \rightarrow A)} = MI(A^{H_{max}}; B) + MI(B^{H_{max}}; A) \\ &= [H(A^{H_{max}}) + H(B) - H(A^{H_{max}}B)] + [H(B^{H_{max}}) + H(A) - H(B^{H_{max}}A)]. \end{aligned} \quad (10)$$

For example:

$$\Phi(S) = \Phi(A \rightarrow B) = [1+1-1] + [1+1-2] = 1 \text{ bit and } \Phi(A \leftrightarrow B) = [1+1-1] + [1+1-1] = 2 \text{ bits.} \quad (11)$$

In other words,  $\Phi(A \rightarrow B) = 1$  bit is the degree/amount of integrated information for one-way  $A$  to  $B$ , whereas it is 2 bits for two-way  $A$  to  $B$  and  $B$  to  $A$ , This implies that feedback has higher degree/amount of integrated information.

Alternatively, as per Tononi, the relative entropy (Kullback-Leibler divergence) between two probability distributions  $p$  and  $q$  (Tononi, 2008) is:

$$H[p|q] = \sum_i p_i \log_2(p_i/q_i); \quad (12)$$

and the effective information EI can be expressed as the entropy of the actual ( $x_1$ ) ‘relative to’ (indicated by  $\parallel$ ) the potential distributions in the expression of integrated information  $\Phi(S)$  with an example as:

$$\Phi(S) = \Phi(A \rightarrow B) = EI(X(\text{mech}, x_1)) = H[p(X_0(\text{mech}: A \rightarrow B, x_1)) \parallel p(X_0(\text{maxH}))] \quad (13)$$

$$= H[(0, 0, 1/2, 1/2) \parallel (1/4, 1/4, 1/4, 1/4)] = 0+0+(0.5)\log_2(0.5/.2) + (0.5)\log_2(0.5/.25) = 1 \text{ bit.} \quad (14)$$

Here, the term ‘mech’ is mechanism. We can also calculate using relative entropy method:  $\Phi(A \rightarrow B) = 1$  bit is the degree/amount of integrated information for one-way  $A$  to  $B$ , which is the same result as in Eq. (11).

### 2.6.1. Stationary systems: Experiential aspect of consciousness (subjective aspect of qualia) as maximally integrated conceptual 3pp-physical information in the eDAM framework

*Motivation:* As elaborated in Section 1, consciousness has two aspects: functional and experiential (Vimal, 2009b, 2010b). The experiential aspect of consciousness is the subjective aspect of qualia, where consciousness is the 1pp non-physical aspect of integrated information. IIT (Tononi, 2012) proposes that the subjective aspect of qualia is the maximally integrated conceptual 3pp-physical information. A specific subjective experience is selected by the matching and selection mechanisms through the interaction

between the nearest future (represented in stimulus dependent feed-forward (FF)) signals and nearest past (represented in cognitive feedback (FB)) signals (Section 1.3 and (Vimal, 2010a)).

In this section, we extend further the information theoretic terms and related expressions derived in previous section **A** by using the concept of past and future information, the result of which will be used for the matching and selection mechanisms (Section 1.3 and (Vimal, 2010a)) in next Section **C**.

For this purpose, the following information theoretic terms and related expressions are required (Tononi, 2012):

- (a) The cause-effect information that needs past and future effective information EI as in Eqs. (15)-(17),
- (b) The cause-effect integrated (irreducible) information that needs past and future integrated (irreducible) information and uses the result of (a) as in Eqs. (18)-(20),
- (c) The cause-effect maximally integrated information that uses the result of (b) as in Eq. (21),
- (d) The maximally integrated irreducible cause-effect information repertoire that uses the result of (c), and
- (e) The qualia as maximally integrated conceptual information by complexes that use the result of (d).

These information theoretic terms and related expressions are detailed below, which is adapted from (Tononi, 2012):

(a) *Past and future effective information and cause-effect information:* Let  $P^{H_{\max}}$  is the maximum uncertainty (entropy) distribution, in which all past state P outputs are equally likely *a priori*. Let  $(P|s)$  is the distribution of P states that could have caused s given its present mechanism and present state s. Here, a state is a state of related NN of brain-mind system. Then the effective information (EI) between P and s is given by:

$$EI(P|s) = D[(P|s), P^{H_{\max}}] = H[p(X_0(\text{mech}, x_1)) || p(X_0(\text{maxH}))], \quad (15)$$

where D is the difference between its arguments (Tononi, 2008). Similarly, for future state F we can write:

$$EI(F|s) = D[(F|s), F^{H_{\max}}]. \quad (16)$$

The *cause-effect information* (CEI) is then written as:  $CEI(P,F|s) = \min[EI(P|s), EI(F|s)]$ . (17)



(b) *Past, future, and Cause-effect integrated (irreducible) information*: “The integrated (irreducible) information  $\phi$  is a measure of the difference  $D$  between the repertoire specified by a whole and the product of the repertoires specified by its partition into causally independent components” (Tononi, 2012).  $\phi^{\text{MIP}}$  is  $\phi$  when the difference is taken over the partition that yields the least difference from the whole (the *minimum information partition* (MIP)). One can then measure the difference  $D$  between the unpartitioned cause repertoire (CR) and the partitioned CR, i.e.,  $\phi^{\text{MIP}}(P | s)$  is the ‘past’ *integrated (irreducible) information*:

$$\phi^{\text{MIP}}(P | s) = D[(P | s), \prod(P | s / \text{MIP})]. \quad (18)$$

The same holds for difference  $D$  between the unpartitioned and partitioned effect repertoire (ER):  $\phi^{\text{MIP}}(F | s)$  is the ‘future’ *integrated (irreducible) information*:

$$\phi^{\text{MIP}}(F | s) = D[(F | s), \prod(F | s / \text{MIP})]. \quad (19)$$

The cause-effect integrated information is:

$$\phi^{\text{MIP}}(P, F | s) = \min[\phi^{\text{MIP}}(P | s), \phi^{\text{MIP}}(F | s)]. \quad (20)$$

(c) *Cause-effect maximally integrated information using exclusion principle*: As per the exclusion postulate (Tononi, 2012), “*integrated information is about one set of causes and effects only – those that are maximally irreducible – other causes and effects are excluded.*” The cause-effect *maximally integrated information*  $\max\phi^{\text{MIP}}(P, F | s)$  is the minimum of the past  $P$  and the future  $F$  as mediated by the mechanism  $S$  in its present state  $s$ ” (Tononi, 2012). In other words,

$$\max\phi^{\text{MIP}}(P, F | s) = \min[\max\phi^{\text{MIP}}(P | s), \max\phi^{\text{MIP}}(F | s)] \quad (21)$$

(d) *Maximally integrated irreducible cause-effect information repertoire using core concept principle*: A concept is defined as the “cause-effect repertoire of  $s$  that has  $\max\phi^{\text{MIP}}(P, F | s)$  within a system  $X$ ” (Tononi, 2012). A concept or ‘core’ concept specifies a maximally integrated irreducible cause-effect *information repertoire* ( $\max\phi^{\text{MIP}}$ ).

(e) *Qualia as maximally integrated conceptual information generated by complexes*: According to the exclusion postulate, “out of many possible constellations of concepts generated by overlapping sets of elements only one exists: the one that is maximally irreducible” (Tononi, 2012). A *complex* is defined as “*a set of elements generating a maximally irreducible constellation of concepts* (a maximally integrated conceptual structure)” (Tononi, 2012). The main *complex* is the set of elements that generate the constellation within the overall system with the maximum value of  $\Phi^{\text{MIP}}$  ( $\max\Phi^{\text{MIP}}$ ), which is called *maximally integrated conceptual information*. The *qualia space*<sup>15</sup> is the corresponding

concept space (simplex). A (subjective aspect of) *quale*  $Q$  is the *maximally integrated conceptual (information) structure*, which is the constellation of concepts generated by the set  $s$  (Tononi, 2012). In the eDAM framework, the above is interpreted as the development for the integration of 3pp physical information, which is automatically translated into *inseparable* 1pp mental information as information is conserved.

### 2.6.3. Stationary systems: IIT in the eDAM framework

*Motivation:* Since materialistic Identity theory and to some extent a version of panpsychism based IIT (Tononi, 2012) has serious problems, it is justified to interpret IIT in the least problematic eDAM framework. This interpretation is for the experiential aspect of consciousness (subjective aspect of qualia) in terms of maximally integrated conceptual information.

In this section, we extend further the information theoretic terms and related expressions derived in previous sections 2.6.1 and 2.6.2 by using the concept of past and future information and the matching and the selection mechanisms (Section 1.3 and (Vimal, 2010a)).

For this purpose, the following required information theoretic terms and related expressions are interpreted in the eDAM framework:

- (i) Past effective information as in Eqs. (22) and (15);
- (ii) Future effective information as in Eq. (16);
- (iii) The cause-effect information that uses past and future effective information as in Eqs. (23) and (17);
- (iv) The cause-effect integrated (irreducible) information as in Eqs. (24) and (20);
- (v) The exclusion principle, concepts, and complexes related to maximally integrated (irreducible) information as in Eqs. (25)-(26) for matching between feed-forward (FF) and feedback (FB) signals and the selection of a specific subjective experience (SE) for experiencing it at conscious level;
- (vi) Qualia space, conscious SEs and neural correlate(s) of consciousness (NCC) (Crick & Koch, 2003);
- (vii) Conceptual structure in qualia space (the constellation of concepts);
- (viii) Matching of past and future maximally integrated conceptual information for consciousness; and
- (ix) Causation related to endogenous signals (such as in intention of pulling a trigger) and exogenous signals (such as perception and experiences related to external stimulus).

These information theoretic terms and related expressions related to Tononi's IIT (Tononi, 2012) are interpreted in the eDAM framework in detail as follows:

(i) *Past effective information*: The differences in the past states of P is represented by  $EI(P|s)$ , which “can be detected by mechanism S in its present state s” ((Tononi, 2012).p.298), i.e.,

$$EI(P|s) = D[(P|s), P^{H_{\max}}]. \quad (22)$$

In the eDAM framework, a past state P is a 3pp-physical aspect of a state of cognitive feedback (FB) system related to the cognitive nearest past approaching towards present (*non-tilde mode*) (Section 1.3). The *effective information* (EI) between P and s,  $EI(P|s)$ , represents the differences in the past states of P represented by this cognitive feedback system that can be detected by a detection mechanism S in its present state s. The mental aspect of the state of cognitive feedback system is still non-conscious because *potential* SEs in feedback system are still in superposed form as the relevant matching and selection processes are not yet performed.

(ii) *Future effective information*: Similarly, the differences in the future states of F are represented by  $EI(F|s)$ , which can be detected by mechanism S in its present state s. In the eDAM framework, a future state F is the 3pp-physical aspect of a state of stimulus-dependent feed-forward (FF) system related to the nearest future approaching towards present, i.e., the present is reaching to nearest future that becomes present (*tilde mode*). It is an entropy-reversed representation of *non-tilde mode* (Section 1.3), where entropy is related to time. The  $EI(F|s)$  represents the differences in the future states of F represented by this feed-forward system that can be detected by a detection mechanism S in its present state s. The mental aspect of the state of the feed-forward system is still non-conscious because *potential* SEs in feedback system are still in superposed form as the relevant matching and selection processes are not yet performed.

(iii) *Cause-effect information*: As per Tononi, “ $EI(P|s) > 0$  only if past states of P make a difference to [present] s, and  $EI(F|s) > 0$  only if s makes a difference to [future] F” (Tononi, 2012).(p.298). The *cause-effect information* (CEI) can be written as:

$$CEI(P,F|s) = \min[EI(P|s), EI(F|s)]. \quad (23)$$

In the eDAM framework, Eq.(23) tries to investigate which is more sensitive: cognitive feedback signals representing past states of P making a difference to the present s or the present s making difference to future F represented in feed-forward signals.

(iv) *Cause-effect integrated (irreducible) information*: As per Tononi, a mechanism S in its present state s “generates integrated information only if it has *both* irreducible causes ( $\varphi^{\text{MIP}}(\text{P} | \text{s}) > 0$ ) and irreducible effects ( $\varphi^{\text{MIP}}(\text{F} | \text{s}) > 0$ )” (Tononi, 2012). (p.299). The cause-effect integrated information is:

$$\varphi^{\text{MIP}}(\text{P}, \text{F} | \text{s}) = \min[\varphi^{\text{MIP}}(\text{P} | \text{s}), \varphi^{\text{MIP}}(\text{F} | \text{s})]. \quad (24)$$

In the eDAM framework,  $\varphi^{\text{MIP}}(\text{P} | \text{s})$  represents the ‘past’ *integrated (irreducible) information* related to the 3pp-physical aspect of a state of cognitive feedback system. This is related to the *non-tilde mode* that is the cognitive nearest past (stored in memory) approaching towards present. The mental aspect of the state of the feedback system is still non-conscious. However,  $\varphi^{\text{MIP}}(\text{F} | \text{s})$  is the ‘future’ *integrated (irreducible) information* related to the 3pp-physical aspect of a state of stimulus dependent feed-forward system, which is related to the *tilde mode* that is the nearest future approaching towards present. It is an entropy-reversed representation of *non-tilde mode*. The mental aspect of the state of feed-forward system is still non-conscious. In both cases, information will be integrated only if a detection mechanism S in its present state s has *both* irreducible causes, i.e.,  $\varphi^{\text{MIP}}(\text{P} | \text{s}) > 0$  and irreducible effects i.e.,  $\varphi^{\text{MIP}}(\text{F} | \text{s}) > 0$ .

(v) *Exclusion principle, concepts, and complexes*: The *exclusion* (p.301), *concepts* (p.302), and *complexes* (p.303-4) sections of (Tononi, 2012) are interpreted as follows:

In the eDAM framework,  $\max \varphi^{\text{MIP}}(\text{P} | \text{s})$  represents the maximum ‘past’ *integrated (irreducible) information*. In addition, the  $\max \Phi^{\text{MIP}}(\text{P} | \text{s})$  represents the *maximally integrated conceptual information* for past. Both are related to the 3pp-physical aspect of a state of cognitive feedback system. This is further related to the *non-tilde mode*, which is the cognitive nearest past (cause) approaching towards present. Here, the maximum is taken over all possible subsets P within the system. The mental aspect of the state of feedback system related to the maximum ‘past’ *integrated (irreducible) information* is still non-conscious. This is because *potential SEs* in feedback system are still in superposed form.

Moreover,  $\max \varphi^{\text{MIP}}(\text{F} | \text{s})$  represents the maximum ‘future’ *integrated (irreducible) information*. In addition, the  $\max \Phi^{\text{MIP}}(\text{F} | \text{s})$  represents the *maximally integrated conceptual information* for future (effect). Both are related to the 3pp-physical aspect of a state of stimulus-dependent feed-forward system. This is further related to the *tilde mode*, which is the nearest future approaching towards present. Here, the maximum is taken over all possible subsets F within the system. The mental aspect of the state of feed-forward system related to the maximum ‘future’ *integrated (irreducible) information* is still non-conscious. This is because *potential SEs* in feed-forward system are still in superposed form as the relevant matching with feedback system and selection processes are not yet performed. To accomplish the matching, we can have,

$$\max_{\Phi} \Phi^{\text{MIP}}(F, P | s)_{\text{matching}} = D[\max_{\Phi} \Phi^{\text{MIP}}(F | s), \max_{\Phi} \Phi^{\text{MIP}}(P | s)]_{\text{irreducible}}, \quad (25)$$

where  $D$  indicates the difference between two maximally integrated (irreducible) information or

$$\max_{\Phi} \Phi^{\text{MIP}}(F, P | s)_{\text{matching}} = D[\max_{\Phi} \Phi^{\text{MIP}}(F | s), \max_{\Phi} \Phi^{\text{MIP}}(P | s)]_{\text{conceptual}}, \quad (26)$$

where  $D$  indicates the *difference* between two *maximally integrated conceptual information*, namely, the nearest future *tilde* and the nearest past non-tilde modes.

If  $\max_{\Phi} \Phi^{\text{MIP}}(F, P | s)_{\text{matching}} = \max_{\Phi} \Phi^{\text{MIP}}(F, P | s)_{\text{matching}} = 0$ , then the matching is 100% and the selection of a specific experience related to stimulus is accomplished and we become conscious of related subjective experience (SE). If this difference is  $> 0$ , the stimulus has some novel information. Otherwise, if the difference is  $< 0$ , stimulus-information is already in our memory and the matching is accomplished. In all cases, a specific experience related to stimulus is selected by the ‘self’ from the repertoire containing all superposed *potential* experiences. Here, the repertoire is the mental aspect of the state related to feed-forward and/or feedback neural-network. After the selection, the ‘self’ experiences the specific SE as a *realized* conscious experience assuming the necessary conditions of consciousness (Vimal, 2014b) are satisfied. The ‘self’ is the mental aspect of the self-related neural-network-state [39], which is a part of cognitive feedback neural-network. Conscious subjective experience can be for a specific dimension, sub-mode, mode or all combined (as in crowded market).

(vi) Qualia space, conscious subjective experiences and NCC: As per Tononi, the central identity is “an experience is a maximally integrated conceptual (information) structure or quale – that is, a maximally irreducible constellation of points in qualia space” (Tononi, 2012).(p.306). In other words, the identity theory of materialism suggests that a (3pp) brain-state is identical with the related (1pp) mental-state (such as experience), (1pp) mental property is identical with the related (3pp) brain property, or (1pp) consciousness is identical with the related (3pp) integrated information. However, this materialistic identity theory has serious problem of materialism and does not address the hard problem (see Section 2.7).

In the eDAM framework, information is a dual-aspect entity with *inseparable* 1pp non-physical aspect (mental information) and 3pp-physical aspect (physical information). We argue that:

- (a) An experience is the 1pp non-physical aspect of a state of a maximally integrated information structure, i.e., an experience is a maximally integrated conceptual mental-information structure; and

- (b) The neural correlates of the experience is the 3pp-physical aspect of the same state of the same maximally integrated information structure, i.e., NCC (neural correlates(s) of consciousness) is a maximally integrated physical information structure.

Here, the information is conserved across mental and physical aspects because of the *doctrine of inseparability*.

One could argue that both (identity theory and doctrine of *inseparability* of the eDAM framework) appears to imply effectively the same or similar suggestion that 3pp and 1pp views are the same or similar in their own metaphysical language. However, this may be misleading because materialism has serious problems (Vimal, 2010b, 2013), such as matter is non-experiential entity and does not even have *potential* for experiences (see Section 2.7 below). However, the eDAM framework does not have such problems.

Furthermore, in the identity theory, even intention and the initiation of thoughts are identical with the related integrated information in their neural correlates (matter). This may not be true because conscious intention to act starts before cerebral activity (Libet, Gleason, Wright, & Pearl, 1983) although it is controversial (King, 2014; Libet, 2006; Pockett, 2006).

The intention and the initiation of thoughts can be explained better in the eDAM framework. This is because an intention and the initiation of a thought are 1pp non-physical information in the mental aspect of our brain-mind state. This is then reflected in the physical aspect of our brain-mind state with integrated 3pp-*physical* information by the doctrine of *inseparability*. This 3pp-physical signal then becomes the cause of further 3pp-cerebral-activity without making category mistake. There are psychosomatic effects, which can be similarly explained better in the eDAM framework. In materialism, it will be hard to explain because of category mistake.

(vii) *Conceptual structure in qualia space (the constellation of concepts)*: As per Tononi, “the particular ‘content’ or quality of the experience is the shape of the maximally integrated conceptual structure in qualia space (the constellation of concepts)” (Tononi, 2012).(p.306). In the eDAM framework, the particular ‘content’ or quality of the experience is the particular ‘content’ or quality of the 1pp non-physical aspect of a state related to the shape of the maximally integrated conceptual information-structure in qualia space that represents this state.

(viii) *Matching of past and future maximally integrated conceptual information for consciousness*: The matching section (p.306-8) of (Tononi, 2012) is interpreted as follows:

- (a) In the eDAM framework, the feed-forward-neural-network signals consist of endogenous information if a brain-mind system is isolated from environment (as in dreams).

- (b) However, in a brain-mind system interacting with environment, the feed-forward-neural-network signals have exogenous stimulus-dependent information.
  - (c) A neural-network complex with high maximally integrated conceptual information ( ${}_{\max}\Phi^{\text{MIP}}$ ) has a large number of concepts in ‘memories’ formed over a long time (Tononi, 2012). These qualia-concepts are embedded in cognitive feedback signals as *potential* SEs during development and *neural Darwinism* (Section 1.3).
  - (d) In matching process, feed-forward information is matched with feedback information through interactions between feed-forward and feedback signals.
  - (e) Since information is a dual-aspect entity (Chalmers, 1995; Vimal, 2008, 2010a, 2013), matching can be between physical (or mental) feed-forward information and physical (or mental) feedback information (Section 1.3 and (Vimal, 2010a)).
  - (f) Consistent with (Tononi, 2012), high degree of matching requires high (suprathreshold)  $\langle {}_{\max}\Phi^{\text{MIP}} \rangle$ . An increase in matching will be associated with an increase in integrated information and with an increase in consciousness.
- (ix) *Causation related to endogenous and exogenous signals*: The information and causation section (p.308-9) of (Tononi, 2012) is interpreted as follows:
- (a) In the eDAM framework, past resides as a memory in feedback (FB) system. The future is in feed-forward (FF) signals. However, feed-forward 3pp-physical signals are the cause for its matching with feedback 3pp-physical signals.
  - (b) his matching process may ‘*appear*’ to be inconsistent with Tononi’s hypothesis of 3pp-past causes 3pp-future compatible with 3pp-present (Tononi, 2012).
  - (c) However, there is no ‘real’ inconsistency. This is because the Tononi’s maximally irreducible sets of past causes are in the memory of past event that was in feed-forward signals in the past. This was stored in the feedback system. Then, this past feedback signal causes future endogenous signal, such as in the intention to pull a trigger in the feed-forward pathway. This then matches with feedback signal for the confirmation to pull the trigger.
  - (d) However, when new external event occurs, it is represented in feed-forward signals as an exogenous stimulus dependent signal in the feed-forward pathway. This is for *becoming* future of the ‘now’ or ‘specious present’. The ‘specious present’ is the time duration in which our perceptions are considered to be in the present (James, 1893). Both the feed-forward (as a cause) and feedback signals interact in the matching process for a future-effect.
  - (e) In the example of finding the cause for the pulling of the trigger, all the 3pp-information in the past was maximally integrated in 3pp-neural-network-complex. This then caused to generate 3pp-signal for a 1pp non-physical concept of 3pp-action

of pulling the trigger above its threshold value. This was then selected and immediately available in 1pp non-physical aspect of the state of neural-network-complex as a conscious decision to pull the trigger. If the integrated information were below threshold value then trigger will never be pulled.

### **2.6.2. Stationary systems: 1pp non-physical information integration and consciousness**

Can we mentally integrate experiences such as segment-ness, left-ness, redness, circular-ness to result the experience of ‘circular red segment on left’? The integration of 1pp non-physical information would be harder to understand than 3pp-physical information integration. However, the information-integration could be either from its physical aspect or its non-physical aspect in the eDAM framework. For example:

- (i) Try to mentally combine the individual experiences such as segment-ness, left-ness, redness, circular-ness to result the experience of whole ‘circular red segment on left’. It will be hard to do.
- (ii) The intention (a part of cognition) to look at a static scenic view is initiated from 1pp non-physical aspect. In this process, first mental information is integrated in the 1pp cognitive non-physical aspect of the intention-related state of our mind-brain system. Then, the doctrine of inseparability necessitates an automatic translation into 3pp-physical aspect of the same state. This 3pp-physical signal then causes to physically look at the static scenic view. This process does not make category mistake.

### **2.6.3. Dynamic systems: temporal information integration**

Temporal (dynamic) integration has three components (Faivre & Koch, 2014):

- (i) Non-conscious temporal integration that is the representation of the duration of propagation of stimulus-dependent signals in feed-forward neural-network.
- (ii) Conscious temporal integration that is the representation of the duration of reentrant signals in cognitive feedback neural network. This enables temporal integration and persistent neural activity (Wang, 2002) with the help of feed-forward signals.
- (iii) Temporal binding that synchronizes neural firings within millisecond-range-precision (Engel & Singer, 2001). In addition, attention can modulate temporal integration.

The IIT for stationary systems ((Tononi, 2004, 2008, 2012) and (Balduzzi & Tononi, 2009): Section 2.6.1) was extended to dynamic systems by Balduzzi and Tononi (Balduzzi & Tononi, 2008). They investigated the (dynamic) relationship between (a) integrated information and (b) discrete dynamical neural networks, causal architecture, and connectivity. They assumed that time passes in discrete instants, such as milliseconds. In addition, the output of an element at time  $t$  depends only on the inputs at time  $(t-1)$ . They defined the integrated information  $\Phi$  as “the entropy of the *a posteriori* repertoire of the system relative to the combined *a posteriori* repertoires of the parts”. The  $\Phi$  is high when



“many alternatives are ruled out by the entire system, and the parts are comparatively ineffective at specifying causes”. They (Balduzzi & Tononi, 2008) found the following:

- (i) The integrated information  $\Phi$  varies depending on the state of a network.  $\Phi$  is lower if the network is inactive (‘comatose’) or hyperactive (‘epileptic’) and is higher if active and inactive elements are balanced. This is because “the output state of the system is highly flexible in its local causes and extremely rigid globally.”
- (ii) The integrated information  $\Phi$  depends on the causal architecture that underlies the systems with identical or similar surface dynamics. The systems that merely copy or replay activity states can generate low  $\Phi$ , whereas the causally interacting system can generate potentially high  $\Phi$ .
- (iii) The integrated information  $\Phi$  varies as a function of network architecture. For example:
  - (a) Strongly modular system and homogeneous system (with all-to-all connectivity, including self-connections) have low  $\Phi$  due to the lack of integration and information, respectively.
  - (b) Architectures that balance functional specialization with functional integration can have high  $\Phi$ .
  - (c) However, although feedforward and lattice architectures can generate high  $\Phi$  but they are inefficient.
- (iv) A Hopfield network is a probabilistic system, in which the network tends to one of a few stable firing-patterns (attractors embedded/stored in the network) for any initial condition. In such a network,  $\Phi$  is low for attractor states and neutral states; both elements in each couple have the *same* output. The tense states are locally compatible with the architecture of the system, but globally incompatible (opposite of neutral states). The  $\Phi$  increases if the network is optimized to achieve tension between local and global interactions. High  $\Phi$  can be sustained by a functionally integrated and functionally specialized probabilistic network.
- (v) The integrated information
  - (a)  $\Phi$  “measures a process” such as the transition of the system from one state to the next,
  - (b)  $\Phi$  “is a causal measure”, and
  - (c)  $\Phi$  “captures an intrinsic property of a system”, independent of external observers (Balduzzi & Tononi, 2008).

In the eDAM framework, the balanced activity can be interpreted as the ‘intermediate’ activity between inactivity and hyperactivity in dynamical systems for high integrated physical information  $\Phi$ . This is reflected in its *inseparable* non-physical aspect as consciousness, in analogy to Buddha-Nāgārjuna’s *Mādhyamika* (‘intermediate’) framework related to momentary interconnected events and consciousness (Nāgārjuna & Garfield, 1995; Vimal, 2009c).

The integrated information analysis for discrete time (Balduzzi & Tononi, 2008), as they seem to acknowledge, should be extended to natural continuous temporal integration for dynamical systems.

#### **2.6.4. IIT 3.0, Shannon-information vs. IIT-information, cause and effect repertoire, unconscious system, consciousness and information, and the eDAM framework**

1. *Shannon-information vs. IIT-information*: Shannon-information is extrinsic information without any meaning and is from 3pp, whereas IIT-information is intrinsic information with a specific meaning and is from 1pp. The circuits (neural-networks) that “generate meaning originate, develop, and refine through a long process of evolution, neural development, and learning, under the selective pressure of a complex environment” (Supporting Information S3 of (Oizumi, Albantakis, & Tononi, 2014)). This intrinsic information with a specific ‘meaning’ is related to the specific subjective experience (SE), such as redness. However, it is unclear where from such a specific SE comes. In the eDAM framework, the source of such primary irreducible SEs *potentially* pre-exist in the Nature such as in the universal potential consciousness informational energy field (UPCIEF), which is the non-physical aspect of the unmanifested state of the primal unified informational energy field (UIEF); its (state’s) inseparable physical aspect is physical UIEF (quantum vacuum).

2. *Cause and effect repertoire*: In Oizumi, Albantakis, & Tononi’s IIT 3.0, both the cause and the effect of a mechanism in a state of mind-brain system are necessary to generate information *intrinsically* (Oizumi et al., 2014). Here, the mechanism is the elements of a system, such as a neuron in the brain, or a logic gate in a computer.

3. *Unconscious system and information*: A purely feed-forward computational network has one layer feeds the next one without any recurrent connections. It does not have “a cause repertoire within the system itself, since its input is imposed from outside the system, nor does it have an effect repertoire, since its output does not feed back to any element within the network”. Therefore, it is a zero- $\Phi$  unconscious system (Tononi & Koch, 2014).

4. *Consciousness and information*: As per Tononi and Koch (Tononi & Koch, 2014), “to generate experience, a system of mechanisms must have cause-effect power *within* itself, i.e. *intrinsically*, independent of extrinsic causes and effects. [...] the central identity of IIT, which states that a conscious experience is *identical* to a maximally irreducible conceptual structure [the quale generated by a main complex, in our case one made up by a set of neurons in a particular state] [...] information is not in the message that is broadcast by an element, but in the shape of the conceptual structure [...] consciousness is an intrinsic, observer-independent property of certain mechanisms in a state - how they shape<sup>16</sup> the space of possibilities in their past and their future.” A conceptual structure (quale) is the set of all concepts specified by a system set with their respective  $\Phi^{\max}$  (maximally integrated information) value.

5. *The eDAM framework*: In this framework, information is a dual-aspect entity with 3pp-physical information and its *inseparable* 1pp non-physical information. Therefore, both the cause and the effect of a mechanism in a mind-brain-state are necessary to generate 3pp-physical information and its *inseparable* 1pp non-physical information *intrinsically*.

## 2.7. An attempt to solve the Hard Problem of Consciousness

The hard problem of consciousness is: how experiences arise and how the explanatory gap between 1pp non-physical aspect (such as a subjective experience) and 3pp-physical aspect (such as related NCC/NPB) can be closed. There are four major metaphysics to address this problem:

- (i) The *materialism*-based frameworks have been trying hard to address this issue but have failed. It cannot address the hard problem of consciousness because matter does not even have *potential* for experiences, by definition, as elaborated later.
- (ii) The *idealism*-based framework can solve this problem because it hypothesizes that experiences ‘really’ pre-exist. However, it has its own explanatory gap problem: how physical-neural-substrate-in-itself can be created from the related experience.
- (iii) The *interactive substance dualism* can address the explanatory gap because it also hypothesizes that experiences ‘really’ pre-exist. However, it has serious problems, such as how to associate a specific experience with the specific neural-network in addition to 12 more problems (Vimal, 2012b). The problems of these three metaphysics are also elaborated in (Vimal, 2010b, 2013).
- (iv) The least problematic metaphysics is the *eDAM* framework. It can also solve the hard problem because it hypothesizes that experiences ‘*potentially*’ co-exist with its neural-physical basis (NPB) in Nature.

The *panpsychism* framework proposes that all entities have mind/consciousness to some extent. In general, there are panpsychists with dual-aspect view (Skrbina, 2009), panpsychist dualists, idealists, reductive materialists, and so on (Skrbina, 2005). However, panpsychism has serious problems, such as the combination problem as elaborated in (Vimal, 2010b, 2013).

The solution of the hard problem is further elaborated as follows: To address the hard problem of consciousness, we first need to understand the concept of matter (entity), which has two different meanings (personal communication with Pereira Jr.):

- (i) The concept of Democritus (c.460-370 BC), who identifies matter with atoms (particles), and
- (ii) The concept of Aristotle (384-322 BC) for whom matter is “possibility of being” (Pereira Jr., 2013), which also includes ‘form/pattern’.

These two western concepts of an entity seem close to that of eastern system:

- (i) *Cārvāka* system and Kaṇāda’s atomism (c. 800-600 BC), and
- (ii) Yājñavalkya’s ‘rūpa’(form) (c. 1000-700 BC) in *Bṛhadāraṇyaka Upaniṣad* (Swami Krishnananda, 1983), and Bādarāyaṇa’s ‘rūpa’ (form/pattern) (c. 500-400 BC) in *Brahma Sūtra* (Radhakrishnan, 1960), respectively.

In Aristotle’s framework, matter (material cause) alone does not explain the becoming process of reality; the efficient, formal and final causes are also needed. Natural beings (substances) are composed of matter and form/pattern (qualitative sub-aspect). The interactions of form/pattern and matter are central to the understanding of natural beings. In modern science (such as physics, chemistry and biology), the formal and final causes

were abandoned. Therefore, the understanding of physical systems was reduced to the actions of efficient and material causes. This implies “matter” in the sense of Democritus. Here, matter is defined as particles that are aggregated and recombined according only to their actual properties. This is where matter was assumed as *non-experiential* entity that *does not even have potential for experience*. This metaphysical view is called materialism that was adapted by science and end up with the hard problem of consciousness: how can experiences arise from non-experiential matter that does not even have a single trace of an experience?

In an Aristotelian perspective, there is no “pure matter”; all matter has embedded potential forms/patterns. This concept seems consistent with the quantum concept of superposition: what are superposed in quantum states are *potential* forms/patterns that can be actualized once the adequate conditions are satisfied in the previous state of the system as happens after measurement (this is Bohr’s interpretation of QM).

The eDAM framework (Sections 1.3, 2.1-2.6) and Triple Aspect Monism framework (TAM) (Pereira Jr., 2013) are close to Aristotelian perspective and Yājñavalkya-Bādarāyaṇa’s ‘rūpa’ (form/pattern); ‘rūpa’ is in the sense that *potentialities* of subjective experiences exist in Nature. The eDAM is also close to *Rāmānujāchārya’s cit-acit Viśiṣṭādvaita* (1017–1137 AD), *and Kashmir Shaivism* (Vasugupta, 860–925 AD) (Vimal, 2013, 2014c), where the primal entity is called *Brahman* with dual-aspect states, but are based on the top-down approach (TDA) from manifested cosmic consciousness to universe that includes us.

One of the key features of the eDAM framework is that states related to proto-experiences (PEs) *potentially* co-exist with its (state’s) physical aspect in superposed form in the qualitative sub-aspect of the non-physical aspect of a state of each entity. This is in analogy to a tree *potentially* exist in its seed (Vimal, 2013). Here, *potential* PEs are precursors of *real* subjective experiences (SEs).

The materialism based frameworks, unfortunately, do not have this *essential* and *natural* key feature built-in from the dawn of physics, chemistry, and biology because of the *Kaṇāda-Democritus’* definition of materialism (matter is non-experiential entity and does not even have *potential* for experiences), and this is one of the main reasons, why materialism based frameworks cannot solve the hard problem.

Critiques could argue that abandoning formal and final causes by science is a good feature because presumably they can emerge from material and efficient causes (but how is unknown)<sup>17</sup> so the redundancy is minimized to observe Occam Razor. However, we also know that an entity has a form or pattern, which when present makes matter into a particular type of thing. Therefore, one could argue that natural science should explicitly reconsider formal cause. Furthermore, we know that we have experiences. Therefore, in the eDAM framework, it is *natural* to accept that matter has *potential* for experiences because we are one of the biological products of evolution and natural selection. Thus, the eDAM framework cannot fail because there could be a physics of consciousness with the assumption that matter has *potential* for experiences. We have shown that physics is invariant if we introduce mental (experiential and cognitive) sub-aspect of the non-physical aspect of a state of an entity (Vimal, 2008, 2009d, 2009e, 2010a, 2010c, 2010d, 2010e).

Biology, unfortunately, was developed without this key feature and was based on this problematic materialism. Here, the origin of the problem was Kaṇāda-Democritus' definition of matter that does not have potential for experiences. Instead, we must use the alternative definition of matter proposed by Yājñavalkya-Bādarāyaṇa-Aristotle that includes rūpa/form and has *potential* for experiences. It is essential that we as biologists must instill this essential feature in biology if we want to solve the hard problem from the biological point of view. This does not violate any biological or physical law.

The hard problem of consciousness is: how experiences arise, i.e., how to explain the experiential aspect of consciousness. An attempt towards the solution for this hard problem needs all five components of the eDAM framework (Sections 1.3 and 2.1-2.6). This challenge can be met through the selection of a specific SE (let us take an example of *redness*), after the completion of matching/non-matching process as follows:

- (I) The color-related long-term memory stores all possible (potential) color-related beable ontic dual-aspect states of the color-related neural-network of a mind-brain system in superposed form as [engrams](#) or memory traces. Each of these states has 1pp non-physical and inseparable 3pp physical aspect. Each aspect has four sub-aspects: experiential, cognitive, qualitative, and functional sub-aspects as elaborated in Section 1.3.1.3. The experiential sub-aspect has color SEs such as redness.
- (II) The interaction of 'long wavelength light'-stimulus dependent feed-forward (FF) and feedback (FB) signals in the 'V8/V4/VO' Red-Green color neural-network creates a specific beable ontic neural-network state.
- (III) This specific beable ontic state as a basis state is assigned to a specific SE, *redness*, and is included in the abstract [Hilbert space](#) during neural Darwinism (Section 1.3). The neural Darwinism includes co-evolution, co-development and sensorimotor co-tuning by the evolutionary process of adaptation and natural selection.
- (IV) The specific SE, *redness*, is embedded as a memory trace ([engram](#)) of related PEs in the 'V8/V4/VO' Red-Green color neural-network.
- (V) Similarly, all SEs are embedded in appropriate neural-networks and their states are included in the [Hilbert space](#) as basis states.
- (VI) When, for example, a specific *redness*-related stimulus (such as long wavelength light) is presented to our visual system, information is irreducibly integrated (Sections 2.3-2.6) through:
  - (a) The matching/non-matching brain process (Section 1.3) such as the interaction of the stimulus dependent feed-forward (FF) with feedback (FB) signals in the thalamocortical 'V8/V4/VO' Red-Green color neural-network, and
  - (b) The selection brain process (Section 1.3) in which the associated specific SE, such as redness, is selected by the self. The self is a part of the feedback system. A large amount of dual-aspect information is generated to reduce the uncertainty during the selection (a brain process) of a specific conscious SE. The selection is out of all possible *potential* SEs embedded in the related neural-network by ruling out alternative *potential* SEs. This large amount of information is irreducibly integrated.

We do not consciously compare *all* (innumerable) possible SEs. Is this done non-consciously? This is highly unlikely because it is also a very time consuming Herculean

task. The co-evolution and co-developmental processes (neural Darwinism) have already done this time consuming task during the formation of a specific neural-network (NN). For example, the formation of Red-Green channel related NN leads to a smaller repertoire of states for colors that have just noticeable differences (JND) between redness to greenness embedded in this specific NN. Therefore, the comparison between stimulus-dependent feed-forward signals with this small repertoire in feedback system during matching is a feasible faster task and can be done non-consciously. When a specific SE is selected then consciousness arises. Similarly, we can argue for whole unified consciousness, which will require the unification of experiences related to modes, submodes, and dimensions. Thus, the processes related to the information generation can be divided in two groups:

- (a) The co-evolution and co-development time-consuming processes, and
- (b) The faster matching and selection processes.

**(VII)** The degree  $\bar{d}$  of the manifestation (appearance/strength) of the mental aspect of the brain-mind state is proportional to the degree of integrated information ( $\Phi$ ). In other words, if the degree (or amount) of integrated information ( $\Phi$ ) is higher than the critical threshold for consciousness (Sections 2.1-2.6), the degree  $\bar{d}$  is also higher than its critical threshold for a specific SE. The degree  $\bar{d}$  also represents the degree of specificity of SE. When  $\bar{d} = 1$ , the selection of a specific SE is completed. Then this specific SE redness is experienced by the 'self' (Section 1.3).

Furthermore, the repertoire of possible causal effects of A on B and of B on A is related to IIT's cause-repertoire/effect-repertoire. It is measured by the effective information (EI) between A and B. The value of EI for their minimum information bipartition is the integrated information  $\Phi(S)$  for subset S. In other words,  $\Phi(S)$  is the degree/amount of integrated information. Moreover, the cause-repertoire/effect-repertoire of IIT is related to the degree of integrated information ( $\Phi$ ). Therefore,  $\Phi(S)$  is related to the degree  $\bar{d}$  of the manifestation of the mental aspect of the brain-mind state.

The generation of specificity involved in premises **(II)-(VI)** is further unpacked using *neural Darwinism*. The development of specificity of a SE in a specific neural network (such as color in V8/V4/VO area) is detailed in (Vimal, 2008). Furthermore, how quantum-superposition relates to qualia (SEs) and the specific and unified experience needs further clarification, which is as follows:

- (i) Primary experiences are fundamental and irreducible; they are not derived mental entities.
- (ii) For example, in color vision, there are 3 primary color experiences (redness, greenness, and blueness). Other colors are mixtures of these 3 primary colors with appropriate proportions (Vimal, Pokorny, & Smith, 1987).
- (iii) The basis-states related to *potential* primary irreducible SEs are superposed in the a state of each entity.
- (iv) For example, the subjective experience 'redness' is a primary color experience that cannot be reduced further. Therefore, the related state is called 'redness' basis-state, similarly for other experiences.

- (v) These experiences, when unrealized, are in *potential* form. Therefore, they can be called proto-experiences (precursor of SE).
- (vi) In the superposed form of many basis-states, it is impossible to have a specific SE. The SEs will all be ‘blurry’/vague in superposed form and will not be crisp/specific (Perlovsky, 2009).
- (vii) We need brain with complex adaptive neural-networks (such as thalamocortical reentrant network) that can have high degree of integrated information ( $\Phi$ ). In addition, all the necessary conditions of consciousness need to be satisfied (Section 1.3.6).
- (viii) Then, the matching/non-matching and selection mechanisms (Section 1.3) of the eDAM framework will facilitate in collapsing these *potentially* superposed basis-states into a specific basis-state related to a specific primary SE (such as redness) for its *realization* (actualization) as a specific beable ontic state.
- (ix) Once this is accomplished, the self-related signals (from cortical-midline-structures) interact with stimulus-related feed-forward signals and related cognitive feedback signals. This will then let the self to select and experience this specific experience ‘redness’.
- (x) For non-primary SEs, such as binary purpleness (mixture of blueness and redness), extra processing is needed for integrated information related to color mixture. However, a specific experience ‘purpleness’ must be selected by matching/non-matching mechanism before it can be experienced. This is an explanation for (a) the dimensional (redness, blueness) feature integration and (b) the experience of redness or purpleness.
- (xi) We also need integrated information for sub-modal (such as color, motion, shape), modal (such as visual, auditory), spatial (such as whole visual spatial field), and temporal (such as critical temporal grain-size  $\Delta t$ ) attributes to have the experience of unified SE such as that of crowded downtown market.

Moreover, a subtle issue needs further clarification:

- (i) What is superposed? A state related to the ‘element of a conscious experience’ (Pereira Jr., 2013) is a basis-state. These basis-states are the states that are superposed in the state related to the mental aspect of a state of an entity.
- (ii) A basis-state related to a proto-experience/feeling is a precursor of a basis-state related to the *actual/real* subjective experience itself. This is because an experience requires the experienter and the experienced object.
- (iii) This needs the formation of neural-networks and fulfillment of other necessary conditions of consciousness (Section 1.3.6).
- (iv) These conditions are missing in an inert system unless conscious robots are developed.
- (v) A state related to the ‘element of the experienter’ is a basis-state related to proto-self, core self and/or autobiographical self.

- (vi) A state related to the elements of the experienced object is a basis-state related to proto-cognitions, as in the case of the property of red.
- (vii) These basis-states (i.e., the states related to the ‘element of the experiencer’ and the ‘elements of the experienced object’) are also superposed in that state.
- (viii) They are *actualized* at the moment of experience forming episodes.
- (ix) What is conscious is always an episode composed of a collection of these elements (subjective and objective). An experience is an episode where “red” features as one of the proprieties that is instantiated (Pereira Jr., 2013).

We summarize the matching and selection process as follows:

- (i) The basis-states related to *potential* primary irreducible subjective experiences (SEs) are superposed in a state of neural-network.
- (ii) The superposed basis-states collapse/reduce to a specific basis-state related to a specific primary SE (such as redness) for its *realization* (actualization).
- (iii) This realization is through the matching/non-matching and selection processes. The non-matching implies a novel stimulus with a beable ontic state, which is selected and experienced. If this is a salient stimulus, an engram is generated as a long-term memory trace for future encounter and matching.
- (iv) A specific SE is selected by the self (not by any homunculus).
- (v) The selection is accomplished when the integrated information ( $\Phi$ ) (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) is higher than its critical threshold value for consciousness in the related neural-network ‘complex’.

### 3. Discussion

#### 3.1. Materialism and/or panpsychism based Integrated Information Theory (IIT) vs. eDAM framework

##### 3.1.1. The claims of integrated information theory (IIT) (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) are as follows:

- (i) Integrated information rich complexes have (subjective) qualia.
- (ii) Integrated information is connected with qualia (Q) via Q-space.
- (iii) The qualitative properties of experience are *identical* to the information integration properties of the brain (IIT-Q’s claim). In other words, integrated information is consciousness, or consciousness is integrated information (Tononi, 2008).
- (iv) Integrated information is (subjective) qualia.



### 3.1.2. IIT based on materialistic identity theory

One could argue that since IIT ((Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) and (Peressini, 2013)) appear to be based on materialism with identity theory, IIT has the explanatory gap problem. In other words, an appropriate metaphysical link between integrated information in 3pp-brain's complexes and 1pp-subjective experiences is missing. Simply claiming that both (1pp-SEs and 3pp-NCC) are identical is a brute fact (that is the way it is!). This claim seems to be inserted 'by hand', rather than being fundamental.

This problem can easily be resolved by the eDAM framework. Here, the 3pp-physical and 1pp experiential sub-aspect of non-physical aspects of a brain-mind state are *inseparable*. Conscious SE is the experiential aspect of consciousness (Vimal, 2009b, 2010b). When I view a ripe tomato, 'I experience redness'. In this scenario, 'I' is subjective (s) character and 'redness' is a qualitative (q) character of consciousness in the framework of Peressini (Peressini, 2013). In other words, 'I' = the subject = the self = 'subjective character of consciousness'. Moreover, 'redness' is the 'qualitative character of consciousness (qualia)' or SE.

In that case, in my view, integrated information is neither subject/subjectivity (s-character) 'I' nor SE 'redness' (q-character, qualia). Instead, we interpret it follows:

- (i) Tononi's integrated information (Balduzzi & Tononi, 2009; Tononi, 2004, 2008, 2012) is based on materialism. It is 'correlated' with the quantity/amount/degree of consciousness in the sense that dreamless sleep<sup>18</sup> has no or very low degree of consciousness and alert wakefulness has high degree of consciousness. In other words, the 'amount of integrated information' appears to be correlated with the 'amount of consciousness'. Thus, one could safely argue that consciousness is *dependent* on integrated information.
- (ii) The proposal, "formal properties of Q-space capture many qualitative properties of conscious experience" (Peressini, 2013) and/or the above claims of IIT are also only a sort of *correlations* with qualia (q-character) and/or consciousness (q-character plus s-character). This is in analogy to *NCC is a 'neural correlation of consciousness'*. However, there is a gap between NCC and consciousness. This implies that there is also the explanatory gap between (a) integrated information and (b) qualia and/or consciousness. Therefore, IIT does not address the explanatory gap between subjective experience and its NCC. This is because any materialism-based framework cannot address this gap due to its fundamental assumption that matter is non-experiential and does not even have *potential* for SE.

### 3.1.3. IIT based on panpsychism

If IIT is based on panpsychism then one has to address its 7 problems: combination problem, verification problem, inconclusive analogy or not-mental problem, physical emergence problem, implausibility problem, eternal mystery problem, and restricted panpsychism problem. These problems are elaborated in (Vimal, 2010b).

### 3.1.4. Other Critiques on IIT

(Van Gulick, 2015) provides three criticisms:

1. The IIT is an abstract, mathematical, medium-independent, and computational theory of mind. One wonders if “what it is like” is medium-independent.
2. If IIT is based on a form of panpsychism, then a single isolated photo-diode can be conscious to some extent is unclear.
3. As per (Van Gulick, 2015), “It seems odd to suppose that VC1 and VC2 could be physically the same in all respects during T, and yet one of them have has a conscious point of view and the other does not.” Here, VC1 is contained within a complex with higher  $\Phi$ .

### 3.1.5. The eDAM framework

To address the explanatory gap problem, we need to hypothesize that matter has at the least a *potential* for a realization of a specific SE, such as redness. However, then it is no more materialism. This new fundamental assumption entails to move away from the problematic materialism to a better metaphysics, such as the eDAM framework. This does not have the problems of panpsychism as well. In our view, Tononi’s IIT is well developed for the 3pp-physical aspect of informational neural-network-state. Since physical and non-physical aspects are *inseparable*, integrated information in the 3pp-physical aspect of an informational neural-network-state can be faithfully, immediately, and automatically translated into 1pp non-physical aspect of the informational neural-network-state (related to a specific sub-aspect), and *vice-versa*. It is easier to understand the well-developed IIT for the physical aspect (related to a specific sub-aspect) However, if needed, one can similarly develop IIT for the non-physical aspect (related to a specific sub-aspect).

## 3.2. A critical test for the inseparability-hypothesis of the eDAM framework

### 3.2.1. Background

One of the keys features of the eDAM framework is the doctrine of *inseparability* for a conscious brain-mind state. This state has *inseparable* 1pp non-physical and 3pp-physical aspects. This inseparability of aspects addresses the hard problem because it fills the gap between an experience (1pp non-physical aspect) and its neural correlates (3pp-physical aspect). If the *inseparability* principle is rejected, the eDAM framework is rejected and this framework cannot address the hard problem. This is because the gap will be created as the two aspects will then be separable. To solve the hard problem is basically to fill this gap by making the 1pp non-physical and 3pp-physical aspects *inseparable*. In other words, *the 1pp non-physical aspect of a specific conscious brain-mind state and the 3pp-physical aspect of the same brain-mind state are inseparable within a critical spatiotemporal interval.*

I would like to use the eDAM in the following example: a conscious experience and a conscious function (such as picking up a coffee cup by hand) create a specific conscious brain-mind state. I am emphasizing about this *specific beable ontic conscious brain-mind state*. This conscious brain-mind state has *the inseparable* non-physical aspect from the 1<sup>st</sup> person perspective (1pp) and the inseparable physical aspect (its neural-physical basis: NPB) from the subject’s 3<sup>rd</sup> person perspective (3pp) for the experiential, cognitive,

functional, and qualitative sub-aspects. *The doctrine of inseparability is for this specific beable ontic conscious brain-mind state within a critical spatiotemporal interval.* If we separate these *tightly linked* aspects, then that specific function or cognition will never be completed and the related specific experience will never be experienced.

To appreciate the empirical test for the *doctrine of inseparability*, consider one worst-case example related to biological function. Some biologists could argue that this function can be *separated* from its neural-physical basis (NPB) because of the lack of 1-1 relationship. Consider the function of 'hand' for the function 'picking up a coffee cup'. Once this function entails a *beable ontic* brain-mind state then its 1pp-aspect ('picking up' function) and 3pp-aspect (its NPB) must remain *inseparable* until the function is completed. If we disturb this tight link, physically, we will never able to pick up the coffee cup. In other words, the *inseparability doctrine* is for the *beable ontic* brain-mind state and for the critical spatiotemporal interval needed to complete the required function. During this interval, the integrity between 1pp and 3pp aspects must be maintained; otherwise, the function cannot be completed. In other words, a structure such as a hand can have many functions, but for a specific function, there is just one specific neural-physical basis of function. This specific NPB (3pp-physical aspect) and related function (1pp-functional sub-aspect) must remain *inseparable*; otherwise, the function will never be completed.

### 1. Discussion with McCard, Joseph (10-11 Jan 2018)

**1. McCard:** What comes first, the mind initiating the function, or the actual picking up? What are the details for the creation of a mind-brain state?

**Vimal:** The intention/desire of picking up a coffee is endogenously generated because of, for example, feeling sleepy so try coffee. This should precede the actual picking up the cup of coffee. The necessary conditions of consciousness, as elaborated in (Vimal, 2016c), must be satisfied for the creation of a beable ontic (conscious) state of a mind-brain system.

**2. Vimal:** One of the keys features of the eDAM framework is the doctrine of inseparability

**McCard:** So, we are talking about the inseparability between the body qua physical, and consciousness, the explanatory gap. Are you explaining the gap, removing the gap?

**Vimal:** The inseparability is between 1pp non-physical aspect and 3pp-physical aspect of a beable ontic wakeful active dual-aspect state of a mind-brain system with common information between aspects. I am sorry but writing precise sentence in the eDAM language is mandatory otherwise confusion and distortion will easily arise. Yes, e-gaps of both materialism and Idealism will be removed.

**3. Vimal:** [...] for a conscious brain-mind state.

**McCard:** So, one conscious state. Why not call it a conscious brain state? Just mentioning "mind" seems to add an unnecessary level of complication. Isn't the mind just a brain system?

**Vimal:** Sorry, it will distort the eDAM. Brain state indicates materialism and adjective conscious will lead to circularity problem.

**4. Vimal:** This state has inseparable 1pp non-physical and 3pp-physical aspects.

**McCard:** It seems Ned Block would call your 3-pp physical aspect phenomenal consciousness, and 1pp non-physical aspect Aspect Consciousness. Yet, you seem to indicate that 3pp-aspect is not conscious. In a recent e-mail to Alfredo, I asked him to explain exactly what he took experience to be. Is 3pp-physical aspect experience, simply contact, with no consciousness of the contact. or, maybe a kind of consciousness that is not in the conscious brain, say, subconscious?

**Vimal:** Sorry, you have misconstrued Block's phenomenal and access consciousness; both are from subject's 1pp. Subject's 3pp is always for public and is from public's 1pp as 3rd person and represents the related NN and neural signals. Inseparability is inherent property of all monist frameworks including your idealism based awarized energy framework.

**5. Vimal:** This inseparability of aspects addresses the hard problem because it fills the gap between an experience (1pp non-physical aspect) and its neural correlates (3pp-physical aspect).

**McCard:** Was there any doubt they are inseparable. Can you provide an example? Again, are the neural correlates, the nerves themselves, conscious? They may be the correlates of consciousness, but that does not imply they are not conscious in some way does it? What exactly do you take an experience to be? For example, is there non-conscious experience and conscious experience?

**Vimal:** The necessary conditions of consciousness must be satisfied for any entity to be conscious as elaborated in (Vimal, 2016c). Correlation is inherent property of dualism and the inseparability is inherent feature of all monist frameworks including the eDAM. Yes, both conscious and non-conscious experiences exist as discussed in (Vimal, 2010b).

**6. Vimal:** If the inseparability principle is rejected, the eDAM framework is rejected and this framework cannot address the hard problem. This is because the gap will be created as the two aspects will then be separable.

**McCard:** Hence, I wonder if the nerves themselves are conscious.

**Vimal:** see above. Do they satisfy the necessary conditions of consciousness?

**7. Vimal:** To solve the hard problem is basically to fill this gap by making the 1pp non-physical and 3pp-physical aspects inseparable.

**McCard:** And, what exactly are you saying is inseparable, the brain and mind, 1pp and 3pp, the nerves themselves and consciousness, or all of those?

**Vimal:** The hard problem is the gap between SE and its neural basis (NN and neural signals, NCC). To solve the hard problem is basically to fill this gap by making the 1pp non-physical and 3pp-physical aspects of a beable ontic wakeful active state of a mind-brain system inseparable. This is true because the information is the same in both aspects.

**8. Vimal:** In other words, the 1pp non-physical aspect of a specific conscious brain-mind state of a mind-brain system and the 3pp-physical aspect of the same brain-mind state of the same mind-brain system at a specific moment are inseparable.

**McCard:** Why not just say, "the 1pp non-physical aspect of a specific conscious brain-mind system and the 3pp-physical aspect of the same brain-mind system at a specific moment are inseparable." Why to qualify with "state of".

**Vimal:** This is because a mind-brain system has innumerable states; we need to be precise.

**9. Vimal:** In addition to a conscious experience, a conscious function (such as picking up a coffee cup by hand) creates a specific conscious brain-mind state.

**McCard:** So you are saying a conscious function is not a conscious experience? Would this be the difference we feel between what we think and what we do?

**Vimal:** Is the appearance of cup = picking up the cup?

**10. Vimal:** This conscious brain-mind state has inseparable 1pp- mental aspect (such as functional and experiential sub-aspects of consciousness) and 3pp- physical aspect (its neural correlates).

**McCard:** Both conscious experience and conscious function have their own certain feel. Again, Block's phenomenal consciousness and Aspect consciousness.

**Vimal:** Yes. It is “access” (not Aspect) consciousness.

**11. Vimal:** The doctrine of inseparability is for this specific conscious brain-mind state at a specific moment in time. If we separate these tightly linked aspects, then that specific function will never be completed and the related specific experience will never be experienced.

**McCard:** And so when I wondered, "What comes first, the mind initiating the function, or the actual picking up?" When I say "initiate the function", I mean, for example, when an athlete goes through his routine mentally, and that seems to be separate from the actual routine he performs, acts out. Can't the awareness of the function exist separately from the experience of acting out the function?

**Vimal:** Only well designed experiment can precisely answer. It seems they are separate; former seems to come first as elaborated above in 1.

**12. Vimal:** inseparability is between 1pp non-physical aspect and 3pp-physical aspect of a beable ontic wakeful active dual-aspect state of a mind-brain system

**McCard:** Let me try to paraphrase this. A 1pp non-physical aspect (I, we) is one of two aspects of a mind-brain system. A 3pp-physical aspect (he, she, it) is the other one of two aspects of a mind-brain system.

**Vimal:** No, this is a misconception of the eDAM. Whatever, you experience from your 1pp (1<sup>st</sup> person perspective) is the 1pp non-physical aspect of a state of your mind-brain system, so the appearances of “I, you, we, he, she, and it” all are parts of 1pp non-physical aspect. The 3pp-aspect of the same state of the same (your) mind-brain system is from your 3pp (but it will be from my 1pp for me as I as 3<sup>rd</sup> person looking inside of your brain and its activities).

**McCard:** I'm not sure that's quite right. I'm not sure why you included "dual-aspect state of a". Why not, "inseparability is between 1pp non-physical aspect and 3pp-physical aspect of a beable ontic wakeful active mind-brain system." An aspect is a particular part of something, or a feature of something, or a specific way in which something can be considered. You are talking about a mind-brain system.

**Vimal:** An entity can have many states, such as ground state and various excited states. A mind-brain system has innumerable states: e.g.: look at straight is first state, look rightward second state, look left third state, and so on. Each state has its own NN and related activities. Therefore, it is more precise to write “aspect of a state of an entity”, rather

than “aspect of an entity” to avoid confusion. If there is just one single state, then either way is fine.

**McCard:** Are the two aspects, 1pp mental aspect and 3pp-physical aspect, 2 parts of the mind-brain system, such that one part is the mind itself and one part is the brain itself? Or, are the two aspects features, one a feature of the mind and one a feature of the brain? Or, are the 1pp non-physical aspect and the 3pp-physical aspect two different ways the mind-brain system can be considered? Or, are the two aspects are aspects of a unified whole mind-brain system?

**Vimal:** The two aspects of a state of a mind-brain system arose because of the two sources of robust mundane empirical data (Baars’ Dual-Source Theory or DST: Section 3.2.7.1 of (Vimal, 2015d)): experiential subjective data from subject’s 1pp and the NN and its activities (neural basis) objective data from subject’s 3pp. We called it 1pp non-physical aspect and 3pp-physical aspect of a state of subject’s mind-brain system. Since the information comes from the same external source (object), we argued for the same information in both aspects. We also argued that since (I) the state of an entity is the same for both aspects, (II) the information is the same for both aspects, and (III) since the original source of dual-aspect entity is the same dual-aspect structure of primal entity (dual-aspect Brahman in eastern system), the framework should be called inseparable dual-aspect monism; is the **3-way justifications** for the eDAM. I then extended it so that physics includes mental aspect to close the mind-brain gap and 3 levels (gross-macro-and-micro, subtle-astral/causal, and subtlest unifold information primal field) to explain paranormal data. It should be noted that both 1pp non-physical and 3pp-physical aspects of a state of an entity with common information are products of our mind-dependent reality (MDR).

**McCard:** Normatively, "inseparable", used as a noun, means a person or thing inseparable from another. For example. You can't have up without down, in without out. Up and down are inseparable. So are in and out. Is that what you mean by inseparable?

**Vimal:** The doctrine of inseparability between mental and physical aspects is the inherent feature of all monistic frameworks because information is the same in both aspects; ‘whatever is going on’ (activity) in one aspect is the same ‘whatever is going on’ (activity) in the other aspect in addition to 3-ways justifications for the inseparability (see above). You example, in-out, dark-light, and up-down are called complementary aspects and does not reflect all the attributes of inseparability in the eDAM.

**13. Vimal:** I am sorry but writing precise sentence in eDAM language is mandatory otherwise confusion and distortion will easily arise.

**McCard:** Well, I am confused. Perhaps you can help by clarifying the above ambiguities. Can you identify your fundamental beliefs that underlie and motivate your claims. For example, are there specific elements of what is it you follow, *Sāṅkhya* or Vedānta, Eastern metaphysics or western scientific methods?

**Vimal:** I believe that the eDAM is the least problematic metaphysical framework.

*Sāṅkhya* is dualism; it has two versions non-interactive theist as Vinod ji elaborated and interactive atheist as GS elaborated.

The *Vedānta* philosophy was developed after Vedas. It has six main sub-schools (Vimal, 2012b) based on the interpretation of the aspectless and attributeless *Brahmin* (primal entity) and its relationship with *Jīva*/self and matter (*Jagat*): (1) *Advaita* (non-dualism, Adi Śankarāchārya: 788-820), (2) *cit-acit Viśiṣṭādvaita* (qualified non-dualism, [Rāmānujāchārya: 1017-1137 or 1077-1157](#)), (3) *Dvaitādvaita* (Nimbārkāchārya: 1130-1200), (4) *Dvaita* (dualism, Mādhavāchārya: 1238-1317), (5) *Shuddhādvaita* (pure non-dualism, Vallabhacharya: 1479-1531), and (6) *Achintya-Bheda-Abheda* (inconceivable oneness and difference, Chaitanya Mahaprabhu, 1486-1534). For further detail, see Table 1 of (Vimal, 2012b).

The bottom-up (potentiality to actuality) eDAM is somewhat close to in the sense of dual-aspect the top-down (CC is on top) (a) *cit-acit Viśiṣṭādvaita* and (b) *Shiva-Shakti* inseparable aspects of a state of Brahman (the primal entity) in *Kashmir Shaivism* (860-925 AD).

There are two realities: (i) mind-dependent reality (MDR) in which our daily mundane life operates and (iii) mind-independent reality (MIR) has consciousness-in-itself is represented in the mental aspect and matter-in-itself is represented in the physical aspect, but they are unknown; perhaps when thought fluctuations are zero in Samadhi state then we might know something about MIR.

### 3.2.2. The critical experiment

Let us empirically test the *doctrine of the inseparability* (1-1 relationship) between the structure (3pp-physical aspect) and the correlated experience (1pp non-physical aspect) for the experiential sub-aspect. For this, we propose a combination of psychophysical and fMRI/EEG experiments to measure the neural-physical basis (NPB) (3pp-physical aspect) for a specific color experience (1pp non-physical aspect). The stimulus can be long wavelength light on a dark background. The specific subjective experience (SE) can be experiencing the redness on the dark background. If we change any one aspect, we expect that other aspect should also change accordingly as per the *doctrine of the inseparability*. The criterion is the *just noticeable difference* (JND). For example, if the experience is the SE orangeness, which is beyond one JND from the redness, the related NPB (3pp-neural activities for orangeness) should be different from that of the redness. However, if the latter, i.e., the NPB does not change, then the aspects are *separable*. This will then imply that *doctrine of inseparability* is violated. Then, the eDAM framework must be rejected or seriously amended. Thus, this simple experiment will critically test the eDAM framework. If the separability is not found then the *doctrine of inseparability* cannot be rejected.



Similarly, we can test *the inseparability* between a structure (3pp-physical aspect) and its function (1pp non-physical aspect) for cognitive, functional, or qualitative sub-aspect.

In other words, if we can provide, a single empirical contradiction for the above *kind* of inseparability, then the hypothesis of *inseparability* (and hence the eDAM framework) needs to be either rejected or amended. Until this happens, the *doctrine of inseparability* cannot be rejected.

### 1. Samadhi state experiment

So far, the 100s of fMRI/EEG reports failed to find any separability, but they were not specifically designed for this purpose, but the above design will clearly test it. Opponents (such as Sankhya proponents) could argue that other foundational frameworks will also claim this operational type inseparability under such wakeful conscious states. This criticism is addressed by further proposing to test the inseparability/separability issue by measuring the related NPB (neural-physical basis) the highest level of Samadhi state subjective experience, where Sankhya clearly predicts that NPB must not exist and separability must exist. The problem is to find such rare cooperative yogis.

### 2. Meaning of simultaneity and inseparability with an example

The *inseparability of aspects* means 1pp non-physical and 3pp-physical aspect of a beable ontic conscious state cannot be separated as long as this conscious state is maintained. A conscious state arises when all the necessary conditions of consciousness (Vimal, 2016c) are satisfied. A specific dual-aspect beable-ontological state is selected as the dual-aspect conscious state (out of many dual-aspect ontological states stored as engrams in the long-term memory (LTM) of the specific NN) after the matching of Feed-forward (FF) and feedback (FB) signals is completed (Vimal, 2010a). The beable ontic dual-aspect conscious state is caused by a stimulus. The “effective” information is the same in both aspects. If the subject views this information from his first person perspective, then s/he experiences SE such as redness (1pp non-physical aspect); however, if we look at her/his 3pp-physical aspect (from our 1pp), we ‘see’ her/his 3pp-NN and fMRI/EEG activities; we do not ‘see’ red color in his 3pp-phphysical aspect. The measurements of 1pp and 3pp data are done *simultaneous*, which entails inseparability of the aspects of his conscious state, which is caused by the stimulus. The subject’s 1pp is NOT caused by her/his 3pp-NN and its activities or vice-versa.

### 3. The critical threshold interval related to JND

The *critical threshold interval related to JND* arises because of variations between the trials in a day, many days of experiments for a specific subject. For example, let us suppose the 660-641 nm lights appears red to a specific subject, but 640-621 nm appears orange; then the interval for one JND is 20 nm; let mean  $\pm$  SE (standard error) = 650 $\pm$ 5 nm for redness and 630 $\pm$ 5 nm for orangeness. If we change the wavelength of light within one JND (say from 655 to 645), 1pp-SE redness must not change and the correlated 3pp fMRI activities must also remain within its critical interval of 1 JND for the inseparability to hold for a

specific subject. Otherwise, the inseparability between aspects will fail and aspects can be considered separable; note that measurements of 1pp-data and 3pp-data are always done *simultaneously*.

The interval of processing of information (say it is 500 msec) has nothing to do with the inseparability of aspects within one JND of 20 nm; we should note this interval is in the unit of time and 20 nm interval is in unit of length ( $1 \text{ nm} = 10^{-6} \text{ cm} = 10^{-9} \text{ meter}$ ). Thus, the eDAM and its inseparability can be tested.

The spatiotemporal interval should not be confused with JND. The JNDs in 1pp non-physical aspect and 3pp-physical aspect are determined through a control experiment before the testing the inseparability. The 1pp and 3pp measurements must be made simultaneously. The measurements within 1 JND in the 1pp non-physical aspect must have the same NN and related activities (within the 1 JND 3pp NN and related activities) and vice-versa. The measurements for more than 1 JND in the 1pp non-physical aspect must also be more than the 1 JND for 3pp NN and related activities and vice-versa. In other words, 1pp and 3pp data must co-vary correspondingly.

The hypothesis of the inseparability between physical and non-physical aspects for non-conscious states of entities (both living and non-living systems) can be tested using structure and their respective functions (functional sub-aspect) or patterns/forms (qualitative sub-aspect).

### 3.2.3. Integrated Information Theory

The  $\Phi_{\text{physical}}$  represents Tononi's the integrated physical information measure from 3pp, which will not be modified by the eDAM framework. The *inseparable*  $\Phi_{\text{nonphysical}}$  represents the integrated mental information from 1pp. This would be equivalent to  $\Phi_{\text{physical}}$  because the information is precisely the same in both aspects. However, the perspective of 'looking' is different (1pp vs. 3pp). The  $\Phi_{\text{nonphysical}}$  could be measured in terms of psychophysical measures using psychophysical experimental design as done in (Vimal et al., 1987) for color appearances.

### 3.2.4. Evolution, ecosystem ecology, and inseparability

The eDAM framework does not claim the *inseparability* of the non-physical aspect of one brain-mind state and the physical aspect of different brain-mind states at different moments of time. The ecosystem ecology takes its own time (such as years and generations for some species) to update information. On the contrary, the evolution and the ecosystem ecology make sure that both aspects are *inseparable* for a conscious brain-mind state once this state is formed at that particular temporal moment or within the temporal grain-size. This could be in milliseconds range (such as 50-500 msec) (Sections 2.6 and specifically 2.6.3).

### 3.2.5. Baars' dual-source theory: two (1pp and 3pp) sources of information

As per Baars (personal communication with Bernard Baars on 20 Nov. 2015), “At this time I’m convinced by the brain imaging evidence that conscious cognition is a biological phenomenon with two sources of information - our own experiences, and our shared experiences via public phenomena. I would not call that dual-aspect theory, but rather dual-source ‘theory.’ It is a useful working frame for sensible science”.

### 3.2.6. The difference between dual-source and dual-aspect theories

What is the difference between dual-source and dual-aspect theories? My understanding is as follows:

#### 1. Dual-Source Theory (DST)

As per Baars (personal communication with Bernard Baars on November 20, 2015), “At this time I’m convinced by the brain imaging evidence that conscious cognition is a biological phenomenon with two sources of information - our own experiences, and our shared experiences via public phenomena. I would not call that dual-aspect theory, but rather dual-source ‘theory.’ It is a useful working frame for sensible science”.

In other words, in the DST, there are **two sources of information**:

- (i) Our own subjective experiences (SEs) from first person perspective, and
- (ii) Our shared experiences (of NN and its activity) via public phenomena from third person perspective.

In the DST, these two sources may be *separated* (which causes association problem of dualism), but in the eDAM the two aspects are *inseparable* within a critical spatiotemporal interval and are the aspects of the same state of the same entity (such as a brain-mind system). In the DST, our shared experiences may or may not include information related to the physical aspect of the same state of the same brain-mind system; it could be just the consent of public about their own experiences. For example: (i) when trichromats look at the ripe-tomato, they may have consent that the color related experience is redness. (ii) We have consent on the Maxwell’s electromagnetic theory in classical physics. Furthermore, it is unclear if the DST can address the above hard problem of consciousness.

#### 2. The extended Dual-Aspect Monism (eDAM) framework

This is an extended version of dual-aspect monism ((Vimal, 2008, 2010a, 2013, 2015d, 2016c) and summarized in (Vimal, 2016b) and Section 1.3) that has addressed the shortcomings and problems of dual-aspect theories. An entity may have many states. A state of an entity has two *inseparable* aspects. An entity could be living or non-living system. For living system such as our system, a conscious state of a brain-mind system has two *inseparable* aspects: non-physical aspect from first person perspective (such as our subjective experiences) and physical aspect from third person perspective (such as related neural-network and its intrinsic and extrinsic activities). Both aspects have precisely the same “effective” information; they ‘look’ different because the perspectives of ‘looking’ are different. For a non-living system, the two *inseparable* aspects are qualitative sub-aspect

(such as spatiotemporal structures/patterns/forms) of non-physical aspect and the related physical aspect (Pereira Jr. et al., 2016).

As per (Northoff, 2014).p.414), “qualia [what it is like], being purely subjective, cannot be observed in the rather objective neuronal activity of the brain. The search for the neuronal mechanism of qualia is therefore regarded as one of the hardest nuts to crack.” The eDAM has attempted to address this ‘hard problem’ of consciousness in (Vimal, 2015d).

The eDAM is a foundational metaphysical framework; it does not contradict Baars’ Global workspace theory (GWT) (Baars, 1988, 2013; Baars, Franklin, & Ramsoy, 2013), Northoff’s relational ontology, Tononi’s IIT, Searle’s biological naturalism (BN), triple aspect monism (TAM), HOT, biosemiotics, etc. and is complementary to all of them as long as they are properly interpreted in terms of the eDAM. The criticisms of the eDAM are addressed in (Vimal, 2015b) and Section 3.3. So far, the IIT has been interpreted in the eDAM in (Vimal, 2015d), BN in (Vimal, 2015a), TAM in (Vimal, 2014a), and biosemiotics in (Cottam & Ranson, 2013). The eDAM brings science & religions closer in (Vimal, 2012a, 2012b) and science, religions, & spirituality closer in (Vimal, 2015c; Vimal & Bhardwaj, 2015).

### 3.2.7. Working hypothesis

We argue that we cannot reject the *doctrine of inseparability* between the 1pp non-physical and 3pp-physical aspect of a beable ontic conscious brain state empirically, theoretically, qualitatively, or quantitatively. It is one of the underlying principles of the eDAM that addresses the hard problem. If it cannot be rejected, then it is an axiom or a biological law for a beable ontic conscious brain-mind state. This can also be considered as a critical scientific test for the eDAM framework.

Interpreting dual-source theory in terms of the eDAM (from my discussion with Baars (19-22 Nov. 2015)), my working hypothesis evolved to be as follows: *The “effective” information is the same in both two sources (1pp and 3pp) for the same conscious event within the critical spatiotemporal-spectral interval threshold at a beable ontic conscious state of our mind-brain system. They appear different because perspectives (1pp and 3pp) are different (1pp: 1<sup>st</sup> person perspective; 3pp: 3<sup>rd</sup> person perspective). I postulated in the eDAM that these two sources are two inseparable aspects of the same conscious state of the same mind-brain system to avoid the association problem of separability in dualism.*

I am trying to find the separability between 1pp and 3pp sources/aspects for the same conscious event within the critical spatiotemporal-spectral interval threshold (just-noticeable difference: JND) at a beable ontic conscious state of our mind-brain system. So far, I am unsuccessful.

### 3.2.8. Comparison with other frameworks

One could argue that the *identity theory* of materialism assumes that 1pp non-physical aspect and 3pp-physical aspect are *identical* and hence predicts *inseparability* between these aspects. Thus, we cannot reject materialism based on the *doctrine of inseparability*: this is correct. The materialism is rejected not because of the *doctrine of inseparability*. It is rejected because of the *Kaṇāda*-Democritus' definition of matter that does not even have *potential* for experiences. This definition unfortunately leads to the serious explanatory gap problem: how can a non-experiential non-mental matter like brain create experiences?

The alternative definition of matter proposed by *Yājñavalkya-Bādarāyaṇa*-Aristotle includes *rūpa*/form/pattern and has *potential* for experiences. If this definition is used, the explanatory gap problem will be addressed. However, it would not be materialism anymore; it would be a version of dual-aspect monism such as the eDAM framework.

Previous articles in literature, such as (Atmanspacher, 2012; Bohm & Hiley, 1993; Eddington, 1928; Strawson, 2006), argues for Dual-Aspect Monism (DAM) against materialism as this article does. However, DAM is only the first component of the five-component eDAM framework (Sections 1.3 and 2). Therefore, the previous articles have limited scope and do not address the problems of DAM. Thus, the eDAM framework extends previous frameworks to address their problems.

The Cartesian interactive substance dualism, non-interactive dualism based Sāṅkhya, materialism, and idealism have serious problems (Vimal, 2010b, 2013). The eDAM has the least number of problems and hence it is a preferred framework.

As per Occam's razor principle, the eDAM framework (that has 1 free parameter) is more parsimonious than triple aspect frameworks (that has 3 free parameters) such as (Pereira Jr., 2013) and (Cacha & Poznanski, 2014) and dualism (that has 2 free parameters). It would be hard to select between the eDAM and the reflexive monism (Velmans, 2008) because both have one free parameter. They address the brain-mind problem in a little different manner. However, the reflexive monism is currently limited to human observers for conscious states, whereas the eDAM encompasses both living and non-living systems at all states. Perhaps, further research is needed to investigate which has more problems when one tries to enlarge the scope to include other areas, such as cosmology, physics, chemistry, biology, sociology, law, economics, war-peace, international problems and relationship, personal relationship, health, and religions. Perhaps each framework explains different features of consciousness. Therefore, all frameworks are useful and complementary to each other.

Furthermore, we might still able to generate a testable hypothesis related to the *inseparability* between self and its neural correlate(s) by modifying the experiment using functional MRI (Vimal et al., 2009) and EEG discussed above. For example, change the activities of self-related areas (cortical and subcortical midline structures) by perhaps some kind of magnetic stimulation (Saroka, Mulligan, Murphy, & Persinger, 2010)<sup>19</sup> and see what happens to 'self' (subjective experience of subject). Perhaps, OBE (out-of-body experience) of self could happen. It is just a speculation and I am not sure if this is feasible. In this case,

if the *inseparability* hypothesis is rejected then the eDAM (*Dvi-Pakṣa Advaita*) would be rejected or seriously modified. Otherwise, *Sāṅkhya* would be rejected because its *separability* between self (a part of *Puruṣa*) and its neural correlates (*Prakṛti*) would be rejected.

### 3.2.9. Critique on the testing of the doctrine of inseparability between mental and physical aspects

#### 1. Vimal

Sehgal claims “that it only shows correlation, not inseparability but does not provide any justification and how to improve it. I think that it provides 1-1 which is close to inseparability but I am looking for a design that can clearly show the inseparability and reject the separability of Vinod’s framework (non-interactive dualism, *Sāṅkhya*).”

#### 2. Sehgal

I only provide the clarification that there is significant difference between correlation and inseparability. Therefore, any correlation can't be taken as inseparability unless there is the evidence to the effect that the aspects, having a relation of correlation, are originated from the same common entity/source.

The critical test of eDAM, of course, establishes correlation but not the inseparability in the sense inseparability as defined above. For establishing inseparability, the observed correlation needs to be clubbed with an evidence that the correlated aspects have their origination in one common entity/source. The critical test is incapable of dealing with this important aspect of inseparability. Till some experiment is available to test this important aspect (origination from the same source/entity), the interpretation of the correlation can't be taken as inseparability since it is empirically and logically incorrect.

However, if one wants to interpret the observed correlation as inseparability, that is one's sweet will but then one should remain aware of the fact that this is part of his belief system and not science because it is not supported by any empirical evidence.

**27 Dec 2017:** It is right that you have designed critical test in eDAM but this test does not test the inseparability, which is the main doctrine of eDAM but it tests correlation and finds it positive. And interesting point is that this correlation will be found positive regardless of the type of metaphysics you follow.

#### 3. Vimal

Yes, they (mental information in a SE and physical information in related neural signals) are originated from the same common entity/source, which is the same common information. For example, the physical information is originated from the same common

source such as the same exogenous (or endogenous) source, such as external long wavelength light reflected from a ripe-tomato. This physical information is transduced by the related receptors into the information in FF neural signals, which then matched with cognitive FB signals and then a specific SE is selected and self experiences this information from subject's own 1pp (1pp non-physical aspect) and the same information is in NN from his/her own 3pp (3pp-physical aspect).

#### 4. Sehgal (28 Dec. 2017)

The 1-1 relationship and the same information can't prove the inseparability in its real sense. Inseparability in the real sense does not mean only 1-1 relationship and the same information but the key requirement is that both the aspects should be sourced out from the same ontological entity. In other words, before the physical and mental aspects appear on the scene on manifestation, the same do lie in the same ontological entity. This key test of inseparability is not tested by the critical test and this test is also incapable of testing the real inseparability in terms of the key criterion as specified.

Why the above key criterion of inseparability? Since 1 to 1 relationship and the same information shall be observed in other metaphysics also viz. Materialism (wherein both aspects arise from the same material ontological entity), Idealism (where both aspects arise from the same ontological entity of mental or consciousness), Dualism (where the physical aspects arise from the physical matter/physical; energy level and the mental aspects from the Astral mind level with distinct consciousness only) experiencing.

In Materialism and Idealisms also since both aspects do take birth from the same ontology viz. matter and consciousness respectively, they are equally or even more inseparable than eDAM. Therefore, the information is also same. In dualistic *Sāṅkhya*, the physical and mental aspects are ontologically sourced out from different entities with physical from the physical brain in the physical realm and mind from the Astral bodily level, therefore, ontologically they are separate. But for the operational and functions purpose, both act as a joint assembly or aggregate, so operationally, they are inseparable. In *Sāṅkhya*, the physical aspects in form of physical NCCs reflect, as such, at the Astral Mind level with the consciousness permeating both the physical brain and astral mind level, therefore, the information is same.

In the eDAM, both the aspects co-exist in the inseparable state in all the ontological entities but none of the same does take birth from the other. Hence the inseparability and the same information, On the contrary, this raises an important epistemological issue regarding the ontological basis for the mental aspect since neither any dual aspect nor any mental aspect structural entity at the primordial state is recognized by the current science.

So to sum up, the 1 to 1 correlation and the same information are not the exclusive features of the eDAM and these features do exist in other metaphysics also in equal proportions.

## 5. Vimal

In the eDAM, the source of the both aspects is neither based on materialism, idealism, nor dualism; instead, it is based on the dual-aspect Brahman (primal entity/'Unified Field'). This common source along with the same source of common information between mental and physical aspects and the 1-1 relationship between them entails the *doctrine of inseparability*.

Alternatively, the *doctrine of Neti-Neti* implies that Brahman is aspectless and attributeless neutral primal entity/'Unified Field' as in Neutral Monism (NM). However, NM has explanatory gap problem: how can mental aspect and physical aspect emerge from neutral entity that is neither mental nor physical? The eDAM addresses this problem by assuming that both aspects of unmanifested state of the neural entity are latent (unexpressed, hidden) and then these latent aspects are manifested. What else do we need for inseparability?

## 6. Vasavada, Kashyap (28 Dec. 2017)

If there are no human beings (any living system) present in the beginning, who can tell whether it is manifest or unmanifest. So what difference does it make? Also if the primordial entity, whatever you call it, is omnipotent, why can it not change unmanifest form into manifest form without any outside help? The second point is about Vimal's experiment about inseparability. I am sure everyone has heard about quantum entanglement. It gives rise to correlations between widely separated objects. Even if Vimal's experiments prove correlations, that would be quite interesting. That would prove 1pp and 3pp are entangled.

## 7. Sehgal (29 Dec. 2017)

**To Vasavada:** First, let us try to understand what is meant by the manifested or unmanifested CC/primal entity/Brahman at the primordial stages. By the manifested CC, I don't mean the manifestation of the observable/unobservable universe. By the manifested CC, I mean the presence of the CC in the active mode, the presence of an ever manifest awareness, the presence of all the powers of CC in active mode and presence of all the ready mode for any action. The unmanifested mode is opposite to this. If the CC is in the unmanifested state, there will be no active awareness, Nil powers, all the laws as to be emerged out from CC also in the inactive mode, no active mode for action. In other words, CC and all its modes will be in the unmanifested or inactive mode. Such CC can't transform



from the inactive to active mode on its own since everything is in the inactive or dormant mode.

CC does not require help from anything for its manifestation since primordially there was nothing except itself. As per Vedantic view, there was only the CC at the primordial stages. As per Sāṅkhyan view, apart from CC there was the Moola Prakṛti. Prakṛti itself is inert lacking any consciousness, therefore unable to manifest CC from any of its unmanifested state.

In fact, the whole issue of the manifestation and unmanifested CC is redundant since manifestation and unmanifested are the mechanisms falling within space/time. CC, being beyond and outside the time, was never in the unmanifested state, so there is no question of its manifestation. If any entity has never been in the unmanifested state, how will you invoke its manifestation? Still, as a limitation of language, we say that CC was always in the ever manifest awakened state since a CC in the unawakened state (inactive/unmanifest mode) is as good as NIL consciousness or equivalent to the inert entity.

## **8. Vimal**

Random QFs can activate laws, mechanisms, and processes thru Big Bang. Yes, I agree with Vasavada that even if tight positive correlation can address the association problem of dualism.

## **9. Sehgal (29 Dec. 2017)**

I pointed out in one of my earlier messages also that random QFs shall also activate some laws or mechanism as governed by some specific Law only. When all the laws shall be in the inactive mode THAT VERY SPECIFIC LAW, governing the activation of laws by QFs, shall also be in the inactive mode (like all other laws). So the hypothesis of QFs activating the Laws is not logically tenable.

## **10. Vimal**

My understanding is that the term “random” implies without definite aim, without purpose, without method, without adherence to a prior arrangement or without any specific law. Therefore, random QFs in the physical aspect of unmanifested state of the unified field (UF) may lead to the Big Bang that should wake up the sleeping latent laws, mechanisms, and processes. It should be noted that since aspects are inseparable, therefore, there should also be related fluctuations in the universal potential consciousness (UPC: mental aspect).

Let us take an example of the phase transition of water to ice as the temperature is reduced. The laws are embedded in water, ice, and in the environment. Do we need God for this?

Why do the science and the eDAM try not to involve God by making strong effort even when we know that if we assume OOO God our life becomes easier? This is because there is no scientific objective evidence of God and soul; if these entities really exist then they should be present in our mundane life similar to other entities and reveal their secret mechanisms.

### **11. Sehgal (29 Dec. 2017)**

**To Vimal:** You may be correct in holding the above hypothesis that the source of the dual aspects in all entities is the dual aspect Brahman/UF/Primal entity. In my above comments, I had not discussed this point. In my comments the points which I tried to highlight were:

(i) The 1 to 1 correlation and the same information as many presents in Materialism, idealism, dualism as in eDAM. Therefore, the deduction of positive correlation and the presence of the same information in both aspects is no way an evidence of the real inseparability, as should be taken in the eDAM.

(ii) The current science goes up to the level of physical vacuum and physical QFs. Hypothesizing any dual aspect primal entity could be very much correct but not within the scope and scrutiny of the current science.

(iii) At the operational/functional manifestation stage, positive correlation (perceived inseparability) and the same information is observed in Materialism, Idealism, and dualism also as in eDAM.

Therefore, the critical empirical test, in no way, provides any clinching evidence for the dual aspects either in the particles of the brain/inert entities outside a functioning brain/existence of some dual aspect UF or Brahman.

My following comments may facilitate you more deeply on inseparability.

Inseparability can be viewed from two perspectives viz. ontological and operational/functional.

(iv) The eDAM speaks of the ontological as well as the operational inseparability. Operational inseparability, which is like correlation, is present equally in all the metaphysics be it Materialism, Idealism, Dualism, and eDAM. The critical test proves the operational inseparability (equivalent to correlation) but not the ontological inseparability.

(v) In Idealism, there are no ontological physical aspects and in Materialism, there is no ontological mental aspect.

However, in idealism, the physical aspects take birth from the mental aspects and at the operational state; both exhibit operational inseparability and same information.

In Materialism, the mental aspect takes birth from the physical aspect but at the operational state, both exhibit operational inseparability and the same information.

(vi) In dualistic *Sāṅkhya*, both the physical and the mental aspects have the ontological existence like eDAM but with some differences.

(a) In the eDAM, both aspects exist in the same ontological entity and they are inseparable. In dualistic *Sāṅkhya*, both aspects exist in different ontological aspects and they are separable (SEPARABLE ONLY FOR THE ONTOLOGICAL PURPOSES BUT NOT FOR THE OPERATIONAL/FUNCTIONAL PURPOSE).

(b) In the eDAM, all the mental functions (functional sub-aspect of the mental aspect) and consciousness (experiential sub-aspect of the mental aspect) are ontologically synonymous. In dualistic *Sāṅkhya*, there is a difference in the ontology of the consciousness (which experiences) and the mental functions. Strictly speaking in dualistic *Sāṅkhya*, the mental functions are not conscious in themselves from the ontological point of view. Mental functions are produced in the structural derivatives of Moola Prakṛti in the sub-quantum Astral realm below the quantum scales.

(vii) Real inseparability is ontological inseparability. But there is no empirical test to prove the ontological inseparability or separability in any metaphysics. Empirical tests including the critical test of eDAM can study up the operational level and operational inseparability is equally present in all the metaphysics.

(viii) I hope my above comments will facilitate you to think of inseparability in terms of the operational and ontological inseparability and you will realize that the critical test of eDAM proves the operational inseparability, which is equally present with any of the 4 metaphysics as proposed by you, and NOT the ontological inseparability.

## **12. Vimal**

(i) Yes, I agree that all monistic (but not the dualistic) frameworks, including the eDAM, entail the operational inseparability of aspects; but it is an attribute of monism. However, other monistic frameworks have serious problems such as category mistake and explanatory gap problem; therefore, the eDAM is preferred.

(ii) Yes, I agree but the eDAM extends the mainstream physics (gross Level 1: CM, QM, PM) to include the mental aspect and the subtle (Level 2) and the subtlest (Level 3) levels, which are beyond PM (Planck level mechanics/physics).

(iii) Yes, I agree that positive correlation is consistent with all 4 groups of metaphysical foundations. However, there should be a critical test that has ability to reject the eDAM.

(iv) Yes, I agree. The ontological inseparability in the eDAM is based on the same original source for both aspects, which is dual-aspect Brahman (primal entity, UF).

(v) Yes, and both materialism and idealism make their respective category mistake and have their own explanatory gap problem.

(vi) Yes, agree.

(vii) In my view, both types of inseparabilities (operational and ontological) are essential in the eDAM. The operational inseparability can be tested thru the proposed critical test (Section 3.2). The ontological inseparability is currently based on logics (the original source for the both aspects is the dual-aspect Brahman), but subjective and objective evidence are needed, which needs further research.

(viii) We need other framework-selection criteria as well, in addition to Occam Parsimony, which rejects dualism compared to monism: the viability of dualism is 50% of monism because dualism has two free parameters (such as *Puruṣa* and *Prakṛti* of *Sāṅkhya*). Other criteria are: category mistake problems and explanatory gap problems, which rejects materialism and idealism. Thus, the eDAM is the least problematic metaphysical foundation.

### **13. Sehgal (6 Dec. 2017)**

You have designed experiment but does the experiment provides any clinching evidence that the observed relation between the physical and mental aspects at the functioning brain level is inseparability and NOT any positive correlation physical to mental aspects? Obviously NO. In view of this, it will be not be justified to extrapolate this misconceived inseparability outside the brain unless you are not biased towards any particular metaphysics like eDAM.

### **14. Vimal**

The answer of your query related to ‘clinching evidence’ is yes, which will also suggest high statistical positive correlation. The critical experiment in Section 3.2 of (Vimal, 2015d) shows separability, the inseparability of eDAM is rejected. If inseparability fails then mental and physical aspects are separable, which might support dualism.

In the eDAM, the ontology of both aspects is always the same as the ontology of common information because information is the same in both aspects at all levels. Therefore, aspects are inseparable. Whatever goes on in one aspect is the same in other aspect as well;

it is just the perspectives of viewing are different. In other words, the ontology of mental and physical aspects = the ontology of dual-aspect primal structure (dual-aspect Brahman) with common information.

For example, physical (light) information (in the form of long wavelength and intensity of light) reflected from a ripe-tomato is transduced into electrochemical signal (same information but in the form of neural signal) in retina which travels towards cortex. Then matching and selection mechanisms select a specific SE redness (which is the same information but in psychological form) and the “self” experiences it. For convenience, we can give names: Information in external light in physical form = physical information in neural form = common information in both aspects in abstract physical-mental form = mental information in experiential/psychological form.

### **15. Sehgal**

The ontology of an entity is not its information. Information is the description of the ontology which could be some matter/energy in the physical world, some mental matter/mental energy in the mental world. Except for the Cosmic Consciousness (CC), information is always built on some ontology. Even CC can be treated as some ontology/some primal structure of consciousness only. So it is the information which may remain the same or there may be some relation to correspondence but not the ontology. At different levels, there may be different ontologies but with the same information or there may be a representative relation of correspondence between the information at the different ontologies. But erroneously you have treated information and ontology as synonymous.

### **16. Vimal**

One could then argue that ontology and information have multiple meanings depending on authors. My view is that since information is the same in both aspects and the original source of all information in entities is the information in UIF with UPC as latent mental physical and PUF as latent physical aspects of unmanifested state of primal dual-aspect structure (dual-aspect Brahman).

In the eDAM, a state of an entity with common information has dual-aspect and both aspects (mental and physical) have the same information, except its form may be different and it appears different depending on the perspective of viewing it. Therefore, the ontology of both aspects is the ontology of dual-aspect constituents/structures with this common information.

### **17. Sehgal**

To distinguish eDAM from materialism, you make an added assumption in the eDAM that the mental aspect does not take birth from material particles but it already exists as some latent PEs as a dual aspect in inseparable form with the physical aspect of the physical

particles. But (and this is very important), you fail to provide any sound epistemic framework providing a convincing understanding as to from where and how any latent mental aspect in form of PEs appear with the physical particles particularly when the entire ontology of the universe, as known to science and as believed by the eDAM, is exhausted in physical structure and physical functions/attributes.

## 18. Vimal

The ontology of a dual-aspect entity arises from the ontology of dual-aspect structure(s) that are constituents of the entity and eventually from the dual-aspect primal entity/structure (dual-aspect *Brahman*); i.e. the ontology mental and physical aspect of the state of the entity is from the ontology of the mental and physical aspects, respectively, of the state of the dual-aspect constituents.

In the eDAM, what is the relationship between mental and physical aspects of a state of information in an entity? An entity could be anything from UIF to elementary particles/fields to classical living and non-living systems/fields to whole universe. As elaborated before, since both aspects have common information, common state, common entity, and framework is monism, the aspects are inseparable. It is just the perspectives of “viewing” are different; so they look entirely different, such as it is a private SE (such as redness related to a ripe tomato) from 1pp and it is NN and its activities from the 3pp.

We start from a beable ontic wakeful active (i.e., conscious) state where we have robust evidence for both aspects, then extrapolate to all states of all other living and non-living entities from the states of macro to ultra sub-Planckian entities/fields to the UIF. The ontology of both aspects is from the ontology of dual-aspect constituents.

For example, consider an inert table. What is the information in a static stable state related to the table? The information are related to its mass, its shape, light reflection property, and so on. Our equation is: physical information in physical form = common information in abstract form = mental information in mental form. Since we are not the table, there is no way we will ever know its 1pp non-physical aspect (if any!). Therefore, for us, its mental aspect is “latent” (hidden, unexpressed); it is not absent as argued before. Therefore, we should not ask any question related to its mental aspect because it is latent to us and hence we are agnostic about it; we can only guess. Thus, interesting queries related to the table (and all non-living entities) is its physical information and its physical functions.

However, a curiosity still remains how aspects arise. The information common to both aspects of the unmanifested state of the UIF (the primal entity) is the source of that of all dual-aspect states of all inert/non-living and living entities including all the laws of Nature for all entities. We have postulated that the mental aspect of the unmanifested state of information in the UIF is UPC (Universal Potential Consciousness) information field and its inseparable physical aspect is PUF (physical unified field). In general, both aspects inter-

dependently co-arise and co-evolve and later co-develop and sensorimotor co-tune in living systems. More precisely, the ontology of both aspects is from the dual-aspect constituents. What is the ontology of common information? The eDAM assumes that it is the Big Bang (BB) ontology because the [BB](#) “offers a comprehensive explanation for a broad range of phenomena, including the abundance of [light elements](#), the [cosmic microwave background \(CMB\)](#), [large scale structure](#) and [Hubble's law](#)”, although other models have been postulated instead of BB.

## **19. Sehgal**

As indicated previously, there is no clinching evidence of any real inseparability between the physical and mental aspects of the conscious state. The observed relation which is perceived as inseparability could very well be a positive correlation from the physical to mental aspects. A static table has some physical structure. We can define and describe this table thru some identifiable parameters like mass, shape, attributes of the reflected light. This constitutes what we call information. All the identifiable parameters to define and describe table are physical. So ontology (structure) is physical and, therefore, information is also physical. A logical approach and story end. But when you speak of any mental information or dual aspect information of the table, the same is untenable. Why? When a table has NO mental ontology, from where and how any mental information can emerge and thus leading to any dual aspect information? Since as per eDAM a table has no mental ontology ( in form of any mental structure and functions) and the ontology of the table ( its structure and functions) are also purely physical, therefore, a table can't have any mental functions. It also can't have any experiential mental sub-aspect of the mental aspect (since mental aspect itself is absent) from lpp aspect of which it may experience any mental functions. Otherwise also, for any lpp aspect to arise and exist, its consciousness or experiential sub-aspect should be in the manifested form. But as per eDAM, consciousness is not in the manifested form in inert entities. While searching for any mental aspect in form of UPC, eDAM has committed the same mistake as done for inert entities like a table, as discussed above. In fact, while searching for any mental aspect, this error has perpetuated from the stage of a conscious functioning brain level till the UF level right thru endless inert entities. In a conscious brain level, when the ontology (structure and functions) comprised of only physical elementary particles, it was an error to hypothesize manifestation of any SEs from any hypothesized PEs as inseparable with the brain. When there has been no mental ontology in form of any mental structure/function at the elementary particles of the conscious brain level, from where and any mental information or mental aspect could emerge out. Alternatively, one can also say that while hypothesizing and searching for any mental aspect, the blunder committed is at the UF level. How? Please try to understand patiently as given below: At the UF level, Physics/cosmology postulates the ontology of the quantum vacuum and popping in/out QFS. So the entire ontology at the UF level is purely physical. eDAM has adopted this ontology at UF level, as such, without applying serious mind. When at the UF level, there is no mental ontology in form of any

structure and functions, therefore, absence of any dual ontology in form of dual structure/functions, from where any mental aspect in form of UPC can emerge out? Therefore, hypothesizing any mental or/and dual aspect information at the UF level is also prima facie untenable within the given postulates of eDAM. Please remember no information (physical/mental/dual) can exist unless there is the presence of the corresponding ontology ( structure/information). Since at the UF level, eDAM postulates that the ontology of structure and functions is purely physical, so this is quite logical that at the UF level, no mental/dual aspect information can be present. There will be only the physical information

## **20. Vimal (19 Jan. 2018)**

As per Max Planck, “I regard consciousness as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything that we talk about, everything that we regard as existing, postulates consciousness.” Source: The Observer (25 January 1931) (via [Wikiquote](#))

Consciousness to matter (Planck) and matter to consciousness (Crick) both seem correct to some extent thru the doctrine of inseparability between aspects in the eDAM (extended Dual-Aspect Monism) framework. This is because whatever goes on in the 3pp-physical aspect also goes on in the 1pp non-physical aspect of a conscious state of a mind-brain system and vice-versa is the essence of inseparability hypothesis. They seem contradictory because of subject-object division that is essential for our survival in our mundane life. I do not understand why it is so hard to understand.

## **21. Sehgal**

Whatever goes in the 3pp physical aspects also goes in the 1pp mental aspects are not the conclusive evidence for inseparability in monist frameworks of either Planck’s matter from consciousness or Crick’s consciousness from matter or your eDAM. The reasons for this are not difficult to find. The relation between the physical and mental aspects is studied at the operational level with physical aspects appearing as NCCs and mental aspects as SEs and NOT at the ontological level beneath the operational level. Even in the case, there is separability at the ontological level; inseparability will be visible at the operational level. So there are twin challenges for scientists trying to devise a scientific framework of consciousness and mind viz.

- (i) Design of an appropriate empirical test which the power to go into the ontological realm and investigate inseparability/separability of the physical and mental aspects (if any mental aspects really exist with the physical aspects)
- (ii) To relate the inseparability, if it is proved at the ontological levels thru i) as above, to metaphysical framework viz. Materials, Idealism, eDAM/TAM.



## 22. Vimal: Inseparability and effective information

I agree with you to some extent. Let me summarize my view. Yes, ontological/operational inseparability predicted by the monist frameworks (such as materialism, idealism, atheist *Sāṅkhya*, and eDAM) vs. ontological/operational separability or correlation predicted by the dualist frameworks (such as interactive substance dualism or theist *Sāṅkhya*) needs further subjective and objective research. However, how to test with clinching evidence is still open; testable suggestions are most welcome!

I proposed 3 justifications in favor of the eDAM: (i) the original source is dual-aspect primal structure (dual-aspect Brahman), (ii) “effective” information (see below) from the same stimulus source to both aspects, and (iii) the critical test should show separability (if it exists). Similar justifications are needed from the supporters of other frameworks.

The ontology of both aspects start from the ontology of primal dual-aspect structure with the **effective information** between aspects. Here, let us use the term “effective information” instead to avoid confusion related to the form of information, information loss during transduction, during information conversion, and during transfer, and passive information not used in the active information. The “effective information” is defined as the information that has the same effect in both aspects, i.e., if there is a change in the physical information (as in the information in neural signals related to stimulus’ neural representation) in the 3pp-physical aspect, it should have corresponding change in the inseparable mental information in the 1pp non-physical aspect and vice versa.

Mathematically, from Section 2.6.1, the *effective information* (EI) between A and B is defined as (Tononi, 2004):

$$EI(A \rightarrow B) = MI(A^{H_{\max}}; B) = H(A^{H_{\max}}) + H(B) - H(A^{H_{\max}}B), \quad (6)$$

Where  $A^{H_{\max}}$  is the source A with maximum entropy to the outputs, B is the target, and  $H(A^{H_{\max}})$  is maximum entropy to the outputs from source A (Tononi, 2004). The arrow  $\rightarrow$  in  $A \rightarrow B$  represents that the source is A and the target is B; all possible effects of A on B are measured by  $EI(A \rightarrow B)$ . If the connections between A and B are specialized and strong,  $EI(A \rightarrow B)$  will be high. The value of  $EI(A \rightarrow B)$  is bounded by  $A^{H_{\max}}$  and  $B^{H_{\max}}$ , whichever is less. In general,  $EI(A \rightarrow B)$  and  $EI(B \rightarrow A)$  are not symmetric. The effective information (EI) between A and B measures the repertoire of possible causal effects of A on B and of B on A.

Since effective information is proposed to be the same (i.e., has the same effect) in both aspects at all levels, both aspects should be inseparable. Whatever goes on in one aspect is the same in other aspect; it is just the perspectives of viewing are different. For example, physical (light) information (in the form of long wavelength and intensity of light) reflected

from a ripe-tomato is transduced into electrochemical signal in retina (same effective information but in the form of neural signal), which travels towards cortex. Then the matching and selection mechanisms select a specific SE redness (which is the same effective information but in psychological form) and the “self” experiences it. For convenience, we can propose as follows: The effective information in the external light in physical form = effective physical information in neural form = common effective information in both aspects in abstract physical-mental form = mental effective information in experiential/psychological form.

### **23. Sehgal (20 Jan. 2018)**

In dualistic frameworks (ISD or theist *Sāṅkhya*), there is no separability at the operational level. At the operational level, there is inseparability like any other monist framework -- materialism, idealism, eDAM/TAM. So at the operational level, there is no difference between different frameworks. The difference in frameworks exist at the ontological level only.

(i) if the original source is the primal-dual aspect structure that should represent in our inert physical world also. But in our inert physical world, none of the dual aspect structure is detectable by empirical studies. The only physical structure is detected by the empirical detection of the physical functions.

(ii) The same information in both aspects is observed in all other monists and dualistic frameworks also and this feature is not unique to eDAM.

(iii) When you can't establish a hypothesis by a positive evidence, it is not correct to treat that hypothesis as true by demanding an evidence to the contrary when it is known that it is not feasible to produce either positive or negative evidence.

(iv) What is the ontology of the effective information i.e. the ontological entity or stuff which constitutes/composes the effective information?

(v) The eDAM treats the conscious self itself as SE of subject. But here some paradoxical issues arise. For the manifestation of any SE (here conscious self), eDAM stipulates the presence of some essential conditions as mandatory viz. the presence of the wakeful state, memory, attention. But all these essential conditions represent states of the manifested mental aspect. The state of these 3 essential conditions can't be treated as the state of non-manifested mental aspect or purely physical aspect. So the unresolved issues remain: From where the manifested mental aspect of the 3 essential conditions (necessary for the manifestation of any SE) appears.

On one issue, you may have a clear conceptual clarity viz. are the states of the wakefulness, memory, attention states of the manifested mental aspect OR physical/non-manifested mental aspect?

(a) If you treat these states as the states of the manifested mental aspect, you need to explain how and from where the mental aspects of these states appear?

(b) If you treat these states the physical states or states of the unmanifested mental aspect, you need to demonstrate the presence of these states in the brain in deep sleep, anesthesia, coma, the brain of a dead person, or in inert matter outside a functioning brain.

#### **24. Vimal (20 Jan. 2018)**

1. My point was to differentiate the logical reason for correlation (predicted by dualism by its definition) and inseparability (predicated by monism) which appear the same at operational level; appreciate this point.

2. Yes, currently, technology is not developed to detect mental aspect in inert system, which is latent/hidden to us and/or measuring detectors. Joseph (McCard) has proposed experiments how to detect monad (consciousness unit, mental aspect) from rock.

3. The effective information is common information between mental and physical aspects as defined before that shows different effects on these two aspects viewed from 1pp vs. 3pp. The ontology of effective information starts from the effective information in dual-aspect primal structure (dual-aspect Braham); see also Section 2.5 and 2.6.

4. The eDAM's view is that the manifested consciousness is not needed for necessary conditions of consciousness. Instead, the latter must be satisfied before the former can arise. We differ because our approaches are fundamentally different: your approach is top-down (from actual OOO-manifested-God to causal/astral entities to Mahābhutas or physical entities) and the atheist (Godless) eDAM's approach is just opposite bottom-up (from Godless potentiality to actuality/manifested consciousness in us).

#### **25. Sehgal (21 Jan. 2018)**

1. I understand and appreciate your point of view when we view the observations at the operational brain level with different metaphysical frameworks in our mind. But this approach is not correct since our purpose for making observations at the operational level is to test and establish some metaphysics. When we will have some metaphysics already in our mind, how can we interpret observations at the operational level in mind from an unbiased mindset? So, in my view, the observations at the operational level in brain, are framework neutral and unable to test and establish any framework.

2. If you understand the test as proposed by Joe to test mental aspect in inert systems say a rock, please apprise me also.

3. The effective information in 3pp physical and 1pp mental aspects which we observe is at the operational level and NOT at the ontological level. At the operational level, information in both aspects appears same in all the metaphysics and it is not unique to eDAM.

Materialism -- Mental aspect takes birth from the physical aspect, so information is same.

Idealism -- The physical aspect takes birth from the mental aspect; so information is same in both aspects

ISD/Dualistic *Sāṅkhya* -- The physical aspects of NCCs reflects in the astral mind level; so information is same.

eDAM --- Information is dual aspect and it appears differently when viewed from a different perspective, so information is same.

In view of above, the presence of the same information does not single out or establish eDAM in any way since this feature is present in all metaphysical frameworks.

4. I understand and agree that as per eDAM no manifested consciousness is required for fulfilling the essential conditions for the manifestation of any SE. You may retain this hypothesis of eDAM, if you desire so. But it is not correct to have any hypothesis which is prima facie inconsistent with rational and obvious logic and observational facts. For example, quite paradoxically you are stating that the states of wakeful conscious state, memory are not the states of the manifested mental aspect!!

It is on account of above reasons that in my previous message, I had requested you to clarify and elaborate your conceptual outlook on the following issues but either you did not take it seriously OR you have no clarity, therefore, did not respond.

## **26. Vimal (21 Jan. 2018)**

If separability is found in the experiment proposed in Section 3.2, then monistic frameworks will certainly be rejected. Otherwise, it will support the eDAM because the eDAM is preferred due to the problems of other frameworks elaborated in Section 1.1 of (Vimal, 2010b), Chapter 2 of (Vimal, 2012b), and Section 2.2.2 of (Vimal, 2013). Therefore, experiment is worth carrying out.

I prefer not to qualify any of the necessary conditions with “conscious” because otherwise it would be circular and misleading. For example, I would prefer to say “wakeful beable ontic state” instead of “wakeful conscious state”. Of course, all the states are dual-aspect, but the degree of manifestation of mental aspect varies with an entity and its state. In this example, wakeful state is related to signals from ARAS system, but this would not have ability that lead to the “self” to experience any specific SE, such as redness, for which other necessary conditions need to be satisfied. Similarly, other necessary conditions will have the same incompleteness problem. When all the necessary conditions are met, then only a specific SE will be experienced by the “self”. Please appreciate what the necessary and sufficient conditions of consciousness mean.

### **3.2.10. Critical discussion on functional sub-aspect of non-physical aspect of a state of an entity**

#### **1. Sehgal (3 June 2018)**

My query was NOT from Sāṅkhya's or materialism's point of view or from eDAM's point of view. The eDAM postulates that an entity having some physical structure has some functions, which interdependently co-arise, co-evolve and co-develop and sensorimotor co-tune.

As I had mentioned in my last message also, to start with forget about metaphysical frameworks -- eDAM, Sāṅkhya, and materialism focus only on macro-level observations and see what the observations state.

For example, in the already given example of "lifting a cup of tea" by our hand, the function of "lifting" appears in hand with the change in the relative position of the hand and relative position of the hand is a physical property AND NOT STRUCTURE. So functions do appear from the change in the physical properties also and not only from the changes in structures. Here one thing worth noting is that function of "lifting up" is the outcome of change in the physical property, i.e., the relative position of hand AND IT IS NOT THAT THIS FUNCTION BEING PART OF SOME FUNCTIONAL SUBASPECT OF SOME NON-PHYSICAL ASPECT WAS IN THE UNMANIFESTED FORM AND NOW IT HAS MANIFESTED. Why? Since we clearly observe that the function of lifting up appears only when following 3 conditions are met viz.

(a) A change in physical structure (like a carpenter converting a log of wood in a table) or a change in the physical property (like lifting a cup of tea).

(b) The presence of the MC possessing person whose desire for a certain act like a desire to construct a table or to drink tea will send requisite commands to the brain and CNS, which will result in a change in physical structure and/or physical properties of the state of an entity.

(c) No function exists by itself. Functions appear with reference to some other physical entities, for example, lifting up of hand w.r.t. cup of tea, placing books on tabletop w.r.t books.

Now above mechanism is purely observation based on simple and obvious macro-level observations and no sane person should refute the above mechanism for the appearance of the functions. Tenets of none of any framework viz. Sāṅkhya, materialism, eDAM are used here. If you think otherwise, you should prove and justify as to how this mechanism is tilted toward Sāṅkhya or materialism?

Since we clearly observe that functions in the state of an entity appear as an outcome of the change in the physical structure or physical properties BY an MC possessing agency or

person AND w.r.t another physical entity, (no role of any framework at this stage), why should we not infer that

(i) Functions are basically and essentially physical since these are the outcome of change in the physical structure or physical properties of the entity (no favor of materialism or Sāṅkhya at this stage but this is what observations are dictating).

(ii) There are no functions as part of any non-physical aspect existing in any unmanifested form since any non-physical aspect without relating to some substance/structure neither can be logically and rationally justified nor it is evidenced based.

Now how do you reconcile and fit eDAM with the above 3 steps for the appearance of functions in the state of an entity? There should be no doubt on these 3 steps since these are observations based and framework neutral.

I understand what you are stating above but functions as part of some primordially existing non-physical aspect are:

(I) not supported by the macro level observations of our mundane life.

(II) the existence of any non-physical aspect, as such, without its relation to some structure or substance for its origination is neither logically justified nor evidence-based.

## **2. Vimal**

Let us consider a simple datum: a subject observes, “books are on a table”. This is a datum independent of any metaphysical framework because it is an empirical datum both subjectively and objectively (one can measure neural activities of subject’s brain related to this subjective experience (SE)).

My view is that this datum can be explained by all four groups of metaphysical frameworks. For example, here, the table is a physical structure, holding the books are a function of the table.

**Dualism:** You have nicely explained using Sāṅkhya **with** “manifested consciousness” (MC: subject, individualized Puruṣa/God).

**Materialism:** The function of the structure (table) emerges from its structure **without** “manifested consciousness” (MC: subject, individualized Puruṣa/God). This is Roman (Poznanski)’s framework.

**Idealism:** The structure emerges from the function, i.e., a structure is condensed/congealed form of MC (God). This is close to Boyer’s framework of the Vedic 3-in-1 model.

The **eDAM**: Here, your view ‘change in the structure and/or its physical property’ is close to ‘change in the **state** of an entity’. There is a misconception of the eDAM by you. The correct way of writing is as follows: a state of an entity has a physical structure as physical aspect and its function as inseparable functional sub-aspect of the non-physical aspect; both aspects interdependently co-arise, co-evolve and co-develop and sensorimotor co-tune. MC/God is not needed in the eDAM. The inter-dependent co-origination at the macro level is that when a carpenter is assembling the parts (four legs, tabletop, screws etc) of the table, its function also inter-dependently co-arises in a step-by-step manner.

### **3. Sehgal-Vimal (4 June 2018)**

**Vimal**: Let us consider a simple datum: a subject observes, “books are on a table”. This is a datum independent of any metaphysical framework because it is an empirical datum both subjectively and objectively (one can measure neural activities of subject’s brain related to this subjective experience (SE)).

**Sehgal**: But here also the function of "books on the table" does not exist in table in the state of "in itself any by itself". This function appears in table w.r.t. books -- another physical entity. Had there been no books as another physical entity, the function of "books on the table" would have also not existed

**Vimal**: My view is that this datum can be explained by all four groups of metaphysical frameworks. For example, here, the table is a physical structure, holding the books are a function of the table.

**Sehgal**: But how the function of "holding the books: appeared in table? Only when (i) some carpenter converted log of wood into table. (ii) When books as physical entity made its appearance.

**Vimal**: **Dualism**: You have nicely explained using Sāṅkhya **with** “manifested consciousness” (MC: subject, individualized Puruṣa/God).

**Sehgal**: As I have explained in my previous messages also many times that the mechanism or process of the appearance of the function of "holding the books on table" right from the state of log of wood has no Sāṅkhya/eDAM/Materialism and it is metaphysical frame neutral based fact. Can Materialism/eDAM/Sāṅkhya/Idealism refute the observational fact that some carpenter having some manifested consciousness is required for converting log of wood into table? Can any of the framework deny the fact that with the change in the structure by the carpenter, function of "holding the books" appears in the table? Can they refute the fact that the function of "holding the books" appears only w.r.t. another physical entity say books. Yes, the difference in the frameworks may exist in how the manifested consciousness appears in the carpenter. But none of the framework can deny the existence

of some MC in the carpenter. But, as I had indicated in my previous messages also, at this stage of making macro level observations, there is no need to go into the question of as to how manifested consciousness appears in carpenter

**Vimal: Materialism:** The function of the structure (table) emerges from its structure **without** “manifested consciousness” (MC: subject, individualized Puruṣa/God). This is Roman (Poznanski)’s framework.

**Sehgal:** No here also some manifested consciousness is required since if carpenter is not having any MC, how can he convert log of wood into table? Please don't misinterpret MC with God/Puruṣa of Sāṅkhya. But by MC, I mean the mundane level consciousness as we experience in the wakeful state irrespective of the framework and mechanism by which it appears in us

**Vimal: Idealism:** The structure emerges from the function, i.e., a structure is condensed/congealed form of MC (God). This is close to Boyer’s framework of the Vedic 3-in-1 model.

**Sehgal:** In above also, you are under misconception. MC (God) is not some function from which some physical structure may be condensed or congealed. No structure can ever emerge out from any functions since there can be no existence of any functions “in itself and by itself” either at the primordial stage or at any of the subsequent stage. (That is my main point of opposition to eDAM). To avoid any confusion and to distinguish MC from God, I use the word cosmic consciousness (CC) for God and MC for the mundane wakeful consciousness in us and other organisms. So CC or God (not MC) is the MOST primordial substance/structure but not composed of any parts. CC in itself is an infinite holistic single most primordial substance. As per Idealism, it is from this most primordial substance of CC that most primordial physical substance (Maya/Moola Prakṛti) emerges out. Any substance/structure can exist “by itself and in itself” and from this another structure or functions can take birth. But none of the functions can exist “in itself and by itself” and no structure can take birth from the same.

**Vimal:** The **eDAM:** Here, your view ‘change in the structure and/or its physical property’ is close to ‘change in the **state** of an entity’.

**Sehgal:** Yes, the state of an entity will change only when there is change in its structure and/or properties. Without change in the structure and/or properties, there can't be change in the state. Can you give any example to the contrary?

**Vimal:** There is a misconstruction of the eDAM by you. The correct way of writing is as follows: a state of an entity has a physical structure as physical aspect



**Sehgal:** Yes, above is OK.

**Vimal:** and its function as inseparable

**Sehgal:** Above is also OK since functions in a physical entity are borne out of change in the state of entity (or change in its structure or properties), therefore, they necessarily will be inseparable (And this is observational based fact and based on materialism or Sāṅkhya)

**Vimal:** functional sub-aspect of the non-physical aspect; both aspects interdependently co-arise, co-evolve and co-develop and sensorimotor co-tune.

**Sehgal:** In above, I disagree with you. Why? First since, we observe that functions in the state of an entity arise with the change in the state of an entity -eDAM language but which substantially means the same thing as change in the structure and or properties - Sāṅkhya language, Irrespective of the language you use, the observational facts indicate that functions appear in an entity with the change in the state of an entity and state of an entity changes when there is change in the structure and or properties. Second. As explained above, none of the functions as part of some non-physical aspect can exist "in itself and by itself" state. Non-physical aspect also requires to be derived from some non-physical substance or dual substance.

**Vimal:** MC/God is not needed in the eDAM.

**Sehgal:** I have already clarified the difference between MC and God (CC).

**Vimal:** The inter-dependent co-origination at the macro level is that when a carpenter is assembling the parts (four legs, tabletop, screws etc) of the table, its function also inter-dependently co-arises in a step-by-step manner.

**Sehgal:** Functions cannot manifest from "no where". To say that functions manifest from some non-physical aspect, you need to explain the origination and nature of the non-physical aspect. And none of the non-physical aspect can be explained at the primordial stages unless this comes from some non-physical or dual primordial substance/structure. The obvious observational fact, irrespective of the type of framework you subscribe to, is that functions in the state of an entity arise in the change in the structure/properties (meaning the same thing as the change in the state of an entity) and they are physical since arise by virtue of change in a physical structure and/or physical properties.

#### **4. Vimal**

If a function requires MC (manifested consciousness = self, SEs, and all mental entities) of a carpenter, table, books, and other hidden entities/processes, then all such entities

should be combined to form a system. This system will have many states. In the eDAM, a state of the system is dual-aspect with the function of the system as the functional sub-aspect of non-physical aspect and physical structures of entities in the system as its inseparable physical aspect.

## **5. Sehgal-Kineman-Vimal (4 June 2018)**

**1. Sehgal:** I understand what you are stating above but functions as part of some primordially existing non-physical aspect are: (a) not supported by the macro level observations of our mundane life.

**Kineman:** That is not correct even for classical science.  $F=ma$  is a non-local (true irrespective of location) function related to inertial mass but not of material nature itself. The function is non-material. Its effects are material and measurable the efficient nature of matter. [F: force, m: mass, a: acceleration].

**Sehgal:** But what is the origination of F? From where does F appear? F could be due to distortion in some Force Field and that force field itself could be some physical substance (some structure). It is another issue that, at present, science is unaware of the substance that composes Force Field. Even inertial mass could be due to some "substance". So here, real function is "a", which is brought in due to change in the physical property i.e., relative position of some inertial mass (m) by some F. However, the function "a" cannot exist by itself and in itself. We are using here the word function not in the mathematical sense.

**2. Sehgal:** (II) the existence of any non-physical aspect, as such, without its relation to some structure or substance for its origination is neither logically justified nor evidence-based.

**Kineman:** Yes, non-local non-material functions are always related to material effects by which they can be known. That is what Vimal is saying about eDAM.

**Sehgal:** That is where I disagree with Vimal and you. Vimal does not say that as per eDAM, non-material functions are produced from material substances. He says that non-material function sits in parallel to the physical substance but from where? How and why -- no explanation. So non-material functions of Vimal stand suspended in limbo. My logical view has been that functions should always come from some substance. Material functions should always come from material substances and non-material (non-physical) functions should always come from some non-physical or dual substance. Here there is a difference in material and non-physical. As per the current science, all the 18 fundamental particles and related fields are included in the material category. All the 18 fundamental particles are restricted in size scale up to  $10^{-16}$  meter. There are particles and fields in the Astral realm also below  $10^{-16}$  meter. Though these fields and particles are also material or physical

since these particles/fields below  $10^{-16}$  meter and known 18 fundamental particles are an extension of the same Moola Prakṛti (primordial physicality) but due to the ignorance of the science of this part of nature ( $10^{-16}$  meter), it is termed as non-physical.

**3. Vimal:** If a function requires MC (manifested consciousness = self, SEs, and all mental entities) of a carpenter, table, books, and other hidden entities/processes, then all such entities should be combined to form a system. This system will have many states.

**Sehgal:** Yes, all the above will form a system with MC already defined. Yes, in the system there will many states with new functions appearing in each state. But these new functions in each state will be physical due to the functions appearing by virtue of change in the physical properties and physical structure of the entity

**4. Vimal:** In the eDAM, a state of the system is dual-aspect with the function of the system as the functional sub-aspect of non-physical aspect and physical structures of entities in the system as its inseparable physical aspect.

**Sehgal:** That is what eDAM states and I understand the same. But this is neither in conformity with the observational facts nor with the logical and rational scrutiny and evidenced based. Why? Functional sub-aspect of the non-physical aspect is not justified at the primordial level since eDAM does not postulate any non-physical or dual substance (structure) at the primordial stage. It postulates only some physical substance (structure) at the primordial stage but does not postulates (unlike materialism) the birth of non-physical functions from the physical structure or substance. In addition to above logical e-gap in eDAM, the observational evidence in our mundane life clearly indicates that functions in a physical entity appear by virtue of change in the physical properties and physical structure (substance) of an entity (which amounts to the same thing as the new state), therefore, in any state of a physical entity, functions are basically physical and they do take birth from the physical structure. BUT, I again say BUT, these physical functions don't constitute our mental or non-physical functions as you have assumed in eDAM. Then from where and how mental or non-physical functions arise is a different story which I will say in detail if you understand and agree to up to what I have stated above.

## **6. Vimal**

In your argument, you forgot to mention that the non-physical and physical aspects of a state of an entity are inseparable in the eDAM framework. What does inseparability really mean and what is its significance in this discussion? Let me try to elaborate it. Briefly, whatever is going on one aspect is reflected in the other aspect automatically and immediately.

Materialism proposes matter is the only fundamental primal entity, and consciousness (includes self, SEs, and all mental entities) is a derived entity. Idealism proposes just opposite, i.e., consciousness is the only fundamental primal entity and matter is derived from it. Let us suppose both are correct. Then how do we make sense of out of this and reconcile them thru some middle ground? This is done in the eDAM. The eDAM combines the essence of these two metaphysics and proposes middle way, i.e., materialism is represented in the physical aspect and idealism is represented in non-physical aspect of a state of an entity; there is a neutral appearing dual-aspect structure as primal entity (Brahman, UIF) that has both aspects latent in unmanifested state. Here, both aspects must be considered inseparable if both metaphysics are correct. What does this mean? It means that whatever is going on in physical aspect will be reflected in the non-physical aspect immediately and automatically because of inseparability. Both aspects are in essence the same in terms of “effective” information. In other words, if we argue that function emerges from material/physical structure (materialism) or vice-versa (idealism), the essence is the same. Physical and non-physical aspects are just for our understanding; otherwise, they are the same in essence. Why? This is because both materialism and idealism both are assumed to be true simultaneously. Both are telling the same truth in different ways. It is like the parable of the [blind men and an elephant](#).

Non-interactive dualism-based Sāṅkhya proposes that experiencer (self/Puruṣa) and the rest ( Prakṛti) are two fundamental independent primal entities. This is another way to explain the same truth.

To sum up, there is really no argument as long as we understand the fundamental truth. All four groups of metaphysics are telling us the same truth in different ways. Each of them has their own problems, which should be appreciated and proponents of the respective frameworks should address them to make their frameworks better more precise, and scientific.

God-theory (such as Sāṅkhya) is in trouble because a soul cannot be made replicas needed in bilocation/multilocation paranormal phenomenon. On the other hand, the eDAM’s self-hypothesis will work at the subtle level.

## **7. Kineman, John (4 June 2018)**

Yes I think that is consistent with the nature of four cause holons, which seem to be saying the same as eDAM. Of course a sophisticated system will have many holistic (structure-function) subsystems as described, and they will have varying degrees of "MC" depending on what they entail. I am not considering the threshold between natural information and awareness of self in more sophisticated systems. That threshold is obviously very important in terms if the explosion of ew functions it affords, but there is still fundamental experience across that threshold. The theory would be that a system is aware of anything it models or

symbolizes. A tree does have an internal model of aspects of its environment. It is this aware of those aspects. We have models of self and environment, so conscious of much more. But in this view it would be as silly to say brains produce consciousness as to say computers produce electricity. Computers use electricity to encode and decode states. Brains use consciousness to encode and decode experiences. Computers are conscious of their states, not what those states mean to human designers. This leads me to propose a distinction between natural and artificial awareness. Artificial intelligence is built on the assembly of states. The larger order that it thus simulates is not entailed in an analogous way. For example, we can build with legos. Lets call those the states. Even building randomly it will look like something familiar. If we place the legos to make it look like a rabbit, it is still not a rabbit. Only one possible model of a rabbit has been used, and that by an external agent. Even if a robot built it from images of a rabbit, it would still not be a rabbit or even alive. To be alive as an organism a system has to be capable of producing all possible models of a living being. It cannot do that by assembly of states because that would be an infinitely long process. Instead there is a much more parsimonious top-down process of building analogous whole systems -- analog models. The assembly of whole systems can produce life and consciousness, but the assembly of fractional systems, i.e. states, requires an infinite series to represent one whole system.

## **8. Sehgal-Vimal (5 June 2018)**

This sub-section is also included in (Vimal, 2009a).

**1. Vimal:** In your argument, you forgot to mention that the non-physical and physical aspects of a state of an entity are inseparable in the eDAM framework. What does inseparability really mean and what is its significance in this discussion? Let me try to elaborate it. Briefly, whatever is going on one aspect is reflected in the other aspect automatically and immediately.

**Sehgal:** But there is no non-physical aspect in the state of an entity. Why there is no non-physical aspect has already been explained by me above and I need not repeat the same. In the state of an entity, there are two aspects viz structure and functions. Both these aspects are physical (since functions are borne out of structure as seen from observational facts) and they are also inseparable. So, of course, there is inseparability but that instability is between physical structure and physical functions and NOT any non-physical functions.

**Vimal:** Whether the function emerges from structure (as in materialism or Sāṅkhya) or structure emerges from its function or they inter-dependently co-arise (as in the eDAM) is interpretation; it is not an observation; the empirical observation is only “books are on table” when a subject walks in the office and nothing else.

**2. Vimal:** Materialism proposes matter is the only fundamental primal entity, and consciousness (includes self, SEs, and all mental entities) is a derived entity. Idealism proposes just opposite, i.e., consciousness is the only fundamental primal entity and matter is derived from it. Let us suppose both are correct. Then how do we make sense of out of this and reconcile them thru some middle ground? This is done in the eDAM. The eDAM combines the essence of these two metaphysics and proposes middle way, i.e., materialism is represented in the physical aspect and idealism is represented in non-physical aspect of a state of an entity; there is a neutral appearing dual-aspect structure as primal entity (Brahman, UIF) that has both aspects latent in unmanifested state. Here, both aspects must be considered inseparable if both metaphysics are correct. What does this mean? It means that whatever is going on in physical aspect will be reflected in the non-physical aspect immediately and automatically because of inseparability. Both aspects are in essence the same in terms of “effective” information. In other words, if we argue that function emerges from material/physical structure (materialism) or vice-versa (idealism), the essence is the same. Physical and non-physical aspects are just for our understanding; otherwise, they are the same in essence. Why? This is because both materialism and idealism are assumed to be true simultaneously. Both are telling the same truth in different ways. It is like the parable of the [blind men and an elephant](#).

**Sehgal:** As I have mentioned many times that you may please don't start with framework i.e materialism or idealism or eDAM otherwise some framework bias is bound to creep in. You may please start with how new states of an entity which ipso facto implies the change in physical structure or/and physical properties of the entity can be brought out at the macro level. As our macro-level observations clearly indicate that process of bringing new states start from some conscious agent (some person) like a carpenter in case of construction of a table from a log of wood. The carpenter should possess some MC. As I indicated previously also that MC does not mean God/Puruṣa but MC means the wakeful conscious state by whatever means it may manifest. When the conscious carpenter brings a change in the physical structure of the log of wood implying a change in the state of the, an entity, automatically some functions appear but these functions appear only with reference to some other physical entities say books or fruits or utensils which will be held by the table top.

Now comes the controversial part on which I have the disagreement with you. You state that these functions are non-physical as part of some functional subaspect of the non-physical aspect as existing in dual aspect of UIF. My argument is that existence of any non-physical aspect at the primordial stage is not justified particularly if there is no non-physical or dual primordial substance/structure. [In line with contemporary science, eDAM also believes in some physical primordial substance/structure and NOT in any DUAL substance/structure. So the existence of any non-physical aspect at the primordial stage is ruled out in eDAM and current science from these arguments. \[Vimal: No, this is a](#)

misunderstanding of eDAM: the eDAM does not follow materialistic science; instead, it extends the science from single-aspect material/physical state to dual-aspect state; the inseparability of aspects never breaks, i.e., it is conserved; this is the conservation natural law related to inseparability doctrine] Further, we clearly observe that functions appearing in the state of an entity appear by virtue of a change in the physical structure and/or physical properties [Vimal: or change of the dual-aspect state of whole system containing carpenter with MC, books, wood, nails, etc. thru inter-dependently co-origination.] And this is what observations states and there is nothing Materialism or Sāṅkhya or eDAM in this. [Vimal: No, the interpretation of the observation depends on metaphysics.]

So one thing you should understand and agree honestly and objectively that functions appearing in a physical entity are NOT part of any non-physical aspect as descending down from the primordial stage. The functions as appearing in the state of a physical entity are basically and essentially physical since they are brought in due to change in the physical structure and/or physical properties of the entity (as is revealed from the observational facts, No Materialism/ Sāṅkhya/eDAM at this stage). But the question remains open if the functions in a physical entity say a table is essentially physical, then how and from where and why some non-physical functions (mental functions) appear in us? As I indicated in my last message that this is another part of the story and I shall elaborate on this but before that, you should understand and be convinced of following

- (i) The functions appearing in a physical entity say a table is basically and essentially physical in nature.
- (ii) These functions are not part of any functional subaspect of any non-physical aspect of primordial UIF. But, as per our observational facts, these functions are produced locally in the entity due to change in the physical structure and/or physical properties of the entity (And that is why these functions are physical)

**Vimal:** No, you still miss the point; you are unable to differentiate between subjective/objective data and interpretation; think hard; read my previous emails many times. Or perhaps, you will never understand. So just forget it and think it is our disagreement. Function in the eDAM is non-physical simply because it does not have mass, charge, or spin by definition of physical as 18 elementary particles have.

**3. Vimal:** Non-interactive dualism-based Sāṅkhya proposes that experiencer (self/Puruṣa) and the rest ( Prakṛti) are two fundamental independent primal entities. This is another way to explain the same truth.

**Sehgal:** While making observations of the manifestation of functions in a physical entity, we should go simply by what the observations state and not by what Sāṅkhya states. That is another different story.

**Vimal:** Please see above.

**4. Vimal:** To sum up, there is really no argument as long as we understand the fundamental truth. All four groups of metaphysics are telling us the same truth in different ways. Each of them has their own problems, which should be appreciated and proponents of the respective frameworks should address them to make their frameworks better more precise, and scientific.

**Sehgal:** We should go by the framework which fits best in the observational facts and also is subjective and objective evidenced based.

**Vimal:** Please see above.

### **9. Sehgal (6 June 2018)**

Neither structure (substance) can emerge out from functions nor functions can interdependently co-arise (as in eDAM) is not a subject of interpretation but a subject of empirical observations and logical deliberations. Logical deliberations state that none of the functions can exist "by itself and in itself" state either at the primordial stage or in inert entities. For example, the function of "holding books: on a table is a function as produced in the table as the log of wood transformed to table. To say that log of wood had any function of "holding of books" in some unmanifested state is bizarre and illogical. The fact is that the function of "holding the books" did not have any existence till table top was ready and books were also made available.

One logical inference is that it is the "substance" or structure which has its ontological existence. There is no meaning of the existence of any ontological primordial functions unless they are originated/related to some substance. This is one of the greatest flaws in eDAM that it postulates the existence of non-physical representing as functional sub-aspect at the primordial stages but unable to relate the same to some non-physical or dual substance.

Our observational facts clearly reveal that functions in an inert entity say a table with the function of holding books has manifested due to change in the physical structure of the log of wood, hence, it is a physical function. When observations so clearly establish that functions in an inert entity are produced due to change in the physical structure and/or physical properties (implying a change in state), and hence functions are physical, why to invoke some hypothetical framework that some non-physical aspect representing as the functional sub-aspect exist at the primordial stage particularly the existence of any non-physical aspect without linkage with some non-physical substance or dual substance is prima facie illogical?



Your assertion that books are on the table when one enters the office is the only empirical observation - that is all amounts to nothing but a naive approach. You cannot have this observation in isolation. There had been a carpenter; there was a log of wood; the carpenter transformed the physical structure of the log of wood; physical structure changed or state of the entity of log of wood changed; books as physical entity appeared on the scene -- these are also equally empirical observations. The set of all these empirical observations constituted a system. And this system of empirical observations establish that functions in a physical entity are produced one due to change in the physical properties or/and physical structure and hence functions in an inert physical entity are physical

Like Science, eDAM starts from the primordial substance of QFs of almost vanishing energy. So where is the difference in the primordial substance of the science and eDAM? Mind please I am speaking of primordial substance and not of primordial aspects

Yes there is the inseparability but that inseparability is in between physical substance/structure and physical function and NOT between any physical substance and some hypothetical non-physical aspects representing as functional sub-aspect or functions. The hypothesis of any non-physical aspect representing as functional sub-aspect or functions WITHOUT RELATING THE SAME TO SOME-Non-PHYSICAL SUBSTANCE OR DUAL SUBSTANCE IS SIMPLY ILLOGICAL AND HENCE UNACCEPTABLE.

Please try to understand the difference between dual aspects and dual substance. There is a great difference between the two. Quantum vacuum, with which like science eDAM also has its start, is neither a non-physical nor dual substance. It is basically a physical substance and from such a physical substance, no non-physical aspect can arise

The existence of any non-physical aspect in an inert entity is simply ruled out from the very primordial stage itself if you start with quantum vacuum as the primordial substance. So there is no dual aspect in an inert entity. When direct observations reveal that functions in an inert physical entity arise by virtue of can be in its physical structure and/or physical properties and, hence, functions are physical, where is the logic and wisdom in invoking some hypothetical non-physical aspect at the primordial; stage and hypothesizing dual aspects in the entity?)

Please explain me in the whole system of empirical observations starting from carpenter, the log of wood, kneels, change in structure of log of wood (or change in the state of entity), books and hence manifestation of functions, why should we bring Sāṅkhya, eDAM, Idealism in picture and what is their role. We are not discussing at this stage as to how any mental aspect/consciousness manifests? We are simply discussing as to how the functions in an inert entity manifest and whether functions are physical or non-physical. So here at this

stage metaphysics should not have any role and we should trust simply what the empirical observations are dictating us.

Your definition of functions that they are non-physical since they have no mass, charge, and spin is an incomplete definition due to following 2 reasons:

(a) Functions cannot be non-physical merely due to reasons that they do not have mass, charge, and spin. There are also the conditions that they should not be originated/related from some physical substance/structure and its physical properties. Macro-level observations in our mundane world clearly reveal that functions in inert entities are produced due to change in the physical structure and/or physical properties of a physical entity. Hence functions do not fulfill the second condition of being non-physical, i.e., not originated/related to some physical structure and or physical properties.

(b) Your attempts to define non-physical in terms of mass, charge, and spin of 18 fundamental particles are incomplete attempts targeting only an incomplete ontology of nature. As you know that all the 18 fundamental particles have size  $> 10^{-16}$  m. As you also agree that Nature starts from the much deeper level at  $10^{-16}$  m (if we assume that G.Srinivasan is correct and we are also correct in this interpretation). It means there are large swathes of nature in between  $10^{-16}$  m and  $10^{-51}$  m. What about the nature of particles in this wide range? Whether particles in this range have any mass, charge, and spin at all? If yes, what the related fields for such particles? These are the issues which neither current science nor you have an answer.

In view of above, any method to define functions as non-physical since they don't have mass, charge, and spin is an incorrect and incomplete definition.

One important point which you miss is that though functions have no mass, charge, and spin (all physical properties) functions are produced due to change in these physical properties.

I hold the view that at the stage when we have to define the origin and nature of functions (i.e. physical or non-physical or produced due to change in physical structure and/or physical properties of the inert physical entity, we should go by only what the direct observations dictate. At this stage since we have not to decide the issue of the origination of any mental aspect/consciousness, therefore, invoking of any metaphysics is uncalled of and unwarranted.

The eDAM does not fit in the light of observational facts for the manifestation of functions in an inert physical entity. Furthermore, there is also no subjective and objective evidence

that an inert physical entity has any non-physical aspect which culminates in mental aspects in the brain.

## **10. Vimal (6 June 2018)**

The eDAM does not propose functions can exist "by itself and in itself" state. The term "physical function" is illogical because a function is not a physical entity as it does not have mass, charge, or spin and your arguments (a) and (b) are untenable; see below.

There is nothing illogical or bizarre to propose that the unmanifested state is the superposition of all possible innumerable beable ontic states as basis states of Hilbert space. A beable ontic state is realized/actualized during evolution. We and each of innumerable beable ontic entities in our physical universe really exists, which can be explained thru collapse process thru this concept, which is from ('t Hooft, 2015) ('t Hooft is a Nobel Laureate in physics, so he cannot be illogical or bizarre as you propose).

The function (holding books) and the structure (table) can inter-dependently co-arise in a step-by-step manner as the eDAM proposes, which can be argued also as if function emerges from the structure using materialism or vice-versa using idealism. The inter-dependent co-origination of both aspects is a concept from Nāgārjuna. There is nothing illogical or bizarre in this concept either.

The "greatest flaw" in the eDAM is your own ignorance and desperation to defend your God-theory. Please note that "[God is Man's greatest invention](#)" ([ईश्वर मनुष्य की सबसे बड़ी खोज](#)).

You always mix data with interpretation; you need to refrain from this. The only empirical datum is "books are on the table" when one enters the office and the rest is explanation/interpretation based on the four groups of the metaphysical frameworks. For example, you explain/interpret this datum based on materialism and/or Sāṅkhya and I use the eDAM; similarly, an idealist uses idealism that table, function, books, carpenter, etc all arise from consciousness.

The term "substance" can be any entity: physical, mental, consciousness, a state with inseparable aspects, and so on. QFs of quantum vacuum are in the PUIF; materialist science is based on materialism that is represented in physical aspect PUIF, whereas the eDAM has extended it to include a non-physical aspect of a state of an entity as well. Is Puruṣa physical? If the answer is No, then it is non-physical; in the eDAM, it is "self" which is a part of experiential sub-aspect of the non-physical aspect of a state of an entity.

Your arguments (a) and (b) are untenable because (i) structure and function inter-dependently co-arise as elaborated above and before, and (ii) in the eDAM and also in G.Srinivasan's framework, MPP (Moola Prakṛti particle) has mass and size, in analogy to

Planck particle. The production of function from structure is NOT a datum and is an interpretation in materialism and/or Sāṅkhya, not in the eDAM and not in idealism. There is nothing illogical and bizarre in any of these interpretations and concepts.

To sum up, you seriously suffer in not understanding the difference between data and interpretation; you seem very desperate in defending God-theory by hook or by crook; you must refrain from this. Yes, we have different views, which is good for further research.

### **11. Shah, Kushal (7 June 2018)**

Strictly speaking, the notion of "books", "table", "above", etc are also merely our interpretations of a deeper underlying reality. Even from the Physics perspective, there is neither a book nor a table, but only a bunch of interacting quantum wave functions or particles. Our brain interprets that in the form of a book or table. Just because two humans agree with the terminology for an object, doesn't necessarily make it an objective fact. I think the important point here is that what is "data" according to one perspective may be an "interpretation" according to another, and vice-versa. And perhaps, both data and interpretation are just different kinds of "information".

### **12. Blauvelt, Whit**

We have different standards for "objective fact." In my world, it's precisely because two humans, looking independently, see books above a table, that the objective fact is confirmed: there are books on a table. The "physics perspective" you advocate does not contain stars, planets, or people either, "only a bunch of ... wave functions or particles." But that is not what our world objectively consists in. Sure, two people can independently look with certain instrumentation and theory and conclude they've both seen wave functions and particles. But implicit in the standard of objectivity is that there are two people to look. If they don't also see two people, and see the books on the table which contain the theories which enable them to analyze wave functions and particles, then the two people have no basis at all by which to confirm their "perspective of physics," let alone claim knowledge of "a deeper underlying reality" based on that

### **13. Vimal**

For me, data is "books are on the table". Kushal (Shah)'s interpretation is based on idealism (consciousness is fundamental), Vinod (Sehgal)'s based on Sāṅkhya (dualism), Whit (Blauvelt)'s based on science (materialism), and mine is based on the eDAM.

**14. Sehgal (6 June 2018)****13. Vimal**

For me, data is “books are on the table”. Kushal (Shah)’s interpretation is based on idealism (consciousness is fundamental), Vinod (Sehgal)’s based on Sāṅkhya (dualism), Whit (Blauvelt)’s based on science (materialism), and mine is based on the eDAM.

**14. Sehgal (6 June 2018)**

The eDAM may not propose that physical functions can exist “by itself and in itself”. But eDAM proposes functions to be the part of some functional sub-aspect of the non-physical aspect. So here in the eDAM, it is the non-physical aspect which exists “by itself and in itself”. But here comes the greatest e-gap of eDAM viz. though eDAM proposes the existence of non-physical aspect in "by itself and in itself" but fails to anchor it to any *non-physical* or *dual substance*. So consequent anomaly arises that non-physical aspect in eDAM continues to hang in limbo. As I indicated in my previous message also that though a physical function could not be an entity and therefore having no charge, mass, and spin but it is an observational fact that a function arises either due to change in the physical properties of mass, charge, and spin or physical structure. So you can't divorce a function from mass, charge, and spin. In either case, a function is very much intricately linked with physical variables either structure or/ and physical properties. Therefore, it is quite logical to infer that functions of an inert physical entity are physical. I have already elaborated on two broad reasons as to why the definition of non-physical as the one which has no mass, charge, and spin is incomplete and having flaws. But you have kept mum on commenting those two broad reasons. It is bizarre and illogical since, in a log of wood, no function of "holding the books" simply exist. So there is no question of the superposition of the innumerable beable ontic states. Superposition of innumerable beable ontic state will be relevant for the physical structure and physical properties and not for functions. You have naively mixed the two. For example, we can say that an electron has some mass when we observe it. So we can say that the observed mass of an electron is the result of the superposition of the innumerable ontic states of the electron. Having Nobel Prize or not is not an indicator of bizarre or illogical. There are a number of Nobel laureate whose theories/hypothesis are opposite to each other. So at least one of them will be bizarre or illogical or not? “The function (holding books) and the structure (table) can inter-dependently co-arise in a step-by-step manner as the eDAM proposes”. Yes, that is what eDAM proposes and I understand it. But this proposal of the co-arising of the function of holding the books from some non-physical aspect is neither logically tenable nor evidenced based due to following reasons: (i) Empirical observational facts clearly reveal that function of "holding the books appear only when there is a change in the state of log of wood which in other words implies a change in the physical structure and /or physical properties of the entity. No Metaphysics of Sāṅkhya or eDAM is invoked in this observations. Since Function of holding the books come into existence due to change in the physical structure, therefore,

the function of holding the books is physical. Your definition of non-physical as the one which has no mass, charge, and spin has limitations and flaws as elaborated by me. Now it is up to you to address those flaws and limitations. (ii) The existence of any non-physical aspect at the primordial stage, without anchoring it to some non-physical or dual substance cannot be logically justified, eDAM does not propose any non-physical or dual substance but sticks to the physical substance of quantum vacuum. This creates a great anomaly in eDAM. As I have noted earlier while making the simple empirical observations of the journey of the table from a log of wood till table, we should go by what observations dictate and any invoking of any metaphysics is uncalled for. For example, a carpenter has some manifested consciousness (normal mundane consciousness of the wakeful state). So we have to recognize only this fact that for converting log of wood to the table some MC of some carpenter person is required. But we have not go into the issue of as to how the MC of the carpenter has manifested i.e. whether thru materialism/eDAM/Idealism/Sāṅkhya. If you will bring any metaphysical framework at this stage, your whole empirical observations will be vitiated and become biased. Can't any proposal of Nagarjuna's be bizarre and illogical? Can a proposal be not bizarre and illogical merely due to reasons that the same is proposed by Nagarjuna's or any other authority? Please point in a specific manner where is the ignorance? I shall welcome the same and rectify the same. I have pointed out above in detail the limitations and flaws in this interpretation and persons (Chandrasekhar and others) who have extended such interpretation. Here I disagree with you. You can't and also should not take merely the data of books on the table in isolation. The data of books on the table is a part of a large system starting from the log of wood with many states in between with new functions appearing in each state. It is from empirical observations of each state (without bringing any metaphysics in the picture) that it becomes clear to us that functions in each state are the outcome of change in physical structure or/and physical properties. Be clear that the inference that functions in any state are produced due to a change in physical structure and/or properties of any entity is the outcome of empirical observations and NOT as the outcome of interpretation of Sāṅkhya/Materialism/eDAM/Idealism. What mistake you make and also fail to realize that you make an observation of books on the table and immediately start interpreting in terms of the metaphysical framework -- be it Sāṅkhya/eDAM/Idealism/Materialism. In this approach, the observationally based mechanism or process by which functions have appeared in table gets eclipsed and sidelined. This leads to the priority of metaphysical framework over the empirical observations and thus leads to a framework biased approach. The Puruṣa is non-physical but it is the most primordial substance and it NOT the functions. A substance will have a structure as well as functions with inseparability between the structure and functions. You are stating above that in eDAM, a nonphysical aspect is included in the entity? But from where any non-physical aspect will come in the entity if the non-physical aspect is not anchored to any non-physical substance or dual substance. Science goes up to the quantum vacuum having QFs as the ultimate substance and it treats it as physical. Now if you want to source out some non-physical aspect from

this physical substance of quantum vacuum, that will imply materialism. *So what is the ultimate primordial substance from which eDAM sources out its non-physical aspect?* If you want some dual aspects in an entity, dual aspects MUST BE anchored to some dual substance also. And that dual substance should be distinct and transcendental to physical quantum vacuum and QFs. So ultimately you will land in a CC of Idealism. I have already pointed out the logical implausibility of the co-arousal of functions as part of the functional sub-aspect of some non-physical aspect due to facts that the same is (i) not supported by independent empirical observations (without bringing any metaphysics in the picture). (ii) The existence of any non-physical aspect can't be logically justified at the primordial stages unless it is not sourced out from some **non-physical or dual substance** (please don't forget that I am saying the non-physical or dual substance and not the non-physical or dual **aspect** with a great difference in aspect and substance. The eDAM does not postulate any dual or non-physical substance but in matter of substance, it goes up to the quantum vacuum having QFs which are physical in nature. So, the non-physical aspect continues to hang in limbo. Yes, in G Srinivasan framework MPP have mass and size but there is no empirical evidence for the same. The production of the function is a data since it is clearly observed from framework free empirical observations and there is no Sāṅkhya or materialism in it. Why data should be taken as real and NOT subject to interpretation by bringing in any metaphysics in the picture has been explained by me in the beginning. I gave the example of how we take the data of the phenomenal reality of a tree in a garden as real without interpreting it in terms of any metaphysics. The same logic should be made applicable to the mechanism of tuning of a log of wood into a table or the experiences of the samādhi state wherein the astral world and CC is vividly observed in 1pp reproducible manner. But you apply artificial double standards of logic. For the physical world experiences, you take the experiences/data as real on the face without interpreting the same in terms of any metaphysics. But in case of the experiences of the subtle astral world, you don't take data as real and insist for interpretations in terms of different metaphysics. Similarly, you don't take the data of empirical observations of turning of a log of a wood into a table as real on the face and insist on interpretations thru different metaphysics. In my view, any subjective or objective data, if it is reproducible either in 1pp or 3pp, should be taken as real on the face and there is no need to ascertain its reality thru interpretation thru any metaphysics. I am not defending manifested C/God theory by hook or crook but it is the outcome of (i) Subjective evidence from the reproducible Samadhi state experiences by a host of Yogis/sages since millennia. (ii) There is the logical need for a manifested CC for many aspects of the creation of the universe. For example, there is the logical need for various universal laws governing the creation and sustenance of the universe. The hypothesis of laws existing on their own is nothing but an illogical dogma though wrapped in scientific colors. (iii) Without some CC, there is no complete and convincing model, based on materialism or even eDAM, to explain the manifestation of mind and our localized consciousness as we all experience all the time. (iv) There is the spiritual wisdom of millennia as enshrined in Vedic, Upanishadic, Bhagwat Geeta texts, the collection of

medieval era saints, Jesus and Christians Saints, Muslim and Sufi Saints and a number of Yogis/saints of different spiritual traditions of our period certifying a CC/God theory. What is the significance of the interpretation of a Nobel laureate of the modern period in comparison to this spiritual wisdom? NOTHING. So there are concrete reasons for my believing in CC/God theory and it is not by hook or crook, as you allege.

**Sehgal to Vimal** (8 June 2018): "Books on the table" is merely an empirical observation, which can be made independently by anyone with **right senses and mind**, and this observation is divorced from any metaphysics Materialism/Sāṅkhya/Idealism/eDAM. Anyone who is totally illiterate and has no idea of these metaphysical frameworks shall also make the same observation provided he has also the right working senses and mind. For understanding how these state of "books of tables" has reached also, no interpretation from any metaphysics required. You simply go back to the previous states of the "books on the tables" to the state of a log of wood or even to the state of the tree and start making empirical observations in a step by step manner, as to how with the change in the physical structure and/or physical properties of the previous state of entity, a new state emerges and with the change in the physical structure /physical properties, new physical functions start cropping up in new states. Any interpretation thru any metaphysics at the stage of empirical observations is uncalled for since we are making empirical observations and we should be dictated by empirical observations only. When we clearly observe thru observations that new functions start appearing in the new state due to change in the physical structure and/or physical properties of the previous state, it becomes clear that functions are physical and are **produced** locally in the entity due to change in the physical structure and/or physical properties only. Any hypothesis at this stage that functions are not physical or that they are part of some functional sub-aspect of some non-physical aspect will be will be unjustified and uncalled for since that will amount to a disregard for empirical observations.

**Sehgal** to Blauvelt (8 June 2018): Behind the books, tables and also behind the two people, there might be interacting quantum waves function and particles but two persons don't see these wave functions and particles, as such Two persons see only tables and books, as such, and that too in a reproducible manner. Then many people also see books and tables only where there are books and tables. Further, one interesting thing is that many people also do see in reproducible manner tables and books ONLY and Not something else, where actually, there are books and table. That is how the objective reality of the phenomenal physical objects is confirmed. So when we confirm the phenomenal reality of the physical objects, any view that these are not books or tables or that these are interacting wave functions or particles is redundant.

**Shah** (Kushal, 8 June 2018) to Sehgal: I would suggest use of the phrase "*commonly found human senses and mind*" instead of "*right senses and mind*". I would like to stress here



that *commonly found* human senses are only one of the infinite ways to observe reality. Even some humans may have their senses and mind functioning in very different ways.

## 15. Vimal

No: the eDAM does not propose the non-physical aspect or physical aspect “by itself and in itself”. Instead, both aspects of a state an entity (including primal entity) are inseparable. Therefore, your arguments are untenable. The dual-aspect structure is a neutral primal entity (as in Neutral Monism), which *appears* as aspectless and attribute primal entity such as Brahman. It appears neutral because aspects are latent. In the eDAM, the state of the entity changes as structure changes So, it is illogical to think physical function in the eDAM. The physical function may be ok in the materialism and Sāṅkhya, but not in the eDAM, where a function is a functional sub-aspect of non-physical aspect. It uses the doctrines of inter-dependent co-origination, co-evolution, co-development and sensorimotor co-tuning, which you do not understand. No I did not kept mum; it is simply you do not understand the above doctrines, and how QM and neuroscience work; so your arguments are untenable and totally illogical. A superposition is of innumerable beable ontic basis or eigen states of an entity. No, ‘t hooft is correct and you are wrong 100%. You need to understand his book. You have misconstruction of the eDAM again: “the co-arising of the function of holding the books **from** some non-physical aspect” is 100% illogical in the eDAM; use “with” instead of “from”. Thus your arguments (i) and (ii) are untenable and illogical: (i) There is no flaw in function as non-physical as eDAM defines it because function (non-physical) and structure (physical) are inseparable aspects. (ii) The two aspects are anchored with neutral entity with latent dual-aspects. The journey of the table is the inter-dependent co-origination in every step (such as starting with table-top, then one leg at a time, then nails and so on over many steps, which you simply do not understand. So your arguments are 100% illogical and untenable. Your every sentence is written in Sāṅkhya’s language, which you deny; this is illogical and you practice dishonesty without unknowingly and when I elaborate then you deny forcefully. You are pigheaded (McCard’s word) and you think you know everything and you are better than ‘t Hooft, Chandrasekhar Nagarjuna’s and many other scientists and philosopher? In my view, this is untenable. I have mentioned ignorance in the eDAM framework many times, edited your texts few times (see above also) and suggested articles and books to read, but never did. You simply do not understand the eDAM because you do not have enough background. You are implicitly using manifested consciousness (MC, experiencer) as fundamental entity and Prakṛti as another fundamental entity that includes functions, SEs, cognition and structure and the rest: this is non-interactive dualistic Sāṅkhya. Please appreciate the difference between data and interpretation. There are over 45 interpretations of QM for the same data. Here, there are 4 groups of interpretations for the same data (such as “books on a table”). I am crystal-clear that function and structure co-arise; one does not produce other. Yes, we should take one datum and explain it. In this process other entities come into picture, but they are not data; they are part of explanation or interpretation. When I walk into my office,

I do not see carpenter, wood, nails etc. I only see “books on my table”. They come later during interpretation. Idealism will interpret all of the entities as the condensation of consciousness (as Kushal (Shah) seems to think). Roman (Poznanski) will think just opposite to Shah: it is all matter without any independent MC. Another misconstruction of eDAM: “a nonphysical aspect is included in the entity” is written in materialism/ Prakṛti’s language; it should be “a non-physical aspect of a **state** of an entity and the inseparable physical aspect of the same state of the same entity”.

Your statement “new functions start appearing in the new state due to change in the physical structure and/or physical properties of the previous state, it becomes clear that functions are physical and are **produced** locally in the entity due to change in the physical structure and/or physical properties only.” The term “produced” indicates Sāṅkhya/materialism interpretation. Idealism will claim just opposite that structure is produced from functions and both are produced from consciousness. In the eDAM, “functions” are not produced from structure, they (function “holding of the books” and structure “table”) inter-dependently co-arise from woods, nails, carpenter’s self, mind-brain system and his/her equipment (such as saw etc). Please note that when we walk in the office we do not see them, we see only “books are on the table”, which I consider 100% reproducible data both subjectively and objectively for all normal health people (millions in number!). On the other hand, the theist-yogi SYP’s SS/NS state experiences related to CC/God are from just one subject (SYP himself)’s subjective data and has zero reproducibility among atheist Buddhist-yogis. None of them has any objective evidence.

**The difference between your term “dual substance” and my term “dual-aspect” is unclear to me.** The eDAM is not two-substance theory (dualism); instead, it is the extension of dual-aspect monism, which is single-substance (aspectless and attributeless appearing Brahman as the primal neutral entity) theory. The non-physical aspect does not continue to hang in limbo because aspects are inseparable; so you cannot treat it separately from the inseparable physical aspect as you do in dualistic Sāṅkhya; both aspects inter-dependently co-arise and always go together; function and structure do not arise separately; if any changes occur in one aspect is immediately and automatically reflected in other aspect. Why you think in Sāṅkhya or materialism manner and apply to the eDAM. I guess this is your major problem; you are firmly fixed to God-theory and you just cannot get out of it and you judge others’ framework from your God-theory ingrained in each and every neuron of your brain. You cannot think anything other than God-theory. Function is sourced out from non-physical aspect separately and structure from physical aspect separate; they always go/arise together inter-dependently; function does not arise structure (Sāṅkhya, materialism); structure does not arise from function (idealism); function does not arise from function separately and structure does not arise from structure separately (dualism). The eDAM is dual-aspect monism; try your level best to understand them. You think that production of function from structure is data; you are wrong; this is materialism/Sāṅkhya

based interpretation. We see tree is data because it is 100% reproducible both subjectively and objectively at suprathreshold conditions; but how and why are interpretation. When you make any sentence you always use Sāṅkhya/materialism and then you say you have not done that; this is 100% dishonesty and unfair. SS/NS SEs are subjective data and not reproducible among many yogis, and there is no objective evidence in our physical world, so they are not the same as seeing a tree in wakeful conscious state because tree has both subjective and objective evidence. Thus, there is no double standard in logic. Yes, thru (i)-(iv), you have proved that you have full conviction in God; God is each and every molecule of your body-brain-mind system: and good for you! Thus, you are 100% immersed and biased towards God-theory. I hope you go to the highest heaven Go-Loka when your soul leaves your physical body. Then you make a scientist your medium and tell him/her the life-after-death, in analogy to Seth made [Jane Roberts](#) as his medium and they wrote many books as per McCard.

### **16. Shah to Vimal (8 June 2018)**

“But you are using consciousness as fundamental: this is a version of idealism.” I might have assumed it in my other responses on this thread/group, but not in any of my responses to you. If you think otherwise, please cite the relevant response.

“Please appreciate the difference between data and interpretation.” That is precisely what I am asking you to do! In other words, the primary question is: How do you decide that a set of information can be classified as data and another set as interpretation?

### **17. Blauvelt to Shah**

At risk of confusing things farther, are there not just levels of interpretation, but an unavoidable distance between data and the actual? There are those who think that the actual and "data" are identical. However, from the assumption that the universe is essentially holistic, all "data" is already an interpretative deviation from the actual, in that "data" is necessarily a description of separable, numerable things. All such separations are to a degree arbitrary and simplistic severing of the whole. It may be that data, as such, can never totally, accurately map the actual, even though some datasets obviously have far greater degrees of accuracy than others. On the other hand, even datasets (and their interpretations) with the highest known degrees of accuracy (say relativity theory and quantum theory), may turn out to never reconcile, much as we hope for it. Holism, seen this way, rules out arriving at a theory of everything, as all data sets are, in the end, imperfect simplifications of the actual.

### **18. Vimal**

Perhaps, we should first propose a hypothesis then try testing it. Then, the difference between data and interpretation related to a specific hypothesis may be clear.

Our discussion is on the relationship between structure and function. We took a simple example: when we walk in our office, we observe books on our table; its reproducibility will be 100% at suprathreshold conditions and standard deviation will be zero and significance p-value will be  $<0.0000000\dots0001$  and confidence level of our observation will be 100%. This can be tested both subjectively and objectively. Scientifically, this is called subjective and objective data with extremely high reproducibility among subjects.

Our goal is to understand the underlying mechanism(s). This is where interpretation enters. Everybody will try explaining in their own frameworks. These frameworks can be categorized into four groups: materialism, idealism, dualism and dual-aspect monism based framework. Thus, there will at least four interpretations. One could try combining two or more groups in his/her framework for explaining/interpreting the above robust data.

### 19. Sehgal (9 June 2018)

All the four metaphysical frameworks itself are some set of interpretations. Any further interpretation of some empirical data like books on the table by any set of interpretations is not the correct approach. The correct approach will lie in taking the empirical objective and subjective data, as such, correct on its face value. For ascertaining as to how the function of holding books on the table has appeared in the table, one can go back to past states of the table up to the log of wood or even tree and see minutely at each stage as to how a change in the physical structure and physical properties in each state, brings about new functions in the next state of the entity. Since these are the empirical observations, therefore, these observations should be taken as correct, as such, on the face value. Any attempt to interpret these observations thru any metaphysical framework (which is nothing but some set of interpretations) is going to vitiate (make it ineffective) and bias the process of empirical observations. Therefore, *if the empirical observations dictate that functions are appearing of the virtue of a change in the physical structure and/or physical properties, and hence functions are physical*. Therefore, one should recognize these observations and resist the temptation of interpretation of this data thru another set of interpretations. That is where one would be making a mistake and falling into the trap of frameworks (set of interpretations).

### 20. Vimal

I argue that you are precisely doing the same thru the statement: *if the empirical observations dictate that functions are appearing of the virtue of a change in the physical structure and/or physical properties, and hence functions are physical*. This is an interpretation of the initial data “books on the table” to understand the underlying mechanism thru further observations and interpreting them in terms of Sāṅkhya and/or materialism. I will argue that the wood, nails, carpenter’s self-mind-brain system, and other necessary pieces of equipment (such as a hammer and a saw) and conditions (such as

room-light or daylight) interact with each other inter-dependently. Then function (holding the books) and the structure (table) inter-dependently co-arise. Both structure and function are inseparable at every step. Since a function does not have mass, charge, spin or volume, it is a not physical entity, which means it is a non-physical entity and can be considered as the functional sub-aspect of the non-physical aspect of a state of an entity in the eDAM framework. It is unclear where to put the dividing line (cut) between data and interpretation. I have put the cut in the beginning, i.e., the primary data is “books on the table” and the rest including secondary data fall under interpretation for me. Your cut between data and interpretation is unclear to me. We must have agreement on where to put the cut then only any discussion will be useful; otherwise we are not on the same page. Let us first try to put the cut as I put it in the beginning. Then I hope you will agree with me.

### **21. Sehgal (10 June 2018)**

No, the above is not interpretation since I am not bringing any metaphysics in the picture. I am merely making empirical observations and I find that (a) a conscious carpenter is required for changing the state of the entity of the log of wood (b) I find that carpenter changes the physical structure of the log of wood, (c) I find that with a change in the physical structure AND when placed with another physical entity (say books), new functions appear in table.

So above is not the interpretation of the initial data of books on the table. I actually go to the state of the log of wood and see as to how in a phased manner the function of the books on the table has appeared in the table.

“Then function (holding the books) and the structure (table) inter-dependently co-arise.” No this is your speculative thought since it is not borne by empirical observations. Empirical observations clearly establish that when there is a change in the physical structure and physical properties, functions manifest appear by virtue of a change in the physical structure and physical properties.

Furthermore, there is one more logical problem in your speculative thought. From which ontological substance Functions should co-arise? You would argue from the functional sub-aspect of some non-physical aspect. But from which ontological substance non-physical aspect will arise? You could argue that non-physical aspect arises from some neutral primal entity. For the primordial ontological existence, the neutral primal entity should be in the substance like form.

Now I pose following issues to you and you MUST address the same for a meaningful dialogue (a) Where is that substance like neutral primal entity? Is there any subjective or objective evidence for the existence of this neutral primal entity? (b) How far and in what way a neutral primal entity is distinct from quantum vacuum/QFs. I agree that both structure and function are inseparable at every step because functions are produced from

the structure. In eDAM, there is no logical explanation as to why and how functions should move in unison with the structure even if both co-arise from the same neutral primal entity). I disagree with the above criterion of non-physical. This criterion is incomplete. The complete criterion lies in that it should not have any mass, charge, spin PLUS it should not be derivable due to change in mass, charge, spin and other physical properties or/and physical structure. Functions in a physical entity fail on the second added criteria and hence functions are not non-physical. Anyhow, functions are not an entity -- either physical or non-physical. Functions itself means some utilitarian purpose due to a change in the physical structure and/or physical properties of the state of an entity BUT w.r.t another physical entity.

Yes, I agree with you. Whenever we make any SE or empirical observation that is datum. Now how this datum has appeared in the table can be ascertained in two ways -- One you may start interpreting this data using some metaphysical framework -- which are nothing but set of some interpretations. Interpreting any data based on some set pre-existing interpretation is dangerous and likely to lead to an erroneous situation. You are adopting this approach. Another way to interpret the data is not to use any set of interpretations. But actually, go to all the previous states of the books on the table till log of wood or true and see actually with your mind/senses all the empirical observations as to how new functions are appearing in each state till the function of "holding the books" appears after the state of the table is achieved. In this process, there is no interpretation but we are making empirical observations and we are taking each observation as correct and real on its face value. When we go back to the state of a log of wood and see it, this is not interpretation but this is an SE/empirical observation.

## **22. Vimal**

The carpenter, wood, saw, nails etc. are secondary observations because carpenter, wood, etc. are not present in the office. It seems that so-called secondary observation (how a function arises) is also metaphysics dependent because you view that a function is produced by the change of physical structure and its properties (this is your view from materialism/Sāṅkhya in my thinking).

On the other hand I view that the function (holding books, laptop, lamp, etc.) and the structure (table thru the change of physical structure and its properties) inter-dependently co-arise thru the interaction of many entities such as carpenter, a log of wood, nails, saw, hammer, and so on; this is from the eDAM.

“From which ontological substance Functions should co-arise? ...” is an ill-formed question in the eDAM because aspects are inseparable and ontology is not of aspects; instead it is of the state from the latent-dual-aspect unmanifested state of the neutral primal entity (Brahman).

(a) The neutral entity Brahman is formless, aspectless, and attributeless; this is how Brahman is defined in Vedanta and Upanishads as well. It appears aspectless because aspects are latent. Evidence of aspectless, formless, and attributeless Brahman is presumably at the highest NS state or highest 7<sup>th</sup> state of consciousness as MMY and Boyer propose. QFs of quantum vacuum are represented in the PUIF (physical unified information field), which is physical aspect; and the inseparable non-physical aspect is represented in UPC-IF (universal potential consciousness information field). Since aspects are inseparable, so they move together. Non-physical is NOT derived from physical aspect (that has entities with mass, charge, or spin) and vice-versa; instead both aspects inter-dependently co-arise. If you do not understand this concept then it is not my problem.

It is still unclear where you put the cut between data and interpretation. We are on the different page because your cut is unclear and my cut is whatever we observe when we walk in the office is a datum, i.e., the datum is “books on the table”; use a sharp knife and make a sharp cut right there, i.e., the rest is interpretation. I hope then you will appreciate what I am trying to say.

### 23. Sehgal (11 June 2018)

The basic question which we are grappling to resolve is how to ascertain that the function of holding books on the table has appeared in the table. Yes, it is true that when we enter the office and see books on a table, this is just an SE or some empirical and reproducible data. If you will start interpreting this data based on some metaphysics say eDAM, for the purpose of ascertaining the nature and origination of the function, *this will amount to interpreting some data based on some tool which already is a set of interpretation and which has no element of empirical verification.* For example, when you interpret the data of books on the table based on eDAM, *the key assumption that the function of holding books co-originate, co-develop, co-evolve as part of some non-physical aspect has no empirical verification and all are based on some hypothetical speculation.*

Yes, in the SE/empirical observation of books on the table, primary observations are the books on the table and log of table, carpenter, kneels, the hammer is secondary observations. But unlike eDAM, these are not part of some speculative hypothesis of some non-physical aspects. if you go back to the *past states of books on the table, one can easily verify empirically that there is the existence of some carpenter possessing some MC, a log of wood, hammer and kneels etc.*

Then there is no Materialism/Saankhya in inferring that functions are produced due to change in physical properties and/or physical structure of the entity since we observe clearly from observations that when physical structure and/or physical properties change only then functions are produced. If there is no change in physical structure and/or

physical properties, no function will appear. *Otherwise, also this inference that functions in a physical entity are being produced due to changes in the physical structure/physical properties is more logical since functions can't exist in itself and they always are produced from some structure or/and physical properties.*

The contention of eDAM that functions are part of some functional sub-aspect of the non-physical aspect (which arises from some neutral primal entity) does not stand the scrutiny of even preliminary logic since immediate question arises:

Where is the non-physical aspect in the table from which function of holding the books on the table will arise? In what ontological form does such non-physical aspect exist? *Then there is the ontologically real substance/structure like neutral primal entity, as distinct from the quantum vacuum/QFS, from which non-physical aspect?* Above questions have no logical answer?

Then some more issues invalidating the existence and evolution of the function of holding books on the table as part of some non-physical aspect is that this *function can't evolve from some non-physical aspect, as such, since the evolution of this function is dependent on some other physical entity say books. Had there been no other physical entity like books, the existence and evolution of this function would have been redundant.* Therefore, existence and evolution of this function from some non-physical aspect, as such, is ruled out.

There are no logical reasons for the interdependent co-evolution and co-development of functions and structure if functions are not to be produced due to change in physical structure/physical properties. *You please provide even a single logical convincing and clear reasons as to why the functions should co-evolve and co-develop with the change in physical structure/physical properties ( or move in unison with the structure/properties) if the functions are not to be produced from the structure/properties. Your contention that functions are inseparable with the structure/properties, on the contrary, reinforces the observational fact that functions are produced due to change in the physical structure/physical properties. Since functions are produced from physical structure and/or physical properties, they are intricately interlinked. This internal intricate interlinking of structure and functions (due to functions produced from structure/properties) make them inseparable. Otherwise, there are no reasons for their inseparability.*

No, above is very valid and logical issue. Since you have no answer, therefore, you say it is illogical. Even if aspects are inseparable, both the aspects need to arise from some ontologically real substance like reality which you say as the neutral primal entity. *So my query had been where is that ontologically real substance like the neutral primal entity from which both the aspects arise and that primal entity needs to be distinct from the quantum vacuum/QFs since quantum vacuum/QFs itself is of physical nature.* In fact, if there is the neutral primal entity incorporating both the aspects, that should be transcendental to



quantum vacuum/QFs and quantum vacuum/QFs should represent the physical aspect of that neutral substance like primal entity,

*It means, you are implicitly recognizing the existence of some ontological substance like ontological existence, as distinct and transcendental to quantum vacuum and QFs. Do you agree?*

Yes, Brahman may be formless, attributeless, and aspectless in terms of all the forms, aspects and attributes of our observable universe. But substantially, Brahman can't be attributeless and aspectless since something can't appear from anything. If there are attributes and aspects in our universe and same have arisen from Brahman, ( NOT to be confused with quantum vacuum/QFs), IT should have infinite attributes and aspects.

Furthermore, all the infinite aspects and attributes can't be in the unmanifested form since. *Since if Brahman itself has unmanifested consciousness, there is no mechanism to manifest these aspects and attributes. The contention that it is the universal laws of nature which will manifest the unmanifested consciousness is an illogical and baseless proposition since all laws in itself have some implicit MC in them ( That is what we observe in our mundane life also). Furthermore, if everything of Brahman is unmanifested, why universal laws should not be manifested or active? To argue that laws are manifested or active is an illogical and artificial argument since it is not in conformity with the unmanifested consciousness status of Brahman.*

But from where PUIF ( physical aspect) and UPC\_IF ( mental aspect) will arise? You will argue from some neutral primal entity. But where are that neutral primal entity and how in what way it is distinct from QFs/quantum vacuum.

*Why aspects are inseparable, if there is no inter-relation of co-production or co-influence from each other? Inseparability between two aspects will show only when there is some intricate relation of inter-influence or inter-production. This is a quite logical and rational argument*

Let me clarify a bit more. Whatever comes in the domain of SEs/empirical observations is data and rest is interpretation. Carpenter, a log of wood, hammer, knees, the process of change in the physical structure of the log of wood -- all can come in the purview of SEs/empirical observations and, therefore, part of data. All data should be taken as real and true on its face value.

*But what should be the basis of interpretation? The basis of interpretation should be the one which itself is empirically verifiable thru SEs or objective observations. Your proposal to interpret the data of books on the table thru eDAM is not the correct approach since the basis for interpretation i.e. the existence of some primordial non-physical aspect is neither subjectively ( i.e. thru SEs) or objectively verifiable?*

## 24. Vimal

My main point is a function is NOT **produced** from a structure (or the change of structure or of its properties); otherwise, it would be problematic materialism or Sāṅkhya; the *vice-versa* is problematic idealism. In the eDAM, both aspects **inter-dependently co-arise** thru the interaction of necessary entities such as carpenter, wood, saw, hammer, nails and so on. Ontology is of the state from the dual-aspect unmanifested state of the primal neutral entity, not of the aspects taken separately.

The dual-aspect unmanifested state is the superposition of all possible innumerable beable ontic basis states, including the beable ontic state of the book-table system as one of the innumerable basis states when we walk in the office. When this beable ontic state inter-dependently co-arises (here, I am not using co-evolution etc, which has already been over billions of years), then it has the function (holding the books) and the structure (table) as inseparable aspects. Both aspects always move together because of inseparability.

For me, the primary data is “book on the table, i.e., the table is holding the books”; the rest including the secondary data are interpretations because of my preferred selection of the cut. If the cut between data and interpretation is between all observable data (both primary and secondary data combined) and the rest, then we can argue how structure (table) and its function (holding the books) arise from four groups of metaphysical frameworks.

Your view is the function is produced from the structure and my view is both the function and the structure inter-dependently co-arise thru interaction between relevant entities.

## 25. Shah-Blauvelt (10 June 2018)

**Shah** (Kushal): Its good that you stated what a table actually means! So if we say that a table is a "flat surface for placing things on at a higher level than the ground or floor", two questions arise: How flat should the surface be and how high from the ground for it to be called a table? Are all such objects categorized as "table" or some of them can also be called a bed or chair or almirah? The point I am trying to make is that all these definitions are not really objective and require a certain cultural and linguistic familiarity.

**Blauvelt** (Whit): Now you've introduced another subject: categories. Do you mean to suggest something can't "objectively" be in multiple categories? I see no problem with that, nor with objects being defined in relation to organism-relative or culturally-assigned affordances. I regard neither organisms nor cultures as taints upon "pure" reality. A hat is objectively a hat, even if it takes a perspective within, say, the British aristocracy to see some of what women there put on their heads as hats. Multiple people can objectively confirm that those are hats. Even a headless Martian could learn to recognize and correctly categorize, in an objective sense, the vast range of hats on Earth.

**Shah** (Kushal): The reverse is also possible. Even within the same species of humans who are familiar with the usual notion of table/book, it is possible to temporarily or permanently be in a state of mind where all these things vanish and all that one sees is the underlying deeper reality. For that person, the "book on the table" as seen commonly would only be a hallucination and not an objective fact.

**Blauvelt** (Whit): There are interesting sorts of brain damage which can lead to failure to recognize particular categories. There are fascinating meditation practices which can seemingly turn off brain areas, and lead to similar temporary blindness to certain categories. To claim this shows a deeper objective reality is like closing the eyes to prove that objective reality is dark and colorless (in my case sort of a dark grey, closing my eyes just now). I don't mean to slight meditation. It's invaluable, as are certain substances which can lead to similar insights. Yet I'm not sure the first conclusions people leap to, on seeing aspects of the world and our customary categories dissolve before them, are necessarily the correct ones.

**Shah** (Kushal): That is at best an assumption which may be right, but we can't be sure as of now. We need to wait for at least AI to be able to categorize things as well as humans can. The brain is just an instrument through which we usually see the world around us. There is no reason to believe that the picture drawn by the brain is any more correct depiction of reality than the picture drawn by a different instrument. It's more a matter of familiarity rather than objectivity. The experiences during deep meditative states could very well be hallucinatory, but could also give a deeper sense of reality. Which of these is true is surely very hard to figure out, but that does not mean that we deny the later possibility.

### **3.2.11. Queries in the eDAM**

**1. Sehgal:** A subjective Samadhi state-based or objective empirical scientific evidence for the existence of any latent mental aspect in entities in entity-specific mode. Your argument that we as living beings are made of 18 fundamental particles and we have consciousness, therefore, consciousness should manifest from some latent mental aspect with particles is an untenable and misleading argument. Why? Since this does not prove that consciousness in us is really manifesting from any mental aspect as latent with the particles. It is our physical body which is composed of 18 particles and there is no evidence as to if consciousness is really manifesting from any mental aspect as latent with the particles. There can be many sources other than the mental aspect as latent with the particles from which consciousness can manifest and, unlike eDAM, there is subjective evidence for these also.

**Vimal:** You have misunderstood the logic of science and the eDAM, where one never questions the postulates. The postulates are validated thru empirical (direct or inference) evidence and logic, which is done above. Yes, there can be many sources, such as MCC/Puruṣa/God of non-interactive dualistic Sāṅkhya's OOO-God theory, that has 13 serious unresolvable problems as I elaborated in the thread "Problems of dualism", but the eDAM proposes the logical inference based evidence above. So-called SS/NS states subjective evidence by SYP is scientifically invalid because skeptics could argue that his SEs are phosphenes; he must have seen something and called all Sāṅkhya's astral entities, soul, and God. In addition, there are no other yogis who replicated his findings and reported thru articles and books; and there is no scientific objective evidence.

**2. Sehgal:** The creation of any fluctuation is contingent on the presence of some underlying substrate. So if eDAM postulates some consciousness fluctuations (CFs), there should be some conscious/mental substrate beneath such CFs. What is that and from where any such conscious/mental substrate appears?

**Vimal:** You have misunderstood the logic of the eDAM's inseparability postulate. If there is QFs in the physical aspect, it must also reflect in non-physical aspects, which is CFs. In addition, CFs are consistent with the most respectable *Bṛhadāraṇyaka Upaniṣad*.

**3. Sehgal:** What is the meaning of the manifestation of the physical aspect in an entity up to the extent of 25% degree in term of its physical structure and or physical observable properties/variables?

**Vimal:** You have misunderstood another postulate of the eDAM's varying degree of manifestation of aspects, which are represented in terms of percentage, which needs calibration based on experiments. This needs further research. For understanding it, the four sub-aspects of the aspects must manifest together because of the inseparability. Therefore, arbitrarily, we can consider 25% for each of the four sub-aspects. For example, consider a statue, it has pattern and form (qualitative sub-aspect); so we can say the degree of manifestation of aspects is 25% compared to us, where all four sub-aspects are manifested.

**4. Sehgal:** Empirical observations and evidence prove that forms and patterns at the macro level manifest when a change is brought in the physical structure and physical properties in an entity by some conscious agent. In the quantum level, due to wave-particle duality, there are no forms/patterns of particles. Furthermore, at the macro levels, forms/patterns can be expressed in term of the physical dimensions of space/time. In view of the above, as per science and empirical observations/evidence, forms/patterns should be physical. But eDAM, why in utter disregard to empirical evidence/observations, treats forms/patterns as

non-physical. What are the logical basis and evidence with eDAM to treat forms/patterns as non-physical?

**Vimal:** Let us take an example of a statue. It has a form/pattern and material clay. When we observe, how a sculpture made it; I see it he, clay, and related tools are inter-dependently used simultaneously within a spatio-temporal interval and both non-physical aspect (form/pattern: qualitative sub-aspect) and physical aspect (clay) of a state of the statue inter-dependently co-arise. You see it differently. Why do we see the same process of making the statue differently? This is because we interpret the data and process in our own framework. You look at from the point of view of Prakṛti part of Sāṅkhya, which is close materialism, so you think that the form/pattern of the statue is derived from the material clay. I look at from the eDAM's point of view using Nagarjuna's inter-dependent co-arising and use the eDAM's definition of physical and postulate qualitative sub-aspect "pattern and form" as non-physical. These postulates are validated later in terms of a number of serious problems that have consensus. For example, Sāṅkhya's postulates end up with 13 serious unresolvable problems and materialism's postulates end up with the serious unresolvable explanatory gap problem. On the other hand, the eDAM's postulates end up with no such problems.

**5. Sehgal:** As per eDAM, both the aspects are inseparable in the quantum world. However, when the beable ontic state of an entity is realized, as per eDAM, it is only the physical aspect which manifests while the mental aspect remains unmanifested. With one aspect unmanifested and the other aspect manifested, this is a clear logical inference that inseparability should get broken the moment physical aspect manifests. Against the above clear logical inference, what is the logical mechanism, with some evidence, with eDAM, that inseparability should still remain maintained with both aspects in a different state of the world -- mental in quantum and physical in real classical?

**Vimal:** Each of the elementary particles has a specific function, which is a sub-aspect. In other words, the function as the functional sub-aspect of non-physical aspect and the mass, charge, and spin as the inseparable physical aspect of a state of an elementary particle inter-dependently co-arise. Thus, there is no violation of inseparability.

**6. Sehgal:** By what mechanism, the cognitive sub-aspect of the mental aspect of memory and attention can manifest within the existing postulates of eDAM?

**Vimal:** A cognitive sub-aspect of both aspects inter-dependently co-arises simultaneously within a critical spatiotemporal interval.

**7. Sehgal:** As per eDAM, attention, and memory (in their manifested cognitive sub-aspect form) are the necessary conditions for the manifestation of the experiential and many

functions of the cognitive sub-aspect (other than memory and attention). This is a clear-cut contradiction in eDAM since cognitive sub-aspect of memory and attention are being stipulated to pre-exist as the prior conditions for the manifestation of the cognitive sub-aspect itself, other than attention and memory.

**Vimal:** I only said that attention and memory are two of the necessary conditions for a **reportable** SE (experiential sub-aspect). If they are also necessary conditions of other cognitive sub-aspects, then still there is no problem. This is because each sub-aspect may have many sub-sub-aspects. It is also possible that they are not mutually exclusive. We need to develop them in such a way that there is no contradiction.

### 3.3. Critiques

#### 1. Vimal: 4/23/16

1. We cannot prove anything in science, but we can reject a hypothesis if we find a single contradiction. For example, if we find inseparability between self and 3pp-physical neural activities, then this would contradict *Sāṅkhya* because *Prakṛti* and *Puruṣa* of *Sāṅkhya* are separable and they do not interact with each other either. Therefore, *Sāṅkhya* would be rejected?

2. As per the dualistic *Sāṅkhya*, only *samskāras* (chitta/memory, a part of causal body), astral bodies (1 manas, 1 buddhi, 5 *tanmātrās*, 10 senses, etc.), and *Ahamkāra* part of causal body go with soul after death; the whole physical body remains with corpse.

3. The 1pp and 3pp data are robust, reproducible, empirical data; data are data; therefore, these data cannot be rejected.

#### 2. Sehgal: 4/24/16

1. Leave self for the time being, even inseparability between 3pp neural activity and mind (mana, buddhi, and senses) will establish the rejection of *Sāṅkhya*. The 3pp neural network is part of physical body in brain and its data is available for public scrutiny. Mind (Mana, Buddhi, Senses) is an element astral body on the same pattern as brain is a part of physical body. As on date, there is no objective access to astral arena, therefore, data (if mind/buddhi/senses also have data!) on Mana/buddhi/senses is not accessible. Despite brain and mind belonging to quite distinct arena of nature, they are in tight link with each other and work in very close conjunction. They mutually affect and interact each other. A slight change in one creates immediate effect upon other. Therefore, how will you establish the inseparability? Magnetic stimulation of self-related parts of brain (cortical and sub-cortical) and reporting by subjects does not establish inseparability?

**2.** At the time death, Soul (self) + Causal body (Chitta, Samskaaras) + Astral Body (Mann, Buddhi, Senses) LEAVE our physical body. As soon as, Soul along with causal and astral body leaves physical body, it stops exhibiting signs of life and becomes corpse. Conscious power of soul act upon physical body via Causal and astral bodies only. There is no interaction between soul (localized) *Puruṣa* and *Prakṛti* (physical, astral, and causal bodies). Physical body exhibit signs of life only when conscious power acts thru causal and astral body. Otherwise, cosmic consciousness is all prevalent in all physical structures but they do not exhibit life. Cosmic consciousness remains present also in corpse (but without interacting with it) having the same organic structure, which was exhibiting life minutes before death, but that does not exhibit life now due to departure of Astral body.

**3.** The 3pp may be robust, reproducible, empirical data since neural activities are accessible and measurable thru objective and scientific methodology. But 1pp pertains to subjective experiences. Such experiences are the exclusive preserve of the subject. There may not be consistent in description of subject over time and from subject to subject. For example, when brain(s) of different subjects are subjected to *same* treatment thru environment or some simulation in some controlled experiment, different subject may narrate different subjective experiences OR a single subject narrate differently each time. In view of this, how do you say that 1pp is robust, reproducible, empirical data?

### 3. Vimal

**1 and 3.** We do (a) psychophysical research for the information from the 1pp source, which is mostly subjective, such as (Vimal, 1997, 1998a, 1998b, 2000, 2002a, 2002b; Vimal, Pokorny, Smith, & Shevell, 1989; Vimal et al., 1987; Vimal & Shevell, 1987), and (b) physiological (objective) research for the information from the 3pp source, such as (Vimal et al., 2009).

Yes, there are subjective variations; but within statistical significance level ( $p < 0.05$ ), these subjective results are reproducible. This is the same limitation with all objective research as well such as within statistical significance level ( $p < 0.05$ ) (see (Vimal et al., 2009)). However, my proposed experiments are for a specific conscious state of a given subject for specific spatiotemporal interval and within a JND (just noticeable difference). Please look at more closely Section 3.2 of (Vimal, 2015g) and let me know if you find any problem.

Furthermore, we might still able to generate a testable hypothesis related to the *inseparability* between self and its neural correlate(s) by modifying the experiment using functional MRI (Vimal et al., 2009) and EEG discussed in Section 3.2 of (Vimal, 2015g) as elaborated in Section 3.2.9.

**2.** In the term ‘Senses’, does dualistic *Sāṅkhya* include our experiences of objects (such as experience of redness when we look at ripe-tomato)? If it does, then you are correct, the

inseparability between a 1pp-experience (such as redness) and 3pp-NCQ (neural correlated of qualia redness) will also reject *Sāṅkhya*.

#### 4. Stanley Klein (24 April 2016)

You often make the 1p and 3p point of view. It is wonderful that the 1pp view (me) has lots of wonderful and wondrous subjective stuff going on. But the 3pp view (you) seems to be under the control of the "machinery" of the brain and muscles. Do you have a different view than that the 3pp view is that everything about others can in principle be understood by science? I say "in principle" because it is likely that brains are way too complex to ever be fully predictable. For example, we'll never be able to predict the temperature a year from now.

#### 5. Vimal

My definition of 3pp is whatever we as public can look at it. Therefore, if I am looking at a ripe-tomato, then I experience of color (such as redness) is private; this I call it 1pp non-physical aspect. Then if anybody else as 3<sup>rd</sup> person (public) looks at related fMRI/EEG of relevant areas then whatever s/he finds is 3pp. Perhaps, they will be able to see anatomy of visual area 8 neural-network (V8-NN) and its activities; in addition, physical aspect also includes the unknown V8-NN-in-itself. Do you think that the proposed experiments will accomplish the specific aim of testing the *inseparability* hypothesis?

#### 6. Sehgal (24 April 2016)

**1 and 3.** Yes, I agree that it *might be possible* to generate a testable hypothesis between neural correlates and experiences of self within the limits of some statistical significance. I also agree that in objective research, findings though within variations are accepted provided these are within acceptable statistical significance.

But here I am raising an issue of inseparability vs. a 1 to 1 correspondence. I am not touching the issue of self for the time being but raising issue of mind vs. neural correlates.

In the very first instance, I am skeptic if manipulation of neural correlates in brain thru some chemo/electric/e.m intervention can produce desired mental output. Had it been, it would have been easy to remove all criminality from world by just by manipulating the neural correlates. But this has not happened. Partly, it may be yet it has not been possible to identify neural correlates for each and every thought process and secondly *may be* some deeper thought may not reflect upon brain in form of neural correlates.

Secondly, even if a testable hypothesis is generated between 3pp correlates and subjective experiences (1pp) thru proposed experiment, this does not establish inseparability between them. This will establish a relation of correspondence between 1pp and 3pp. Please



appreciate the distinction between the *relation of correspondence* and the *inseparability*. As, I have indicated in my previous posts, brain and mind are tightly linked and work in close and strict conjunction albeit being different entities in different arena of nature (*Prakṛti*). When matter and energy interact (e.g. interaction between electron and photon), there may be corresponding relation between energy and matter but they are separate distinct entities, though both within physical realm of nature. But brain and mind are entities belonging to entirely different realms of nature yet working in close and tight conjunction.

As per the dualistic *Sāṅkhya*, (i) as far as entity of self is concerned, it is conscious, distinct, and transcendental above mind. (ii) The narration of subjective experiences by self is distinct from self and mind. (iii) All subjective experiences are experienced by *mind* in the astral plane of nature, reflected upon brain in form of neural correlates at the physical plane of nature, witnessed by *self* (*soul*) and narrated by *mind* thru speech/writing. (iv) In speech, the sense of speech (*Vāka Jñānendriya*) and in writing (*Karmendriya* of *Hasta* is utilized).

In nutshell, the proposed experiment, if successful, shall generate testable hypothesis of correspondence between brain and mind but there would be no evidence that the brain and mind are inseparable and are same entities.

**2.** As per dualistic *Sāṅkhya*, different senses in astral body sense their respective subject (*Vishayas*) thru brain. For example, *Chakshu Jñānendriya* sense *Rupa Vishaya* and *Karna* senses *Shabda Vishaya*. *Chakshu Indriya* does not detect *Shabda Vishaya*. Therefore, *Chakshu Indriya*, thru external eyes, can only see and not listen. Mind plays the role of co-ordination between senses, external stimulus, and *Buddhi*. If mind' co-ordination is lacking, respective sense will not detect the corresponding *Vishaya* despite stimulus signal present in brain. After, concerned *Vishaya* is collected by respective sense, of course after linking of it with a mind, the mind senses the collected signal to *Buddhi*. It is *Buddhi* which gives judgment on the nature of stimulus (tomato is red or not). In the whole process, the self (*soul*) observes and perceives.

Question should be not of the rejection or acceptance/rejection of the dualistic *Sāṅkhya*, or eDAM, or *Vedānta*, but to find what is reality and truth.

## 7. Vimal

**1 and 3.** Yes, I do appreciate the difference between 1-1 correspondence and inseparability. This is indeed very important. My understanding of 1-1 correspondence means there is a 1-1 relationship but they can or cannot be separated in space and/or time within certain critical interval under certain conditions; if they cannot be separated then only it is inseparable and certainly will have 1-1 relationship during that interval. An rough analogy will be the two sides of a coin; if we slice the coin then still there will be two sides;

therefore, the two sides of a coin is inseparable. The proposed experiments will certainly test 1-1 relationship and tight link; this is also very interesting.

Question is how to test inseparability clearly to the acceptance of everybody. Furthermore, how to test that the *self* (soul, localized *Puruṣa*) is separate from *Prakṛti* is also unclear. Unless we generate testable hypotheses, they cannot be part of 'real' science and they will remain simply as fictitious stories in the "eyes of *real* science".

## 8. Stanley Klein

The fMRI has is a factor of about 1000 too little temporal resolution and EEG/MEG has decent temporal resolution but EEG/MEG is not able to connect to fMRI by a factor of about 10. There are methods being developed for mice that within maybe another 10 years will be able to overcome these problems. But we don't have the 1pp point of view of mice. So I worry that your project seems to have some problems in that regard. I suspect that in maybe 50 years we will have the needed technology for getting EEG/MEG/fMRI to have the needed resolution when working together. Could you clarify how you deal with these technical, not philosophical problems?

## 9. Vimal

Thanks for raising the issue. I agree with you. However, the fMRI has high spatial resolution. Therefore, just fMRI and psychophysics should be enough for our purpose. First, we do psychophysics and measure color discrimination and find JNDs (just noticeable differences) from red to green. Then we present the red stimulus and measure the activities using fMRI. Then present red+(1 JND) and measure, then red+(2 JND) and measure, and so on until we reach to green. Then analyze the data; and investigate if the activated-areas and the strengths of activations remain the same or differ. If we find any two stimuli differing 1+ JND gives same activated areas with same strength of activation, then *inseparability* hypothesis is rejected. If not rejected, then we keep on searching using luminance discrimination and other kinds of spatiotemporal discrimination for visual and other sensory systems using this JND-procedure. If we find a single data that rejects *inseparability* then the eDAM is rejected and separability is not rejected, which will also be very interesting indeed because this gives a possibility of the existence of paranormal phenomena such as soul, life after death, rebirth, the entities of astral and causal planes, and so on (the separability of 1pp and 3pp data is one of the predictions of *Sāṅkhya* and Interactive Substance Dualism). The strength of this experimental design is very high because it is a two-way design as negative results are also very interesting. There is an implicit hope of BIG win for all religions, which have lots of money so they should fund this project; I am not sure that NIH would be interested; NSF may be.

## 10. Stanley

I am afraid fMRI is way too coarse to separate red from green. You seem to be implying that. And also the temporal resolution of human psychophysics is way too coarse for what is needed to identify the neural correlates of the types of synchronous neural behavior to identify the activity patterns that are correlated with our incredibly rich qualia. In a baseball game, how incredibly good batters can be for hitting fast pitches. That is the sort of thing that requires very high spatial and temporal resolution. I am afraid fMRI is useless for any such goal.

## 11. Vimal

I guess I was not clear. In fMRI-whole brain scan, the stimulus duration could be 1s with ON-OFF type presentations in simple block-design (1s ON and 1s OFF, 30 repetitions). The ON-stimulus can have color stimulus and OFF-stimulus could be dark. Psychophysics is for finding JNDs as usual. I do not see temporal resolution problem in this type of presentation.

## 12. Stanley

To identify individual neurons and their connectivity one would like to have spatial resolution of about 10 microns and temporal resolution of about 1 msec. That is now feasible in mice where that is becoming possible using optogenetics, with which it is also possible to see the cell firing. The combination of EEG/MEG/fMRI is still quite far from that goal for humans. So to do a decent job of figuring out the neural correlates of subjectivity we will need to be patient.

## 13. Vimal

I agree with you for identifying individual neurons and their connectivity the spatiotemporal resolution should be (10 microns, 1 msec). However, in our case, it takes time to build up neural-network for specific stimulus (such as red stimulus with 1sec or some appropriate duration). The inseparability hypothesis is for a conscious state; 1 sec is presumably enough time for its build up; if it takes more, then we can use longer duration. Thus, we need about 1 sec temporal resolution time. With 3T scanner (Vimal et al., 2009), spatial resolution is 3.44 mm x 3.44 mm x 1.9 mm; this is enough for fMRI in visual cortex. However, Sehgal argued that the proposed experiment is for testing 1-1 correspondence between 1pp and 3pp; it is unclear if it is for inseparability. If 1-1 correspondence is rejected then inseparability will also be rejected. We cannot prove any hypothesis; the best we can do is to reject it. In other words, this project is step-1; if we cannot reject inseparability or 1-1 correspondence then we go for higher resolution to investigate at what time or temporal resolution, it can be rejected, which may indicate that NN-build-up is incomplete.

#### 14. Clough, Roger (Sept. 21, 2016)

From “Semiosis of Mind. The cybernetic, pragmatic birth of this dual-aspect universe”: Firstness consists of eternal, mathematical, timeless and spaceless Universal Mind. Secondness is monadic, issued in with the Big Bang and its production of dual-aspect quantum-particle mental-physical monads. Thirdness is consciousness, according with the development of personal mind in man and animals.

#### 15. Vimal

The Firstness and the Thirdness can be combined into the mental aspect of a state of an entity because both are related to mental entities. The Secondness is the physical aspect of the same state of the same entity. These two aspects are **inseparable** in the eDAM. A state of a monad is a dual-aspect entity. In this way, there is only one free parameter and hence the degree of parsimony in this extended dual-aspect monism framework as per Occam Razor will be 3 times higher than that of Peirce's 3 separable aspects framework with 3 free variables; see also (Vimal, 2015a).

#### 16. Sehgal (14 Jan 2018)

The critical test of eDAM is incapable looking at the ontological realm related to the issue of inseparability/separability between physical and mental aspects.

#### 17. Vimal

By definition, dualistic frameworks (such as interactive substance dualism and *Sāṅkhya*) predict correlation and monistic frameworks (such as materialism, idealism, and eDAM) predict inseparability between 1pp non-physical aspect (SE) and 3pp-physical aspect (neural basis, NN and its activities, physical basis). However, all dualistic frameworks have 12 serious problems, whereas materialism and idealism have their own explanatory gap (e-gap) problem as elaborated in Section 1.1 of (Vimal, 2010b), Chapter 2 of (Vimal, 2012b), and Section 2.2.2 of (Vimal, 2013). Thus, the eDAM is the only remaining framework that has the least number of problems. The eDAM predicts inseparability between aspects at both ‘operational/scientific’ and ontological levels. However, the critical experiment is designed for the operational inseparability at scientific level. If separability is found then the inseparability is rejected and hence the eDAM is rejected. Otherwise, the operational inseparability is maintained at scientific level. Ontological level, I argue that the source of dual-aspect entity is the primal dual-aspect structure (dual-aspect Brahman, the primal entity). The third justification is that the information from the (exogenous or endogenous) stimuli, the state, and the entity are the same for both mental and physical aspects. Thus, three-way justifications hold for inseparability between mental and physical aspect of a state of an entity. If you still feel skeptical, then please let me what else is needed and how it can be addressed to make the eDAM acceptable.

To sum up, irrespective of operational/ontic inseparability, I still hold: if a separability is found in the experiment proposed in Section 3.2 for a single condition, then all monistic frameworks will certainly be rejected; this is a very strong statement, but this is what science's valid 'doctrine of rejection' teaches us; and nobody can deny this! Otherwise, it will support/maintain the eDAM and search for its rejection will continue indefinitely until such rejection is found. Why it will support only the eDAM and not other metaphysics? This is because the eDAM has the least number of problems (if understood correctly) compared to the problems of other frameworks as elaborated above. Therefore, the proposed experiment is worth carrying out.

### **18. Singh (14Jan2019)**

A framework is merely a set of proposed assumptions and concepts that must be developed into a quantitative predictive model whose predictions can be validated by empirical observations. Only after such complete validation a framework or model could be falsified, until then a framework is neither wrong nor right. Is there a plan to develop a quantitative predictive model out of eDam to establish its validity against data?

### **19. Vimal (14Jan2019)**

Thanks, Avtar. I agree with you. Yes, I need collaborators on this project. If you and/or other colleagues are interested, please join me. Many minds are better than one mind.

I do have one experimental design that has a testable prediction: if a separability is found between aspects under any condition then eDAM needs to be modified; this is elaborated in Section 3.2 of (Vimal, 2015) (attached). So far, 100s of fMRI/EEG reports failed to find any separability, but they were not specifically designed for this purpose, but this design will clearly test it. Opponents (such as Sankhya proponents) could argue that other foundational frameworks will also claim this operational inseparability under such conditions. This criticism is addressed by further proposing to test the inseparability/separability issue by measuring the related NPB (neural-physical basis) the highest level of Samadhi state subjective experience, where Sankhya clearly predicts that NPB must not exist and separability must exist.

### **3.4. Anonymous colleagues' and reviewers' evaluations**

We had three anonymous colleagues who evaluated this article. Their comments and my replies are as follows:

**[1]** As per the first colleague, "In principle I am sympathetic to DAM and to the author's project." This colleague also provided useful critical comments in Section 2.7, and Endnote 2 and 8

**[2]** The second colleague's assessment of this article is as follows: "the paper reviews the mathematics of Tononi's theory and aptly applies it to the visual system of primates. This is

a valuable work, possibly the first time that this formalism is discussed and criticized. The metaphysical claims made in the paper are based on former mathematical and neuroscientific approaches. The achieved synthesis is satisfactory, encompassing the complexity of this area of research.”

**[3]** The third colleague appraised as follows: “I agree totally with the author that a [dual-aspect] monism framework is probably better suited to explain the hard problem of consciousness, and it suits rather nicely as an interpretation of the IIT. [...] I like the general idea behind the author's "neural model": that the interaction between feedforward (future) and feedback (past) activity underlies current conscious contents. This is a novel idea, and it is nicely related to previous work in consciousness (e.g. Lamme/Block (Lamme, 2000)/(Block, 2007)), and predictive coding theories (e.g. (Friston, 2012; Friston & Kiebel, 2009)) [...] I would like to say here that I think the authors attempt to interpret the IIT from a dual-aspect monistic framework is a timely question, and could be potentially interesting for a number of philosophers and scientists.”

Our ‘neural model’ has two steps (Section 1.3 and (Vimal, 2010a)):

- (i) First, there is an interaction between feedforward (FF representing future) and feedback (FB representing past) activity that underlies current conscious contents;
- (ii) Second, this interaction entails the matching between two modes. These modes are the 3pp-FF-future and the 3pp-FB-past signals as 3pp-physical aspect and/or related *inseparable* 1pp non-physical aspect. This then leads to the selection of specific subjective experience (SE). This is called the matching and selection mechanism. In other words, when the matching and selection brain-processes complete their functions, *the world-presence (Now)* is disclosed and objects are experienced by the self. The self is the SE of subject, ‘I’, or ‘subjective character of consciousness’.

**[4]** The third colleague further argued that information integration may not be equal to consciousness under certain conditions. I agree; for example, at subthreshold level, information is integrated but cannot be experienced (Mudrik, Faivre, & Koch, 2014). Furthermore, they (Mudrik et al., 2014) hypothesize that consciousness is needed for integration, such as long-range spatiotemporal integration, high-level semantic integration, multisensory integration, and novel information integration. This seems to imply that consciousness (mind) causes neural signals (matter) for integration, entailing idealism and/or interactive substance dualism. However, both have serious problems as elaborated in (Vimal, 2010b, 2013).

The subthreshold, threshold, and suprathreshold data can be better interpreted in the eDAM framework as follows:

The degree of the manifestation (appearance/strength) of 1pp non-physical aspect (i.e., the strength/level of consciousness) of a state of the brain-mind system is represented by  $\bar{d}$ . As the  $\bar{d}$  increases the following attributes of IIT (Balduzzi & Tononi, 2008, 2009; Mudrik et al., 2014; Tononi, 2004, 2008, 2012) also increase:

Spatial integration window,  
 Temporal integration window,  
 Semantic processing integration windows,  
 Multisensory integration windows, and  
 Integrated information  $\Phi$ .

It should be noted that these attributes of IIT are elaborated in (Balduzzi & Tononi, 2008, 2009; Mudrik et al., 2014; Tononi, 2004, 2008, 2012) as 3pp-physical aspect of a state of the brain-mind system in the eDAM framework.. However, they are reflected in 1pp non-physical aspect of the same state as well because both aspects are *inseparable*.

In other words, there is no inconsistency in IIT if it is interpreted in the eDAM framework. Otherwise, IIT certainly has problems. This is because IIT is based on the identity theory of materialism, consciousness as integrated information (Tononi, 2008), and/or a version of panpsychism (Tononi & Koch, 2014). These frameworks have serious problems as elaborated in (Vimal, 2010b, 2013).

Furthermore, Searle (Searle, 2013) argues for two objections against IIT (consciousness as integrated information) as follows:

(i) “[W]hy there should be any special connection between information theory and consciousness ... Why should information theory give us the essence of subjectivity? [...] you can’t explain consciousness by saying it consists of information, because information only exists relative to consciousness. [...] information in the ordinary sense in which it always has a content ... The [Shannon’s] mathematical theory of information is not about content, but how content is encoded and transmitted. ... the commonsense conception of information is semantical, but the mathematical theory of information is syntactical. The syntax encodes the semantics” (Searle, 2013).

(ii) Panpsychism has serious problems, such as the combination problem (Vimal, 2010b). Therefore, the panpsychism based IIT also has problems.

As per Searle (Searle, 2013), “We cannot explain consciousness by referring to observer-relative information because observer-relative information presupposes consciousness already. What about the mathematical theory of information? Will that come to the rescue? Once again, it seems to me that all such cases of ‘information’ are observer-relative. [...] you cannot explain consciousness by referring to observer-relative information, because the information in question requires consciousness. Information is only information relative to some consciousness that assigns the informational status. [...However,] there does seem to be a connection between consciousness and observer-independent information. There is no doubt some information in every conscious state in the ordinary content sense of information. Even if I just have a pain, I have information, for example that it hurts and that I am injured. But once you recognize that all the cases given by Koch and Tononi are forms of information *relative to an observer*, then it seems to me that their approach is incoherent. The matching relations themselves are not information

until a conscious agent treats them as such. But that treatment cannot itself explain consciousness because it requires consciousness” (Searle, 2013).

In the eDAM framework, since information is a dual-aspect entity, Searle’s above objections (Searle, 2013) can be addressed as follow:

- (i) An observer or a conscious agent is the ‘self’. This is the subjective experience (SE) of subject (Bruzzo & Vimal, 2007) or ‘subjective character of consciousness’ (Peressini, 2013). The ‘self’ is also the 1pp non-physical-aspect of a state of self-related neural-network such as cortical midline structures (Northoff & Bermpohl, 2004).
- (ii) The observer relative information is the information relative to self. The term ‘consciousness as integrated information’ in IIT and Searle’s consciousness (Searle, 2013) is a SE of objects, which is the 1pp non-physical aspect of object-information. This is experienced by the ‘self’. Thus, this eDAM’s IIT does not have problems.

**[5]** The third colleague suggested to cite Tononi and Koch (Tononi & Koch, 2014) because they discuss IIT and panpsychism, which is directly related to current article. Tononi and Koch (Tononi & Koch, 2014) propose the followings:

- (i) NCC (Crick & Koch, 2003) is not enough to explain consciousness under all conditions.
- (ii) Panpsychism implies that “consciousness is an intrinsic, fundamental property, is graded, is common among biological organisms, and even some very simple systems may have some of it [... and] perhaps *everywhere* [...] panpsychism is elegantly unitary: there is only one substance, all the way up from the smallest entities to human consciousness and maybe to the World Soul [...] in line with the central intuitions of panpsychism, IIT treats consciousness as an intrinsic, fundamental property of reality. IIT also implies that consciousness is graded [it becomes richer as we grow from a baby to an adult], that it is likely widespread among animals, and that it can be found in small amounts even in certain simple systems [...] for IIT, we happen to find ourselves in a universe in which experience is one of the elementary properties of certain causal systems. [...] In this general sense, at least, IIT is not at odds with panpsychism”.
- (iii) Although sympathetic to panpsychism, IIT implies that not everything is conscious.
- (iv) Even if digital computers functionally equivalent to our behavior (functionalism) would not experience anything.

The eDAM framework would agree that NCC, panpsychism, and functionalism have the above problems (see also (Vimal, 2010b, 2013)). However, it addresses those problems. In addition, it will disagree that materialistic identity theory based IIT can explain experiences because the explanatory gap of materialism still remains. However, this serious problem can be easily addressed if IIT is interpreted in terms of the eDAM framework. Furthermore, if a conscious robot satisfies the necessary and sufficient conditions of consciousness (Section 1.5), then it will have robotic type of consciousness (Vimal, 2015a), which may or may not be similar to our consciousness.

**[6]** As per another colleague, “It seems to me that your conclusion from reflecting on Chalmers’ Hard Problem is - like many other authors - that we must reject the



metaphysical framework of materialism. But then once you do that, you abandon any ambition to explain, in scientific, objective terms, how subjective experience arises. Rather you posit it as part of the basic furniture of the universe. Positing it as only potential consciousness makes no difference, because you still have to simply assert that certain objective conditions transform potential consciousness into a subjective phenomenon. If it seems impossible that those objective conditions could transform ordinary matter into a subjective phenomenon, but not the proto-consciousness you posit, that is only because we do not know what the latter is, and hence have to simply accept that it is the kind of thing that becomes subjective when certain objective conditions are met.”

**Response:** The reviewer has misconstrued the eDAM framework, which does not mean that certain objective conditions could transform ordinary matter into a subjective phenomenon. This is because all possible (*potential*) subjective experiences (such as redness and greenness and all color experiences in-between for the Red-Green channel) are embedded as memory traces during development; these embedded pre-cursors (proto-consciousness) are called proto-experiences (PEs). For realization of a specific subjective experience, the matching and selection mechanism matches and selects a specific subjective experience (such as redness when a ripe-tomato is shown to a trichromat) out of PEs.<sup>20</sup> The ordinary non-experiential matter does NOT magically transformed into a specific experience. Here, a state of an entity (such as V8-NN in this example) has two inseparable 1pp non-physical and 3pp-physical aspects.

This colleague further commented, “We may as well join the dualist in saying that subjective phenomena are basic, and forget about the objective conditions. Consider p. 32, where you say robotic consciousness 'may or may not be similar to our consciousness'. We don't know, because we only have first-person access to consciousness, and your account hasn't explained it in objective terms.”

**Response:** Reviewer has misunderstood. My account explains it. This is because a state of robot has two *inseparable* 1pp non-physical and 3pp-physical aspects. If all necessary conditions of consciousness are satisfied, the robot will be conscious, but only robot will know what its 1pp experience is because 1pp is always private. Its 3pp-physical aspect includes physical (electromagnetic) activities, which can be objectively measured.

### 3.5 Critique of Tononi's IIT

**[Critique:1]** As per (Cerullo, 2011), “*the main failings of the theory are an absence of a link between conscious experience and awareness and the use of Shannon's limited data based definition of information. These limitations prevent the theory from satisfying Chalmers' principles of structural coherence and organizational invariance which any functionalist theory should obey. [...]*”

IIT seems closest to the computational functionalism discussed by Chalmers (1995; 1996). Chalmers also takes information to be the fundamental psychophysical laws linking

consciousness and information. [...] Structural coherence requires a correspondence between awareness [information] and conscious experience: ‘Whenever there is a conscious experience, there is some corresponding information in the cognitive system that is available in the control of behavior, and available for report and global control. Conversely, it seems that whenever information is available for report and global control, there is a corresponding conscious experience. (Chalmers, 1995)’ [...] Thus, some parts of the brain are capable of distinguishing possibilities in the world (i.e. contain integrated information) yet these perceptions never reach awareness. IIT would grant these pre-processing brain systems experience and hence is very liberal in granting consciousness. The drawback for this liberal strategy is that IIT now fails to provide any useful guidance in the search for NCC. The central question in the search for NCC is why some brain regions generate consciousness experience (i.e. the first-person experience of the self) and others don’t. Rather than answer this central question IIT simply grants equivalent conscious experience to any brain region that does a minimal amount of sensory processing.

IIT could be made to partially satisfy structural coherence by adding a postulate stating that only integrated information available to awareness generates conscious experience. Yet there seems no way to link the two together without arbitrarily subordinating integrated information to awareness and thus diluting the empirical usefulness of IIT. Even with this ad hoc addition the second part of the definition of structural coherence is still not satisfied; IIT provides no guarantee that information available for global report is in fact integrated information, and thus this information may not be associated with any subjective experience according to IIT. Hence in its current form IIT does not satisfy structural coherence and it is not clear if it could be made to do so without trivializing the theory. [...]

The principle of organizational invariance states that experience is identical across systems with the same fine-grained functional organization (Chalmers, 1995; 1996). [...] Any theory of mind that satisfies organizational invariance by definition satisfies the thesis of multiple realizability, but the converse is not necessarily true. A theory of mind could allow multiple realizability yet fail to satisfy the principle of organizational invariance (I will argue that IIT is in fact such a theory). [...]

Taken at face value his definition appears to allow two systems with identical experience to have different functional organizations. However, if this is true then the function assigning conscious experience to functional organization is no longer a one-to-one function (computation 1 and computation 2 both map to experience 1). If the mapping is not one-to-one then it is possible that every experience can be generated by multiple (perhaps even infinite) computations; therefore there is nothing unique about a computation (i.e. the fine-grained organizational structure) that relates it to experience and this destroys the vital link between experience and computation that is the heart of functionalism. Therefore the

definition of organizational invariance should read: 'Any two systems share the same fine-grained functional organization *if and only if* they have qualitatively identical experience.' Hence in order to show that IIT does not satisfy organizational invariance it suffices to provide an example of two systems having identical experiences according to IIT which are not computationally isomorphic [1-1 relation]. [...]

This implies that while systems C and D have the same quantity of integrated information they are not computationally isomorphic. Thus IIT assigns identical conscious experience to two distinct computational systems and hence does not satisfy the principle of organizational invariance. [Readers familiar with the second aspect of Tononi's theory examining the quality of experience might suggest that while the two systems discussed have the same quantity of integrated experience they may have different qualities of experience. However, remember that Tononi defined the quantity of conscious experience as the level of consciousness in the neurological sense. Regardless of the occurrence of other qualitative types of experience, the background level of consciousness will be the same in any systems C and D with identical levels of integrated information. It is easy to remove any concern about systems C and D differing in any extraneous qualitative experience by letting the two systems be as minimal level of experience makes it problematic to suggest that the systems differ in extraneous qualitative experiences outside of the minimum level of awareness they share. Finally, nothing in Tononi's follow-up theory regarding the quality of experience prohibits two systems from sharing the same quantity *and* quality of experience.] [...]

Information and Meaning [...] It can easily be seen that this combination of camera plus program is now able to distinguish as many possible images as the human brain. In fact the camera/program can distinguish many more possibilities because of the limitations in the human visual system in distinguishing very small perceptual differences. Therefore IIT concludes that the camera/program has a greater quantity of conscious experience than a person when viewing any 1000 x 1000 pixel image. This is an absurd claim that even the most avid enthusiast of artificial intelligence would deny and thus casts serious doubts on IIT. [...] Perhaps we could fix IIT by somehow expanding the definition of integrated information so that it required this additional 'shared' information or processing. However, for every additional stipulation added to the definition of integrated information we could respond by making our camera/program more complicated. [...] Once the camera/program has this level of complexity it would in fact be *functionally* identical to the brain of the human subject and IIT would reduce to computational functionalism. Thus the only way to prevent IIT from making absurd declarations (such as that the simple camera/program has equivalent visual experience to a human being) is to alter the definition of what causes experience. Integrated information is no longer adequate and Tononi is forced to state that the camera/program has the same visual experience as a human only when it is functionally equivalent to a human having the same visual experience. Tononi's theory reduces to just a restatement of general principles of functionalism (that a system

functionally equivalent to a human being would share its subjective experience), and his definition of integrated information no longer plays any role in determining experience.

The camera/program example reveals the fundamental flaw in IIT which is Tononi's definition of information. Shannon's theory (and Shannon himself points this out) is a theory of data communication and has nothing to say about the meaning of information — i.e. semantics (Pierce, 1961). To use a classic example in information theory, the message 'no' has quite a different meaning when the question is 'do you know the time?' versus 'will you marry me?' Remember that according to Shannon's definition a message consisting of completely random noise contains the greatest amount of uncertainty and hence contains the greatest possible amount of information (Pierce, 1961). [...]

(Floridi, 2009). Most information scientists today adopt the General Definition of Information—GDI (*ibid.*). GDI states that a message has semantic content only if: it contains raw data (still quantified using Shannon's definition); the data is well formed (i.e. has the proper syntax); and the well formed data are meaningful (*ibid.*). [...]

### Conclusion

Given that IIT is not a form of dualism, philosophical behaviourism, physicalism, and now functionalism, just what kind of theory is IIT? The fact that IIT does not easily conform to traditional classification of theories of mind is not a fault in itself. Yet when delving deeper into the theory it becomes clear that IIT attempts to gain the benefits of a functionalist theory without the accompanying restrictions. [...] the one system we know generates conscious experience, the brain, into account. [...] IIT also glosses over the challenge of relating information to mind via its causal structure. [...] Only by including syntactic, and most importantly semantic, concepts can a theory of information hope to model the causal properties of the brain. [...] It is not clear whether IIT can be repaired without reducing the theory to a general statement of computational functionalism. Conceivably, a solution may need to wait for future advances in semantic definitions of information.”

In the sense the quality of experience, IIT is incomplete. IIT should be extended (as in the eDAM) to include qualitative aspect (just noticeable difference in different shades/brightness/saturation of the same hue redness) as well; in addition to 3pp-IIT because NCQ (neural correlates of qualia) will have to be different for different SE (that has qualitatively different experience). This is elaborated in Sections 2.1-2.6 above.

The critique related to structural coherence can be addressed that all those regions are included in NCC that have  $\phi$  greater than critical threshold.

As per (Cerullo, 2015), “According to Chalmers, the easy problem of consciousness is explaining *how* the brain generates the behavior associated with consciousness. In contrast, the hard problem requires a theory to address the question of *why* any physical process generates (or is) consciousness [20,54].

**[Critique:2]** The main theoretical argument for IIT is the principle of information exclusion [Consciousness is *definite*, in content and spatio-temporal grain]. Yet there is no evidence

in support of information exclusion beyond Tononi's claim that it is self-evident, and consequently integrated information does not appear to be sufficient for consciousness."

- As per [Wikipedia](#), "**Exclusion:** Consciousness is *definite*, in content and spatio-temporal grain: each experience has the set of phenomenal distinctions it has, neither less (a subset) nor more (a superset), and it flows at the speed it flows, neither faster nor slower. For example, the experience I am having is of seeing a body on a bed in a bedroom, a bookcase with books, one of which is a blue book, but I am not having an experience with less content—say, one lacking the phenomenal distinction blue/not blue, or colored/not colored; or with more content—say, one endowed with the additional phenomenal distinction high/low blood pressure. Moreover, my experience flows at a particular speed—each experience encompassing say a hundred milliseconds or so—but I am not having an experience that encompasses just a few milliseconds or instead minutes or hours."

**[Critique:3]** IIT also fails to exhibit any explanatory power given that a trivial theory of consciousness, CCMT [Circular Coordinated Message Theory], was able to make the same predictions. **[Critique:4]** IIT is not a computational functionalist theory of consciousness and is therefore vulnerable to fading/dancing qualia arguments. **[Critique:5]** The fact that intuitively nonconscious systems can generate arbitrarily high values of  $\Phi$  suggests that IIT is a theory of proto- or noncognitive-consciousness that says nothing about the type of consciousness discussed by most neuroscientists and psychologists. **[Critique:6]** Finally, IIT seems to be a theory addressing the pretty hard problem of consciousness [the problem of predicting which physical systems give rise to consciousness] rather than the hard problem of consciousness. [...**Critique:7]** I would suggest that IIT is a theory of partial-panexperientialism that, even if correct, does not help us to understand or predict the kind of consciousness that is relevant to our subjective experience."

**[Critique:2]** I agree with (Cerullo, 2015) on the principle of information exclusion because whenever I experience darkness, it is immediate subjective experience within less than 100 msec perhaps, and hence there is not enough time to discount all other innumerable conscious experiences; as a matter of fact they never come in my conscious thought. However, one fix this problem by arguing that all our innumerable experiences are potential experiences and only one of them is realized by some mechanism such as matching and selection mechanism of the eDAM framework (Vimal, 2010a) . This fact may be related to that we have large repertoire of information compared to photodiode.

As per Cerullo (personal Email communication on 8-April-2016), "the reason that a conscious brain has more information than a photodiode is that it takes a lot of information to generate a complex representation within an executive system. Beyond that I don't think we can use information as a first principle to a priori generate a formula for consciousness"; furthermore, a broader definition of information is needed.

(Chalmers, 1995) has argued that information is a dual-aspect entity; it has “two basic aspects, a physical aspect and a phenomenal aspect” (p.216). Therefore, one could argue that the broader definition of information should include phenomenal/mental aspect for semantics, in addition to physical aspect. The physical aspect of information (such as Shannon or entropy related information) does not have semantics and syntax for the data from 1st person perspective (1pp).

**Critiques** [1] and [7] can be addressed by interpreting IIT in terms of the eDAM framework.

### 3.6. Interpretation of Pereira’s Projective Theory of Consciousness (PTC) in the eDAM

1. As per (Pereira Jr., 2019), “The structure of consciousness was philosophically conceived a century ago (Husserl, 1913) as consisting of a subjective pole, the bearer of experiences, and an objective pole composed of experienced contents. In more recent formulations, Nagel (1974) refers to a "point of view", in which qualitative experiences are anchored, while Velmans (1990; 1993; 2009; 2017) understands that phenomenal content is composed of mental representations “projected” to the space external to the brains that constructs them. In Freudian psychology, the conscious mind contains a tension between the Id and the Ego (Freud, 1913). How to relate this bipolar structure with the results of neuroscience? I propose the notion of *projection* (also used by Williford et al., 2012) as a bridge principle connecting the neurobiological systems of Knowing, Feeling and Acting with the bipolar structure. [...] Two central psychological features of conscious experience are the subjective “point of view” (Nagel, 1974), the bearer of qualitative experiences (“what it is like to be”), and the location of perceived objects and processes outside the brain, or "perceptual projection" (Velmans, 1990; 1993; 2009; 2017). [...] Velmans (1990; 1993) assumes the existence of information processing from a stimulus external to the brain to the central nervous system, where a representation of properties of the stimulus is formed. However, [the conscious experience of the properties of the stimulus is not referred to brain activity, but somehow projected to the location of the stimulus](#) [...] Velmans' (1990; 1993; 2009; 2012; 2017) discussion of perceptual projection can be summarized in three sentences:

- 1) We perceive objects and processes by means of the formation of neural representations in our brains, but
- 2) The lived experience we have of physical objects and processes implies that they are located "out there", in the experiential physical space; therefore,
- 3) [We “project” our neural representations into the experiential physical space in such a way that conscious experience is not of a solipsistic kind \(it is not “locked” in the brain\), but somehow “reflects” reality.](#)

[...**Pereira’s Projection hypothesis:**] The bipolar structure of consciousness can be conceived as a *phenomenal informational field* composed of a subjective pole (the *Sense of Self*) and an objective pole (the *Sense of the World*).

This field, according to my hypothesis, is constructed by means of a *projection of neural activity*; being experienced in the perspective of the first person (Nagel, 1974), that is, by the individual who projects it. It is possible to conceive Nagel's concept of "point of view" as a *projective operation*, in this case an inwardly directed one, while *perceptual projection* goes in the outward direction. In this approach, *not only the Sense of the World, but also the Sense of Self, or "point of view" (Nagel, 1974) are considered as resulting from projective operations*; the *Sense of Self* is constituted by an *interoceptive projection*, while the *Sense of the World* is constituted by a *perceptual projection* following the *exteroceptive* direction.

The subjective pole, or *Sense of Self*, is conceived as the "attractor" in the dynamics of sensory, emotional and affective systems of the living body. The attractor state is generated in the feeling history of the individual, and projected as an invariant "identity" in time; the result of this projection is the *Sense of Self* (as further elaborated and discussed in Reddy et al., 2018).

The objective pole, or *Sense of the World*, is the projection of representations from the nervous system to its extensions related to the homeostasis and control of the body, which include neuro-muscular junctions, kinesthetic sensors in muscles, the cardiac and enteric nervous systems (for a discussion of the possible effect of emotions in the psycho-neuro-endocrine-immune system, see Pregolato, Damiani and Pereira Jr., 2017). Feedback cycles between the central nervous system and the extra-cerebral structures of the motor system can give rise to the *Sense of the World*, in which the World is understood as an "intensional object", not as a "thing in itself". In neurobiological terms, such a projection is made from the centre to the periphery of the nervous system, forming of the "egocentric space" (Trehub, 1991), in which the agent who experiences the contents is at the centre, defining a proximal space, and the external world is situated at the distal end, as a field of perception and action.

[...] Mitterauer (2013), in this regard, proposes a "dialogical" model of the conscious mind, in which the subjective and objective poles correspond to the activity of two signaling networks in living tissue, the astroglial (subjective) and the neuronal (objective). In the same way, I conceptualize the interplay of two partners (Figure 3): a) *Feelings* in living tissue, generating the *Sense of Self* as a temporal invariant pattern, or 'attractor', and b) *Mental Representations* carried by patterns of spiking neurons, generating the *Sense of the World*. According to the above hypothesis, the point of view is an interoceptive projective extension of subjective feeling experiences, and the objects and processes out there in the world are exteroceptive projective extensions of the mind/brain representations of them; in our conscious experience, we project the external world on the basis of the representations we make from signals received from stimuli. [...] The neural mental representations that encode information about the 3D experienced realities are "in the head or brain", but the percepts are projected to the outside."

Nagel's "what it is like to be" (SE from 1pp) and Velmans' reflexive dual-aspect monism (the content of SE is "composed of mental representations 'projected' to the space external to

the brains that constructs them” (Pereira Jr., 2019)) can be interpreted in the eDAM as the experiential sub-aspect of the non-physical aspect of a beable ontic conscious state of an observer’s mind-brain system. Its (state’s) inseparable 3pp-physical aspect is the correlated neural-physical basis (NPB) from 3pp. The SE is ‘projected’ onto the object that constructs its NPB, where the object is positioned at specific location in the 3D space external to observer’s brain.

**2.** As per (Pereira Jr., 2019), “In Freudian psychoanalysis, the structure of the conscious mind was conceived as a interplay between the Id and the Ego (Freud, 1913). Morsella (2005) understands that consciousness involves a tension between subjective desires and objective needs. How to relate this bipolar structure to the results of neuroscience?”

However, as per [Wikipedia](#), “The iceberg metaphor is a commonly used visual metaphor when attempting to relate the ego, id and superego with the conscious and unconscious mind. In the iceberg metaphor the entire id and part of both the superego and the ego would be submerged in the underwater portion representing the unconscious mind. The remaining portions of the ego and superego would be displayed above water in the conscious mind area.” This seems that the bipolar structure should be Ego-Superego instead of Id-Ego.

As per (Pereira Jr., 2019), “The bipolar structure of consciousness can be conceived as a *phenomenal informational field* composed of a subjective pole (the *Sense of Self*) and an objective pole (the *Sense of the World*). This field, according to my hypothesis, is constructed by means of a *projection of neural activity*; being experienced in the perspective of the first person (Nagel, 1974), that is, by the individual who projects it. It is possible to conceive Nagel’s concept of “point of view” as a *projective operation*, in this case an inwardly directed one, while *perceptual* projection goes in the outward direction. In this approach, *not only the Sense of the World, but also the Sense of Self, or "point of view" (Nagel, 1974) are considered as resulting from projective operations*; the *Sense of Self* is constituted by an *introceptive* projection, while the *Sense of the World* is constituted by a *perceptual* projection following the *exteroceptive* direction.”

This is consistent with the 1pp-non-physical and 3pp-physical aspects as the bipolar structure related to consciousness and its NPB.

**3.** As per (Velmans, 2012), “the *information structure* of what S [subject] and E [external observer] observe is identical, but it is displayed or ‘formatted’ in very different ways [...] the information displayed in experiences and their physical correlates can be thought of as two manifestations of this information processing [...] the nature of mind is not *either* physical or conscious experience; it is at once physical *and* conscious experience. For lack of a better term we may describe this nature as *psychophysical*”.



As per (Pereira Jr., 2019), “The concept of projection was proposed to explain the generation of the *Senses of Self and the World*, the two poles of the informational field, upon which the dynamic structure of conscious experience is built.”

This is consistent with the “effective” information is the same in both physical and non-physical aspects and is between these two inseparable poles.

**4.** As per (Pereira Jr., 2019), “Advances in cognitive, affective and action neurosciences have suggested - on the basis of the activity of the nervous system - that mental activity can occur, in biological species, in different degrees of self-awareness.”

In the eDAM, this is consistent with varying degrees of manifestation of sub-aspects (experiential, cognitive, functional, and qualitative sub-aspects) depending on the entities and their states.

**5.** As per (Pereira Jr., 2019), “1) *Sentient*: This phase includes the experience of biologically induced states of consciousness (pain and pleasure, basic sensations such as hunger and thirst; see Panksepp, 1996), as well as new or surprising sensory stimuli (for a definition of sentience, see Allen and Treisman, 2016). In human perception this phase covers the first 300 milliseconds after exogenous or endogenous stimulation, but can be prolonged in time if the stimulus continues to be present, as in the case of chronic pain sensations. Sensations are not conceptual, in the sense that at first they are not cognitively recognized; yet, even without being conceptualized, they are consciously experienced. [...] 2) *Interpreted*: In this phase, raw experience is interpreted and categorized within a cognitive framework that includes some kind of language, but not necessarily a symbolic one. We often use maps and multimodal images (visual, auditory, tactile) to interpret and categorize our sensations, resulting in *mental representations* of them.”

The non-reportable SE does not require attention and usually occur for transient presentation such as 1 msec to 300 msec (Pereira Jr., 2019); this is called ineffable SE datum and is also called phenomenal consciousness. For a reportable SE, attention is needed and stimulus presentation is longer; this is called interpretation of data (Pereira Jr., 2019) because we use our own words and is also called access consciousness (Block, 2005; Lamme, 2003).

#### 4. Conclusions

**1.** We proposed an **e**xtended version of **D**ual-**A**spect **M**onism (**eDAM**) framework for consciousness, which has the least number of problems. Consciousness is optimally defined as the non-physical aspect of a beable ontological dual-aspect state of a mind-brain-system or a mind-brain-process, which has four sub-aspects: a conscious experience

(experiential sub-aspect), conscious cognition (cognitive sub-aspect), conscious qualities (qualitative sub-aspect), and a conscious function (functional sub-aspect) from the 1<sup>st</sup> person perspective.

**2.** The eDAM categorizes all properties of entities into two groups: (I) mass, charge, spin as the physical aspect and (II) experiences, cognition, patterns/forms (qualitative), and functions as the non-physical aspect. Why? This is because physics considers only the former as physical attributes. So remaining must be not physical. However, materialism and the Prakṛti part of Sāṅkhya postulate that the non-physical aspect is caused (created/produced) by the physical aspect. The idealism postulates all entities are non-physical whereas the materialism physical. The Cartesian dualism postulates mind as non-physical aspect and matter as physical aspect. All frameworks have to face consequences of their postulates; dualism/Sāṅkhya, materialism and idealism end up with serious unresolvable problems but the eDAM doesn't because of its careful rational and logical categorization postulate.

**3.** The eDAM framework has five components:

**(I)** The first component is *Dual-Aspect Monism* framework. Here, each entity-state has *inseparable* 3pp-physical aspect and 1pp non-physical aspect. The qualitative and functional sub-aspects are for both non-living and living systems. The experiential and cognitive sub-aspects are for conscious living systems. And the 1pp non-physical aspect is for conscious living systems. The *potentiality* of primary *irreducible* subjective experiences (SEs) co-exists with its neural-physical basis (NPB) in Nature (Section 1.3.2).

**(II)** The second component is the *matching and selection mechanism with dual-mode*. The conjugate matching is between stimulus-dependent (or endogenous) feed-forward-signals-related-mode and cognitive-feedback-signals-related-mode. After successful matching, the self selects a specific SE and experience it; otherwise, the stimulus is a novel object and its related beable ontic state is selected and an related engram is created if it is a salient stimulus and is stored in the long-term memory; self experiences the related SE (Section 1.3.3).

**(III)** The third component is varying degrees of manifestation (appearance/strength) of sub-aspects depending on the levels of entities and contexts; in all cases both related aspects are interdependently co-arise simultaneously (Section 1.3.4).

**(IV)** The fourth component is the *segregation and integration of the "effective" information* that is the same between two aspects; this is developed in Sections 1.3.5 and 2.1-2.5.

**(V)** The fifth component is the *necessary conditions of consciousness*, such as neural-network, wakefulness, reentry, attention, working memory and so on (Section 1.3.6).

**4.** The eDAM framework has attempted to address the 'hard' problem of consciousness (how to explain SEs) in Section 2.7

**5.** The eDAM framework can be scientifically tested by challenging its main doctrine of inseparability. If we are empirically (such as using fMRI/EEG) able to separate the 1pp non-physical aspect (such as an experience) of a *conscious* brain-mind state and the related

3pp-physical aspect (its neural correlates) of the *same conscious* brain-mind state at a specific moment of time or within critical temporal integration grain-size, then the doctrine of *inseparability* will be rejected. This will then reject the eDAM framework as well. This is discussed in Section 3.2.

## Appendix A: Modern initial and eternal cosmologies

As per Table 3 of (Vaas, 2004) with minor modification, the possibilities and ‘models (space-time) and their main proponents’ are as follows:

### **I. Beginning and an end possibility**

1. Classical big bang/big crunch model: Alexander Friedmann (1922), Stephen Hawking & Roger Penrose (1965 ff)
2. Quantum tunnel effect model: Alexander Vilenkin (1982 ff)
3. No boundary instanton model: Stephen Hawking & James Hartle (1983)

### **II. Beginning, but no end possibility**

4. Classical big bang/big whimper model: Alexander Friedmann (1924), Georges Lemaître (1927), Stephen Hawking & Roger Penrose (1965 ff)
5. Phoenix universe model (global!): Georges Lemaître (1933), Richard C. Tolman (1934)
6. Quantum tunnel effect and eternal inflation model: Alexander Vilenkin (1982 ff)
7. Cosmic Darwinism model: Lee Smolin (1992 ff)
8. No boundary instanton model: Stephen Hawking & Neil Turok (1998)

### **III. No beginning and no end possibility (static. vs. evolutionary vs. revolutionary)**

9. Static universe model: Albert Einstein (1917)
10. Empty expanding universe model: Willem de Sitter (1917)
11. Eternal expansion out of a static universe model: Arthur S. Eddington (1930)
12. Steady state model: Hermann Bondi, Thomas Gold & Fred Hoyle (1948 ff)
13. Quasi-steady state model: Fred Hoyle, Geoffrey Burbidge & Jayant V. Narlikar (1993 ff)
14. Chaotic inflation model (global!): Andrei Linde (1983 ff)
15. Planckian cosmic egg model (global!): Mark Israelit & Nathan Rosen (1989 ff)
16. Big bounce model Hans-Joachim Blome & Wolfgang Priester (1991)
17. Ekpyrotic and cyclic universe model (global!): Paul Steinhardt & Neil Turok et al. (2001 ff)

### **IV. No beginning, but an end possibility**

18. Collapse out of a static universe model: Arthur S. Eddington (1930)

### **V. Cycle (recurrence) possibility**

19. Oscillating universe model (local!): Mark Israelit & Nathan Rosen (1989 ff), Redouane Fakir (1998)
20. Cyclic universe model local!): Paul Steinhardt & Neil Turok et al. (2002 ff)
21. Circular time in a rotating universe model: Kurt Gödel (1949 ff)
22. Big brunch/time-reversal model: Claus Kiefer & H. Dieter Zeh (1995)

### **VI. Time-loop with/without end possibility**

23. Self-creating universe model: John Richard Gott III & Li-Xin Li (1998)

### **VII. Pseudo-beginning with/without a local end possibility Background-dependent:**

24. Soft bang/emergent universe model: Eckard Rebane (2000), George F. R. Ellis & Roy Maartens et al. (2003)
25. Quantum fluctuation model, de Sitter instability model etc.: Edward Tryon (1973), Robert Brout et al. (1978 ff), Alexei A. Starobinsky (1979 ff), David Atkatz & Heinz R. Pagels (1982), John Richard Gott III (1982), Mark Israelit (2002)
26. Pre-big bang model: Gabriele Veneziano & Maurizio Gasperini (1991 ff)

### **VIII. Background-independent**

27. Pregeometry model: John A. Wheeler (1975), Peter W. Atkins (1981), Stephen Wolfram (2002)
28. Loop quantum cosmology model: Abhay Ashtekar & Martin Bojowald et al. (2002 ff)

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The authors declare that they have no competing interests.

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## Endnotes

<sup>1</sup> For references, see Sections 4-11 of (Chalmers, 2003), Sections 1.1-1.2 of (Vimal, 2010b), and Sections 2-2.2 of (Vimal, 2013). The previous articles, such as (Atmanspacher, 2012; Bohm & Hiley, 1993; Eddington, 1928; Strawson, 2006), discuss the old dual-aspect monism, which elaborates only the first component of the five-component eDAM framework (Sections 1.2-1.5 and 2). In general, there are panpsychists with dual-aspect view (Skrbina, 2009), panpsychist dualists, functionalists, identists, reductive materialists, and so on (Skrbina, 2005).

<sup>2</sup> As per *bhūtavādins in Maṇimēkalai* (Tamil epic), “Life originates from living matter, the body from the lifeless.” This is also consistent with the eDAM and perhaps Substance Dualism. However, *Cārvākas* follow materialism (life from matter). As per Stuart Hameroff (email communication on 2 March 2016), “I distinguish physicalist from materialist. Physicalism can include quantum superpositions which are not material.” Some investigators use the term “material” to mean only fermions and “physical” to mean both fermions and bosons.

<sup>3</sup> Nāgārjuna rejects ‘inherent existence’ or ‘essence’ in favor of co-dependent origination, and that is also why he rejects causality; the entities that lack inherent existence dependently co-arise (Nāgārjuna & Garfield, 1995; Vimal, 2009c).

In the eDAM framework, since the degree of manifestation of qualitative/non-physical aspect of a state of a brain-mind system and that of the *inseparable* physical aspect of the same state of the same brain-mind system vary with the levels of entities and contexts, it lacks inherent existence. Although both aspects inherently exist in each state of each entity at all levels.

In other words, the degree of manifestation of qualitative/non-physical aspect and that of the physical aspect dependently co-arise, co-evolve, co-develop, and co-tuned for sensorimotor system appropriately depending on the levels of entities and contexts, which entail the *inseparability* of both aspects. In this sense, the symmetry between physical and non-physical aspects of a state of brain-mind system in the eDAM framework is maintained, where the 3pp-physical aspect does not *cause* the 1pp-non-physical aspect in living systems or *vice-versa*.

<sup>4</sup> Here, the Kaṇāda-Democritus’ definition of matter (who identifies matter with atoms/particles) is used, which implies that matter is non-experiential, non-mental, formless, and patternless (Vimal, 2015d); it is used in science (such as physics, chemistry, and biology). For example, if a statue is made out of clay, then the matter (or more precisely matter-in-itself) is the formless, patternless, non-mental, and non-experiential clay; the constituents of clay are fermions and bosons (with mass, charge, and spin), which are physical.

<sup>5</sup> Intelligence is a part of cognition. Therefore, intelligence (non-physical aspect of a cognitive state of a mind-brain system) is inseparable with its neural-physical basis (NPB: physical aspect of the same cognitive state of the same mind-brain system) within critical spatiotemporal interval (which may be in msec or sec) because the “effective” information is the same in both aspects and state and entity must remain the same.

<sup>6</sup> **Vimal:** The experiential and cognitive sub-aspects of the non-physical aspect of a conscious state of a mind-brain system have their own neural/physical basis (NPB), i.e., each of the four sub-aspects has its own NPB.

**Sehgal:** What is the evidence for the existence of any experiential and cognitive sub-aspects of the physical aspect of a state of an inert entity in the latent or unmanifested form?

**Vimal:** This is illogical query because if something is latent and hence not detectable/measurable, then how can you have any empirical evidence? I mentioned that experiential and cognitive sub-aspects of the non-physical and inseparable physical aspects of a state of an inert entity are latent thru the eDAM's logic of extrapolation from a dual-aspect conscious state of a mind-brain system. I provided justification for my argument thru the eDAM's logic of re-organization and the evidence thru evolution theory.

**Kineman: A. Conscious function:** Ok quibble with words: I suggest brain-mind "relation". Reserve the word state for material results of a measurement. Brain, usually referring to material aspect, has states being defined and measured all the time. Minds, referring to the unrealized contextual model aspect, do not have states. So brain-minds have relations. Relations are what link brain and mind via information in two directions: structure from the brain to mind (encoding) and function from mind to the brain (decoding). I'm comfortable saying these are simultaneous.

Co-arising: yes, this makes sense to me.

Indeed the functional expression will not occur without this bidirectional information process, and the SE will not happen either without some sustained co-relation. I see in this case how it is useful to think in terms of brain and mind co-arising.

We have the same idea here. My way of saying it and thinking about it is in terms of sustainability. The co-arising bi-directional information relation must be sustained somehow for the motion to take place without spilling the coffee. In the Holon model, it would be all the necessarily related other processes going on like a cloud that keeps the unit together and sustainable. I'm not so keen on inseparability because they are separable, but sustained in relation for the purpose at hand. Possibly it remains whole as a stored experience, again kept sustainable until we get old and forget.

Very nice! Thanks for the example. The language does change in different fields but it seems the principles remain the same.

**B. Latent/unmanifested/hidden vs. absent:** This made me think about how latency works. It would seem to make little sense to say something is generally latent - in other words, that it has no link to anything objective in our universe. I don't think we could even imagine it if that were the case. So, Ram's idea of inseparability would apply, but my less rigid-seeming idea of, say 'necessary' relation and 'sustainable' relation would be similar or the same. It is very fluid in my model, however, and mind-brain or mind-body can uncouple at any time resulting, as Ram says, in loss of the functional link to action. But for something to be latent, we need to talk about where it is latent. In other words, it is hiding out somewhere else, not present in the system being discussed. But it must, due to Ram's principle of inseparability or my principle of necessary relation, be latent in relation to something tangible. If nothing else there must be one Being who knows of it.

For example, there are many strange things that are in Hollywood and Bollywood movies. Also in books. Sometimes science-fiction comes true. I would describe this situation as the fanciful 'thing' was latent in the movie or book or mind of the author. Later it became manifest in the material world, through a whole range of relations and entailments to make that happen.

In the same way, can't a soul lose its link with the body and become latent in the universe? It is a wild conjecture scientifically because I couldn't possibly detail the process. But this is what the spiritualists are saying happens, or at least it is experienced that way. The theory seems to allow it - but how that happens I don't know except for a previous comment that in the holon model the relations with the universe already exists - the holon is both part and individual-whole at the same time, so it is infinitely connected. It is just that the soul-body connection during life is very strong, like a large wave on the ocean. When that dissolves, the universal connection can remain, at least theoretically.

**Vimal: A. Conscious function:** Thanks for your view based on RHT. If the aspects are separable in RHT under any condition then it is no more monistic framework; it would be dualism and Occam razor scientific viability will be reduced to  $1/(\text{number of fundamental substrates}) = 1/2 = 50\%$  of the monism, such as materialism, idealism., and the eDAM The eDAM's working hypothesis is that inseparability is always maintained so that Occam razor scientific viability remains 100%; so far, I do not find any contradiction in any empirical data because none of them show clear-cut separability between physical and non-physical aspects and sub-aspects.

**B. Latent/unmanifested/hidden vs. absent:** My justification for the latent experiential and cognitive sub-aspects in inert entities is that if the elementary particles of the inert entity and other relevant elementary particles are re-organized to form human brain-mind system then these hidden (latent) sub-aspects will certainly show up. Technically by us, it is almost impossible, but logically it is conceivable. Science believes in the evolution theory, which (if true then) clearly already accomplished this almost impossible task but took billions of years. If they were absent then re-organization will not bring them back, which is incorrect. Therefore, the hypothesis of "latent" experiential and cognitive sub-aspects in inert entities is justified in my view.

<sup>7</sup> In the *Sāṅkhya* philosophy ((Swāmi Yogeshwarānanda Paramhans, 1997, 2008) and E-mail communications from 28-Apr-2016 to 15-July-2016 with Vinod Kumar Sehgal), *Puruṣa* is only an experiencer/witness/*Dristā/Sākshi* and *Prakṛti* consists of:

- Causal world (*kāraṇ jagat*) is composed of 3 *Guṇas* (*Santa, Rajas, and Tames*), *Citta/Chitta* (memory), and *Ahaṁkāras* (false ego);
- Astral world (*Sūkṣma jagat*) consists of five *Tanmātras* (*rūpa*/visual form, *śabda*/sound, *sparsā*/touch, *rasa*/taste, and *gandha*/smell), *Buddhi*/intellect, *Manas*, and ten senses (5 of action/*karmendriya* and 5 of perception/*jñānendriya*); and

- Physical world (*sthūla jagat*) containing fermions, bosons, and four fundamental forces.

The *Puruṣa* has two components, namely, *Ātman* (self/soul) and *Parmātman* (fully manifested eternal *Brahman*, universal consciousness, or omnipresent, omnipotent, and omniscient God). Thoughts are not fundamental; they are aggregates and are created by causal and astral bodies.

As per (Rao, 1998), “The *manas* is the central processor which selectively reflects on the material provided by the senses and determines its character by assimilation and discrimination” (p.319).

In the eDAM, the categorization of entities is based on perspectives: the 1pp-non-physical aspect is from first person perspective and is *private*. The 3pp is for *public*. The causal and astral bodies of *Sāṅkhya* are parts of the cognitive sub-aspect, and conscious subjective experiences and the self (the experiencer) are parts of the experiential sub-aspect. Each of these entities has a neural basis.

<sup>8</sup> As per [Bernard Baars](#) (email communication on 3 May 2018), “I spend 10 years listening to Gerald Edelman, Walter Freeman, and before that, E.R. John, and a little bit of Karl Pribram and Ann Butler.

1. From their points of view, there are few, if any simple animals. The reason is that you get "Neural Darwinism" at all levels of organization, from genes to epigenetics to momentary cortical organization, which we experience subjectively as conscious.
2. The color cones of the human/maaque fovea are important for color detection, but they DO NOT determine conscious color. That is now believed to be done in area V3/V4, according to a recent finding by Li et al (2017)?
3. Conscious visual input has a different course of processing in the visual brain, as demonstrated by literally decades of research by the Dehaene and Changeux team at CNRS, and by the Max Planck Tuebingen team by Logothetis and Panagiotaropoulos on the macaque visual system, which is strikingly similar to the human visual cortex.
4. The ability to distinguish clearly between conscious vs. unconscious visual input, as in binocular rivalry, with IDENTICAL physical foveal and retinal input in both ideas, that ability has been crucial in the last 20-30 years of research. Dehaene uses the attentional blink, but there are a dozen settled ways of comparing C-to-Ucs sensory input. You can do it with distraction, and one of the early studies by Rosen et al did it by comparing painful ischemia to silent ischemia.
5. So we know with considerable certainty what the brain differences are (some of them) between experimentally matched conscious and unconscious conditions in vision, in external body touch, in interoception (anterior insula), in audition, and now, in Feelings of Knowing, as in the subjective feelings of effort that have been studied since Wilhelm Wundt in the 19th century. This phenomenon of subjective effort has been studied especially well by John Duncan and Adrian Owen in the UK. Beautiful work

that converges well with the Five Factors of personality, where "conscientiousness" has to do with sustained feelings of effort in PFC, both medially and laterally.

6. The idea that we know nothing about consciousness is therefore a myth, a leftover from behavioristic denial. If we have a choice between ignoring it and studying it, I would think scientists would study it. But residual behaviorism continues today - perhaps because the ethical implications are too mind-boggling. Scientists are human.
7. There is strong, convergent evidence from global states of vigilance in the cortex (both neo and paleo). This was already observed by Wilder Penfield early in the 20th century, based on 1,200 (!) major epileptic surgeries with waking patients who talked to their surgeons during exploratory surgery, which was needed at that time to identify areas to avoid harming, and areas of cortex that were essentially dead and needed to be removed to stop major seizures. Most of those surgeries were medically helpful, but HM (Henri Molaison) shows BI-lateral hippocampal neural cell death, and the decision was therefore made to excise hippocampal tissue on both sides. This left HM impaired, because the hippocampus is the first experiential memory system, and he had to live in the fleeting moment with no ability to USE his conscious experiences to learn, solve problems, develop perceptual learning, and more. Dr. Brenda Milner took charge of his life, along with family (?) possibly. HM was studied for sixty years by multiple laboratories, and is still our primary HUMAN reference case for bilateral hippocampal excision. This case is still medically controversial.
8. Penfield's main goal was medical, and in that respect he and his team (from 1920s to 1950s) were successful enough to lead to a modern series of direct cortical surgeries in waking patients who can talk about their experiences with the surgeons. But Penfield also published several short articles which are very important even today. His primary claim is that CORTEX IS THE ORGAN OF MIND.

Penfield was certainly not the only one to believe this, it was a general medical belief voiced by William James in 1890. But with 1200 cases, Penfield had by far the biggest archive of evidence.

NB: The Penfield archives at the Montreal Neurological Institute are still closed, to protect patient privacy. All we have therefore is the publications, which tell their conclusions and some illustrative anonymous cases, but not all the details. This may be one reason why Penfield's work is still disregarded in science, but NOT in neurosurgery. In the last few decades, waking neurosurgery has been revived, and we have 200 articles in the literature on various aspects. Yitzhak Fried has been one of the leading neurosurgeons who works with scientists like Christof Koch and many others on this. This material is easy to find on PubMed and Google Scholar.

9. The evident role of BOTH kinds of cortex (neo and paleo) poses rather scary questions, notably, a. The very ancient biological origins of cortex. Neocortex is routinely claimed to arise with early mammals. Paleocortex goes back to vertebrate fish. The leading edge science on these species is now going on, in part because we have the genomes of the species involved, and previously taboo generalizations across species are now opening up. The zebrafish is one, the lamprey is another, amniotes (mammal

ancestors) look like salamanders and are another one. Pain perception is a survival function, and is therefore likely to be very ancient.

10. The implications for the ontogeny of conscious pain perception in utero are therefore very real. In utero pain can never be dismissed, and pain in fish can't either. Sorry about that.
11. The idea that we don't know anything scientifically about conscious brains is simply false. The evidence can be found via a simple search under "conscious AND brain" in PubMed or Google Scholar. You may be surprised at the number of peer-reviewed excellent articles that show up.
12. The ethical consequences cannot be ignored. Scientists are NOT experts on ethics, but then neither are philosophers. Or anybody else, for that matter, although there are ethical debates on animal pain and killing that go back to hunter-foraging cultures. Hunters are often very aware of the fear and pain experienced by wild prey. Even cows, sheep, lambs, and chickens seem to show fear and alarm, and the brain evidence today shows they have cortex, and pallium in the case of chickens.

Ann Butler and other comparative neurobiologists have published a consensus paper to rename the avian and reptilian pallium "cortex." The reason is that the microstructure of cortex is ultraconserved among birds and reptiles, and possibly even ancestral species. The gross anatomy of the pallium LOOKS different, but careful histological studies show the strong similarity across large genetic taxa.

13. All of which leaves civilized with a dilemma. But evidence is evidence is evidence. We can either face it or evade it."

<sup>9</sup> In *consciousness electromagnetic information field (Cemi field) theory*, experiences are presumably from the 1pp-experiential sub-aspect of the non-physical aspect of a state of dual-aspect electromagnetic (em) field: "what Chalmers terms *experience* [(Chalmers, 1995).p.201] ... is what complex information encoded in em fields feels like *from the inside*" (McFadden, 2002). In (Cacha & Poznanski, 2014), the concept of *functional field* is used. These fields may have many potential states related to experiences in superposed form embedded in the field. In that case, it would still be non-conscious processing and then explanatory gap of materialism remains. However, if these frameworks use the essential matching and selection mechanisms of the eDAM framework to select one specific experience after matching along with necessary conditions of consciousness to be satisfied (Section 1.2.5), and then the gap will be closed.

<sup>10</sup> As per (Block, 2018), "Sampling is a way of moving from probabilistic representations to narrower probability distributions or to non-probabilistic representations in populations of neurons. [...] Applied to the problem at hand, the suggestion would be that probabilistic representations are unconscious, but conscious perception reflects the sampling, not the probabilistic representations themselves. The sampling answer to 'If perception is probabilistic, why doesn't it seem probabilistic?' then is that unconscious perception is probabilistic but conscious perception is not." (Block, 2018) further proposes, "*The success of the Bayesian perspective in explaining perceptual phenomena has motivated the view that perceptual representations are probabilistic. But if perceptual representation is probabilistic,*



why doesn't normal conscious perception reflect the full probability functions that the probabilistic point of view endorses? For example, neurons in cortical area MT/V5 that respond to the direction of motion are broadly tuned: a patch of cortex that is tuned to vertical motion also responds to horizontal motion, but when we see vertical motion, foveally, in good conditions, it does not look at all horizontal. The standard solution in terms of sampling runs into the problem that sampling is an account of perceptual decision rather than perception. This paper argues that the best Bayesian approach to this problem does not require probabilistic representation. [...] The subject of this article is probabilistic representation in perception, not cognition (thinking, reasoning, deciding). And it is *probabilistic representation*, not representation of probabilities. Let me explain the difference. The probabilistic perceptual representations at issue here are of this sort: <red, there<sub>i</sub>, .7>, to be read as a representation of redness at the location indicated by 'there<sub>i</sub>', with a .7 probability. But what if what is represented in perception is not redness but itself a probability, say the probability that something is red being .3? This is a representation of a probability. Humans certainly have cognitive representations of probabilities. We know that if A causally influences B, then the presence of A makes B more probable. And we use such representations in reasoning and problem solving (11, 12). There is some evidence of representations of probabilities in perception (13), though I am not persuaded that this study concerns perception as opposed to perceptual judgment. If there is perception of probability, the question arises as to whether there could be a *probabilistic representation of probability*, for example, a representation of the form: <probability of redness of .3, there<sub>i</sub>, .7>. (If this seems unintelligible, note that I can have a .9 credence that the probability of decay of a certain subatomic particle is .1.) In any case, this article concerns probabilistic representation, not representation of probabilities; and in perception, not cognition. [...] My objection to sampling is that standard sampling models model *perceptual decision rather than perception* itself. [...] The basic problem is that sampling models model perceptual decision rather than perception, i.e. the formation of a percept. Perception takes place routinely with no task, explicit or implicit, and without any need for perceptual decision as to which cognitive category to apply. I am appealing here and in what follows to the difference between perception and cognition--where cognition includes thought, reasoning and decision-making. Although I can't argue for it here, I believe that perceptual representations are constitutively iconic, non-conceptual and non-propositional in content whereas cognitive representations do not have these properties. There is an important divide between the types of representations involved in perception and cognition (30-32). [...] In sum, my answer to the question "If perception is probabilistic, why doesn't it seem probabilistic?" is that we would do well to think of probabilities in perception instrumentally, avoiding the realist interpretations that motivate the question of the title."

<sup>11</sup> Mathematically, from Section 2.6.1 of (Vimal, 2015d), "the *effective information* (EI) between A and B is defined as (Tononi, 2004):

$$EI(A \rightarrow B) = MI(A^{H_{\max}}; B) = H(A^{H_{\max}}) + H(B) - H(A^{H_{\max}}B),$$

Where  $A^{H_{\max}}$  is the source A with maximum entropy to the outputs, B is the target, and  $H(A^{H_{\max}})$  is maximum entropy to the outputs from source A (Tononi, 2004). The arrow  $\rightarrow$  in

$A \rightarrow B$  represents that the source is A and the target is B; all possible effects of A on B are measured by  $EI(A \rightarrow B)$ . If the connections between A and B are specialized and strong,  $EI(A \rightarrow B)$  will be high. The value of  $EI(A \rightarrow B)$  is bounded by  $A^{H_{max}}$  and  $B^{H_{max}}$ , whichever is less. In general,  $EI(A \rightarrow B)$  and  $EI(B \rightarrow A)$  are not symmetric. [...] The effective information (EI) between A and B measures the repertoire of possible causal effects of A on B and of B on A.”

**12** Certain neural-network or brain complex, such as thalamocortical ‘complex’, comparatively has very high integrated information ( $\Phi$ ), so it is a privileged area for consciousness.

**13** As per (Logan, 2012), “Shannon information does not make a difference because it has nothing to do with meaning; it is merely a string of symbols or bits. On the other hand, Bateson information, which as we discovered should more accurately be called MacKay information, is all about meaning. [...] Information is not an invariant like the speed of light, but depends on the frame of reference or context in which it is used. [...] The information of DNA is not fixed like Shannon selective information but depends on context like MacKay structural information so that identical genotypes can give rise to different phenotypes depending on the environment or context. [...] biotic information ... arises from the constraints that allow a living organism to harness free energy and turn it into work so that it can carry out its metabolism and replicate its organization. [...] Langefors [22] suggested that a better term for Shannon’s information theory would therefore perhaps be “signal transmission theory” [...] • Data are the pure and simple facts without any particular structure or organization, the basic atoms of information, • Information is structured data, which adds more meaning to the data and gives them greater context and significance, • Knowledge is the ability to use information strategically to achieve one’s objectives, and • Wisdom is the capacity to choose objectives consistent with one’s values and within a larger social context [23]. [...] The knowledge and intention of the sender and the receiver as well as the effects of the channel all affect the meaning of the message that is transmitted by the signal in addition to its content. [...] “For Shannon the semantics or meaning of the message does not matter, whereas in biology the opposite is true. Biotic agents have purpose and hence meaning [1]”. [...] the “meaning of life” is propagating organization. [...] The purpose of life is the creation or propagation of more life. [...] **we are a process and not a thing** [...] Shannon information is independent of meaning, organization and its material instantiation, which is just the opposite for biotic information, and the information associated with language and culture.”

As per (Pepperell, 2018), “I will argue that the governing principle of the brain at the neural level is not information processing but energy processing. [...] For Shannon ... The information is the amount of uncertainty in a message (a sequence of data) measured through probabilistic analysis of its elements. [...] The other commonly cited definition of information is Gregory Bateson’s “a difference that makes a difference” (Bateson, 1979). [...] The integrated information theory of consciousness (IIT) proposed by Tononi and colleagues provides an alternative, non-Shannonian, definition of information as “a form in cause-effect space” (Tononi et al., 2016). Cause-effect space, according to their theory, contains a

“conceptual structure”— a constellation of related concepts — that is specified by the “physical substrate of consciousness” (PSC), this being the precise complexes of neural activation involved in any experience. Each conscious experience is identical with this “form”, denoted  $\Phi_{max}$  when maximally integrated. But while IIT is presented as a theory of integrated information, it could just as well serve as a theory of how energetic processing is organized since the PSC consists in the causally interrelated patterns of neural firing that are identical with the conscious experience. [...] (Logan, 2012), citing work undertaken with Stuart Kauffman and others, defines ‘biotic information’ as the organization of the exchange of energy and matter between organism and environment. [...] the brain operates on the principle of energetic processing and that a certain organization of energy in the brain, measured with information theoretic techniques, can be reliably predict the presence and level of consciousness. Since energy is causally efficacious it is reasonable to claim that consciousness is in principle caused by energetic processes and how they are dynamically organized in the brain. **Information in the scientific sense is best understood as a measure of the way energetic processes are organized, that is, their degree of differentiation and integration.** [...] It is a certain dynamic organization of energetic processes with a high degree of differentiation and integration. This organization is recursively self-referential and results in a pattern of energetic activity that ‘blossoms’ to a degree of complexity sufficient for consciousness. [...] The principle outlined here might be construed as a form of **panpsychism or panexperientialism**. My claim is not that consciousness is a fundamental property of nature, universally distributed. Rather, I claim it is a fundamental property of all physical processes that there is something it is like to undergo actualized difference, a certain organization of which causes consciousness.”

As per (Pepperell, 2018), “I will argue that the governing principle of the brain at the neural level is not information processing but energy processing. The information-theoretic approach to measuring and modelling brain activity, however, can usefully complement the energetic approach [...] For many neuroscientists the main function of energy in the brain is to fuel neural signaling and information processing (Hall et al., 2012; Magistretti, 2013; Sterling and Laughlin, 2017). [...] Overall, it seems we find no clear correlation between the total amount of energy used by the brain, or the location where the energy is used, and the level of consciousness detectable in the person. [...] Although information theoretic tools were being used to analyse and interpret the data in these studies we should note that what was actually being detected by the experimental procedures was not information per se but the organization of energetic activity or processing in the brain. [...] The evidence discussed above suggests the level of consciousness is determined by the organization of energy processing in the brain rather than on its global level or localization; wakeful conscious states are associated with more complex organization. [...] Kinetic energy is difference as motion or change; potential energy is difference as tension or antagonism. [...]

in nature they [energy, force and work] are integral and actualized, acting collectively in time and space with causal efficacy. By observing nature, we can infer there is ‘something it is like’ to be a physical system undergoing antagonistic forceful interactions, and what it is like will vary as the interactions vary.<sup>9</sup> There is something it is like, for example, to be a piece of rope undergoing great tension that is different from what it is like to be the same rope when relaxed, or for a rock to crash to earth having been in freefall. Some effects of

these interactions may be observed from an extrinsic perspective; we might hear a creak or a crunch. But the something it is like to undergo the interactions themselves is an intrinsic property of the observed system to which the extrinsic observer has no access. It is for this reason that its presence and nature can only be inferred.<sup>10</sup> This is not to claim that all forces acting at the subatomic scale, or those acting at the macro scale in a rope or rock, undergo anything like the experience we undergo as conscious humans.<sup>11</sup> Something it is like-ness is not in itself consciousness. Rather, it is to recognise that: (i) force, energy, and work are *actualized*, (ii) they are expressions of *difference*, and (iii) there is *something it is like*, intrinsically, to undergo actualized difference. [<sup>10</sup> Note that this claim is not as far-fetched as it might at first seem: If (i) consciousness in people is a physical process — due to energy, forces and work — and (ii) we infer the presence of consciousness in other people on the basis of observing them extrinsically — as we habitually do — and (iii) there is something it is like to be a conscious person — as we assume there is — then (iv) we routinely infer the presence of an intrinsic something it is like-ness in a physical process on the basis of observing it from an extrinsic perspective. However, as discussed below, human consciousness is a particular kind of something it is like-ness that occurs only when certain conditions are met. <sup>11</sup> In discussions of the nature and behaviour of forces at the microscopic level we often find references to the way they ‘feel’ (Feynman, 1963), or the way they ‘experience’ each other in fields (Rennie, 2015). It would be interesting to investigate what motivates the use of such terms in this context. [...]

**Energy and information** For many contemporary scientists, information is a basic physical property of nature. For some it is *the* most basic property of nature (Davies, 2010). Neuroscientists often assume that the brain operates according to the principle of information processing. We read that “the brain is fundamentally an organ that manipulates information” (Sterling and Laughlin, 2017) and that brains are “information processing machines” (Ruffini, 2017). Individual neurons are treated as information processing units, while neural spikes are represented as sequences of binary digits (1s and 0s) that encode information (Koch, 2004). Recent prominent theories claim consciousness is identical with (Tononi et al., 2016) or results from (Dehaene et al., 2017) certain kinds of information structures or information processes in brains. Information is variously and sometimes imprecisely defined (Capurro and Hjørland, 2005), its meaning is still strongly contested (Lombardi et al., 2016; Roederer, 2016), and many people regard it as being to some extent subjective, relativistic or observer-dependent (von Foerster, 2003; Deacon, 2010; Werner, 2011; Logan, 2012; Searle, 2013; de-Wit et al., 2016). The term is often used in science colloquially (meaning ‘what is conveyed by an arrangement of things’) or “intuitively” (Erra et al., 2016). [...] The most widely cited technical definition of information is that given by Claude Shannon (1948) as part of his mathematical theory of communication. For Shannon, information does not refer to meaning or semantics, as it does colloquially. [The information is the amount of uncertainty in a message \(a sequence of data\) measured through probabilistic analysis of its elements.](#) Information theory has developed into an exceptionally powerful mathematical tool that can be used, among many other things, to [measure the complexity of physical systems](#). But a quantity of Shannon information is a measure of what can be *known* about a system as distinct from the physical system itself. [The information lies with the measurer rather than the measured.](#)<sup>13</sup> The other commonly cited definition of [information](#) is Gregory Bateson’s “[a difference that makes a difference](#)” (Bateson, 1979). Like his fellow cybernetic theorist Norbert Wiener (1948), [Bateson sharply distinguished information from energy. Difference](#)

as he describes it is not a property of what he calls the “ordinary material universe” governed by energetic activity. It is not subject to the effects of impacts and forces but is an abstract, relational property of the mind that exists outside the realm of physical causation: “Difference, being of the nature of relationship, is not located in time or space”. Information, defined according to Bateson as a “nonsubstantial” abstract difference, cannot be used to explain consciousness as a physical process.<sup>14</sup> The integrated information theory of consciousness (IIT) proposed by Tononi and colleagues provides an alternative, non-Shannonian, definition of information as “a form in cause-effect space” (Tononi et al., 2016). Cause-effect space, according to their theory, contains a “conceptual structure”—a constellation of related concepts — that is specified by the “physical substrate of consciousness” (PSC), this being the precise complexes of neural activation involved in any experience. Each conscious experience is identical with this “form”, denoted  $\Phi_{max}$  when maximally integrated. But while IIT is presented as a theory of integrated information, it could just as well serve as a theory of how energetic processing is organized since the PSC consists in the causally interrelated patterns of neural firing that are identical with the conscious experience. [13 Arieh Ben-Naim sets out in some detail how Shannon information is a probabilistic measure, and therefore not a physical property of systems (Ben-Naim, 2015). Note that the act of measurement presupposes a conscious mind capable of carrying out the measurement procedure and interpreting the result. 14 Had he a fuller understanding of the nature of energy Bateson might not have been so dismissive about its role in mental processes. In *Mind and Nature* (Bateson, 1979) he referred only to kinetic energy (which he defined as “MV<sup>2</sup>”), thus ignoring potential energy, and was by his own admission “not up to date in modern physics”. In fact, slightly modifying Bateson’s much-cited phrase to *an actualized difference that makes a difference* yields a description of the essence of energetic action, that is, the way energy, forces and work act antagonistically to effect change and cause further actions.] Treating brains as neural information processors does not help us to understand consciousness as a physical process because information, according to the commonly accepted definitions, is not a physical property of brains at the neural level; *there is no information in a neuron*.<sup>16</sup> It is useful, however, to apply information-theoretical methods to study the organization of physical systems, such as brains. Norbert Wiener (1948) stated: “...the amount of information in a system is a measure of its degree of organization...”. As exemplified in several studies and theories cited here, we can measure and model the way the organization of energetic processes in the brain contributes to the presence of consciousness in a person.<sup>17</sup> [16 Brains — as parts of people — process information in the colloquial sense, just as they process abstract ideas, equations, numbers, thoughts, emotions, or memories. But they do so as a *consequence* of the underlying energetic processing (distribution, conversion, dissipation) going on in neural tissue. Computers also ‘process’ information in the colloquial sense. Mechanically and electronically speaking, however, they actually manipulate energy states (voltages, light, etc.) the results of which we, as conscious people, interpret informationally. It is worth noting that all mechanical information processing necessarily entails the dissipation of a certain amount of energy (Landauer, 1961). Recent experiments have confirmed this principle and demonstrated the intimate link between energy and what many refer to as information (Bérut et al., 2012). 17 (Logan, 2012), citing work undertaken with Stuart Kauffman and others, defines ‘biotic information’ as the organization of the exchange of energy and matter between organism and environment. [...] organisms inhabit a physical

world that is structured through the actions of energy, forces and work. To survive and prosper in this world they must continually work to acquire new supplies of high-grade or free energy to maintain an internal state far from thermodynamic equilibrium [...] In organisms endowed with nervous systems survival necessitates exercising at least two critical abilities: (i) *discriminating* between differences in environmental conditions (such as temperature, acidity, salinity, sugar levels, or presence of predators) and (ii) *moving towards environmental conditions that are beneficial to survival* and away from those that are harmful. [...] It is the *actualized* difference that makes the difference. [...] **Energetic organization as the cause of consciousness** [...] There is something it is like, intrinsically, to be networks of neurons in fantastically complex states of actualized differentiation from other networks, with action potentials propagating through vast arrays of fibres. But all this something is it like-ness is not in itself consciousness. [...] The idea that consciousness depends on the integration of differentiation lies at the heart of IIT [...] A potential mechanism supporting global integration of local differentiation is recurrent or reentrant processing, in which widely distributed areas of the brain engage in complex loops of cortical feedback via massively parallel connections (Edelman et al. 2011; Edelman & Gally, 2013). A number of studies of the effects of anaesthetics have shown that they disrupt feedback connectivity, and hence integration, particularly in the frontoparietal area of the brain (Lee et al., 2009; Hudetz & Mashour, 2016). Studies of brain organization during deep sleep have also reported an increase in modularity consistent with the loss of integration among regions of the brain found in the awake state (Tagliazucchi et al., 2013). This suggests that the presence of consciousness in a person is sustained by a certain level of functional integration enabled by loops of cortical feedback (Edelman, 2004; Alkire et al., 2008). It is not known why cortical feedback loops across the brain are necessary for consciousness, but the following suggestion may have some value. [...] Feedback systems in general are self-referential in that the behaviour of one part of the system casually affects another, which in turn affects the first. [...] Feedback systems in general are self-referential in that the behaviour of one part of the system casually affects another, which in turn affects the first. [...] Feedback systems in general are self-referential in that the behaviour of one part of the system casually affects another, which in turn affects the first. [...] Since this is an energetically actuated process we can infer, following the arguments already given, that there is something it is like to be the video feedback system in full bloom, from its intrinsic perspective Gerald Edelman has proposed that “phenomenal experience itself is entailed by appropriate reentrant intracortical activity” (Edelman & Gally, 2013). In the human brain we are dealing with recursive or reentrant behaviour of an unimaginably higher order of complexity than in the video system.<sup>21</sup> But the underlying operating principle may be analogous. Video feedback arises because the system is organized as a self-observing loop. If we assume that reentrant activity in the brain is also a kind of self-observing loop in which processes in one part the brain both affect and are affected by processes in other widely distributed parts, then we can envisage a kind of pattern blooming in the brain analogous to that we see in video feedback. In this case it is actuated by sufficiently organized electro-chemical impulses channelled through reentrant neural circuits. The something it is like-ness a brain organized in this way would be undergoing is of a different order to that of a brain with diminished integration in dreamless sleep or under anaesthesia. [...] Or put succinctly, *there is something it is like, intrinsically, to be something it is like, recursively, to undergo the particular organization of actualized*

differences found in the conscious brain. For this we have the most direct and irrefutable evidence possible — what it’s like to undergo our own conscious experience.<sup>22</sup> Is it reasonable then to propose that consciousness is *caused* by the way energetic processes are dynamically and recursively organized in the brain? [...] If consciousness is a physical (biological and chemical) process, and if physical processes are caused by the actions of energetic processes (including forces and work), then consciousness, in principle, could be caused by energetic processes and the way they are organized. **Naturalising consciousness** [...] He was compelled to wonder “Is the mind in any strict sense energy?” but reluctantly concluded that “thoughts, feelings, and so on are not amenable to the energy (matter) concept.” They lie beyond the purview of natural science, despite the “embarrassment” this causes for biology. [...] If we are to naturalise consciousness, we must reconcile energy and the mind. **Conclusion** The challenge posed by Sherrington and Nagel is how to explain consciousness as a physical process. If consciousness is a physical process then it should be explicable in terms of energy, forces and work. Energy is a physical property of nature that is causally efficacious and, like forces and work, can be conceived in terms of actualized differences of motion and tension. Evidence from neurobiology tells us that the brain operates on the principle of energetic processing and that a certain organization of energy in the brain, measured with information theoretic techniques, can be reliably predict the presence and level of consciousness. Since energy is causally efficacious it is reasonable to claim that consciousness is in principle caused by energetic processes and how they are dynamically organized in the brain. Information in the scientific sense is best understood as a measure of the way energetic processes are organized, that is, their degree of differentiation and integration. Information theoretic techniques provide powerful ways of measuring, modelling and mapping the organization of energetic processes, but we should not confuse the map with the territory. Actualized differences of energy, forces and work, as opposed to abstract values of mathematics and information theory, are characterised by there being something it is like, intrinsically, to undergo those differences, that is, to undergo an antagonistic state of opposing forces. All physical processes undergo this something it is like-ness, but not all are conscious. It is proposed that a particular kind of physical process occurs in human brains that causes our conscious experience. It is a certain dynamic organization of energetic processes with a high degree of differentiation and integration. This organization is recursively self-referential and results in a pattern of energetic activity that ‘blossoms’ to a degree of complexity sufficient for consciousness. If consciousness is a physical process, and physical processes are actualized differences of motion and tension, then there is something it is like to undergo actualized differences organized in a certain way in the brain, and this is what we experience — intrinsically.<sup>23</sup> [23 The principle outlined here might be construed as a form of **panpsychism or panexperientialism**. My claim is not that consciousness is a fundamental property of nature, universally distributed. Rather, I claim it is a fundamental property of all physical processes that there is something it is like to undergo actualized difference, a certain organization of which causes consciousness.]”

As per (Logan, 2012), “[**Abstract**] We introduce the notion of the relativity of information and show that the concept of information depends on the context of where and how it is being used. We examine the relationship of information to meaning and materiality within information theory, cybernetics and systems biology. We show there exists a link between

information and organization in biotic systems and in the various aspects of human culture including language, technology, science, economics and governance. [...**1. Introduction**] Information... arises... as natural selection assembling the very constraints on the release of energy that then constitutes work and the propagation of organization—Kauffman, Logan, Este, Goebel, Hobill and Shmulevich [1]. We have represented a discrete information source as a Markoff process. Can we define a quantity, which will measure, in some sense, how much information is ‘produced’ by such a process, or better, at what rate information is produced?—Shannon [2]. To live effectively is to live with adequate information—Wiener [3]. Information is a distinction that makes a difference—MacKay [4]. Information is a difference that makes a difference—Bateson [5]. [...] Is there only one form of information or are there several kinds of information? In other words is information an invariant or a universal independent of its frame of reference or context? What is the relationship of information to meaning and organization? Is information a thing like a noun or a process like a verb? Is information material or is it a form of energy or is it just a pattern? Is information a uniquely human phenomenon or do non-human forms of life contain information? What is the relationship of energy and information? [...] information and entropy are opposites and not parallel as suggested by Shannon. [...] in biotic systems that information and organization are intimately linked. [...] relationship between energy and information. **2. Origins of the Concept of Information** [...] If  $p$  is the probability of an observation falling into any one class, the amount of information in the sample is  $S\{(\partial m/\partial \theta)^2/m\}$  where  $m = np$ , is the expectation in any one class [and  $\theta$  is the parameter] [7]. Another OED {Oxford English Dictionary} entry citing the early work of mathematicizing information is that of R. V. L. Hartley [8]. “What we have done then is to take as our practical measure of information the logarithm of the number of possible symbol sequences.” It is interesting to note that the work of both Fisher and Hartley foreshadow Shannon’s concept of information, which is nothing more than the probability of a particular string of symbols independent of their meaning. [...] **3. Shannon and the Birth of Information Theory** [...] He [Shannon] defined information as a message sent by a sender to a receiver. [...] Information is defined as the measure of the decrease of uncertainty for a receiver. [...] Suppose we have a set of possible events whose probabilities of occurrence are  $p_1, p_2, \dots, p_n$ . These probabilities are known but that is all we know concerning which event will occur. Can we find a measure of how much “choice” is involved in the selection of the event or of how uncertain we are of the outcome? If there is such a measure, say  $H(p_1, p_2, \dots, p_n)$ ... we shall call  $H = -\sum p_i \log p_i$  the entropy of the set of probabilities  $p_1, \dots, p_n$ ... The quantity  $H$  has a number of interesting properties, which further substantiate it as a reasonable measure of choice or information. [...] **4. The Relationship of Information and Entropy** [... entropy =] energy transformation. Clausius felt the need to define entropy because the energy of the universe is conserved but its entropy is constantly increasing. The relationship between entropy and probability is due to the work of Boltzman from his consideration of statistical mechanics, which is an alternative way of looking at thermodynamics. He showed that the entropy of a gas is proportional to the logarithm of  $W$  where  $W$  is the number of microstates of the gas that yield identical values of the thermodynamic variables of pressure, temperature and volume. The formula he derived, namely, that  $S = k \ln W$  where  $k$  is the Boltzman constant is what inspired Shannon to call his expression for the measure of information content of a message information entropy despite the difference in sign and the fact that the proportionality constant or Boltzman constant has the physical dimensions of



energy divided by temperature. [...] There is no violation of the Second Law because acquisition of that information causes an increase of entropy greater than the decrease of entropy represented by the information. [...] Lewis [12] also saw an inverse relationship between information and entropy. He wrote, “Gain in entropy always means loss of information, and nothing more”. [...] Schrödinger [13] in his famous and highly influential book *What is Life? ...* Thus a living organism continually increases its entropy—or, as you may say, produces positive entropy—and thus tends to approach the dangerous state of maximum entropy, which is death. It can only keep aloof from it, *i.e.*, alive, by continually drawing from its environment negative entropy—which is something very positive as we shall immediately see. What an organism feeds upon is negative entropy [negentropy]. [...] Wiener [3] wrote, Messages are themselves a form of pattern and organization. Indeed, it is possible to treat sets of messages as having entropy like sets of states in the external world. Just as entropy is a measure of disorganization, the information carried by a set of messages is a measure of organization. In fact, it is possible to interpret the information carried by a message as essentially the negative of its entropy, and the negative logarithm of its probability. That is, the more probable the message, the less information it gives (p. 39)... This amount of information is a quantity which differs from entropy merely by its algebraic sign and a possible numerical factor. Brillouin [14] also argued that a living system exports entropy in order to maintain its own entropy at a low level. Brillouin used the term negentropy to describe information rather than negative entropy. The reason that Wiener and Brillouin consider entropy and information as opposites or regard information as negative entropy follows from the tendency in nature for systems to move into states of greater disorder, *i.e.*, states of increased entropy and hence states for, which we have less information. [...] It therefore follows that as the entropy increases the amount of information we have about the system decreases and hence entropy is negative information or vice-versa information is the negative of entropy. [...] Wiener and Brillouin relate information to entropy with a negative sign whereas Shannon uses a positive sign. [...]

### **5. MacKay’s Counter Revolution: Where Is the Meaning in Shannon Information?**

According to Claude Shannon [2] his definition of information is not connected to its meaning. However, as Shannon suggested, information in the form of a message often contains meaning but that meaning is not a necessary condition for defining information. So it is possible to have information without meaning, whatever that means. [...] MacKay argued that he did not see “too close a connection between the notion of information as we use it in communications engineering and what [we] are doing here... the problem here is not so much finding the best encoding of symbols... but, rather, the determination of the semantic question of what to send and to whom to send it.” He suggested that information should be defined as “the change in a receiver’s mind-set, and thus with meaning” and not just the sender’s signal [6]. The notion of information independent of its meaning or context is like looking at a figure isolated from its ground. As the ground changes so too does the meaning of the figure. [...] The problem with MacKay’s definition was that meaning could not be measured or quantified and as a result the Shannon definition won out and changed the development of information science. The advantage that Shannon enjoyed over MacKay by defining information as the signal rather than meaning was his ability to mathematicize information and prove general theorems that held independent of the medium that carried the information. [...] People that shared MacKay’s position complained that Shannon’s definition of information did not fully describe communication. Shannon did not disagree—

he “frequently cautioned that the theory was meant to apply only to certain technical situations, not to communication in general [2].” He acknowledged that his definition of information was quite independent of meaning; however, he conceded that the information that was transmitted over the telecommunication lines he studied often had meaning as the following quote from his original paper written at the Bell Labs indicates: The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one **selected** from a set of possible messages. The system must be designed to operate for each possible **selection**, not just the one that will actually be chosen since this is unknown at the time of design. [...] He [MacKay] also defended his definition from the attack that it was subjective. [...] Mackay’s first move was to rescue information that affected the receiver’s mindset from the “subjective” label. He proposed that both Shannon and Bavelas were concerned with what he called “selective information”, that is information calculated by considering the selection of message elements from a set. But selective information alone is not enough; also required is another kind of information that he called “structural”. Structural information indicates how selective information is to be understood; it is a message about how to interpret a message—that is, it is a metacommunication [6]. [...] Structural information has a relationship to pragmatics as well as semantics where pragmatics tries to bridge the explanatory gap between the literal meaning of a sentence and the meaning that the speaker or writer intended. [...] This raises the question of whether subjectivity can be studied scientifically. [...] **6. Information: The Difference That Makes a Difference** [Bateson] [...] **“information is a distinction that makes a difference.”** [MacKay] ... The use of the term “distinction” in MacKay’s one-liner is more closely tied to the idea of “meaning” than the term “difference”. [...] Fredkin which I would put in a league with Mackay and Bateson’s one-liners. “The meaning of information is given by the processes that interpret it.” This is a very insightful definition because it explicitly incorporates the notion that information depends on context. If information is the distinction (McKay) or the difference (Bateson) that makes a difference then if there is no distinction or no difference then there can be no information. This would mean chaos or random numbers contain no information because there is no difference or distinction in one part of the stream of numbers as opposed to another part of the stream because of a lack of organization. This is opposite to the conclusion of Shannon who claims that a stream of random numbers contains the maximum information. While it is true each element is different from the next and is a complete surprise it is also true that the overall pattern of chaos and randomness is the same and hence there is no distinction nor is there any difference in the stream of random numbers. [...] This raises the question of whether or not organization is information, a point we will return to later in this paper once we have dealt with the nature of information in biotic systems. **7. Information in Biotic Systems** [...] **1953** J. C. ECCLES *Neurophysiol. Basis Mind* i. 1 We may say that all ‘information’ is conveyed in the nervous system in the form of coded arrangements of nerve impulses. **1953** WATSON and CRICK in *Nature* 30 May 1953/2 In a long molecule many different permutations are possible, and it therefore seems likely that the precise sequence of the bases is the code

which carries the genetical information. [...] **8. Life as Propagating Organization** Stuart Kauffman [15] defined an autonomous agent (or living organism) acting on its own behalf and propagating its organization as an autocatalytic system carrying out at least one thermodynamic work cycle. The relationship of the information found in living organisms to the kind of information treated in Shannon information theory was not clear ... Shannon information could not be used to describe information contained in a biotic system. ... information is not an invariant independent of its frame of reference [Kauffman et al, 2007]: Propagating Organization: An Enquiry (POE)]. [...] **9. The Relativity of Information** [... As per] Losee ... Information may be defined as the characteristics of the output of a process, these being informative about the process and the input. This discipline independent definition may be applied to all domains, from physics to epistemology. [...] Shannon information does not make a difference because it has nothing to do with meaning; it is merely a string of symbols or bits. On the other hand, Bateson information, which as we discovered should more accurately be called MacKay information, is all about meaning. And thus we arrive at our second surprise, namely the relativity of information. Information is not an invariant like the speed of light, but depends on the frame of reference or context in which it is used. We discovered in our review of POE that Shannon information and biotic or instructional information are quite different. Information is not an absolute but depends on the context in which it is being used. So Shannon information is a perfectly useful tool for telecommunication channel engineering. Kolmogorov [18] information, defined as the minimum computational resources needed to describe a program or a text and is related to Shannon information, is useful for the study of information compression with respect to Turing machines. [...] MacKay identified two main categories of information: selective information not necessarily linked to meaning and structural information specifically linked to meaning. [...] Shannon and Kolmogorov information are what MacKay termed selective information. Biotic or instructional information, on the other hand, is a form of structural information. The information of DNA is not fixed like Shannon selective information but depends on context like MacKay structural information so that identical genotypes can give rise to different phenotypes depending on the environment or context. [...] Tzannes [6] on page 56. He “wanted to define information so that its meaning varied with context... [and] pointed out that whereas Shannon and Wiener define information in terms of what it is, MacKay defines it in terms of what it does [6].” Both Shannon and Wiener’s form of information is a noun or a thing and MacKay’s form of information is a verb or process. [...] Shannon there is no explanation as to where information comes from and how it came into being. Information in Shannon’s theory arrives *deus ex machina*, [god (unexpected power) from the machine: a seemingly unsolvable problem is suddenly and abruptly resolved] whereas biotic information as described in POE arises from the constraints that allow a living organism to harness free energy and turn it into work so that it can carry out its metabolism and replicate its organization. Kauffman [15] has described how this organization emerges through autocatalysis as an emergent phenomenon with properties that cannot be derived from, predicted from or reduced to the properties of the biomolecules of which the living organism is composed and hence provides an explanation of where biotic information comes from. **10. Information and Its Relationship to Materiality and Meaning** [...] Katherine Hayles [6]. She points out that although information is used to describe material things and furthermore is instantiated in material

things information is not itself material. “Shannon’s theory defines information as a probability function with no dimension, no materiality, and no necessary connection with meaning. It is a pattern not a presence [6]”. [...] Hayles [6] traces the origin of information theory to cyberneticians like Wiener, von Forester and von Bertalanffy and telecommunication engineers like Shannon and Weaver. She points out that they regarded information as having a more primal existence than matter. Referring to the information theory they developed she wrote: “It (information theory) constructs information as the site of mastery and control over the material world”. [... As per] Wiener [2], “information is information, not matter or energy”. The question that arises is whether or not there is something intrinsic about information or is it merely a description of or a metaphor for the complex patterns of behavior of material things. Does information really control matter or is information purely a mental construct based on the notion of human communication through symbolic language, which in turn is a product of conceptual thought as described in Logan [21]? [...] The notion of information as the master or controller of the material world is the view of the cyberneticians beginning with Wiener [3]: “To live effectively is to live with adequate information. Thus, communication and control belong to the essence of man's inner life, even as they belong to his life in society”. [...] Langefors [22] suggested that a better term for Shannon’s information theory would therefore perhaps be “signal transmission theory” [...] • Data are the pure and simple facts without any particular structure or organization, the basic atoms of information, • Information is structured data, which adds more meaning to the data and gives them greater context and significance, • Knowledge is the ability to use information strategically to achieve one's objectives, and • Wisdom is the capacity to choose objectives consistent with one's values and within a larger social context [23]. [...] The knowledge and intention of the sender and the receiver as well as the effects of the channel all affect the meaning of the message that is transmitted by the signal in addition to its content.

**11. The Meaning of Information in Biotic Systems**

Biotic or instructional information, defined in POE as the constraints that allow an autonomous agent, *i.e.*, a living organism, to convert free energy into work so that the living organism is able to propagate its organization through growth and replication, is intimately connected with meaning. “For Shannon the semantics or meaning of the message does not matter, whereas in biology the opposite is true. Biotic agents have purpose and hence meaning [1]”. [...] the “meaning of life” is propagating organization. [...] The purpose of life is the creation or propagation of more life. [...] The independence of Shannon and cybernetic information from the medium of its instantiation is what gives rise to ... the human mind can somehow be transferred to a silicon-based computer and does not require the wet computer of the human brain. [...] This is not the case with living organisms in the biosphere where information is stored in DNA, RNA and proteins. [...] Identical genotypes can produce very different phenotypes depending on the physical and chemical environment in which they operate. Consider the fact that identical twins are not “identical”. The reason identical twins are not “identical” is that the environment in which the biochemical interactions between biomolecules takes place alters the outcome.

**12. The Materiality of Information in Biotic Systems**[:] Information is information, not matter or energy. No materialism which does not admit this can survive at the present day.–Norbert Wiener [2] Shannon’s theory defines information as a probability function with no dimension, no materiality, and no necessary connection with meaning. It is a pattern not a presence [6]. [...] A biological system is both an information pattern and a material object or

more accurately information patterns instantiated in a material presence. Schrödinger [13] long ago before the discovery of DNA described this dual aspect of chromosomal material metaphorically. “The chromosome structures are at the same time instrumental in bringing about the development they foreshadow. They are law-code and executive power—or, to use another simile, they are architect's plan and builder's craft—in one.” It is the dynamic of the interaction between the patterns of information and the material composition of the biotic agents that determines their behavior. [...] The medium is both the message and the content for a biotic system because information in a biological system is not symbolic but rather chemical. It is for this reason that the notion of transferring the contents of the human brain to a computer is pure nonsense. To conclude we have argued that information is not an invariant independent of the frame of reference in which it operates. In the biotic frame of reference information is always associated with meaning, which is not necessarily the case with Shannon or Kolmogorov information. In the biotic frame information cannot be separated from the medium of its instantiation as is the case in the Shannon and Kolmogorov reference frames. In other words the information in DNA, RNA and proteins are embodied. They differ from human symbolic information, which can be disembodied and moved from one medium to another. [...]

**13. Organization as Information** What is the relationship of organization and information? What we discovered in POE was that the autocatalysis of biomolecules led to the organization of a biological living organism whose organization of constraints allowed it to convert free energy into work that sustained growth and permitted replication. We identified the constraints as instructional or biotic information, which loops back into the organization of the organism. This model of information holds for biotic systems where autocatalysis is the organization and the components are the individual biomolecules. The argument seems circular only because a living organism represents a self-organizing system. This is still another way that biotic information differs from Shannon information which is defined independent of meaning or organization. In fact organized information has less Shannon information because it does not reduce as much uncertainty as disorganized information. It is also the case as we mention above that this model provides a mechanism for the creation of information which is not the case with the Shannon model of information. [...]

**14. Who Are We? What Are We, Information or Flesh?** [...] The organic chemicals of which we are composed are continually replaced so that after seven years there is a completely new set of molecules. **So we are not flesh or a particular set of molecules but the organization of the molecules of which we are composed or more accurately we are a process and not a thing that can be duplicated.** [...] I believe that the proponents of strong artificial intelligence (AI) and strong artificial life (AL) make the mistake of considering intelligence or life as merely reified information. They do not take into account that it is the interaction or organization of flesh-based matter that makes intelligence and life. The pattern of that interaction or organization that we identify as information cannot be abstracted away from the physical medium in which it is instantiated and remain unchanged or, even more importantly, continue as the process that gave rise to that intelligence or life in the first place. A feature of both intelligence and life is that it is autonomous. A living organism is an autonomous agent that has the capacity to exploit free energy from its environment and use that energy in the form of work to carry out its metabolism, to replicate and to make use of its intelligence. The proponents of strong AI and AL overlook this important factor when they claim that intelligence and life is nothing more than information or a pattern that is

independent of its physical instantiation. At best artificial life forms may be regarded as obligate symbionts with humans but not as independent living organisms as they are not autonomous. **15. Human Language, Culture, Technology, Science, Economics and Governance as Forms of Propagating Organization** [...] Therefore a definition of information as reducing uncertainty does not make sense since no matter how much one learns from the information in a linguistic or cultural system, as was the case with a biotic system, the uncertainty remains infinite because the number of possibilities of what can evolve is infinitely non-denumerable. Because science, technology, economics and governance are part of culture and it is also true that their evolution cannot be predicted; the argument we just made for language and culture applies to these subsets of culture as well. [...] The model holds for economic-governance systems where the economic model is the organization and the components are the individual business transactions. [...] **16. Conclusions** We have demonstrated the relativity of information by showing that information is not a unitary concept independent of the phenomena it is describing or the frame of reference with respect to which it is defined. In particular we have shown that Shannon information cannot properly describe living organisms, language, culture and the various components of culture such as technology, science, economics and governance. We have examined the relationship of information to materiality, meaning and organization and showed that Shannon information is independent of meaning, organization and its material instantiation, which is just the opposite for biotic information, and the information associated with language and culture. We have also shown that that there exists an intimate relationship between information and organization for biotic systems and the elements of human culture including language, technology, science, economics and governance.”

<sup>14</sup> As per Kelso (Kelso, 2012), “In the metastable brain, the activity of individual elements obeys neither the intrinsic dynamics of the elements nor the dynamics dictated by the assembly. A delicate balance between the two poles of integration (coordination between individual elements in transiently synchronized ensembles) and segregation (expression of individual behaviour in diverging neural ensembles) is thus achieved [...] This design plays out in space and time, with ensembles of various sizes coming together and disbanding incessantly”.

Segregation and integration are structural concepts. However, they involve attributes related to dimension (such as redness, greenness, blueness etc.) of a submode (such as color, motion, shape, etc. of vision) of a mode (such as vision, audition, pain, etc.). As per (Kelso, 2012), the metastability is related to segregation and integration in the sense of the analysis and synthesis of information entrenched in stimulus-attributes. The analyzed attributes of stimuli in specialized brain-areas are synthesized for unified consciousness.

<sup>15</sup> A quale has two sub-aspects:

- (i) Its subjective aspect is our experience, such as redness (subjective quale);
- (ii) Its objective aspect is qualitative aspect of external object such as red in long-wavelength reflecting ball (objective quale).

<sup>16</sup> As per Tononi and Koch (Tononi & Koch, 2014), “This is like a shape, a constellation in a fantastically high-dimensional qualia space, which specifies how the neurons of the main complex, in various combinations, give form to the space of possible past and future states of the complex”.

<sup>17</sup> According to (Wurzman & Giordano, 2009), “In a complex system with causal convergence, the formal cause of consciousness (and perhaps the final cause as well) is emergent from the material and efficient causes.”

<sup>18</sup> As per Tononi and Koch (Tononi & Koch, 2014), “when we fall into a deep, dreamless sleep and don’t report any experience upon being awoken, our sleeping brain is still not fully disconnected and some complex within it will likely have a  $\Phi^{\max}$  value greater than zero, yet that may not amount to much compared to that of our rich, everyday experience.”

<sup>19</sup> (Saroka et al., 2010) produced artificial OBEs (such as the self detached from the body and moving through space) in normal subjects using a brief exposure to the magnetic field generated from 64 solenoids designed to affect the brain-fields. Within a few seconds after the 5-min stimulation, (a) subjects felt mild lightness followed by (b) the feeling of floating, then (c) intermittent ‘rushes of anxiety or sensations of falling’ similar to motion sickness, (d) these ‘rushes’ became more and more frequent and were associated with feelings of dissociation from the body and a loss of body image and awareness, (e) the experience lead to the feeling that subject’s head was floating above the spot where his body was sitting, (f) then subject could not distinguish between his limbs, his torso, or the surrounding space and objects in the room, and (g) subject asked to terminate the experiment, and then he felt fatigue and headache. Left temporal lobe (linked with the sense of self and consciousness) and right prefrontal areas (associated with spatial navigation) had high EEG-activities in 4-7 and 15-21 Hz band. The signals for the ‘left temporal-right prefrontal coherence’ started from left temporal areas to left frontal areas to the right frontal areas. This reconstructs the autobiographical memory about where, when, and with whom an event occurred (Buckner & Petersen, 1996) and then ‘mental time travel’ could entail OBEs. The above coherence entails (a) the feeling of separation of the self from the body, (b) the ‘movement in space’, (c) ‘thought’ as the central frame of reference to control this movement, and (d) the feeling of being somewhere else. If the magnetic field stimulation is stopped suddenly, OBEs decreased. Furthermore, one could argue that the states of consciousness are analogous to quantum states embedded with cerebral fields, where the fields contain quantized points.

<sup>20</sup> In the (eDAM), a state of our mind-brain system has *inseparable* 1pp non-physical aspect (such as subjective experience redness when we view a ripe tomato) and 3pp-physical aspects (such as brain’s visual area (V8) neural-network and its activities related to redness). The degree of the manifestation of aspects from primal entity (*Brahman*) varies with the level of states of our mind-brain system. [1pp: 1<sup>st</sup> person perspective and 3pp: 3<sup>rd</sup> pp]. We have assumed that, in Nature, the subjective experiences (mental aspect) *potentially* co-exist with its *inseparable* physical aspect. Here, the 1pp non-physical aspect consists of superposed *potential* basis-states related to the *potential* primary irreducible subjective experiences (SEs) representing the co-existence of the *potentiality* of experiences for us. A specific SE is *realized* by the matching and selection mechanism (see below). In

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other words, there are two sources of information 1pp and 3pp; this is empirical data that we need to explain how are they linked. In the eDAM, the *doctrine of inseparability* of aspects tightly links these two sources of data.

The eDAM uses dual-mode and the matching and selection mechanisms to connect qualia/subjective experience (SE, such as redness when a trichromat views a ripe tomato) to neurons: this is discussed in (Vimal, 2010a). Briefly, there are two modes: stimulus-dependent-feed-forward-signals-related-extrinsic-mode and cognitive-feedback-signals-related-intrinsic-mode. They interact for conjugate matching and then the selection of a specific subjective experience occurs and experienced by the self (Bruzzo & Vimal, 2007). For experiencing a specific SE, there are three major interacting signals: (i) stimulus-dependent feed-forward (FF) signals, (ii) stimuli-related-memory-dependent cognitive feedback (FB) signals, and (iii) self-related signal that is a part of reentrant FB signals. The *potential* SEs are embedded as memory traces in FB signals during developmental period. The self (a) is the subjective experience of subject (Bruzzo & Vimal, 2007), (b) consists of proto-self, core-self, and autobiographical-self (Damasio, 2010), and (c) is the 1pp non-physical aspect of a state of 'self-related neural network (such as cortical and subcortical brain-stem midline structures: (Northoff, 2014; Northoff & Bermpohl, 2004)) and its activities (intrinsic activities).

The matching/interaction is between FF and FB signals (or mode if we use QED); then the self-related signals/modes interact with the resultant signal/mode representing the matching between stimulus-related FF signal/mode and cognitive FB signals/mode; thus, there are interactions between the three major signals/modes; this interactive process can be called as 'the specific SE is selected and experienced by the self'.